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Master thesis

Cross-Cultural Comparison of Action Competence for Sustainability

An Investigation of Measurement Invariance Between Swedish and Norwegian Students Based on Observations From the Self-Perceived Action Competence for Sustainability Questionnaire.

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Popular Abstract

In 2015, the United Nations introduced the 17 Sustainable Development Goals, one of which was to ensure that all learners acquire the knowledge and skills necessary to take action for sustainable development. Action competence is a desired outcome of education for sustainable development. With this, there arises a need for instruments suited to monitor the development of action competence for sustainability across multiple countries. A group of scientists based in Sweden has developed a promising instrument meant to measure this outcome, which was translated into Norwegian with the idea of including it in the evaluation of the latest curriculum reform in Norway. This thesis aims to evaluate the comparability of the results between Norwegian and Swedish school students. If the results are comparable across these two neighboring countries, the instrument could be of use for monitoring the development of action competence across more diverse educational settings. The findings from this thesis indicate that scores on this instrument are comparable and that the instrument works similarly for both Norwegian and Swedish students.

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Abstract

The aim of this thesis is to evaluate the level of measurement invariance between Swedish and Norwegian students, based on observations from the "Self-Perceived Action Competence for Sustainability Questionnaire" (SPACS-scale instrument). This study uses already collected data, from 2018 and 2021 for Swedish and Norwegian students respectively. The sample consists of 1034 Swedish and 2012 Norwegian students. The SPACS-scale instrument is intended to measure action competence for sustainability, a desired outcome of education for sustainability. To evaluate the level of measurement invariance we used marginal maximum likelihood estimator to fit several confirmatory factor analysis models. These models were estimated with varying levels of constraints, and compared.

The findings of this study confirms that the SPACS-scale instrument is effective and indicate good fit using observations from both Norwegian and Swedish students. The findings further indicate measurement invariance at the scalar level, meaning that latent means are comparable across groups. These findings can be used as a first step towards using the SPACS-scale instrument in more diverse educational settings. One of the 15 sustainability goals states that learners should develop the necessary knowledge and skills needed to take action for sustainable development. With the results from this study, the SPACS-scale instrument could be used in the future to monitor the development of action competence for sustainability.

Keywords: measurement invariance, confirmatory factor analysis, sustainable development, education for sustainable development, action competence for sustainability.

Cross-Cultural Comparison of Action Competence for Sustainability

In the UN General Assembly in 2015, the United Nations presented 17 Sustainable Development Goals (SDGs), as a part of the 2030 Agenda for Sustainable Development (United Nations, 2015). Goal four of the SDGs focuses on education, and one of the goals outlined is to ensure that all learners acquire the knowledge and skills necessary to promote sustainable development. It's crucial for students to develop the competence needed to take action towards sustainable development (Sass et al., 2023). To ensure that this goal is achieved across various educational settings, there is a need for instruments suited to monitor student progress towards action competence for sustainability. A group of researchers has developed and tested a promising instrument meant to measure action competence for sustainability called the "Self-Perceived Action Competence for Sustainability Questionnaire" (SPACS-scale instrument) (Olsson et al., 2020). The instrument, originally validated in Sweden, has demonstrated both reliability and validity, and has been found useful in monitoring students' development of action competence for sustainability over time. (Olsson et al., 2022).

The SPACS-scale instrument has recently been translated and adapted into Norwegian (Brandmo et al., 2021). This adaptation intends to utilize the SPACS-scale instrument to evaluate parts of the Knowledge Promotion Reform 2020 (LK20), the most recent curriculum change in Norway. The reform introduced sustainable development as part of its core curriculum for all primary and secondary education. The curriculum states that students should develop competence that enables them to make responsible choices and practice sustainable behavior (Utdanningsdirektoratet, 2017). This thesis aims to examine the degree of measurement invariance (Leitgöb et al., 2023), between Swedish and Norwegian observations on the SPACS-scale instrument. There is a need for instruments suited to monitor and measure the desired outcomes of education for sustainable development.

Investigating the comparability of observations on the SPACS-scale instrument from Swedish and Norwegian students represents an initial step towards using this tool across a wider range of educational settings in a more diverse, international context.

Theory

Relevant concepts for this thesis will be described in the following. First, we will discuss sustainable development, education for sustainable development, and action competence for sustainability. Second, we will look at how the concept of action competence is connected to the latest school reform in Norway, the Knowledge Promotion Reform 2020, and the ongoing process of evaluating this reform. Third, the concept of measurement invariance and its relevance for both the evaluation and this thesis will be described. Lastly, we will present the relevance of this thesis, as well as the research questions.

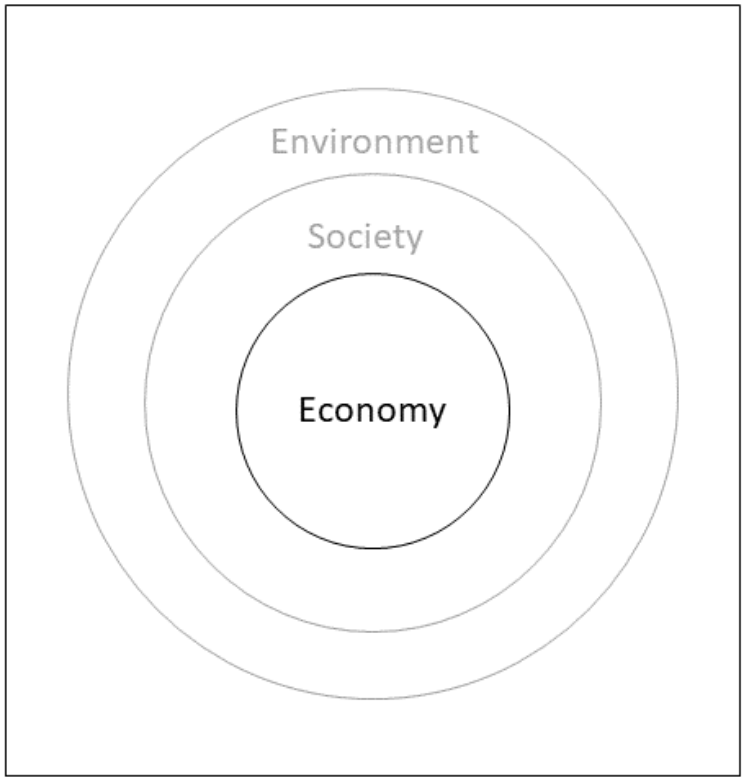
Sustainable development

The 1987 Brundtland Commission Report defines sustainable development (SD) as "development that meets the needs of the present without compromising the ability for future generations to meet their own needs" (Brundtland, 1987). Sustainable development is usually structured around three dimensions, commonly represented by three intersecting circles: social, economic, and environmental (Purvis et al., 2019). The social dimension focuses on ensuring that all members of society have access to basic needs such as education, healthcare, and housing. The economic dimension focuses on promoting economic growth and development while ensuring that the needs of the present are met without compromising the ability of future generations to meet their own needs. The environmental dimension focuses on protecting and preserving natural resources for future generations. Viewing these three dimensions as interconnected circles implies that trade-offs can be made between the dimensions to reach sustainability goals. Giddings et al., (2002), argue against this view and instead propose these dimensions to be considered at different spatial levels (see Figure 1).

Dimensions within the circles are a subset of the ones above, economy within society, and both within the environment. This emphasizes the view that sustainable development is a complex concept with many interconnected aspects and issues. These kinds of problems are sometimes described as wicked problems or super-wicked problems (Lambrechts, 2020). Wicked problems are difficult to solve because of high levels of uncertainty, ambiguity, and the involvement of multiple stakeholders with conflicting values, goals, and interests. The wicked problem of sustainable development has had repercussions within many fields of society, including education. How do you equip students with the knowledge and capability to manage such complex issues?

Figure 1

Nested dimensions of sustainable development – economy dependent on society and both dependent on the environment. Adapted from Giddings et al., (2002).



Education for Sustainable Development

Education for sustainable development (ESD) aims to equip students with the necessary knowledge, skills, values, and agency to tackle interrelated global issues such as climate change, biodiversity loss, unsustainable resource utilization, and inequality (UNESCO, 2016). It seeks to enable learners to make well-informed decisions and take both individual and collective action to transform society and preserve the planet. ESD further seeks to integrate sustainability into all aspects of education, from formal schooling to non-formal and informal learning opportunities. It emphasizes a lifelong learning approach, recognizing that sustainability is an ongoing and dynamic process that requires continuous learning, reflection, and action (UNESCO, 2016).

In 2015, the UN presented an initiative consisting of 17 sustainable development goals. These are supposed to give clear directions on achieving sustainable development and require the active engagement of all sectors of society, including education (United Nations, 2015). All countries connected to the UN are committed to achieving these goals by 2030. Goal number 4 is about education, and subsection 4.7 states: "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development…" (UNESCO, 2016, p. 21). UNESCO has a vital role in promoting ESD globally, as outlined in its 2030 framework for action (UNESCO, 2016). In line with the SDGs, UNESCO has published a comprehensive global framework for reaching these goals by 2030, with a particular emphasis on achieving SDG 4.7 (UNESCO, 2020). One crucial aspect of this framework is the development of instruments that can effectively monitor progress towards this goal. These instruments will be used both by individual countries and by UNESCO at a global level, in order to assess progress towards achieving SDG 4.7. UNESCO recommends the use of surveys as a reliable and effective means of measuring progress in this area. Nations are further encouraged to report their progress, on all 17 goals, through a process

called the Voluntary National Reviews (VNR) (United Nations, n.d.). The VNR provides an opportunity for countries to share their challenges, successes, and experiences in the process of achieving the sustainable development goals. Only a selection of few countries presents each time. The UN also collects and presents data from various sources in a report called the Global Sustainable Development Report, which provides a comprehensive assessment of progress towards the sustainability goals.

Action Competence for Sustainability

Developing students' action competence is perhaps the ultimate goal of the school (Sinnes, 2021, p. 64). Merely being aware of the wicked problems of sustainable development is not sufficient. To truly have influence, students must understand their agency and potential to effect change, this is called action competence (Sass et al., 2023). Schools have a crucial role to play in shaping the future by not just providing information about current issues but also by equipping students with the skills and knowledge to contribute to sustainable development action taking (Sinnes, 2021). Action competence has been forwarded as a measurable and valid outcome of ESD (Olsson et al., 2020; Sass et al., 2020).

Sass et al. (2020) define action competence as being able to and having the competence for solving and acting on problems based on intertwined perspectives (for example issues related to sustainable development). Three sub-dimensions define action competence, "knowledge of action possibilities" (KAP), "confidence in one's own influence" (COI), and "willingness to act" (WTA) The first dimension, knowledge of action possibilities, encompasses knowledge and skills, as well as critical reflection (Olsson et al., 2020; Sass et al., 2020). This requires students to possess the competence to analyze the different dimensions of sustainability issues and their potential solutions. This involves having a comprehensive understanding of the root causes, effects, and conflicting interests of sustainability issues, as well as the ability to critically evaluate and prioritize potential

solutions (Sass et al., 2020). The second dimension, confidence in one's own influence, relates to an individual's self-efficacy, including their beliefs in their capacities to contribute to change and their expectations of the outcomes of their actions (Sass et al. 2020). The final dimension, willingness to act, reflects an individual's desire to take responsibility for themselves and others through their actions. It encompasses their commitment and passion for addressing sustainability issues and engaging with others to find solutions (Sass et al. 2020). Developing these aspects of action competence, especially in young students, can be a challenge and may require personal sacrifice in terms of immediate well-being. For example, students may have to take specific actions to reduce their personal resource use, such as shorter showers or eating less meat.

Action competence plays a central role in the pedagogical discussion of ESD (Breiting & Mogensen, 1999). According to Jensen & Schnack, (1997), developing action competence means developing the will and ability to take part in democratic processes concerning humanity's exploitation of and dependence on natural resources in a critical way. This is similar to the ideal goal of ESD (UNESCO, 2017): “ESD is about empowering and motivating learners to become active sustainability citizens who are capable of critical thinking and able to participate in shaping a sustainable future.” (p. 54). One important consequence of this definition is that ESD should empower rather than dictate the students. Education must equip students for finding solutions to broad and controversial environmental issues. In the following, we will present how ESD has developed towards action competence for sustainability in the Norwegian educational setting.

