Green schools in Taiwan : effects on student sustainability consciousness

Green Schools in Taiwan – Effects on Student Sustainability Consciousness

Abstract

In recent decades, the Taiwanese government has worked actively to implement the concept of a sustainable Taiwan. As an important step in their strategy, the Ministry of Education has decided to promote the Green School Partnership Project in Taiwan (GPPT). However, academic research and critical reflection on the effects of this environmental and sustainability education initiative are lacking. Therefore, this study focuses on filling this gap by means of a nationwide generalizable effect study. The sampling allowed comparisons between the sixth, ninth, and twelfth grades in GPPT and non-GPPT schools and considered the geographic location (north, center, and south of Taiwan) as well as socio-economic area of the schools. A total of 1,741 students participated, answering a questionnaire that focused on student sustainability consciousness (SC) and its components (i.e., knowingness, attitudes, and behaviors in relation to sustainability). Data were analyzed through structural equation modeling. Our findings make an important empirical contribution, indicating that GPPT schools and non-GPPT schools have a similar effect on the SC of students, i.e. schools engaged in the GPPT do not enhance student SC. In addition, the gender gap regarding SC increased consistently with each increasing grade level, yielding higher mean values for the girls than for the boys. Furthermore, an adolescent dip occurred in the student SC, especially with regard to student sustainability behavior. Given these findings, implications for developing GPPT are discussed; this research could provide valuable information about the educational transformation process to enhance environmental and sustainability behavior among students in Taiwan.

Keywords

Adolescent dip; education for sustainable development; gender gap; green schools; sustainability consciousness

1. Introduction

During the United Nations (UN) decade of education for sustainable development (DESD), many initiatives were adopted by schools to support the implementation of education for sustainable development (ESD) in teaching and learning. These initiatives typically involve some type of certification or award, designating the institutions green schools or ESD-schools. The aim of this study was to determine the effect, at the student level, of such certification in Taiwan.

In North America, the U.S. Department of Education Green Ribbon Schools[1] scheme is one example of a certification program related to sustainability education. In Europe, schools are typically supported by the eco-school[2] certification program as well as other national and local certifying organizations. Chinese communities have implemented government policies and relatively decentralized programs, including green school development based on the same ideas as the certification programs found in western cultures (Lee, Wang, & Yang, 2013; Wang, 2009). One example is the government initiative referred to as the Green School Partnership Project in Taiwan[4] (GPPT). The GPPT program, like the eco-school program, is based on the idea of whole-school approaches to sustainability and is characterized by a reward and evaluation system (Lee, Wang, & Yang, 2013; Wang, 2009). Environmental and sustainability awards and certifications (henceforth referred to as certifications) play a significant role in education. The current study contributes to the body of knowledge by focusing on the effects (at the student level) of the most widely implemented ESD-certification system in Taiwan, the GPPT.

1.1. What is the Green School Partnership Project in Taiwan (GPPT)?

In recent decades, the Taiwanese central government has worked actively to implement the concept of a sustainable Taiwan (Tsai, 2012). In 1999, as an important step in this work, the Ministry of Education decided to promote and fund the Green School Partnership Project.

The GPPT is *'characterized by school autonomy, connections among green school partners, and having a reward and evaluation system'* (Lee, Wang, & Yang, 2014, p. 185) and is comparable to the eco-school certification and school partnership in Europe. Schools join the project voluntarily, and can (through the project) get (i) support for their action plans, (ii) teaching material, and (iii) access to various resources. After becoming part of the partnership project, the GPPT administration awards the green schools *Leaves of Hope* (GPPT certification logos) as they develop and contribute reports about their activities within the GPPT (Taiwan Green School Partnership Network, 2017). Lee, Wang, and Yang (2014) have reported that ~3,700 schools are participating in the GPPT as green schools.

Wang (2009a; b) identified criteria and defined indicators for a successful green school in Taiwan. These are described in terms of the three operational dimensions: (1) participation and partnership; (2) reflection and learning; and (3) ecological considerations (Wang, 2009a, b). This means that many of the indicators operate at the level of the teachers and the school as an organization. However, Wang (2009a) stresses that green schools should also *'engage students in environmental inquiry to increase students' environmental knowledge, attitudes and skills and to act harmoniously with people and nature'* (p. 51).

1.2. What Do We Know About the Effects of ESD Certification Programs?

In this section we elaborate on experiences from previous research about the effects of environmental and ESD certifications. Furthermore, we highlight the two factors, gender and age, that have been shown to have an impact on the effects of such certifications and are, therefore, important for an investigation into the effects of the GPPT on students in Taiwan.

Towards the end of the DESD, many researchers in Europe, Israel, and North America evaluated ESD-certification programs with the aim of gathering knowledge about the effects of these programs on student outcomes with respect to sustainability. Investigations (e.g., Boeve de-Pauw, & Van Petegem, 2011; 2017; Cincera & Krajhanzl, 2013; Johnson &

Cincera, 2015; Olsson, Gericke, & Chang Rundgren, 2016; Shay-Margalit & Rubin, 2017) focused on the knowledge, attitudes, and behaviors of students. These studies have mainly reported very limited effects, weak long-term effects, or in some cases, even, negative effects of the implementation of environmental and sustainability education programs at the student level. In a recent study, Boeve de-Pauw and Van Petegem (2017) found that Flemish eco-schools (in Belgium) had no impact on the long-term environmental behavior of students. These findings confirmed their previous results in a study on student perception of the environment (Boeve de-Pauw & Van Petegem, 2011). Jonson and Cincera (2015) studied attitudinal and behavioral change among young people in the US and the Czech Republic who participated in an environmental education program. They found that it was difficult to discern participant retention of the attitudinal and behavioral changes sparked by the program. In addition, in the case of an Israeli green school program,[3] long-term influence of student environmental behavior was shown to be limited (Shay-Margalit & Rubin, 2017). In fact, a positive effect on student environmental behaviors was achieved only by the most persistent green schools. Berglund and colleagues (2014) and Olsson and colleagues (2016) investigated the overall sustainability consciousness of Swedish 18–19-year-olds and 12–16-year-olds, respectively. These investigations also considered social and economic aspects of sustainability. Both these studies revealed that ESD-certified schools had very limited impact on student knowingness, attitudes, and behaviors toward sustainability (where knowingness taps into what students acknowledge as important or necessary for sustainable development. See also the methods section). In fact, among 15–16-year-old students, an ESD certification had a negative impact on student outcome with respect to sustainability (Olsson et al., 2016).

Otto and colleagues (2016) found a negative relationship between income and certain pro-environmental behavior (e.g. travel mode choice). One hypothesis is that this relationship influences student perceptions of sustainability issues as well. If schools in areas with higher

104 income are more likely to certify themselves as ESD schools, it might lead to a reduced effect
105 on pro-environmental and sustainable behavior among the students in these schools.
106 However, in a Swedish study by Olsson and colleagues (2016), the ESD certified schools and
107 non-certified schools were in areas with the same kind of socioeconomic conditions; thus, it
108 was argued that the absence of an effect of the ESD certification was a result of the school's
109 pedagogy rather than socioeconomic factors.
110 Moreover, environmental and ESD-certification programs seem to have different effects
111 on boys and girls (Boeve-de Pauw, Jacobs, & Van Petegem, 2014; Cincera & Krajhanzl,
112 2013; Goldman, Pe'er, & Yavertz, 2015; Oerke & Bogner, 2010; Olsson & Gericke, 2017).
113 Using the Bogner and Wiseman (2006) framework for the two-dimensional model of
114 environmental values (2-MEV), several studies investigating the effects of environmental and
115 sustainability education programs have found significant differences between boys and girls.
116 Values representing utilization were found to be lower among girls and higher among boys,
117 and those values representing preservation were found to be lower among boys and higher
118 among girls (e.g., Boeve-de Pauw, Jacobs, & Van Petegem, 2014; Liefländer & Bogner,
119 2014; Oerke & Bogner, 2010). An Israeli study of 14–17-year-old members of a youth
120 movement confirmed the general trend among young people. The results revealed that,
121 compared with boys, girls express more concern for the environment and more interest in
122 environmental education (Goldman et al., 2015). Cincera and Krajhanzl (2013) showed that
123 the level of action competence among secondary students in Czech eco-schools differed
124 between boys and girls, i.e., significantly higher mean values were obtained for the girls than
125 for the boys. In a Swedish study of the effects of ESD implementation, Olsson and Gericke
126 (2017) found, through a cross-sectional comparison, an increased gender gap for each grade.
127 This gap was amplified among students in schools participating in ESD-certification
128 programs (Olsson & Gericke, 2017), indicative of a gender socialization process.