Education for Sustainable Development in Norway

Sustainability has been a part of the Norwegian education policy since the beginning of 1970 (Sinnes & Straume, 2017). Originally, the focus was limited to protecting nature. The curriculum later expanded on this to include the protection of nature and the environment,

with a focus on problems such as lack of resources and pollution. In 2006, a new curriculum was put in place, with sustainable development included in the competence goals for social and natural sciences (Sinnes & Straume, 2017). In the latest curriculum reform, LK20 (Knowledge Promotion Reform 2020), ESD has been given even greater focus. LK20 was implemented in 2021 and included a new core curriculum, the purpose of which was to implement values and principles for both primary and secondary education (Utdanningsdirektoratet, 2017). These values are from the objective clauses in the Education Act (Opplæringslova, 1998). The aim is for students and apprentices to acquire the necessary knowledge, skills, and attitudes to effectively manage their lives and contribute to society and the workforce. The students should be encouraged to express creativity, dedication, and curiosity. The core curriculum states, about the purpose of the education:

> The pupils and apprentices shall learn to think critically and act ethically and with environmental awareness. They shall have joint responsibility and the right to participate. (Utdanningsdirektoratet, 2017, p. 3)

The newest curriculum also introduced three interdisciplinary and connected themes, health and life skills, democracy and citizenship, and sustainable development. In addition to acting with the environmental awareness, the students are supposed to learn that all individual activities and choices are significant. Further, to gain a comprehensive understanding of sustainable development, students should learn about a range of issues such as the environment, poverty, resource allocation, conflict, health, equality, demographics, and education (Utdanningsdirektoratet, 2017). The curriculum also states that students should develop competence and willingness to act and impact the world in a more sustainable direction (Sinnes, 2021). With the most recent school reform in Norway, the LK20, education for sustainable development has moved towards action competence as a desired educational

outcome. With this, there arises a necessity for an approach to monitor and evaluate this outcome of ESD.

Evaluation of the Knowledge Promotion Reform

This master thesis project is connected to an ongoing evaluation of the recent Knowledge Promotion Reform (LK20). This evaluation is called EVA2020 (Karseth, 2019). Its overall goal is to develop knowledge on all aspects of the curriculum renewal. Including the process of establishing the changes, the quality of the reform, and the management of the curriculum. This thesis is further connected to one part of this project, aimed at creating an instrument to be answered by students and teachers for the first four years of the reform (Brandmo et al., 2021). The project started by creating or adapting instruments for a pilot study planned for 2020, followed by a main study with adapted instruments from the pilot study in 2021. The SPACS-scale instrument was translated and included in the study. Students are asked a set of items, covering the three sub-dimensions of the concept (KAP, COI, and WTA). Validation and fit estimation by the creators of this instrument in Sweden indicated a good fitting and well-developed instrument, suited to measure action competence for sustainability (Olsson et al., 2020). In a follow-up study, the developers found that the instrument is suited to monitor the development of action competence for sustainability over time (Olsson et al., 2022).

Several other instruments were also included in the Norwegian evaluation study, to cover the other aspects of LK20. The first trial of instruments (pilot study) suffered from recruitment issues, mainly because of COVID-19. As a consequence, not only was the pilot delayed until 2021, but there were also only a few student responses to the pilot. Observations on the SPACS-scale instrument were evaluated based on this limited number of observations, without any comparison to Swedish data. The analysis in this thesis will primarily be based on data from the Norwegian main study, as well as the data from the original Swedish study. The

thesis aims to investigate if observations from Swedish and Norwegian students on the SPACS-scale instrument are comparable across groups, by estimating the level of measurement invariance.

Measurement Invariance

A physical example can be used to describe measurement invariance (MI). It is to be expected that a weight scale can differentiate between objects that differ in weight. It would, however, be a point of concern if the scale reported different weights for objects that have the same weight but differ in other aspects, such as size or shape (Millsap, 2011). The scale would be non-invariant and biased across size and shape.

Bias occurs when differences in scores on an instrument do not reflect actual differences in the underlying trait or latent variable (Van de Vijver & Tanzer, 2004). He & Van de Vijver (2012) differentiates between three types of bias, construct bias, method bias, and item bias. Construct bias may arise if the concept of sustainable development is taught differently in Norwegian and Swedish schools, leading to different interpretations of the construct being measured. Method bias refers to bias derived from the sampling, structural features of the instrument or the administration process. One type of method bias is sampling bias, leading to incomparability of samples due to differences. Students could start school at different ages across countries, and therefore not be equally educated at the same age. Item bias is bias from specific items within an instrument. Some words or analogies may not work across cultures and languages, for example, the sentence “I feel blue” would not make sense if directly translated into Norwegian.

The goal of measurement invariance evaluation is to investigate to what degree a construct is measured equally across groups, in other words, if there is bias. (Putnick & Bornstein, 2016). Three levels of measurement invariance are usually included, each level tested for in sequential steps. Putnick and Bornstein (2016) explain the different levels of MI.

The first level is configural invariance, which checks if the same theoretical construct can be measured in each group. This is done by estimating a model with observations from both groups without any constraints. If the model indicate good fit with observations from both groups, configural invariance is achieved. The second level is metric invariance, which checks if the relationship between the latent construct and its observed indicators is the same across groups. This is done by constraining the factor loadings to be equal between groups. Metric invariance is supported if the fit of this second model is not significantly worse than the first model. The third level is scalar invariance, which checks if the average scores of the underlying construct accounts for all variations in the items. This is done by constraining both the factor loadings and the intercepts of the observed indicators to be equal across groups. Scalar invariance is supported if the fit of this third model is not significantly worse than the second, metric, model.

Achieving scalar invariance allows means on the latent constructs to be compared between groups (Meredith, 1993). Some literature also refers to the term strict invariance, where measurement errors are also equal across groups, but this level of invariance does not have a direct consequence on the comparability of model parameters between groups and is not commonly used (Leitgöb et al., 2023; Millsap & Olivera-Aguilar, 2012).

Relevance

It is important to have access to standardized measures for evaluating ESD, and its progress towards reaching the sustainability goals (Wendlandt Amézaga et al., 2022). There is a need for instruments suited to measure this progress across countries worldwide, to determine whether ESD strategies have led to the desired changes in students (Kopnina & Meijers, 2014). Action competence is a desired outcome of ESD (Sass et al., 2023). Among the few instruments available for measuring this concept, the SPACS-scale instrument from Sweden appears to have potential as a useful resource. However, comparing observations

across cultures cannot be assumed to be valid or reliable without testing (Van de Vijver & Tanzer, 2004). As a first step towards evaluating the comparability of this instrument, this thesis looks at whether results can be compared across two neighboring countries with similar education systems, cultures, and languages. If the SPACS-scale instrument is found to produce comparable results across the Norwegian and Swedish educational settings, it could prove to be a valuable tool for monitoring action competence for sustainability across other countries. We will investigate this by evaluating the level of measurement invariance between Norwegian and Swedish school students. Based on this, the research questions are as follows:

Research Questions

- Is the conceptual structure of the SPACS-scale instrument the same for students from Norway and Sweden? (Configurable invariance)
- Is the relationship between construct and indicators of the SPACS-scale instrument the same for students from Norway and Sweden? (Metric invariance)
- Does scores on the SPACS-scale instrument reflect the same latent variable for students from Norway and Sweden? (Scalar invariance)

Method

In the Method section, we start with an introduction to the importance of validity in the current study. We then present the SPACS-scale instrument, including its model structure. We also describe the sample used in the study. To estimate the models, we utilize confirmatory factor analysis and explain the models being estimated. We discuss maximum likelihood, fit indices, and expected parameters change. Lastly, we cover model comparison for estimating measurement invariance.

Validity

Validity is a vital part of any test creation or adaption and concerns the interpretations of test scores. The interpretations of test scores for a proposed use of tests are considered valid

when there is a high degree of support from both evidence and theory (American Educational Research Association, 2014). Validation is the continuing process of accumulating evidence from various sources to support the use of a test score for a particular purpose (Kane, 2006). The desired use for the test scores from the SPACS-scale instrument is to measure students ction competence for sustainability. This use has already gone through a validation process in Sweden (Olsson et al., 2020) and we want to make sure results are comparable across Swedish and Norwegian schools. Evidence towards the comparability of latent mean scores on the SPACS-scale instrument can be provided by answering the research questions.

SPACS-Scale Instrument

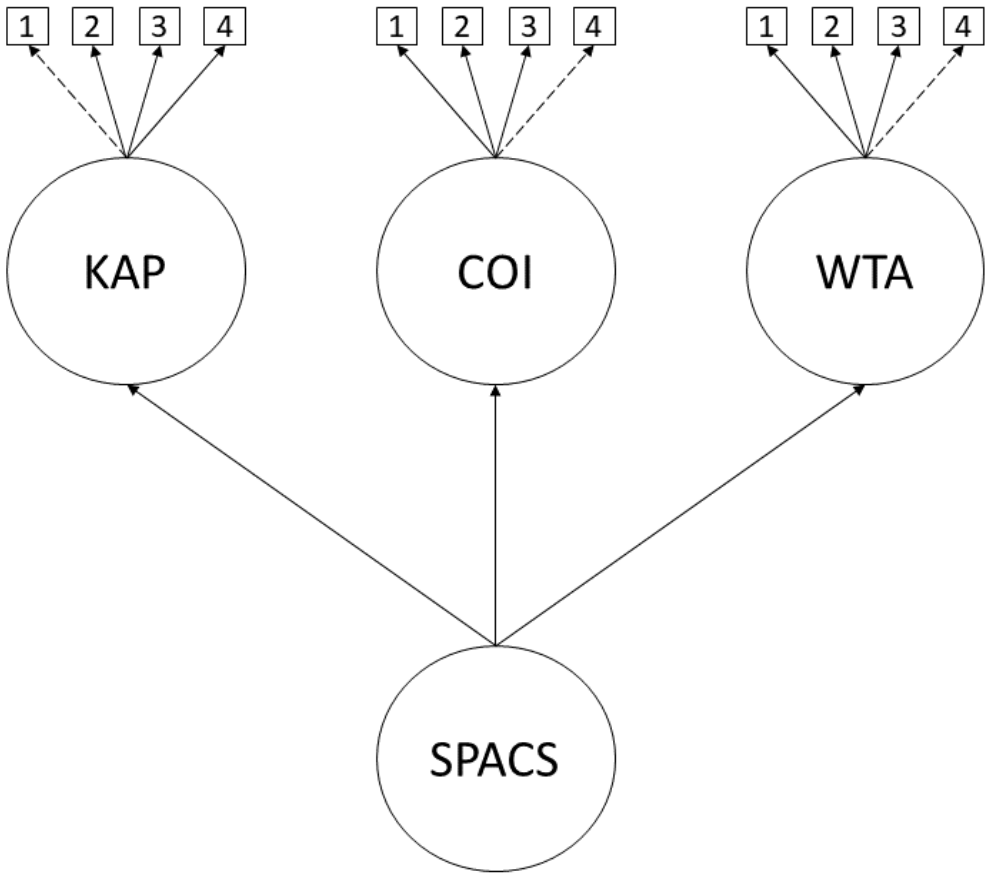
The SPACS-scale instrument consists of 12 items covering the three sub-factors of action competence for sustainability. The respondents are asked to what degree they agree to different statements, on a five-point likert-scale, ranging from “strongly disagree” to “strongly agree.” See Table C2 in Appendix C for a complete overview of item formulations. The model proposed by Olsson and his colleagues differs from a traditional factor analysis model in that it is a second-order model (see Figure 2). A second-level factor accounts for the correlation between first-level factors (Brown, 2015). Olsson et al. (2020), argue for this type of model based on the theoretical model of the action competence for sustainability construct, which is built up of the three sub-construct (KAP, COI and WTA). Second-order models have implications on how they should be estimated and evaluated. Brown (2015) recommends starting with one-level models, before moving on to higher orders. Evaluating measurement invariance is more complex for second-order models, because we have to evaluate MI for both the first and second order models (Chen et al., 2005).