129 According to many studies, age must also be considered when investigating the effects
130 of environmental and sustainability implementation initiatives (e.g., Boeve de-Pauw, Donche,
131 & Van Petegem, 2011; Liefländer & Bogner, 2014; Negev et al., 2008; Olsson & Gericke,
132 2016; Otto & Kaiser, 2014; Wiernik, Ones, & Dilchert, 2013). Otto and Kaiser (2014) and
133 Wiernik and colleagues (2013) found a positive relationship between increased age and pro-
134 environmental engagement among adults; they also found that pro-environmental behavior
135 increases when people are more exposed to relevant environmental topics in their daily lives.
136 Boeve de-Pauw, Donche, and Van Petegem (2011) investigated whether age affects the
137 relationship between personality and the environmental worldview of adolescents. They
138 found that personality-related factors (e.g. well-organized and goal-oriented students) explain
139 only a small fraction of the variation among the students. However, their data showed that age
140 is an important factor, and so must be included in investigations of the effects of
141 environmental and sustainability education programs. Liefländer and Bogner (2014)
142 investigated environmental attitudes in terms of utilization and preservation values among 9–
143 13-year-old German students participating in an environmental education program. The
144 results revealed that (compared with their adolescent peers) younger students adopted more
145 environmentally friendly attitudes. The same trend was observed in an Israeli study, in which
146 younger students exhibited more environmentally friendly attitudes and behavior than
147 adolescents (Negev et al., 2008). A Swedish study expanded on the environmental education
148 research studies mentioned previously by also including social and economic components in
149 their investigations of young peoples' sustainability consciousness (SC) (Olsson & Gericke,
150 2016). Their investigation revealed (what they referred to as) an "adolescent dip" in student
151 SC among sixth, ninth, and twelfth graders in Sweden. The dip was characterized by a
152 decrease in the SC between the sixth and ninth grades, and a subsequent rebound for the
153 twelfth grade SC. This dip was amplified among students in schools participating in ESD-

certification programs (Olsson & Gericke, 2016). In contrast, Wiernik and colleagues (2013) found a consistently positive relationship between age and pro-environmental engagement in adults.

1.3. Environmental Education and GPPT in Taiwan

The number of empirical studies on the effects of ESD certification programs has increased in many western communities. However, in Taiwan, academic research and critical reflection on the effects of the ESD initiative GPPT are lacking (Lee et al., 2014; Wang, 2009a). Some studies on the environmental perspectives of education have, nevertheless, been published. Chang, Chang, and Yang (2009), for example, found a gap between the intended and actual teaching goals of secondary school teachers delivering Earth Science education in Taiwan. The goal of those teachers was to focus on the effect of their teaching on student attitudes towards the environment, but they were unsuccessful in their efforts (Chang et al., 2009). Hsu and Roth (1998) investigated environmental literacy and environmentally responsible behavior of secondary school teachers and found differences between teachers in urban and rural areas. Compared with their counterparts in rural settings, teachers in urban settings were more intent on taking environmentally responsible actions. These studies focused on the intention and practices of teachers. Several studies have also focused on the student perspective. The cognition, attitude, and behavioral intention of elementary school students with respect to the conservation of wetland habitats have been investigated (via the Environmental Learning Center initiative) in Taiwan. The results revealed that the intervention had a more substantial effect on younger students than older elementary students (Lin &Wang, 2006).

Wang (2009b) developed a framework for performance evaluation of the GPPT, covering school organization and teachers. Evaluation results indicate that not everyone (i.e not the whole school) was commonly involved in the GPPT (Lee, Wang, &Yang, 2014;

Wang, 2009a). However, the performance evaluation tool neglected the effect of the GPPT on the environmental and sustainability literacy of students participating in the project. These features are, nevertheless, included in the definition of a successful green school (Wang, 2009b). Thus, environmental and sustainability literacy among students is the outcome that ESD in general and the GPPT in particular aims for, which is why it should be investigated and evaluated. The current study was designed to close this gap in empirical research examining the impact of the GPPT on student sustainability learning outcomes.

1.4. Sustainability Consciousness (SC)

The 2-MEV scale is commonly used to investigate environmental attitudes. In Europe and the U.S., this scale has sometimes been used to evaluate the effects of environmental education programs and interventions on the environmental learning outcomes of students (e.g., Johnson & Manoli, 2010; Liefländer, Fröhlich, Bogner, & Schultz, 2013). Scales covering environmental behavior, environmental knowledge or connectedness to nature are also commonly used in the field of environmental education research (e.g. see Otto & Pensini, 2017). Instruments that only cover environmental issues are sometimes inadequate for evaluating ESD projects that typically include environmental, social, and economic dimensions. The concept of Sustainability Consciousness (SC) was therefore developed and operationalized into a survey instrument (Gericke, Boeve-de Pauw, Berglund, & Olsson, 2018). The concept of SC includes environmental, as well as social and economic aspects of sustainability. The Sustainability Consciousness Questionnaire (SCQ) allows the investigation of student sustainability knowingness, attitudes, and behaviors (Gericke et al., 2018). Moreover, the SCQ covers important aspects of education that are vital to the investigation of the overall awareness of sustainable development and the preparedness of young people for future action on sustainability issues. In this paper, we use the SCQ in the context of Taiwan and investigate the effects of the GPPT at the student level. Since age and gender are reported

as two common factors that affect environmental and sustainability education, we also investigate the possible effects of GPPT schools on these factors through the SCQ.

The SCQ has been used in several Swedish studies to investigate the effects of ESD at the student level (e.g., Berglund et al., 2014; Olsson & Gericke, 2016; Olsson et al., 2016). The construct was developed in Sweden to describe an individual's action potential with respect to sustainability. SC is defined as a composite of *knowingness, attitudes, and self-reported behaviors* related to each of the three components (environmental, social, and economic) of SD, as illustrated in Figure 1 (in the SC concept, knowingness does not refer to purely factual knowledge. Instead, knowingness is defined by a recognition of the fundamentals of the concept of sustainable development and is measured by the degree of recognition of these fundamentals). Recently, Gericke and his colleagues (2018) reported on the theoretical underpinnings of the SC concept as well as the development, validation, and operationalization of the questionnaire (SCQ) measuring SC.

The SC definition is closely related to the description of action competence by Breiting and Mogensen (1999), who describe action competence as co-variations in the knowledge of action possibilities, confidence in one's influence, and a willingness to act, thereby coinciding with the purpose of ESD (Vare & Scott, 2007). These three aspects of action competence are considered in the SC concept (for further information, see Gericke et al., 2018) by taking a holistic approach to the psychological constructs of knowingness (K), attitudes (A), and behaviors (B) within the environmental, social, and economic components of sustainable development (see Figure 1).