Not only is this more complex, with the model structure proposed by Olsson et al., (2020), it is also problematic. The reason is that the second order part of this model is made up of only three sub-factors, resulting in a model with a saturated second-order factor (Brown,

2015). We are unable to give any meaningful interpretations about the second-order part of the model. Because of this, the model used for measurement invariance testing used the structure shown in Figure 3. This model uses three correlated sub factors. The Swedish study originally used four items for each sub-factor, which was reduced to three items for each sub-factor in the main Norwegian study. This was done for pragmatic reasons to keep the lengthy and broadly scoped questionnaire as short as possible.

Figure 2

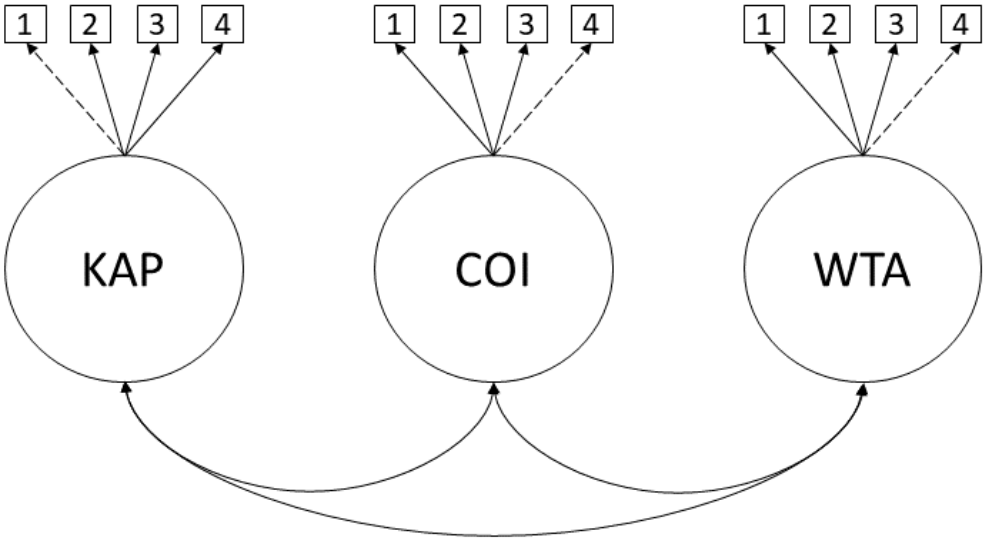
The factor structure of the original self-percieved action competence for sustainability (SPACS) second-order model.



Note. KAP = knowledge of action possibilities, COI = confidence in one's own influence, WTA = willingness to act. Adapted from Olsson et al., (2020). Dashed lines indicates items that were removed for the Norwegian study.

Figure 3

The factor structure of the self-percieved action competence for sustainability (SPACS) three-factor correlated model.



Note. KAP = knowledge of action possibilities, COI = confidence in one's own influence, WTA = willingness to act. Dashed lines indicates items that were removed for the Norwegian study.

Sample

See Tables C3, C4 and C5 in Appendix C for a complete overview of the sample. The SPACS- scale instrument was used in Sweden and Norway, with a pilot study in Norway before the main study. The data from Sweden were collected in September 2018, with data from grade 6 to 12. The data from grades 6 to 9 are from three different schools, while the data from grades 10 to 12 are from the same school. There is a total of 1034 observations from the Swedish study. The Norwegian pilot study resulted in only 99 viable answers. The Norwegian main study was distributed to ninth graders. The sampling of schools for the Norwegian main study followed a method ensuring that all schools in Norway had the same probability of being drawn. A single school's probability of being drawn was proportional to

the number of students (Brandmo et al., 2021). In total, the researchers asked 9550 students (from 150 different schools) to participate in the study. 52 schools agreed to participate in the main study, and 23 agreed to participate in the pilot study. This was well below their goal of 75-100 schools, and additional schools were asked to participate in the main study. In total, 86 schools agreed to participate in the study. The total number of observations collected from the main study was 2235. Some observations were removed after the initial data collection (Brandmo et al., 2021) Respondents who answered too systematic way under a set time were removed. Respondents with non-systematic answers who used less time than the researchers deemed reasonable were also removed. Observations that could not be connected to a consent form from the student's parents were also removed. This left 2012 Norwegian observations from the main study. In total 3046 observations, from both Sweden and Norway, were used in the following analysis.

Neither dataset included any variable that could be used to identify individuals, meaning that no declaration according to the regulations from GDPR (General Data Protection Regulation) was needed to approve this study. See Appendix A for the original registration form from the Norwegian study, as well as the consent forms from both the Norwegian and Swedish study.

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) models were conducted using different model structures. First, a model with nine items and one common latent factor. Second, individual models for the three sub-factors of action competence (KAP, COI and WTA). Third, the main model used for measurement invariance evaluation, with all three latent sub-factors allowed to correlate. All models were estimated using lavaan (Rosseel, 2012), in R version 4.2.2 (R Core Team, 2021). The coding script can be found in Appendix B. The marginal maximum likelihood estimator with robust standard errors (MLR option in lavaan) was implemented in

the parameter estimation. The following fit-indices were used for evaluating the models; root mean square error of approximation (RMSEA; Steiger, 1990), standardized root mean squared residual (SRMR; Hu and Bentler, 1999), comparative fit index (CFI; Bentler, 1990) and Tucker-Lewis index (TLI; Bentler & Bonett, 1980). We used the following cut-off values, indicating good fit: RMSEA < 0.06; SRMR < 0.08; CFI and TLI; > 0.95.

Answers to the SPACS-scale instrument were treated as continuous in this study. Although Olsson et al., treated the data as categorical and used weighted least squares mean and variance (WLSMV), we used marginal maximum likelihood estimator with robust standard errors. Research has shown that maximum likelihood, with five or more categories, produce similar or more robust answers, compared to WLSMV (Rhemtulla et al., 2012). Further, marginal maximum likelihood estimator with robust standard errors accounts for the possibility of non-normal data, and outliers. Brown (2015) lists the following assumptions for maximum likelihood: large sample size, indicators measured on a continuous scale and multivariate normal distribution of indicators. The impact of breaking some of these assumptions has however shown to be limited (Beauducel & Herzberg, 2006).

To assess the interpretability and strength of the models, factor loadings and correlations were investigated. These parameters should be in a direction and magnitude in line with the conceptual theory (Brown & Moore, 2012). Hair Jr. et al., (2019) suggest factor loadings above 0.5 to be practically significant, and factor loadings over 0.7 to be indicative of well-defined structures. Modification indices were investigated for the individual models if fit-indices indicated a poorly fit model. Modification indices are indicators of localized strain in a model that can be computed for fixed and constrained parameters, approximating the change in overall model chi-square if the parameter is freely estimated (Brown, 2015). They can be used to identify whether freed parameters would significantly improve the model. However, modification indices are sensitive to sample size, so expected parameters change

(EPC) values are often used and can provide an estimate of the expected change in the parameter (Brown, 2015). Changes to the model should, however, not be made just to improve a model and without justification in theory.

Measurement Invariance Model Comparison

MI was tested for in three sequential steps. First, a model with data from both Sweden and Norway, with no constraints was estimated to establish configural invariance. The aim was to investigate if the proposed factor structure of the SPACS-scale instrument is appropriate for both groups. Second, for testing metric invariance, the factor loadings of the nine items on the SPACS-scale instrument were constrained to be equal between groups. Third, to test for scalar invariance, both factor loadings and intercepts were constrained to be equal across the two groups.

When testing measurement invariance using CFA, invariance is tested by comparing fit statistics of models without or with fewer constraints, to models with stricter group constraints (Cheung & Rensvold, 2002). If the models with more constraints have lower value of a chosen fit statistic, then this constraint is "wrong", i.e., there is no measurement invariance. The change in chi-square test of fit have traditionally been used to compare models with different levels of constraints, to assess measurement invariance. Specifically, the significance of the change in chi-square for two nested models (Byrne et al., 1989). However, the use of chi-square has been discussed in literature and studies have shown that the test is sensitive to large sample sizes (Cheung & Rensvold, 2002). Based on this, we will use the recommended fit indices and cut off values from Chens (2007) study, as well as Rutkowski and Svetina (2014). Models are assumed to be invariant if the following fit indices change by; less than 0.010 for CFI, less than 0.01 for RMSEA and less than 0.030 for SRMR.

Results

The result section is structured in the following way. First, descriptive statistics, with answer distribution and sum score correlation divided between observations from Sweden and Norway. Second, fit is presented for multiple models; one factor for all items, one model for each sub-factor and the main model for this study with three correlated factors. Third, measurement invariance results are presented.

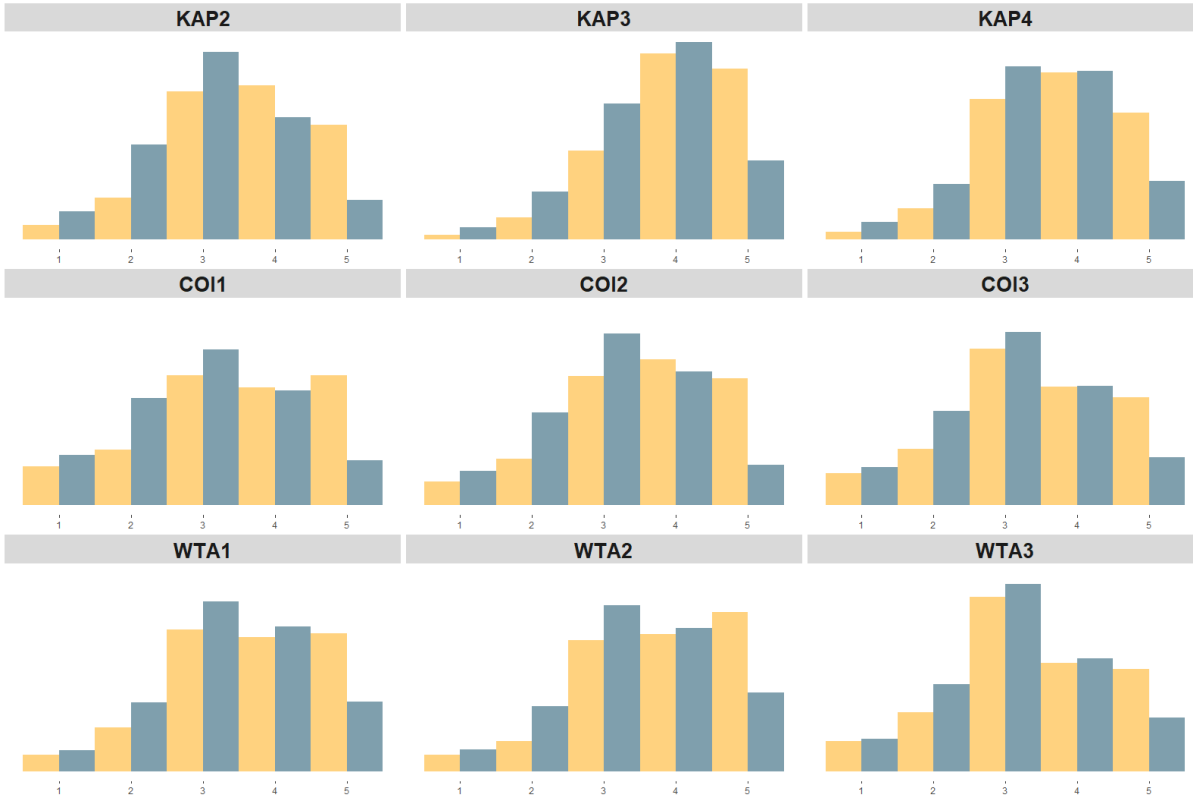
Descriptive Statistics

Figure 1 presents the distribution of student's responses to the nine items from the SPACS-scale instrument. The figure is split between the answers from Swedish and Norwegian students. Table 1 shows the mean, skewness, and standard deviation for all observed variables. Observations are left-skewed for all items. The analysis of the Norwegian data reveals a normal distribution for all nine items, with skewness ranging from -0.07 to -0.49. The Swedish data have a more skewed distribution, with skewness ranging from -0.23 to -0.79. Item KAP3 (*I know how one should take action at home in order to contribute to sustainable development*) has the highest mean and skewness for both groups. These values do not indicate a substantially skewed distribution (Hair Jr. et al., 2019). The mean score for all items are higher for Swedish students compared to Norwegian students, while the standard deviation is similar.

Table 2 and 3 show the sum-score correlation between the nine items used in the instrument, for Swedish and Norwegian observations respectively. As expected, correlations within the three factors (KAP, COI, and WTA) are higher than between the factors. The correlation between sub-factors is low to moderate, while the correlation of items within the same sub-factors is moderate to high. This supports the supposed factor structure, with three sub-factors. The highest correlated item for both countries is between item WTA1 and item WTA2 (*I want to take action for global sustainable development,* and *I want to engage in*

Figure 1

Distribution of answers on nine items SPACS-scale instrument items split between Norwegian and Swedish observations.



Note. Blue = Norway, yellow = Sweden.

Table 1

Descriptive statistics for observed variables.

	Swedish Students			**Norwegian Students**		
Item	Mean	SD	Skewness	Mean	SD	Skewness
KAP2	3.66	1.03	-0.43	3.11	1.01	-0.07
KAP3	4.05	0.91	-0.79	3.6	.96	-0.49
KAP4	3.79	0.96	-0.44	3.41	.97	-0.34
COI1	3.52	1.24	-0.44	3	1.13	-0.03
COI2	3.65	1.13	-0.54	3.11	1.05	-0.16
COI3	3.45	1.16	-0.33	3.09	1.08	-0.09
WTA1	3.7	1.09	-0.47	3.37	1.04	-0.23
WTA2	3.83	1.07	-0.64	3.41	1.06	-0.25
WTA3	3.41	1.14	-0.23	3.15	1.06	-0.07

Table 2

Correlation between items, Swedish data.

	KAP2	KAP3	KAP4	COI1	COI2	COI3	WTA1	WTA2	WTA3
KAP2	1								
KAP3	0.58	1							
KAP4	0.62	0.65	1						
COI1	0.3	0.36	0.34	1					
COI2	0.36	0.44	0.41	0.69	1				
COI3	0.32	0.37	0.34	0.62	0.66	1			
WTA1	0.4	0.43	0.41	0.46	0.54	0.49	1		
WTA2	0.36	0.44	0.41	0.52	0.53	0.53	0.78	1	
WTA3	0.34	0.32	0.34	0.46	0.48	0.54	0.63	0.68	1

Note. Items within the same sub-factor are highlighted.

Table 3

Correlation between items, Norwegian data.

	KAP2	KAP3	KAP4	COI1	COI2	COI3	WTA1	WTA2	WTA3
KAP2	1								
KAP3	0.65	1							
KAP4	0.65	0.75	1						
COI1	0.37	0.41	0.43	1					
COI2	0.42	0.44	0.49	0.75	1				
COI3	0.39	0.41	0.44	0.7	0.7	1			
WTA1	0.41	0.47	0.47	0.56	0.56	0.52	1		
WTA2	0.39	0.47	0.48	0.55	0.55	0.53	0.85	1	
WTA3	0.35	0.44	0.45	0.52	0.53	0.52	0.75	0.74	1

Note. Items within the same sub-factor are highlighted.

changing society towards sustainable development). The correlation is 0.78 for the Swedish sample, and 0.85 for the Norwegian sample. The correlation between observations from Norwegian students are overall higher than the correlation between observations from the Swedish sample.

One Factor for All Items.

Two models were estimated initially, split by country. The factor structure for this model was one factor for all nine items. Both models had poor fit as indicated by the fit indices, with values outside the recommended cutoffs. Sweden; CFI = 0.760, TLI = 0.680, RMSEA = 0.211, SRMR = 0.101. Norway: CFI = 0.734, TLI = 0.645, RMSEA = 0.249, SRMR = 0.109. These findings suggest that a single factor is insufficient to account for all the items. This model was included for completeness and the results were not unexpected given the sum score correlation reported above.

One Model for Each Sub Dimension of Action Competence

In the next step, models were estimated for each sub-factor individually, with four items for each factor. These models were estimated using the limited sample of 99 observations from the Norwegian pilot study. Further models were also estimated using the Swedish sample. Table 4 shows fit indices for these models. These results show that the "willingness to act" model has poor fit based on data from both countries, while the "knowledge of action possibilities" model based on data from the Norwegian pilot study has poor fit according to fit measures. Modification indicies and expected parameters change were examined for signs of local areas of strain within these sub-factors. The results indicated that these models had some issues, concerning the correlation between indicators. By allowing the items WTA3 and WTA4 to correlate in both "willingness to act" models, the fit improved for both groups. Similarly, by allowing items KAP1 and KAP3 to correlate in the "knowledge of action possibilities" model based on data from the Norwegian pilot, the fit improved. This could indicate that these two pairs of items share unique variance, not accounted for by the respective factors. See Appendix C for an overview of the modification indices and expected parameter change analysis. The data used for further analysis only have three items per factor, and one of the correlated items is removed from both sub-factors (items KAP1, COI4 and

Table 4

Fit measures, one-factor models.

	CFI	TLI	RMSEA	SRMR
Swedish data				
KAP	1	1	.003	.007
COI	.999	.997	.030	.008
WTA	.965	.894	.193	.040
Norwegian pilot				
KAP	.992	.977	.088	.024
COI	1	1	.000	.008
WTA	.941	.823	.271	.051

WTA4). This means that we avoid the possible correlation problem for both sub-factor instruments and can move on to models where the sub-factor are allowed to correlate.

Three Correlated Factors

The next models were estimated using observations on all nine items divided between the three sub factors and the factors were allowed to correlate. Fit indices indicated good fit for both models. Norway: CFI = 0.995, TLI = 0.992, RMSEA = 0.038, and SRMR = 0.016. Sweden: CFI = 0.982, TLI = 0.973, RMSEA = 0.061, and SRMR = 0.025. A third model, using observations from both countries together also indicated good fit. CFI = 0.994, TLI = 0.991, RMSEA = 0.038, and SRMR = 0.016. This indicates a good fit for the three-factor model. Table 5 shows the factor covariance and correlations for the three-factor model with data from both groups. The factor correlations were all significant and ranged from 0.609 to 0.724, in addition, all latent factors had significant variances. Table 6 shows the completely standardized factor loadings for this final model. The factor loadings range from 0.763 to 0.918. These results indicates that the nine-item instrument measures three correlated, but instinctive, factors.

Table 5

Factor variance and correlations from SPACS-scale instrument three-factor model.

	Knowledge of Action Possibilities.	**Confidence in one's Own Influence.**	**Willingness to Act**
Knowledge of Action Possibilities.	.644**		
Confidence in one's Own Influence.	.617**	1.015**	
Willingness to Act	.609**	.724**	.925**

Note. Factor variances on the diagonal, and correlation between factors. ** p<.001

Measurement Invariance

The level of measurement invariance was examined to answer the research questions. Table 7 shows the fit for the baseline models, as well as the configural, metric and scalar invariance models. Also included is the change in fit measures between these models. For the metric model, RMSEA improved compared to the configural model. CFI decreased by 0.001 and SRMR increased by 0.002. This indicates that factor loadings were invariant between Swedish and Norwegian students. Further, the relationship between constructs and indicators

Table 6

Completely standardized factor loadings for the three sub-factor model with observations from both Sweden and Norway.

Item	**Knowledge of Action Possibilities.**	**Confidence in one's Own Influence.**	**Willingness to Act**
KAP2	.763**		
KAP3	.848**		
KAP4	.856**		
COI1		.844**	
COI2		.872**	
COI3		.803**	
WTA1			.900**
WTA2			.918**
WTA3			.793**

Note. ** p < .001

Table 7

Measurement invariance

	RMSEA	ΔRMSEA	CFI	ΔCFI	SRMR	ΔSRMR
Single group						
Sweden	0.061		0.982		0.025	
Norway	0.038		0.995		0.016	
Measurement invariance						
Configural	0.047		0.991		0.017	
Metric	0.045	-0.002	0.991	0	0.019	0.002
Scalar	0.05	0.005	0.987	-0.004	0.025	0.006

Note. Δ is the change in fit from the one model above the current reduced model.

are the same for both groups, metric invariance is achieved. For the scalar model, the change in fit indices were within the presented cut-off values. RMSEA and SRMR increased by 0.005 and 0.006, respectively, while CFI decreased by 0.003. This indicates that both factor loadings and intercepts are similar for both groups, and that scores on the instrument reflect the same latent variable for Swedish and Norwegian students.

Discussion

The discussion is structured as follows. First, the main findings and their relevance will be discussed. Second, the three research questions will be addressed with corresponding discussions. Third, the implications of this thesis will be covered. Fourth, limitations of the study will be discussed. Fifth, recommendations for future work will be proposed. Lastly, a conclusion will be provided.

Based on the results from measurement invariance evaluation between Swedish and Norwegian students, we argue that measurement invariance is achieved at the scalar level, and latent mean scores on the SPACS-scale instrument are comparable across the two countries. Monitoring students' action competence for sustainability using the SPACS-scale instrument could be an important tool used to track the progress towards the SDGs. This thesis extends

upon the work by Brandmo et al., (2021), by not only assessing the validity of the SPACS-scale instrument in a Norwegian setting, but also comparing observations with observations form Sweden.

The first research question asked if the conceptual structure of the SPACS-scale instrument was the same for Norway and Sweden. This is conceptually the same as achieving measurement invariance at the configural level (Putnick & Bornstein, 2016). To answer this, we estimated several CFA models, with the goal of evaluating the performance and fit for models with data from both groups and the model structure used for measurement invariance evaluation. First, models with nine items and one latent variable were estimated, divided between observations from Sweden and Norway. Fit indices for these models indicated poor fit, which implies that the SPACS-scale instrument is not measuring just one construct. Second, each of the sub-factors as individual models were estimated for each group respectively, using observations from the Swedish study, as well as the Norwegian pilot study. One sub factor model indicated poor fit for Swedish observations, and two indicated poor fit for Norwegian observations. Investigation of modification indices, and estimated parameter changes**,** revealed that some items were closely correlated. This was resolved without intervention because each sub-factor was reduced to three items by the Norwegian research team. Third, models divided by country, with all nine items and three correlated latent factors were estimated (see Figure 2), fit indices indicated that these models fit well. A well fitting single group model estimated with Swedish observations is similar to the results from the original validation of the instrument Olsson et al., (2020). The well fitting single group model estimated with Norwegian observations were not surprising, given the results of the pilot validation from Brandmo et al., (2021). We further estimated a joint model using observations from both countries. This model also had good fit, and correlation between factors indicated that the SPACS-scale instrument measures three similar, but distinct constructs. Factor

loadings for the joint model were all above 0.7, and thus considered excellent by the standards of (Hair Jr. et al., 2019). A well-fitting final model meant that the conceptual structure was the same for both groups, and measurement invariance was achieved at the configural level.

The second research questions asked if the relationship between constructs and indicators on the SPACS-scale instrument were the same for both Swedish and Norwegian students. This is conceptually the same as achieving metric invariance (Putnick & Bornstein, 2016). This was answered by estimating a new CFA model, with factor loadings constrained to be equal across groups. Using change in fit indices CFI, RMSEA and SRMR as indicators, (Chen, 2007; Rutkowski & Svetina, 2014), measurement invariance was achieved at the metric level. This means that the three indicators for KAP, COI and WTA contribute to the sub-factors in a similar degree for both Swedish and Norwegian students (Putnick & Bornstein, 2016).