The features of the SC concept are closely linked to the descriptions of the successful outcomes associated with the student level of the GPPT (Wang, 2009a). The SC framework and the operationalization of the concept through the SCQ are, therefore, used to investigate the effect of the GPPT on student SC at different levels of the school system in Taiwan.

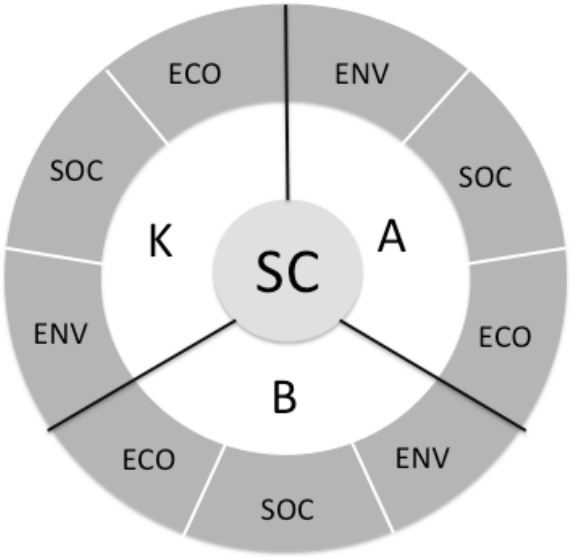


Figure 1. A representation of the concept of Sustainability Consciousness. K=knowingness; A=attitudes; B=behaviors; ECO=economic; SOC=social; ENV=environmental; SC=sustainability consciousness

1.5. Aim and Research Questions

The aim of our study was to investigate the effects of the GPPT on the overall SC, sustainability knowingness, attitudes, and behaviors of students attending GPPT schools. We compared students in GPPT schools and those in non-GPPT schools. We also evaluated the difference in the SC, sustainability knowingness, attitudes, and behaviors of (i) boys and girls and (ii) students in different grades, depending on whether they attended a GPPT or non-GPPT school.

Our three research questions were as follows:

1. What are the effects of the GPPT on the overall SC and on sustainability knowingness, attitudes, and behaviors of the students?
2. Is the effect of gender on the SC, sustainability knowingness, attitudes, and behaviors of students moderated by schools participating in the GPPT?
3. If there are age-based effects on the SC, sustainability knowingness, attitudes, and behaviors of students, do these differ between GPPT schools and non-GPPT schools?

2. Method

2.1. The Sample of Students

To investigate the effects of the GPPT, the sample included schools participating in the GPPT certification program and comparable non-GPPT schools. We examined three different grades in this study (grades 6, 9 and 12, which are the final year of elementary school, junior high school and senior high school), allowing for cross-sectional comparisons to study age effects. The age of the students was 12, 15 and 18 years respectively. The naturally occurring mix of boys and girls allowed for investigations of gender differences.

The sampling process considered the balance between GPPT and non-GPPT schools, the school location (northern, central, and southern Taiwan) and socio-economic factors. The schools were selected to ensure that the socio-economic background of the students was the same in the GPPT and non-GPPT schools from the same geographic area, so as not to bias our comparisons. Nine schools participated in the study of sixth grade students. Four schools in northern Taiwan were chosen, two were typical GPPT schools, and the other two schools were non-GPPT schools. Similarly, two GPPT schools and two non-GPPT schools were chosen in southern Taiwan. Only one non-GPPT school in central Taiwan was selected as a control school; this represents the actual situation, with fewer GPPT schools located in this area than in the northern and southern parts of the country. For the ninth-grade sample, seven schools joined the study (four GPPT schools and three non-GPPT schools). The number of junior high schools in northern Taiwan is higher than in southern Taiwan and just a few GPPT junior high schools are located in central Taiwan. Therefore, two GPPT and two non-GPPT schools from the north and two GPPT and one non-GPPT school from the south were invited to participate in the study. The sample of twelfth-grade students was similar to that of the sixth-grade students. Nine schools were asked to respond to the questionnaires: four GPPT schools (two in the north and two in the south) and five non-GPPT schools (two in the

north, two in the south, and one in the center). As previously stated, all non-GPPT schools were selected on the basis that they were in the same region as a GPPT school, and recruit students from the same socio-economic background. The participating schools were all located in urban areas, reflecting the fact that in Taiwan GPPT schools are mainly located in urban areas. Each school was asked to contribute to the study by randomly selecting two classes of students to fill in the questionnaire.

The sex ratios of the sixth-graders and ninth-graders represent the actual situation in schools. However, the sex ratio (girl/boy) was higher than the actual value associated with the twelfth grade, because one of the selected GPPT schools was an all-girl high school. This school was a typical GPPT school and therefore represented a valid part of the sample for the current study.

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

	Grade six			Grade nine			Grade twelve			Whole sample		
	GPPT	Control	Total	GPPT	Control	Total	GPPT	Control	Total	GPPT	Control	Total
Number of schols	4	5	9	4	3	7	4	5	9	12	13	25
Number of students	216	346	562	292	215	507	294	378	672	802	939	1741
Sex ratio (girls/boys)	0.85	1.00	0.97	1.09	0.90	1.01	3.39	1.09	1.72	1.48	1.01	1.21
Missing data (%)	18.1	15.0	16.2	5.8	19.5	11.6	5.4	7.1	6.4	9.0	12.9	11.1

2.2. The Sustainability Consciousness Questionnaire

Several researchers (e.g. Berglund et al., 2014; Boeve de-Pauw et al., 2015; Olsson et al., 2016) have used the survey instrument to evaluate the SC of students. The instrument was developed in Sweden and operationalizes the concept of SC through a 49-item questionnaire (Gericke et al., 2018). The SC consists of three aspects, namely sustainability knowingness, sustainability attitudes, and sustainability behaviors. In addition, each item in the questionnaire also reflects the environmental, social or economic component of SD (see Figure 2 for the theoretical model). However, in the current study, we focused on the SC, sustainability knowingness, attitudes, and behaviors of students, rather than on the

environmental, social or economic components. The sustainability knowingness, attitudes, and behaviors sections reflect (i) what people acknowledge as necessary features of SD, which is closely related to the cognitive aspect of attitudes (beliefs), (ii) feelings about SD and what people think about SD issues, and (iii) the self-reported behavior of people about their actions in relation to these issues.

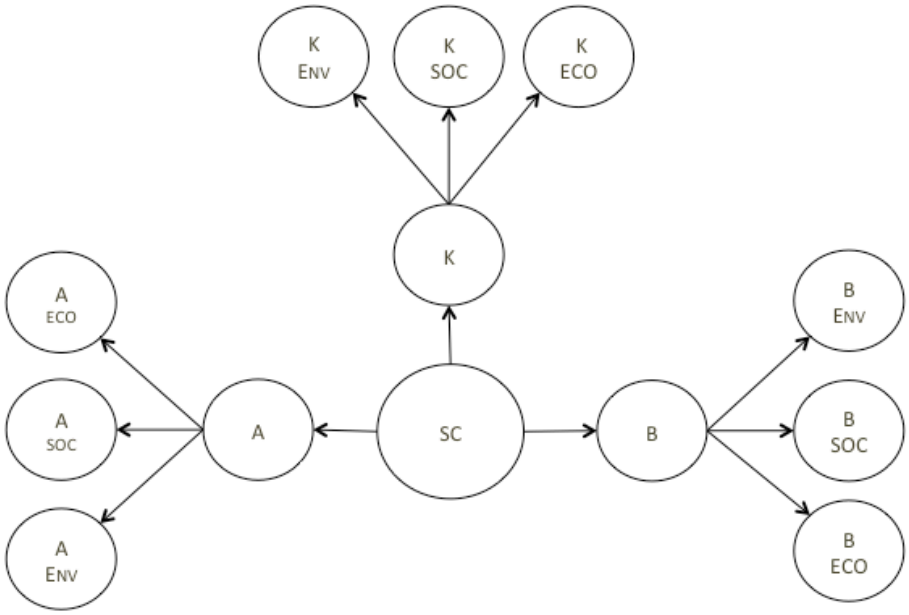


Figure 2. Theoretical model of sustainability consciousness (SC). The three-order model consists of second-order latent variables referred to as sustainability knowingness (K), sustainability attitudes (A), and sustainability behaviors (B). The first-order latent variables consist of items categorized into environmental (ENV), social (SOC) or economic (ECO) aspects of sustainable development

A native Mandarin speaker, who is 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.