The third research question asked if scores on the SPACS-scale instrument reflect the same latent variable for Swedish and Norwegian students. This is conceptually the same as achieving scalar invariance (Putnick & Bornstein, 2016). This was answered by estimating a third model with equal intercepts as well as factor loadings. Fit indices for this model did not differ more than the proposed cut-off values for CFI, RMSEA and SRMR, and measurement invariance at the scalar level was achieved. Scalar invariance means that individuals with the same score on the latent construct would obtain the same score on the indicators regardless of what group they are in (Coulacoglou & Saklofske, 2017). This further means that there is no construct bias between the two groups (He & Van de Vijver, 2012).

Implications

The result of achieving measurement invariance at the scalar level is that latent means are comparable across groups (Leitgöb et al., 2023). These findings provide evidence for the comparability of observations on the SPACS-scale instrument across Swedish and Norwegian

students. Meaning that the instrument is suited to measure the concept of action competence for sustainability in both countries, producing comparable results. Monitoring students' progress is critical to solving the wicked problem of sustainable development (Sass et al., 2023). This thesis can act as a starting point towards using this instrument to measure action competence for sustainability across more diverse educational settings, to evaluate if ESD strategies have led to the desired outcome in students (Kopnina & Meijers, 2014). The UN places great importance on tracking and reporting progress towards fulfilling the sustainable development goals, by reports such as the Voluntary National Reviews and Global Sustainable Development Report. UNESCO is responsible for monitoring the progress of ESD, and its development towards reaching the SDGs (UNESCO, 2016). In order to track and report this development, standardized measures for evaluating ESD is needed (Wendlandt Amézaga et al., 2022). It is conceivable to imagine a need for indicators capable of measuring action competence for sustainability in the future. This thesis has demonstrated that observations on the SPACS-scale instrument is comparable across a Swedish and Norwegian setting. This makes it a promising candidate for measuring action competence across more diverse educational settings in the future.

Limitations

Some limitations must be acknowledged. First, the item formulations in the SPACS-scale instrument are very general in that it treats sustainable development as an abstract concept. Other instrument meant to measure similar concepts instead focuses on concrete actions for SD (Gericke et al., 2019; Sass et al., 2021). Participants answering the SPACS-scale instrument has to have some assumed mutual comprehension of the complex concept of SD (Sass et al., 2021). Despite this limitation, this thesis has provided valuable evidence for measurement invariance at the scalar level. This finding indicates that there is some level of mutual comprehension of SD between Swedish and Norwegian students. Further, in more

diverse global settings, concrete actions towards SD may be understood in different ways due to varying cultural contexts and perspectives.

Second, the sample itself have some limitations. The observations from Sweden were drawn from a convenience sample (Given, 2008), which could limit the generalizability of results. While the Norwegian researchers attempted to ensure that all schools in Norway had an equal probability of being drawn, the challenge of getting enough schools to participate may have led to sampling bias. This could have affected the representativeness of the sample and limit the generalizability of the findings (He & Van de Vijver, 2012).

Third, it is important to acknowledge that the investigation of model fit for models using only sub-factors and four items was based on a small Norwegian sample size of only 99 viable observations. While the main study used a larger sample size for the measurement invariance evaluations, this specific model-fit evaluation was more limited in scope.

Given these limitations, this study provides a strong foundation for further research on the usability of the SPACS-scale instrument in diverse educational settings.

Future Work

The results of this study, and its limitations, gives more thorough evidence and argumentation for using the SPACS-scale instrument to monitor how action competence for sustainability evolve in the Norwegian educational setting, following the LK20. This would be possible if the instrument is included in the further evaluation of the school reform in Norway. Further, this thesis can act as a first step towards validating the SPACS-scale instrument for use in a global setting to assess and measure the progress on the education for sustainability goals (UNESCO, 2017). Therefore, a logical next step would be to gather data across multiple, and more diverse education systems, and investigate the comparability of observations. The concept of action competence and the SPACS-scale instrument seems to work in an equivalent way between Sweden and Norway, but these countries are also very

similar in terms of cultures and education. Further analysis should focus on how the concept of action competence for sustainability operates within a wider range of educational settings, with a particular emphasis on diversity.

Conclusion

Goal 4.7 of sustainability highlights the importance of learners taking action towards sustainable development. With this, there is a need for instruments that can accurately measure this action competence for sustainability while ensuring comparability across various educational settings. To address this, this thesis has examined the "Self-Perceived Action Competence for Sustainability Instrument" and evaluated the level of measurement invariance between Swedish and Norwegian students. Through our findings, we have demonstrated that the instrument achieves measurement invariance at the scalar level, indicating comparable latent means between the two groups. This research serves as a crucial first step towards the utilization of the instrument to measure action competence for sustainability in a broader range of educational settings.

References

American Educational Research Association (Ed.). (2014). *Standards for educational and psychological testing*. American Educational Research Association.

Beauducel, A., & Herzberg, P. Y. (2006). On the Performance of Maximum Likelihood Versus Means and Variance Adjusted Weighted Least Squares Estimation in CFA. *Structural Equation Modeling: A Multidisciplinary Journal*, *13*(2), 186–203. https://doi.org/10.1207/s15328007sem1302_2

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588–606. https://doi.org/10.1037/0033-2909.88.3.588

Brandmo, C., Bjørnebekk, G., Mononen, R., Olsen, R. V., & Slungård, K. (2021). *Læring, motivasjon, trivsel og tverrfaglige tema i fagfornyelsen: Teknisk rapport fra utviklingen av spørreskjema til elever og lærere* (Rapport nr. 3; Evaluering Av Fagfornyelsen: Intensjoner, Prosesser Og Praksiser (EVA2020)). Universitetet i Oslo. https://www.uv.uio.no/forskning/prosjekter/fagfornyelsen-evaluering/

Breiting, S., & Mogensen, F. (1999). Action Competence and Environmental Education. *Cambridge Journal of Education*, *29*(3), 349–353. https://doi.org/10.1080/0305764990290305

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (Second edition.). The Guilford Press.

Brown, T. A., & Moore, M. T. (2012). Confirmatory Factor Analysis. In *Handbook of Structural Equation Modeling*. United States: Guilford Publications.

Brundtland, G. H. (1987). *Our common future*. Oxford University Press.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin*, *105*, 456–466. https://doi.org/10.1037/0033-2909.105.3.456

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling*, *14*, 464–504. https://doi.org/10.1080/10705510701301834

Chen, F. F., Sousa, K. H., & West, S. G. (2005). Teacher's Corner: Testing Measurement Invariance of Second-Order Factor Models. *Structural Equation Modeling: A Multidisciplinary Journal*, *12*(3), 471–492. https://doi.org/10.1207/s15328007sem1203_7

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*, 233–255. https://doi.org/10.1207/S15328007SEM0902_5

Coulacoglou, C., & Saklofske, D. H. (2017). Chapter 1—Recent Advances in Psychological Assessment and Test Construction. In C. Coulacoglou & D. H. Saklofske (Eds.), *Psychometrics and Psychological Assessment* (pp. 3–25). Academic Press. https://doi.org/10.1016/B978-0-12-802219-1.00001-8

Gericke, N., Boeve-de Pauw, J., Berglund, T., & Olsson, D. (2019). The Sustainability Consciousness Questionnaire: The theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development. *Sustainable Development (Bradford, West Yorkshire, England)*, *27*(1), 35–49. https://doi.org/10.1002/sd.1859

Giddings, B., Hopwood, B., & O'Brien, G. (2002). Environment, economy and society: Fitting them together into sustainable development. *Sust. Dev*, *10*(4), 187–196. https://doi.org/10.1002/sd.199

Given, L. M. (2008). *The Sage encyclopedia of qualitative research methods*. SAGE.

Hair Jr., J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis* (Eighth Edition). Cengage Learning.

He, J., & Van de Vijver, F. (2012). Bias and Equivalence in Cross-Cultural Research. *Online Readings in Psychology and Culture*, *2*. https://doi.org/10.9707/2307-0919.1111

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Jensen, B. B., & Schnack, K. (1997). The Action Competence Approach in Environmental Education. *Environmental Education Research*, *3*(2), 163–178. https://doi.org/10.1080/1350462970030205

Kane, M. (2006). Content-Related Validity Evidence in Test Development. In *Handbook of test development.* (pp. 131–153). Lawrence Erlbaum Associates Publishers.

Karseth, B. (2019). *Evaluering av Fagfornyelsen: Intensjoner, prosesser og praksiser*. Det utdanningsvitenskapelige fakultet - Universitetet i Oslo. https://www.uv.uio.no/forskning/prosjekter/fagfornyelsen-evaluering/publikasjoner/prosjektbeskrivelse.pdf

Kopnina, H., & Meijers, F. (2014). Education for sustainable development (ESD). *International Journal of Sustainability in Higher Education*, *15*(2), 188–207. https://doi.org/10.1108/IJSHE-07-2012-0059

Lambrechts, W. (2020). Learning 'for' and 'in' the future: On the role of resilience and empowerment in education. *UNESSCO*, *26*, 13.

Leitgöb, H., Seddig, D., Asparouhov, T., Behr, D., Davidov, E., De Roover, K., Jak, S., Meitinger, K., Menold, N., Muthén, B., Rudnev, M., Schmidt, P., & van de Schoot, R. (2023). Measurement invariance in the social sciences: Historical development,

methodological challenges, state of the art, and future perspectives. *Social Science Research*, *110*, 102805. https://doi.org/10.1016/j.ssresearch.2022.102805

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrika*, *58*(4), 525–543. https://doi.org/10.1007/BF02294825

Millsap, R. E. (2011). *Statistical approaches to measurement invariance.* Routledge. https://doi.org/10.4324/9780203821961

Millsap, R. E., & Olivera-Aguilar, M. (2012). Investigating measurement invariance using confirmatory factor analysis. *Handbook of Structural Equation Modeling.*, 380–392.

Olsson, D., Gericke, N., & Boeve-de Pauw, J. (2022). The effectiveness of education for sustainable development revisited – a longitudinal study on secondary students' action competence for sustainability. *Environmental Education Research*, *28*(3), 405–429. https://doi.org/10.1080/13504622.2022.2033170

Olsson, D., Gericke, N., Sass, W., & Boeve-de Pauw, J. (2020). Self-perceived action competence for sustainability: The theoretical grounding and empirical validation of a novel research instrument. *Environmental Education Research*, *26*(5), 742–760. https://doi.org/10.1080/13504622.2020.1736991

Opplæringslova. (1998). *Lov om grunnskolen og den vidaregåande opplæringa (opplæringslova) Kapittel 1. Formål, verkeområde og tilpassa opplæring m.m.* (LOV-1998-07-17-61). Lovdata. https://lovdata.no/pro/#document/NL/lov/1998-07-17-61/KAPITTEL_1

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. *Sustainability Science*, *14*(3), 681–695. https://doi.org/10.1007/s11625-018-0627-5

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, *41*, 71–90. https://doi.org/10.1016/j.dr.2016.06.004

R Core Team. (2021). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Rhemtulla, M., Brosseau-Liard, P. É., & Savalei, V. (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. *Psychological Methods*, *17*, 354–373. https://doi.org/10.1037/a0029315

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Rutkowski, L., & Svetina, D. (2014). Assessing the Hypothesis of Measurement Invariance in the Context of Large-Scale International Surveys. *Educational and Psychological Measurement*, *74*(1), 31–57. https://doi.org/10.1177/0013164413498257

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

Sass, W., De Maeyer, S., Boeve-de Pauw, J., & Van Petegem, P. (2023). Honing action competence in sustainable development: What happens in classrooms matters. *Environment, Development and Sustainability*, *25*(4), 3649–3670. https://doi.org/10.1007/s10668-022-02195-9

Sass, W., Pauw, J. B., Maeyer, S. D., & Petegem, P. V. (2021). Development and validation of an instrument for measuring action competence in sustainable development within early adolescents: The action competence in sustainable development questionnaire (ACiSD-Q). *Environmental Education Research*, *27*(9), 1284–1304. https://doi.org/10.1080/13504622.2021.1888887

Sinnes, A. T. (2021). *Utdanning for bærekraftig utvikling: Hva, hvorfor og hvordan?* (2. utgave.). Universitetsforlaget.