2.3. Data Analysis

We performed confirmatory factor analyses (CFA) to empirically confirm the hypothetical model of the SC construct, since this was the first time the questionnaire was used in the context of Taiwan. The CFA was performed using structural equation modeling

(SEM) and the statistical software package *Mplus* (Muthén & Muthén, 2015). The model described by Gericke and colleagues (2018) was taken as the starting point for our analysis.

As a basis for the CFA in Taiwan, our higher-order model consisted of the same 49 items corresponding to the (i) third-order latent variable constructs of SC and (ii) three underlying second-order latent variables, sustainability knowingness, attitudes, and behaviors (see Figure 2). To evaluate the model fit, multiple fit indices were used with recommended values of ~.95 for the comparative fit index (CFI) and Tucker-Lewis index (TLI). Values ≤.06 were used for the root mean square error of approximation (RMSEA: Tabachnick & Fidell, 2007). Where necessary, modification indices determined how to further improve the model fit to the Taiwanese data based on meaningful error co-variance between items (Byrne, 1993). This procedure resulted in the inclusion of three additional error co-variances: two associated with the sustainability behaviors construct (B6–B7 and B2–B7) and one associated with poverty reduction, including one item in each of the constructs sustainability knowingness and sustainability attitudes (K17–A7). Based on the model fit indices, item A19, *I think it is okay that each one of us uses as much water as we want*, was found to be especially problematic in the Taiwanese context. As in the English version, the respondents could interpret the Mandarin translation of the item in two ways. First, they may respond in relation to whether it is ok for humanity to use as much water as it wants. Alternatively, it is also possible to respond in relation to whether it is ok that each individual person uses as much as they want. The model fit indices of the Swedish CFA (Gericke et al., 2018) showed that this was not an issue for the Swedish students considered in previous studies. However, the ambiguity of the item blurred our analysis of the Taiwanese data and, hence, we excluded it from further analysis.

The data were categorical by nature and, hence, the weighted least squares mean and variance (WLSMV) estimator was used with delta parameterization (Muthén & Muthén,

2015). The SEM analyses took into account the nested nature of the data (or hierarchical dependency of the errors) through the *Mplus* type=complex command (students clustered in schools). The final model (consisting of 48 items) was validated with excellent model fit estimates, CFI= .94, TLI=.94, and RMSEA=.03. The final model and additional statistical information are presented in the Appendix. Cronbach's alpha values were calculated to evaluate the reliability of the entire questionnaire as well as the sub-constructs of sustainability knowingness, attitudes, and behaviors. Based on the guidelines of Field (2013), our questionnaire exhibits good reliability (see Table 2).

Table 2

Reliability measures of the questionnaire and its sub-constructs

	Whole sample	GPPT	Control	Number of Items
SC	.92	.91	.93	48
K	.94	.85	.83	18
A	.79	.75	.83	13
B	.77	.76	.78	17

Note. SC=sustainability consciousness, K=sustainability knowingness, A=sustainability attitudes, and B=sustainability behaviors. Cronbach's alpha values are shown for the entire sample, GPPT group of students, and control group of students.

To answer the research questions, we used the SEM model to detect significant differences and to calculate effect sizes between sub-groups within the sample. A GPPT dummy variable was included in the analysis to allow comparison between the effects on students in the GPPT group and the non-GPPT group. As Table 1 shows, the sex ratio is skewed for the group of students constituting the GPPT group in grade twelve. Therefore, in our analysis, we accounted for gender by including a gender dummy variable that allows (i) distinction between the sexes (boys and girls) and (ii) analysis of the possible effects of gender on the latent variables. Two dummy-grade variables were included for the comparison between students in grades six, nine, and twelve. For calculating the descriptive statistics, we used SPSS version 22.

3. Results

3.1. Effect of the GPPT on Student Sustainability Consciousness

To answer the *first research question,* we used the SEM model and the GPPT dummy variable to detect differences between the two groups of students. The results reveal only slight differences between the groups. It follows that GPPT has no effect on student SC or the sub-constructs sustainability knowingness, attitudes, and behaviors when we used the entire sample (all three grades), or separated the different grades (six, nine, and twelve; see Table 4). For grade nine, the negative effect of attending a GPPT school on student attitudes was just outside the significance level.

To complement the results of the first research question, we present values of the mean and standard deviation based on the raw data of student answers to the questionnaire focusing on SC and the three corresponding sub-constructs sustainability knowingness, attitudes, and behaviors. Table 4 shows the descriptive statistics for the sample as a whole and for the GPPT group and the non-GPPT group. As the table shows, the mean and standard deviation for the GPPT students are almost the same as for the non-GPPT students. The mean values of each group of students are all higher than the neutral value (3) of the Likert-scale. Moreover, for both groups of students, the mean values associated with the behaviors sub-construct are slightly lower than those associated with knowingness and attitudes.

Table 3

Descriptive statistics

	Whole sample		GPPT		Control	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
All grades						
SC	3.95	0.44	3.97	0.46	3.93	0.43
K	4.02	0.53	4.04	0.55	4.01	0.51
A	4.12	0.54	4.14	0.57	4.10	0.51
B	3.78	0.52	3.80	0.53	3.76	0.51
Grade six						
SC	4.06	0.48	4.12	0.52	4.02	0.45
K	4.16	0.55	4.23	0.60	4.12	0.51
A	4.14	0.61	4.22	0.73	4.09	0.52
B	3.94	0.55	3.98	0.57	3.92	0.53
Grade nine						
SC	3.90	0.44	3.88	0.45	3.93	0.42
K	3.98	0.53	3.97	0.56	4.03	0.50
A	4.08	0.56	4.03	0.56	4.15	0.55
B	3.68	0.52	3.69	0.53	3.67	0.50
Grade twelve						
SC	3.91	0.39	3.97	0.38	3.86	0.39
K	3.95	0.49	4.00	0.48	3.91	0.48
A	4.13	0.47	4.18	0.43	4.08	0.49
B	3.71	0.46	3.78	0.45	3.66	0.46

Note. Means and standard deviations describing student sustainability consciousness (SC) and the sub-constructs sustainability knowingness (K), attitudes (A), and behaviors (B) for the entire sample, GPPT students, and control group.

Table 4

GPPT and control group comparisons

	All grades			Grade six			Grade nine			Grade twelve		
	Effect size	S.E.	P-value	Effect size	S.E.	P-value	Effect size	S.E.	P-value	Effect size	S.E.	P-value
SC	0.030	0.056	0.593	0.113	0.071	0.108	-0.057	0.074	0.441	0.097	0.056	0.086
K	0.040	0.069	0.565	0.134	0.092	0.145	-0.044	0.059	0.454	0.102	0.072	0.155
A	0.008	0.021	0.695	0.025	0.020	0.212	-0.085	0.043	0.051	0.063	0.045	0.159
B	0.036	0.075	0.627	0.096	0.082	0.242	0.039	0.101	0.697	0.121	0.076	0.112

Note. Effect (β) of the GPPT on student sustainability consciousness (SC), knowingness (K), attitudes (A), and behaviors (B). No estimates were significant at $p<0.05$.

3.2. The GPPT and the Effect of Gender on Student Sustainability Consciousness

Our SEM analysis also revealed some grade-specific effects of gender, where the mean values obtained for girls were significantly higher than those for boys. In this part of the analysis, the GPPT dummy variable was included when gender effects were calculated. The

results in Table 5 show that, for the entire sample, gender had a significant effect on student SC (β=0.058, p=0.022), attitudes (β=0.034, p=0.006), and behaviors (β=0.104, p<0.001). Therefore, with respect to sustainability behaviors, the girls scored 10% of a standard deviation higher than the boys. However, the student sustainability knowingness appears to be independent of gender, irrespective of whether the entire sample or separate grades are considered.

Grade-specific effects of gender on the student SC, sustainability knowingness, attitudes, and behaviors (see Table 5) reveal negligible gender differences for grade six students. Gender effects for grade nine follow the same trend as those describing the effects for the entire sample. For twelfth graders, a significant gender effect occurs only for their sustainability behaviors (β=0.186, p<0.001): girls scored ~19% of a standard deviation higher than boys. The effect size of sustainability behaviors increases with increasing grade (i.e., from the sixth through to the twelfth grades; see Table 5). This is indicative of an increasing gender gap between boys and girls, and for which the mean values obtained for girls were consistently higher than those obtained for boys.

Table 5

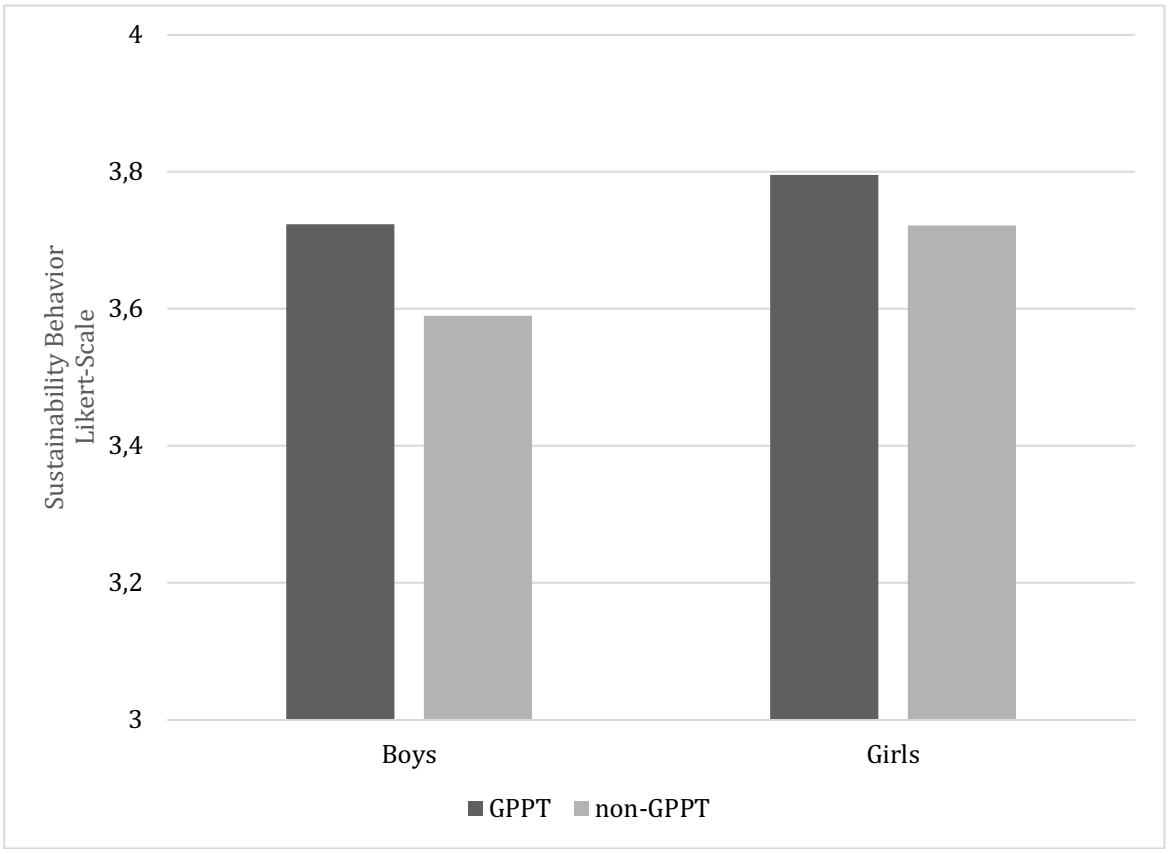
Differences between boys and girls

	All grades			Grade six			Grade nine			Grade twelve		
	Effect size	S.E.	P-value	Effect size	S.E.	P-value	Effect size	S.E.	P-value	Effect size	S.E.	P-value
SC	0.058*	0.025	0.022	0.044	0.038	0.252	0.076*	0.018	0.000	0.059	0.033	0.073
K	0.003	0.034	0.938	0.029	0.050	0.554	-0.004	0.036	0.923	-0.015	0.041	0.723
A	0.034*	0.013	0.006	0.013	0.012	0.252	0.072*	0.013	0.000	0.044	0.030	0.136
B	0.104*	0.030	0.000	0.047	0.031	0.126	0.139*	0.043	0.001	0.186*	0.045	0.000

Note. Differences are shown in terms of effect (β) of gender on student sustainability consciousness (SC), knowingness (K), attitudes (A), and behaviors (B). Results marked with * indicate estimates significant at p<0.05. A positive effect indicates that a higher mean value was obtained for the girls than for the boys.

We also investigated the interaction between the GPPT group and gender, as significant gender effects must be considered for the entire sample as well as for grade nine and grade twelve. Significant interaction effects would indicate that girls and boys react differently to

449 the GPPT. A significant interaction effect between gender and GPPT was found for the
450 overall SC (β=0.094, p=0.007) and behaviors (β=0.197, p<0.001) of grade 12 students.
451 However, no interaction effects were found for attitudes and knowingness. The interaction
452 effect for sustainability behaviors (see Figure 3) results from the larger impact of GPPT on
453 boys than on girls (although GPPT has no overall direct effect, see Table 4). The gender
454 effects and the interaction between gender and the GPPT must therefore be considered in
455 discussions of the effect of the GPPT, especially on student sustainability behaviors.



456
457 *Figure 3.* Twelfth grader sustainability behaviors (B) showing the mean values for the boys
458 and girls in the GPPT and non-GPPT groups. The GPPT has a slightly greater impact on the
459 boys than on the girls.
460

461 **3.3. The GPPT and Age-Specific Differences**

462 To answer the third research question, the grade variables were used in the SEM model.
463 The age effect of the GPPT on student SC, sustainability knowingness, attitudes, and

behaviors was determined by comparing pairs of grades in our cross-sectional design (grades six and nine; nine and twelve; six and twelve).

The results of the sixth and ninth grade pairwise comparison show that the effect in all cases was negative. This indicates that the SC, sustainability knowingness, attitudes, and behaviors of the students decreased when the grade increased from six to nine. The student SC for the GPPT and non-GPPT groups was compared. In general, the GPPT-certification amplifies the effect associated with the decrease between the sixth and ninth graders. However, a significant decrease occurs for the overall data set (i.e., when the entire sample is considered) with respect to the students' SC (β=-0.100, p=0.023) and knowingness (β=-0.163, p<0.001). This trend was also observed for the GPPT group. The sixth graders scored 10–16% of a standard deviation higher than the ninth graders for both SC and knowingness. A significant negative effect between the ninth graders and the sixth graders in the non-GPPT group was observed only for sustainability knowingness (β=-0.130, p<0.012).