Sinnes, A. T., & Straume, I. (2017). Bærekraftig utvikling, tverrfaglighet og dybdelæring: Fra big ideas til store spørsmål. *Acta Didactica Norge-Tidsskrift for Fagdidaktisk Forsknings-Og Utviklingsarbeid i Norge*, *11*(3).

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, *25*, 173–180. https://doi.org/10.1207/s15327906mbr2502_4

UNESCO. (2016). *Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all—UNESCO Digital Library*. https://unesdoc.unesco.org/ark:/48223/pf0000245656

UNESCO. (2017). *Education for sustainable development goals: Learning objectives*. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000247444

UNESCO. (2020). *Education for sustainable development: A roadmap*. United Nations Educational, Scientific and Cultural Organization. https://doi.org/10.54675/YFRE1448

United Nations. (n.d.). *Voluntary National Reviews | High-Level Political Forum*. Retrieved February 20, 2023, from https://hlpf.un.org/vnrs

United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development (A/RES/70/1)*. United Nations. https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf

Utdanningsdirektoratet. (2017). *Core curriculum – values and principles for primary and secondary education*. Utdanningsdirektoratet. https://www.udir.no/Udir/PrintPageAsPdfService.ashx?pdfId=150459&lang=eng

Van de Vijver, F., & Tanzer, N. (2004). Bias and Equivalence in Cross-Cultural Assessment: An Overview. *European Review of Applied Psychology/Revue Européenne de Psychologie Appliquée*, *54*, 119–135. https://doi.org/10.1016/j.erap.2003.12.004

Wendlandt Amézaga, T. R., Camarena, J. L., Celaya Figueroa, R., & Garduño Realivazquez, K. A. (2022). Measuring sustainable development knowledge, attitudes, and behaviors: Evidence from university students in Mexico. *Environment, Development and Sustainability*, *24*(1), 765–788. https://doi.org/10.1007/s10668-021-01467-0

Appendix A

GDPR documents & Ethical approval

I have attached the original registration form from the Norwegian study, as well as the consent form from both Norwegian and Swedish studies. I have not had access to any directly or indirectly personally identifiable information. The original Norwegian survey collected consent from parents and linked their responses to the students' answers (with data deletion where such linkage was not possible). I was able to obtain only this limited dataset that has been fully anonymized.

The same is true for the Swedish study, I have only had access to a limited dataset that has been fully anonymized. From the original validation of the SPACS-scale instrument, Olsson and colleagues writes “Ethical guidelines and regulations in Sweden associated with this type of research were followed” (Olsson et al., 2020, p. 11). Students who did not want to participate in the study did not submit the online questionnaire.

Additionally, I have conducted a self-assessment on sikt.no and received confirmation that there was no need to report this work.

Sikt

Meldeskjema

Referansenummer
983850

Hvilke personopplysninger skal du behandle?

- Navn (også ved signatur/samtykke)
- Fødselsnummer eller andre nasjonale identifikasjonsnumre
- Fødselsdato
- Bakgrunnsopplysninger som vil kunne identifisere en person
- Helseopplysninger

Beskriv hvilke bakgrunnsopplysninger du skal behandle

Fylke, skole, klasse, kjønn, morsmål

Prosjektinformasjon

Prosjekttittel

EVALUERING AV FAGFORNYELSEN: INTENSJONER, PROSESSER OG PRAKSISER Prosjekt 3.2: Utvikling og analyse av indikatorer for implementering av sentrale begreper i Fagfornyelsen

Prosjektbeskrivelse

I det større evalueringsprosjektet "Evaluering av fagfornyelsen: Intensjoner, prosesser og praksiser" undersøkes fagfornyelsens intensjoner og politikkutforming, endringsprosesser og arbeidsformer i utvikling og bruk av læreplanene, og virkninger på skolens praksis.

Prosjekt 3.2 har som mål å fremskaffe informasjon som kan generaliseres til systemnivå. Data samles gjennom selvrapporteringer fra elever og lærere. Den grunnleggende antakelsen bak dette prosjektet er at dersom Fagfornyelsens intensjoner blir implementert, så vil dette påvirke elevers egenvurderinger og holdninger.

Enhver fornyelse eller reform av skolens innhold og verdigrunnlag vil kreve tid før endringer er observerbare på systemnivå, og dette delprosjektet vil derfor ha hypoteser om gradvise endringer i det nasjonale gjennomsnittet for en rekke selvrapporterte mål. De utvalgte selvrapporterte målene er valgt fordi de representerer plausible indikatorer for sentrale begreper i det nye læreplanverket.

Dersom personopplysningene skal behandles til andre formål enn behandlingen for dette prosjektet, beskriv hvilke

Elevdataene fra de to første spørrerundene i hovedprosjektet er planlagt koblet med registerdata, herunder resultater nasjonale prøver, grunnskolepoeng/karakterdata, valg av videregående opplæring, foreldres utdanningsnivå og inntekt. Personopplysninger vil bli oppbevart til 31.12.2030. Etter denne dato vil alle data bli anonymisert og gjort tilgjengelig for forskere ved norske forskningsinstitusjoner da data fra dette prosjektet kan ha nasjonal og historisk interesse.

Begrunn hvorfor det er nødvendig å behandle personopplysningene

Elevundersøkelse: Deltakerne er skolelever og mindreårige. Vi trenger å innhente samtykke fra foreldre og behandle personopplysninger. I denne undersøkelsen ønsker vi å samle inn fødselnummer for koble data fra undersøkelsen med registerdata. Det vil være frivillig å oppgi fødselnummer for elevene dette samles inn i forbindelse med innhenting av samtykke. Det vil bli brukt elektronisk samtykke. Ved bruk av elektronisk samtykke vil foreldrenes fødselnummer bli registrert - dette skjer gjennom et sikkert innloggingsystem (BankID).
Når det gjelder andre bakgrunnsvariabler, så ses disse på som viktige for undersøkelsen formål da sosioøkonomiske forhold ofte har vist å ha en sammenheng med utdanningsrelaterte spørsmål og valg.

Lærerundersøkelse: I utgangspunktet ber vi ikke om personopplysninger i denne undersøkelsen, men kombinasjoner av ulike bakgrunnsopplysninger (skoletilknytning kombinert med undervisningsfag) kan likevel gjøre det mulig å identifisere enkeltpersoner.

Prosjektbeskrivelse

Prosjektbeskrivelse_prosjekt3.2_NSD_cb_06.06.2020.docx

Ekstern finansiering
- Offentlige myndigheter

Type prosjekt
Forskerprosjekt

Behandlingsansvar

Behandlingsansvarlig institusjon
Universitetet i Oslo / Det utdanningsvitenskapelige fakultet / Institutt for spesialpedagogikk

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)
Christian Brandmo, christian.brandmo@isp.uio.no, tlf: 90208596

Skal behandlingsansvaret deles med andre institusjoner (felles behandlingsansvarlige)?
Nei

Utvalg 1

Beskriv utvalget

Utvalg 1 representerer første runde i hovedundersøkelsen av elever og gjennomføres tidsrommet fra januar til mars 2021. Dette er elever i 9.trinn i ca. 90 norske grunnskoler.

Beskriv hvordan rekruttering eller trekking av utvalget skjer

Det er trukket tilfeldig utvalg på 150 skoler og disse er invitert til å delta i både undersøkelsen (runde 1 - jan/mars 2021; runde 2 - okt/nov 2021; runde 3 - okt/nov 2022; runde 4 - okt/nov 2023). Skolens kontaktinformasjon ble hentet fra Grunnskolens Informasjonssystem (GSI). Invitasjon til å delta i undersøkelse (pilotstudie + hovedspørrerunder) ble sendt ut per juni 2020. Skolen svarte på hvorvidt de ønsket å delta via Nettskjema. Det er også sendt ut informasjonsbrev til eierne av de utvalgte skolene.

På spørreskjema er det oppgitt flere skoler enn de utvalgte skoler. Under hvert av fylkene er det ca. 20 skoler flere enn det som er egentlige utvalg i nedtrekksliste. Det har vi gjort for å kamuflere hvilke skoler som er med i utvalget.

Alder
13 - 15

Personopplysninger for utvalg 1
- Navn (også ved signatur/samtykke)
- Fødselsnummer eller andre nasjonale identifikasjonsnumre
- Fødselsdato
- Bakgrunnsopplysninger som vil kunne identifisere en person
- Helseopplysninger

Hvordan samler du inn data fra utvalg 1?

Elektronisk spørreskjema

Vedlegg

Evaluering av fagfornyelsen (EVA2020) - Elevspørreskjema våren 2021 – Vis - Nettskjema.pdf

Grunnlag for å behandle alminnelige kategorier av personopplysninger
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Hvem samtykker for barn under 16 år?
Foreldre/foresatte

Grunnlag for å behandle særlige kategorier av personopplysninger
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Redegjør for valget av behandlingsgrunnlag

Informasjon for utvalg 1

Informerer du utvalget om behandlingen av personopplysningene?
Ja

Hvordan?
Skriftlig informasjon (papir eller elektronisk)

Informasjonsskriv

Informasjonsbrev til elever og foresatte Hovedundersøkelse 05.01.21.pdf

Utvalg 2

Beskriv utvalget

Utvalg 2 vil bestå av lærerne som underviser elevene i utvalg 1.

Beskriv hvordan rekruttering eller trekking av utvalget skjer

Dette utvalget av lærerne følger av utvalg 1 (elevene). Lærerne på de utvalgte skolene informeres i eget brev som utleves av lokal kontaktperson på skolen (skal leveres til alle lærere som underviser på 9. trinn). Lærerne responderer på et eget nettskjema og samtykker på første side i skjemaet.

Alder
18 - 80

Personopplysninger for utvalg 2

- Bakgrunnsopplysninger som vil kunne identifisere en person

Hvordan samler du inn data fra utvalg 2?

Elektronisk spørreskjema

Vedlegg

Evaluering av fagfornyelsen (EVA 2020) - Lærerspørreskjema våren 2021 – Vis - Nettskjema.pdf

Grunnlag for å behandle alminnelige kategorier av personopplysninger
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Informasjon for utvalg 2

Informerer du utvalget om behandlingen av personopplysningene?
Ja

Hvordan?
Skriftlig informasjon (papir eller elektronisk)

Informasjonsskriv

Invitasjonsbrev til lærere Hovedundersøkelse 05.01.21.pdf

Tredjepersoner

Skal du behandle personopplysninger om tredjepersoner?
Ja

Beskriv tredjepersoner

Foreldrene/foresatte blir bedt om å identifisere seg i forbindelse med at de samtykker i barnas/elevenes deltakelse i undersøkelsen.

Typer personopplysninger om tredjepersoner

- Navn (også ved signatur/samtykke)

- Fødselsnummer eller andre nasjonale identifikasjonsnumre

Hvilke utvalg avgir personopplysninger om tredjepersoner?

- Utvalg 1: Utvalg 1 representerer første runde i hovedundersøkelsen av elever og gjennomføres tidsrommet fra januar til mars 2021. Dette er elever i 9.trinn i ca. 90 norske grunnskoler.

Samtykker tredjepersoner til behandlingen av personopplysningene?
Ja

Mottar tredjepersoner informasjon om behandlingen av personopplysningene?
Ja

Informasjonsskriv

Informasjonsbrev til elever og foresatte Hovedundersøkelse 05.01.21.pdf

Dokumentasjon

Hvordan dokumenteres samtykkene?

- Elektronisk (e-post, e-skjema, digital signatur)

Hvordan kan samtykket trekkes tilbake?

Elever og foresatte: Foresatte og elevene kan ta kontakt med prosjektet og trekke sitt samtykke. Informasjon som vedrører elevene og foresatte kan spores og slettes ved å oppgi elevens skole, klasse og navn eller fødselnummer (til foreldre eller til barn der dette foreligger). Det er også en egen link i det elektroniske samtykkeskjemaet hvor foresatte kan trekke sitt samtykke hvis de logger seg inn på nytt. Denne linken er aktiv frem til prosjektets slutt.