The ninth grade and twelfth grade comparison revealed rebound in the student SC of the GPPT group (β=-0.112, p<0.007), non-GPPT group (β=-0.089, p<0.030), and the entire sample β=-0.095, p<0.007 (see Table 6). The twelfth graders scored 9–11% of a standard deviation higher than the ninth graders. The effects (see Table 6) for the ninth and twelfth graders' SC in the GPPT and the non-GPPT groups show that the ninth-grade dip was, in general, amplified by GPPT certification. As the table shows, the rebound was associated with sustainability behaviors between the ninth and twelfth grades (β=-0.363, p<0.001 and β=-0.344, p<0.001 for the GPPT and non-GPPT groups, respectively). This indicates that, with respect to their behaviors, the twelfth graders scored 34–36% of a standard deviation higher than the ninth graders.

Furthermore, the results also show that the SC, knowingness and attitudes of the twelfth graders were lower than those of the sixth graders (the column to the right in Table 6). The

difference between students in grades six and twelve follows the same trend as the difference between students in grades nine and six. Overall, these results provide an answer to our third research question: they show age-specific differences when we compare the sixth, ninth, and twelfth graders' SC, knowingness, and behaviors. Compared with that of the non-GPPT group, these differences were, in general, larger for students in the GPPT group.

Table 6

Pairwise comparisons of students in different grades with respect to sustainability consciousness (SC), knowingness (K), attitudes (A), and behaviors (B).

	Grade 9 : Grade 6			Grade 9 : Grade 12			Grade 12 : Grade 6		
	β	S.E.	P-value	*β*	S.E.	P-value	*β*	S.E.	P-value
Entire sample									
SC	-0.100*	0.044	0.023	-0.095*	0.035	0.007	-0.085*	0.034	0.013
K	-0.163*	0.006	0.000	-0.019	0.045	0.667	-0.173*	0.041	0.000
A	-0.045	0.027	0.098	-0.019	0.019	0.321	-0.028	0.020	0.160
B	-0.011	0.068	0.874	-0.415*	0.055	0.000	0.045	0.064	0.476
GPPT									
SC	-0.105*	0.050	0.036	-0.112*	0.041	0.007	-0.091*	0.040	0.023
K	-0.151*	0.054	0.005	-0.052	0.050	0.292	-0.182*	0.048	0.000
A	-0.042	0.028	0.132	-0.027	0.022	0.234	-0.022	0.022	0.304
B	-0.070	0.071	0.323	-0.363*	0.062	0.000	-0.003	0.068	0.968
Non-GPPT									
SC	-0.090	0.049	0.067	-0.089*	0.041	0.030	-0.075	0.040	0.057
K	-0.130*	0.051	0.012	-0.021	0.052	0.686	-0.158*	0.046	0.001
A	-0.037	0.028	0.179	-0.019	0.020	0.345	-0.018	0.022	0.414
B	-0.054	0.069	0.441	-0.344*	0.061	0.000	0.017	0.067	0.800

Note. A negative effect in the left *β*-column indicates a decrease between grades six and nine. A negative effect in the middle *β*-column indicates a rebound from grade nine to grade twelve. The right *β*-column shows the grade twelve and grade six comparison. Results marked with * indicate estimates significant at $p<0.05$.

4. Discussion

Our reliability and validity measures for the final model of the SC questionnaire can be considered to be well within the recommended ranges (Field, 2013; Tabachnick & Fidell, 2007). Given the validity of our data, our findings can be considered to contribute novel knowledge about ESD teaching and learning as well as being relevant to ESD research in Taiwan.

The main findings of this study can be summarized in relation to the research questions. First, negligible effects on student SC were found between students in the two groups (GPPT and non-GPPT). Slightly lower mean values were obtained for the sustainability behaviors of students in both groups compared with the values obtained for corresponding knowingness and attitudes. Second, for the entire sample, gender has a significant effect (especially on behaviors), with higher mean values consistently obtained for girls than for boys. Our findings also reveal that the gender effect on sustainability behaviors increased with increasing grades in the school system. However, the GPPT seems to reduce the effect by affecting the self-reported behaviors of twelfth grade boys more than girls, although the overall gender-effect was largest for twelfth grade students. Third, an adolescent dip in student overall SC was identified, as characterized by a decrease in the SC of students in the ninth grade, followed by a rebound in the SC in the twelfth grade. The dip was particularly clear for the sustainability behaviors of the students.

4.1. Effect of the GPPT on the SC of Students

The impact of ESD-certification programs (e.g., the eco-school program in Europe) on student perceptions of environmental and sustainability issues has been examined elsewhere (e.g. Boeve-de Pauw & Van Petegem, 2011; Cincera & Krajhanzl, 2013; Johnson & Cincera, 2015; Olsson et al., 2016). The results of the present study concur with those of studies (e.g. Olsson et al., 2016; Olsson & Gericke, 2016; Olsson & Gericke, 2017) performed in western

531 countries. The development of the GPPT-certification system in Taiwan was based on the
532 same features as those characterizing the ESD-certification system (e.g., the European eco-
533 school system) in western cultures (Lee, Wang, & Yong, 2013). The fact that our results for
534 the GPPT and non-GPPT comparison confirm previous research is, therefore, unsurprising.
535 There could be several reasons for the lack of impact of the ESD certifications in
536 Taiwan and elsewhere. Income has been shown to correlate negatively with pro-
537 environmental behavior (e.g. travel mode choice) among Chilean adults (Otto et al., 2016).
538 Taiwanese students in schools from areas with higher socioeconomic status could, therefore,
539 be expected to score lower for their sustainability behaviors. However, the GPPT schools and
540 non-GPPT schools were selected to be as similar as possible with respect to socioeconomic
541 factors, and therefore such a difference should not have biased our results. Moreover, in
542 Flanders as well as Sweden, socioeconomic background has been shown not to be the reason
543 for the absence of effects on students in ESD-certified schools in comparison with students in
544 non-certified schools (Boeve-de Pauw & Van Petegem, 2017; Olsson et al., 2016).
545 The limited effect of GPPT on the SC of students may, instead, be attributed to the
546 possibility that students in GPPT-schools lack ESD teaching, or do not experience this
547 teaching differently from students in non-GPPT schools. A Swedish study cites the
548 importance of students experiencing ESD teaching in terms of holism and pluralism (Boeve-
549 de Pauw et al., 2015). As a pedagogy, pluralism is characterized by the aim of acknowledging
550 and engaging with different views, values and perspectives in education and society, without
551 the teacher being presented as having “the right answer” and imparting predefined solutions
552 (Rudsberg & Öhman, 2010). The holistic perspective taps into the relationships between
553 environmental, social and economic perspectives, the past-present-future, and local-regional-
554 global relationships embedded in these issues to deliver the approach to content. Boeve-de
555 Pauw and colleagues (2015) have shown that ESD in terms of holism and pluralism have an

effect on students' sustainability knowingness and sustainability behaviors, respectively. Moreover, they found that students in grades six and nine of ESD-certified schools in Sweden experienced similar (or lower) levels of pluralistic teaching, in comparison to students in non-certified schools. Nevertheless, in grade twelve, the students in ESD-certified schools experienced more pluralistic teaching than students in non-certified schools (Boeve-de Pauw et al., 2015). Given that the same trend could be observed in Taiwan, (i.e., students in GPPT-certified schools experience similar levels of ESD teaching in terms of holism and pluralism to those in regular schools), it is a plausible explanation for our results. If so, GPPT certification seems to have negligible influence on teaching practice in grades six and nine.