Lærerne: I utgangspunktet ber vi ikke om personopplysninger i denne undersøkelsen, men kombinasjoner av ulike bakgrunnsopplysninger kan likevel gjøre det mulig å identifisere enkeltpersoner. Dersom lærerne kan identifiseres, kan de når som helst trekke samtykket uten å oppgi noe grunn. For å trekke samtykke kan de ta kontakt med oss på epost eller telefon.

Hvordan kan de registrerte få innsyn, rettet eller slettet personopplysninger om seg selv?

Ved å ta kontakt med prosjektet via kontaktinformasjonen som blir oppgitt i informasjonsbrevet og i samtykkeskjema.

Foresatte gir samtykke til at vi kan behandle personopplysninger. Vi informerer om hvordan disse behandles, og om at informanten kan kreve innsyn, retting eller sletting av egne personopplysninger.

Samtykke kan trekkes muntlig eller skriftlig. I henhold til tidligere diskusjoner med NSD og NESH i forbindelse med et annet prosjekt ved Institutt for lærerutdanning og skoleforskning, UiO, har vi lagt inn følgende to alternativer for avkrysning i samtykkeerklæringene til elever/foresatte.
- "Ja, jeg samtykker"
- "Nei, jeg samtykker ikke"

I tillegg har vi lagt inn følgende setning: "Dersom du krysser av for enten «Ja, jeg samtykker» eller «Nei, jeg samtykker ikke», vil dette samtykkeskjemaet bli lagret så lenge prosjektet pågår. All deltakelse i prosjektet er frivillig, og du kan når som helst trekke ditt samtykke uten noen grunn. Dersom du trekker deg, vil alle opplysninger bli slettet."

Grunnen til at vi har lagt inn et "nei-samtykke" er at det vil være lettere for forskerne å få oversikt over hvem som deltar, og at man slipper å purre på elever/foreldre som aktivt har krysset nei. Det kan forøvrig være belastende for foreldre å få spørsmål flere ganger om deltagelse i et forskningsprosjekt, når de ikke ønsker å delta. Vi understreker forøvrig at vi er klar over at det må være et aktivt samtykke, noe som innebærer at de som ikke svarer på skjemaet i det hele tatt - dvs hverken krysser av for ja eller nei, ikke skal delta i prosjektet.

Totalt antall registrerte i prosjektet
5000-9999

Tillatelser

Skal du innhente følgende godkjenninger eller tillatelser for prosjektet?
Ikke utfyllt

Behandling

Hvor behandles personopplysningene?
- Maskinvare tilhørende behandlingsansvarlig institusjon
- Ekstern tjeneste eller nettverk (databehandler)

Hvem behandler/har tilgang til personopplysningene?
- Prosjektansvarlig
- Interne medarbeidere
- Databehandler

Hvilken databehandler har tilgang til personopplysningene?

Nettskjema, Tjeneste for Sensitive Data (TSD)

Tilgjengeliggjøres personopplysningene utenfor EU/EØS til en tredjestat eller internasjonal organisasjon?
Nei

Sikkerhet

Oppbevares personopplysningene atskilt fra øvrige data (koblingsnøkkel)?
Nei

Begrunn hvorfor personopplysningene oppbevares sammen med de øvrige opplysningene

Data oppbevares i sin originale form i Tjenester for sensitive data (TSD). Det er kun medarbeider knyttet til delprosjekt 3.2 som vil ha adgang til komplette data med personopplysninger. Det vil bli laget egne anonymiserte datasett for analysearbeid i og utenfor TSD sin plattform. Dette gjelder også når datasett kobles med registerdata.

Hvilke tekniske og fysiske tiltak sikrer personopplysningene?
- Personopplysningene anonymiseres fortløpende
- Opplysningene krypteres under lagring
- Adgangsbegrensning
- Flerfaktorautentisering
- Andre sikkerhetstiltak

Hvilke

Innlåsing av dokumenter ved behov

Varighet

Prosjektperiode
01.11.2019 - 31.12.2025

Hva skjer med dataene ved prosjektslutt?
Data med personopplysninger oppbevares midlertidig til: 31.12.2030

Hva er formålet med den videre oppbevaringen av dataene?
Langtidslagring og/eller arkivering for deling av data

Hvor oppbevares personopplysningene?
Internt ved behandlingsansvarlig institusjon

Vil de registrerte kunne identifiseres (direkte eller indirekte) i oppgave/avhandling/øvrige publikasjoner fra prosjektet?
Nei

Tilleggsopplysninger

Prosjektet er del av det overordnede prosjektet Fagfornyelsen: Intensjoner, prosesser og praksiser (EVA2020). Se vedlagt prosjektbeskrivelse.

Informasjonsbrev med link til samtykke formidles til elever og foreldre via en kontaktperson (lærer) ved hver skole. Foreldresamtykke innhentes digitalt ved bruk av nettskjema/TSD. Foreldrene identifiserer seg ved bruk av BankID.

Vedlagt er skjema for samtykke for elever og foresatte.

Undersøkelsen innebærer fire spørrerunder til elever og lærere. Første runde gjennomføres januar-mars 2021, andre runde gjennomføres oktober/november 2021, tredje spørrerunde gjennomføres oktober/november 2022 og fjerde runde gjennomføres oktober/november 2023. Eventuelle endringer i skjema eller rutiner for senere spørrerunder vil bli meldt til NSD som endring.

Andre vedlegg

Prosjektbeskrivelse_EVA2020_Hovedtekst.pdf

Evaluering av fagfornyelsen (EVA2020) - Samtykkeskjema for elever og foresatte våren 2021 – Vis - Nettskjema.pdf

UiO : Universitetet i Oslo

Samtykke til deltakelse i spørreundersøkelse knyttet til evaluering av den nye læreplanen i skolen

På oppdrag fra Utdanningsdirektoratet skal Det utdanningsvitenskapelige fakultet ved Universitet i Oslo gjennomføre en evaluering av det nye læreplanverket, «fagfornyelsen». Forskningsprosjektet, EVA2020, skal undersøke hvordan den nye læreplanen forstås og innføres i skolen. I tillegg skal konsekvensene av den nye læreplanen undersøkes gjennom både klasseromsstudier og spørreundersøkelser til elever og lærere. Prosjektet gjennomføres i perioden 2020 til 2024.

Din skole har takket ja til å delta i den landsdekkende spørreundersøkelsen. Din skole er én av 150 skoler som er tilfeldig trukket ut blant alle skoler med 9.trinn i Norge. For å sikre at vi skal kunne si noe om utviklingen over tid, ønsker vi at de samme skolene deltar fire år på rad. I hver spørrerunde er det elevene på 9. trinn som deltar, så hver enkelt elev skal kun delta én gang. Årets spørreundersøkelse gjennomføres etter avtale med skolen i løpet av de neste ukene. For at ditt barn skal kunne delta i spørreundersøkelsen, trenger vi samtykke fra ditt barn og deg.

Hvordan gir vi samtykke? Samtykke avgis digitalt via nettlink under og ved bruk av sikker identifisering (BankID). Dere vil bli bedt om å svare på to punkter: (1) samtykke til deltakelse i undersøkelsen samt behandling av persondata (2) samtykke til at data fra spørreundersøkelsen blir koblet med registerdata fra SSB. Vi ber også elever/foresatte som ikke ønsker å delta i undersøkelsen om å fylle ut samtykket. Dette for å unngå unødvendige purringer.

Se neste side for detaljert informasjon om spørreundersøkelsen og hva samtykket innebærer.

Dere gir samtykke ved at

1. Foresatte logger seg inn på elektronisk samtykkeskjema ved å klikke på linken under og bruke sikker identifisering (BankID).
2. Eleven og foresatte fyller ut samtykkeskjema i fellesskap.
3. Foresatte signerer samtykkeskjemaet ved bruk av sikker identifisering.
4. Foresatte får en kopi av samtykkeskjema på Digipost.

Fyll ut samtykkeskjema her: https://nettskjema.no/a/elektroniskforeldresamtykke

For å endre dette samtykket, kan du logge inn i samtykkeportalen:
https://consent-portal.tsd.usit.no

Vår kontaktinformasjon. For spørsmål om undersøkelsen, kan du kontakte oss på e-post: eva-2020@uv.uio.no Ved behov for direkte kontakt: Kristin Slungård, tlf. 46417608

Med vennlig hilsen

Christian Brandmo
Professor, prosjektansvarlig spørreundersøkelsen

Kristin Slungård
Vitenskapelig assistent

Du kan lese mer om EVA2020 på denne nettsiden:
https://www.uv.uio.no/forskning/prosjekter/fagfornyelsen-evaluering/

Videosnutt:
https://www.youtube.com/watch?time_continue=71&v=VxKr0qNCBn8&feature=emb_title

UiO : Universitetet i Oslo

Formålet med spørreundersøkelsen er å studere hvordan elever opplever skolehverdagen etter innføringen av de nye læreplanene. Gjennom dette ønsker vi å finne svar på spørsmål som:

- Fører satsingen på dybdelæring til at elever endrer læringssyn og oppfatninger om kunnskap?
- Bidrar satsingen på de tverrfaglige temaene til endringer i elevenes holdninger og beredskap til å møte livsutfordringer?
- Utvikler elever holdninger og handlingskompetanse knyttet til medborgerskap og bærekraftig utvikling?

Om innhold og gjennomføringen av undersøkelsen. Undersøkelsen gjennomføres digitalt på skolen og vil ta ca. 30 minutter å besvare. Undersøkelsen besvares på datamaskin eller nettbrett. Elevene vil motta spørsmål om deres motivasjon for skolearbeid, hvordan de best kan lære, hvordan de løser ulike oppgaver og problemer i skolehverdagen, hvordan de opplever egen trivsel og klassemiljø, samt hva de tenker rundt bærekraftig utvikling, demokrati og medborgerskap.

Sammenkobling av data med registerdata fra SSB. For å kunne sette resultatene fra spørreundersøkelsen inn i et større samfunnsmessig perspektiv og analysere konsekvensene av den nye læreplanen, ønsker vi å koble data fra spørreundersøkelsen med registerdata fra Statistisk sentralbyrå (SSB). Dette betyr at vi kobler informasjon fra denne undersøkelsen med data om elevenes skoleresultater (eksamenskarakterer, grunnskolepoeng og resultater på nasjonale prøver) og valg av videregående utdanning, samt foresattes inntekt og utdanningsbakgrunn. Denne koblingen vil følge en rutine som gjør at enkeltpersoner ikke kan identifiseres i analysene. Det er mulig å delta i undersøkelsen uten at dine data blir sammenkoblet med registerdata fra SSB – se eget punkt i samtykkeskjemaet.

Ditt personvern og hvordan vi oppbevarer og bruker dine opplysninger. Undersøkelsen vil bli gjennomført i tråd personvernreglementet og anbefalinger fra Norsk senter for forskningsdata (NSD). All datainnsamling vil foregå ved hjelp av godkjente elektroniske løsninger (Nettskjema) og data vil bli lagret på sikre servere (Tjeneste for sensitive data – TSD). Personopplysninger vil bli behandlet konfidensielt og kun være tilgjengelig for prosjektets medarbeiderne. Det vil bli laget egne anonymiserte datasett for analysearbeidet. Personopplysninger vil bli oppbevart til 31.12.2030. Etter denne dato vil alle data bli anonymisert og gjort tilgjengelig for forskere ved norske forskningsinstitusjoner da data fra dette prosjektet kan ha nasjonal og historisk interesse.

Frivillig deltakelse. Det er frivillig å delta i undersøkelsen. Vi vil imidlertid sette pris på om elevene blir oppfordret til å delta da undersøkelsen kan ha stor betydning for en vellykket etablering og justering av de nye læreplanene. Elever som ikke deltar vil få tilbud om ordinært skolearbeid når undersøkelsen gjennomføres.