Similarly, in a Chilean study involving young adults, Neaman, Otto and Vinokur (2018) found that pro-social behavior and pro-environmental behavior were simply two facets of the same thing. They concluded that working with pro-social behavior in education will also affect pro-environmental behavior. Based on the findings of Neaman and colleagues (2018), it could be hypothesized that students' sustainability behavior will be affected if they experience pluralistic teaching in which pro-social behavior is encouraged. Once again, in comparison with other research, the most plausible explanation for our negative results is that the certification program and the evaluation system of the GPPT do not have the power to change teaching practices in the participating schools, although this conclusion needs to be empirically tested.

In the Global Action Programme (GAP) (UNESCO, 2014), a whole-school approach to ESD is highlighted as a prerequisite for building sustainability competences among young people. It has been suggested that the GPPT supports whole-school approaches to sustainability (Lee, Wang, & Yong, 2013). However, Jeng (2004) and Wang (2009) consider that there is a lack of whole-school teamwork and internal support among the GPPT schools. This may be attributed to the fact that whole-school approaches to ESD have only been partly

581 implemented in the investigated GPPT schools. Such partial implementation is also cited as a
582 possible general explanation for the limited effect of different certification programs in other
583 countries (Warner & Elser, 2015).

584 **4.2. The GPPT and the Effect of Gender on Student SC**

585 In general education, the socialization of gender is manifested as an increased gender
586 gap between boys and girls, where girls (in general) outperform boys (Lahelma, 2014;
587 Quenzel & Hurrelmann, 2013). Apparently, the gender socialization process starts at an early
588 age and continues through adolescence into adulthood (Lahelma, 2014; Pomerantz, Ng, &
589 Wang, 2004; Quenzel & Hurrelmann, 2013). The occurrence of the same phenomenon in
590 environmental and sustainability education research is therefore unsurprising. However,
591 previous studies examining environmental and ESD-certification programs have revealed that
592 girls and boys are affected differently by these programs (Boeve-de Pauw, Jacobs, & Van
593 Petegem, 2014; Cincera & Krajhanzl, 2013; Goldman, Pe'er, & Yavertz, 2015; Oerke &
594 Bogner, 2010; Olsson & Gericke, 2107). Our results on the effect of gender on student SC
595 concur with those of Swedish studies in which a gender gap was identified (Olsson &
596 Gericke, 2017). As in the present study, the mean values and SC of the girls in that study were
597 consistently higher than those of the boys.

598 In the same Swedish cross-sectional study (Olsson & Gericke, 2017), the gender-gap
599 increased with increasing grade (six, nine, and twelve). Our cross-sectional results in the
600 Taiwanese context follow the same trend, i.e., the effect of gender on student SC increases
601 with increasing grade. According to the research literature (e.g. Pomerantz et al., 2004;
602 Quenzel & Hurrelmann, 2013), the most plausible explanation for gender differences is that
603 the students have been socialized into different identities. In addition, the socially constructed
604 girl and boy stereotypes expect girls to adopt values of doing "public good" and to be more

caregiving, nurturing, and cooperative than boys (Pomerantz et al., 2004; Schwartz & Rubel, 2005), which is in line with SC.

Olsson & Gericke (2017) also found that the ESD-certified schools in Sweden amplified the gender difference in student SC, which was a result contrary to the official description of the attributes of ESD (UNESCO, 2006; 2009; 2014), In the present study conducted in Taiwan, the results suggest that the GPPT-certification actually reduces the gender gap in grade twelve by affecting the sustainability behaviors of boys more than that of girls (see Figure 3). Our result, therefore, differs from those obtained in the Swedish context, indicating that some teaching component affects the sustainability behavior of the students (especially boys). Fishbein & Ajzen (2011) argue that behavioral approaches in western cultures, where decisions are often made on an individual level, are not applicable to non-western cultures. In non-western cultures, decisions about actions are often group-based and influenced by social factors that sometimes differ from individual preferences. Thus, the effect of the GPPT on the sustainability behaviors of grade twelve boys could be due to this social effect, but warrants further investigation. Students' experience in relation to characteristics of ESD teaching and learning should, therefore, be considered in future research in Taiwan.

4.3. The GPPT and Age-Specific Differences

Previous research has shown that age must be considered when the effects of environmental and sustainability implementation initiatives are investigated (e.g., Boeve de-Pauw, Donche, & Van Petegem, 2011; Liefländer & Bogner, 2014; Negev et al., 2008; Olsson & Gericke, 2016; Otto & Kaiser, 2014). For example, younger students have been found to adopt more environmentally friendly attitudes and behaviors than their adolescent peers (Liefländer and Bogner, 2014; Negev et al., 2008). Olsson and Gericke (2016) found a dip in the SC of Swedish adolescents, using the constructs used in the present study. The dip was characterized by a decrease in the SC between the 12–13-year old students and their

adolescent (15–16-year old) peers. The decrease was followed by a rebound in the SC of 18–19-year old students. Our current findings suggest that the same pattern is present among Taiwanese students. The biggest effect of this adolescent dip is manifested in students' self-reported behaviors (see Table 6, both columns to the left).

One possible explanation for the dip might be a link between the *Reasonable Person Model* (RPM), developed by Kaplan and Kaplan (2009), and the principles of ESD teaching and learning. According to the RPM, adolescent students readily explore new areas (both mentally and physically) and in the development of their autonomy, have (in general) less consideration of others (Kaplan & Kaplan, 2009). Therefore, adolescent perceptions of environmental and sustainability issues tend to be less fixed to their surrounding world, compared with pre-adolescent perceptions (Crone & Dahl 2012). The RPM implies that education in which teaching activities attempt to transfuse sustainability attitudes and behaviors could have particularly negative effects on the adolescent age group (Kaplan & Kaplan, 2009; Olsson & Gericke, 2016), which could explain our current findings.

ESD is described as a teaching approach that promotes critical thinking and the development of competences as a means of realizing sustainable development (Vare & Scott, 2007). Given the relationship between ESD and the RPM, ESD should have the capacity to remedy an adolescent dip (Olsson & Gericke, 2016). However, this was not the case in either Sweden or in the current study in Taiwan. Our sixth-ninth and ninth-twelfth grade comparisons show that effect sizes are slightly larger for the GPPT-group than for the non-GPPT group of students. We suggest that a normative teaching approach, where the teachers implement actions for transfusing behaviors into students, would have a specific negative effect on the adolescent age group. Studies in western cultures indicate that teachers generally teach environmental and sustainability issues in this manner (see Olsson & Gericke, 2016), e.g., they teach about sustainability rather than for sustainability (Lee, Wang, & Yang, 2013).

Thus, the observed trend may be a direct result of the current teaching tradition in Taiwan, which might even be enhanced by the GPPT certification system, and runs counter to the previously discussed ESD teaching approaches of holism and pluralism. We therefore encourage Taiwanese ESD educators to consider developing new teaching practices in GPPT-schools.

4.4. Conclusions and Implications

Our findings make a novel and important empirical contribution to the current research, by indicating the effects of ESD implementation in Taiwan at a student level. They can be summarized as follows: (1) GPPT schools and non-GPPT schools have a similar effect on students' SC. Hence, the findings suggest that the investment in the GPPT does not pay off in terms of sustainability knowingness, attitudes and self-reported intended sustainability behaviors among the students. (2) The gender gap, as it relates to SC, increases through the investigated grades, and consistently higher mean values are obtained for girls than for boys. However, the GPPT positively effects twelfth grade boys' self-reported intended behaviors with respect to sustainability. (3) The adolescent dip in student overall SC occurs especially for students' self-reported sustainability behaviors.

Based on the above discussion, there are some key issues to consider for further development of the GPPT and for further research examining the GPPT. The first issue concerns the lack of effect on student SC of the teaching in the GPPT schools. Given the above discussion, development of the GPPT could involve (i) continuing the job of implementing whole-school approaches (Wang, 2009) and (ii) focusing on ESD-teaching approaches that include holism and pluralism, which include teaching components strengthening students' pro-social behavior that have been shown to have an impact on student SC (Boeve-de Pauw et al., 2015; Neaman et al., 2018). Second, in general, our results reveal an increasing gender gap in student SC. The results from grade twelve GPPT-schools

reveal, however, that this gap is reduced (in general) by some aspect of teaching in these schools. Further investigation of the pedagogy and ESD teaching approaches in the twelfth grade of GPPT-certified schools could, therefore, provide a means of improving the GPPT-certification system, particularly with respect to the gender gap. Based on our discussion above, a third implication for the GPPT certification system relates to the presence of an adolescent dip in student SC and the fact that the GPPT-certification tends to enhance this. This indicates the need for an age-adapted transformation of ESD teaching and learning (see also Olsson & Gericke, 2016) that will meet the needs of adolescents.

Our results also reveal opportunities for further research into how students in Taiwan experience ESD teaching and learning. Given the limited effects of the GPPT schools on student SC, future research should examine the kind of teaching approaches that the students experience in the GPPT schools, including holistic and pluralistic teaching and pro-social approaches (Boeve-de Pauw et al., 2015; Neaman et al., 2018). It would also be fruitful to include socioeconomic factors in any investigations of the GPPT certification system to dig deeper into the relationship between income and non-sustainable behaviors (Otto et al., 2016). Further research should also focus on the relationship between the current teaching approach in the Taiwanese GPPT certification system and the adolescent dip in student self-reported sustainability behaviors. Moreover, investigating in greater depth the link between the twelfth grade ESD teaching approach and the positive effect on the behaviors of boys, as reported in the present study, could provide further information of value to the development of the Green School Partnership Program in Taiwan.

5. Notes

1. U.S. Department of Education Green Ribbon Schools. https://www2.ed.gov/programs/green-ribbon-schools/index.html
2. Eco-school certification program. http://www.ecoschools.global/
3. Green schools program in Israel, see Shay-Margalit and Rubin (2017)

4. Web-address for the questionnaire and categorization of items:
English version: [Removed due to blinded review. For the review process, see supplementary file]
Chinese version [Removed due to blinded review. For the review process, see supplementary file]
Categorization of items: [Removed due to blinded review. For the review process, see supplementary file]

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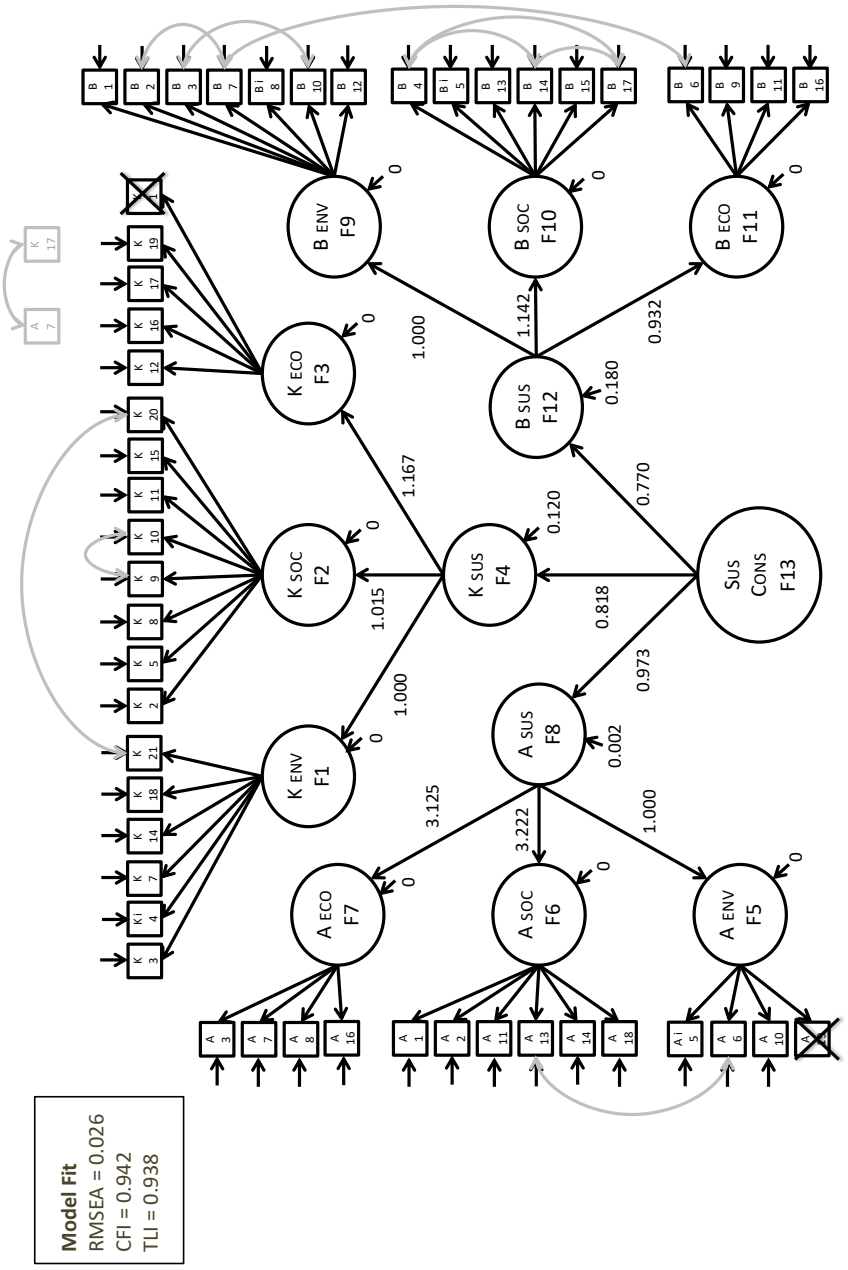
Appendix



Appendix figure. CFA results for the final full SC model, all grades, Taiwan.
Note: Residual variances of first order factors are constrained to 0*. Squares represent observed variables and circles are latent variables. Arrows without origin are residual variances and the full arrows are factor loadings. Curved double arrows represent relevant error covariances. And are presented in the appendix table on the next page along with factor covariances.

* Sometimes there can be small negative residual variances between levels of multilevel models. It is common practice to adjust such residual variances to zero (Muthen & Muthen, 2015).

Appendix Table. *Relevant error covariances between variables and factor covariances.*

	Estimate	S.E	Two-tailed P-value
K21 with K20	0.191	0.015	0.001
K9 with K10	0.240	0.020	0.001
A7 with K17	0.351	0.014	0.001
A13 with A6	0.016	0.012	0.178
B2 with B7	0.250	0.021	0.001
B3 with B10	0.041	0.017	0.016
B4 with B14	-0.076	0.016	0.001
B14 with B17	-0.007	0.016	0.663
B4 with B17	-0.093	0.016	0.001
B6 with B7	0.321	0.022	0.001
F2 with F1	-0.072	0.005	0.001
F2 with F3	0.020	0.004	0.001
F1 with F3	-0.073	0.006	0.001
F7 with F5	0.020	0.003	0.001
F7 with F6	-0.007	0.006	0.227
F5 with F6	-0.002	0.002	0.293
F11 with F9	-0.033	0.009	0.001
F11 with F10	-0.070	0.008	0.001
F9 with F10	-0.064	0.007	0.001
F4 with F8	0.209	0.013	0.001
F4 with F12	0.256	0.019	0.001
F8 with F12	0.114	0.012	0.001

Note. Two error covariances between items and two factor covariances are not significant. We kept them in the model since they were included in the original Swedish model upon which this work was based.