Samtykke og dine rettigheter. Vi behandler personopplysninger om elevene basert på eleven og foresatte sine samtykker. Eleven eller foresatte kan når som helst trekke samtykket tilbake uten å oppgi noe grunn. Så lenge eleven kan identifiseres i datamaterialet, har eleven/foresatte rett til:

- innsyn i hvilke personopplysninger som er registrert om seg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om seg,
- å få slettet personopplysninger om seg, og
- å sende klage til Datatilsynet om behandlingen av sine personopplysninger

For å trekke samtykke, ta kontakt med oss på epost eller telefon – se kontaktinformasjon på første side. For ytterligere opplysninger om personvern, ta kontakt med Personvernombudet ved Universitetet i Oslo: epost: personvernombud@uio.no

Informationsbrev om forskningsprojekt i din skola

Till elev (och vårdnadshavare om du är yngre än 18 år)

SMEER, CENTER OF SCIENCE, MATHEMATICS AND ENGINEERING EDUCATION RESEARCH

Inom kort kommer en forskare från Karlstads universitet att besöka din skola. Syftet är att samla in data kring elevers uppfattningar och erfarenheter kring hållbar utveckling via en enkät. Detta är en del av skolans pågående utvecklingsprocess kring lärande för hållbar utveckling. Genom att delta i forskningsstudien, så bidrar du som elev med dina erfarenheter, vilket är viktigt för skolans fortsatta utvecklingsarbete. Vi är intresserade av dina erfarenheter, kunskaper och attityder kring hållbar utveckling. Forskningsstudien pågår under ca tre år. Du kommer därför att få fylla i en enkät vid ytterligare något/några tillfällen.

Du som svarar på enkäten är helt anonym. Ditt deltagande är frivilligt men det skulle vara mycket betydelsefullt om du väljer att delta. Enkäten består av påståenden som du svarar på genom att klicka eller kryssa för det alternativ som bäst överensstämmer med din uppfattning. Den tar mellan 20-30 minuter att slutföra och genomförs på lektionstid. Du kan avbryta ditt deltagande ända fram tills du lämnat in enkäten. Inget skriftligt godkännande behövs, utan du samtycker till att delta i studien genom att klicka på knappen ”jag samtycker” när du går in på enkätlänken.

Om du har frågor är du välkommen att kontakta någon av oss:

Årskurs 6 - 9

Daniel Olsson
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Karlstads universitet
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Gymnasiet

Teresa Berglund
Inst. För miljö-och livsvetenskaper
Karlstads universitet
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teresa.berglund@kau.se

Appendix B

Data Management and Analysis Code

```
# PART 0 Packages and functions ----------------------------------
install.packages("haven")
install.packages("lavaan")
install.packages("tidyverse")
install.packages("ggplot2")
library(haven)
library(tidyverse)
library(lavaan)
library(ggplot2)

# Fit measures function
fit.m <- function(model) {
  fit_indices <- fitMeasures(model, c("CFI", "TLI", "RMSEA", "SRMR"), output = "ma
trix")
  fit_indices <- round(fit_indices, digits = 3)
  fit_indices2 <- data.frame(fit_indices)
  return(t(fit_indices2))
}

# PART 1 data management -----------------------------------------
SWE.DATA <- read_sav("Student data_master project.sav")
PILOT.DATA <- read_sav("SCQ_SPACS_DEMO_studentprosjekt.sav")
NOR.DATA <- read_sav("hoveddata_elev_analysefil_26.05.21.sav")

## NOR HOVED ####
# Removing unwanted columns
NOR.DATA <- select(NOR.DATA, kjonn, bae08:bae16)

# Renaming
NOR.DATA <- NOR.DATA %>%
  rename(KAP2 = bae08, KAP3 = bae09, KAP4 = bae10, COI1 = bae11, COI2 = bae12, COI
3 = bae13, WTA1 = bae14, WTA2 = bae15, WTA3 = bae16)

## PILOT ####
# Removing unwanted columns
PILOT.DATA <- select(PILOT.DATA, kjonn, bae001:bae012)

# Renaming
PILOT.DATA <- PILOT.DATA %>%
  rename(KAP1 = bae001, KAP2 = bae002, KAP3 = bae003, KAP4 = bae004, COI1 = bae005
, COI2 = bae006, COI3 = bae007, COI4 = bae008, WTA1 = bae009, WTA2 = bae010, WTA3
= bae011, WTA4 = bae012)

# Removing NA
PILOT.DATA <- PILOT.DATA[complete.cases(PILOT.DATA[, c("KAP1","KAP2", "KAP3", "KAP
4", "COI1", "COI2", "COI3", "COI4", "WTA1", "WTA2", "WTA3", "WTA4")]), ]

## SWE ####
# Removing unwanted columns
SWE.DATA <- select(SWE.DATA, Gender, KAP1:WTA4)

## COMBINDING ####
NOR.DATA$KAP1 <- NA
NOR.DATA$WTA4 <- NA
NOR.DATA$COI4 <- NA
```

```
NOR.DATA$source <- "NOR"
PILOT.DATA$source <- "PILOT"
SWE.DATA$source <- "SWE"

# Rename kjonn and gender to Gender in each data frame
names(NOR.DATA)[names(NOR.DATA) == "kjonn"] <- "gender"
names(PILOT.DATA)[names(PILOT.DATA) == "kjonn"] <- "gender"
names(SWE.DATA)[names(SWE.DATA) == "Gender"] <- "gender"

# Combine the data frames into one
Combined.DATA <- rbind(NOR.DATA, PILOT.DATA, SWE.DATA)
Combined.DATA <- select(Combined.DATA, gender, KAP1, KAP2, KAP3, KAP4, COI1, COI2,
COI3, COI4, WTA1, WTA2, WTA3, WTA4, source)

# Write data file
write.csv2(Combined.DATA, "SPACSQ.csv", row.names = FALSE)

## Final data ####
data <- read.csv2("SPACSQ.csv")

## subsets ####
cols <- grep("KAP2|KAP3|KAP4|COI1|COI2|COI2|COI3|WTA1|WTA2|WTA3", names(data), val
ue = TRUE)
cols2 <- grep("^KAP|^COI|^WTA", names(data), value = TRUE)
subset.nor.swe <- data[data$source == "NOR"| data$source == "SWE",]
subset.nor.swe.12 <- data[data$source == "NOR"| data$source == "SWE",cols]
subset.nor <- data[data$source == "NOR", cols]
subset.swe <- data[data$source == "SWE", cols]
subset.swe.12 <- data[data$source == "SWE", cols2]
subset.pilot <- data[data$source == "PILOT", cols2]

# PART 2 model structures -------------------------------------------------------
### Three sub-factors correlated ####
M <-     "      KAP =~ KAP2 + KAP3 + KAP4
               COI =~ COI1 + COI2 + COI3
               WTA =~ WTA1 + WTA2 + WTA3"

### One factor ####
M.ONE <- "SPACS =~ KAP2 + KAP3 + KAP4 + COI1 + COI2 + COI3 + WTA1 + WTA2 + WTA3"

### One factor for each sub-factor ####
KAP.FULL <- "KAP =~ KAP1 + KAP2 + KAP3 + KAP4"
KAP.9 <-    "KAP =~ KAP2 + KAP3 + KAP4"
COI.FULL <- "COI =~ COI1 + COI2 + COI3 + COI4"
COI.9 <-    "COI =~ COI1 + COI2 + COI3"
WTA.FULL <- "WTA =~ WTA1 + WTA2 + WTA3 + WTA4"
WTA.9 <-    "WTA =~ WTA1 + WTA2 + WTA3"

# PART 3 cfa models -------------------------------------------------------------
### One Factor Nine Items ####
SQ.ONE.SWE <- cfa(M.ONE, subset.swe, estimator = "MLR")

SQ.ONE.NOR <- cfa(M.ONE, subset.nor, estimator = "MLR")

### Individual one-factor models, 12 items ####
# SWE
#KAP
SWE.KAP.FULL <- cfa(KAP.FULL, subset.swe.12, estimator = "MLR")
#COI
```

```
SWE.COI.FULL <- cfa(COI.FULL, subset.swe.12, estimator = "MLR")
#WTA
SWE.WTA.FULL <- cfa(WTA.FULL, subset.swe.12, estimator = "MLR")

# NOR
#KAP
NOR.KAP.FULL <- cfa(KAP.FULL, subset.pilot, estimator = "MLR")
#COI
NOR.COI.FULL <- cfa(COI.FULL, subset.pilot, estimator = "MLR")
#WTA
NOR.WTA.FULL <- cfa(WTA.FULL, subset.pilot, estimator = "MLR")

# Modification indices single factor models
# Swedish data
SWE.WTA.EPC <- modindices(SWE.WTA.FULL, sort = TRUE, maximum.number = 10)

WTA.M.2 <- "WTA=~ WTA1 + WTA2 + WTA3 + WTA4
            WTA3 ~~ WTA4"

SWE.WTA.FULL.2 <- cfa(WTA.M.2, subset.swe.12, estimator = "MLR")
fit.m(SWE.WTA.FULL.2)

# Pilot data
NOR.WTA.EPC <- modindices(NOR.WTA.FULL, sort = TRUE)

NOR.WTA.FULL.2 <- cfa(WTA.M.2, subset.pilot, estimator = "MLR")
fit.m(NOR.WTA.FULL.2)

NOR.KAP.EPC <- modindices(NOR.KAP.FULL, sort = TRUE)

KAP.M.2 <- "KAP =~ KAP1 + KAP2 + KAP3 + KAP4
            KAP1 ~~ KAP3"

NOR.KAP.FULL.2 <- cfa(KAP.M.2, subset.pilot, estimator = "MLR")
fit.m(NOR.KAP.FULL.2)

### Three sub-factors correlated models ####
SQ.FULL <- cfa(M, subset.nor.swe, estimator = "MLR")
SQ.SWE <- cfa(M, subset.swe, estimator = "MLR")
SQ.NOR <- cfa(M, subset.nor, estimator = "MLR")

# PART 4 measurement invariance ---------------------------------------------------
CONFIG <- cfa(model = M, subset.nor.swe, estimator = "MLR", group = "source")
fit.m(CONFIG)

METRIC <- cfa(model = M, subset.nor.swe, estimator = "MLR", group = "source", grou
p.equal = c("loadings"))
fit.m(METRIC)

SCALAR <- cfa(M, subset.nor.swe, estimator = "MLR", group = "source", group.equal
= c("loadings","intercepts"))
fit.m(SCALAR)

# PART 5 plots and tables ---------------------------------------------------------
----------
### plotting item distribution ####
cols3 <- grep("KAP2|KAP3|KAP4|COI1|COI2|COI2|COI3|WTA1|WTA2|WTA3|source", names(da
ta), value = TRUE)
data.subset <- data[data$source == "NOR"| data$source == "SWE",cols3]
```

```
data.subset$source <- factor(data.subset$source, levels = c("SWE","NOR"))
data.melted <- reshape2::melt(data.subset, id.vars = "source")

ggplot(data.melted, aes(x = value, fill = factor(source))) +
  geom_histogram(aes(y = after_stat(density)), bins = 5, position = "dodge", alpha
= 0.5) +
  facet_wrap(~variable, scales = "free_x") +
  labs(x = NULL, y = NULL, fill = NULL) +
  scale_fill_manual(values = c("#ffa600", "#003f5c"), name = NULL) +
  theme(panel.background = element_rect(fill = "white"),
        axis.title.y = element_blank(), axis.text.y = element_blank(), axis.ticks.
y = element_blank(),
        legend.position = "none",
        plot.title = element_text(size = 16, face = "bold"),
        strip.text = element_text(size = 14, face = "bold"))

### Descriptive Statistics ####
# NOR
# Mean, Standard Deviation and Skewness
mean.data.nor <- subset.nor %>% select(all_of(cols)) %>%
  summarise(across(everything(), mean))
sd.data.nor <- subset.nor %>% select(all_of(cols)) %>%
  summarise(across(everything(), sd))
skewness.data.nor <- subset.nor %>% select(all_of(cols)) %>%
  summarise(across(everything(), psych::skew))

# Creating table
nor.desc <- mean.data.nor %>% pivot_longer(cols = everything(), names_to = "Item",
values_to = "Mean") %>%
  left_join(sd.data.nor %>% pivot_longer(cols = everything(), names_to = "Item", v
alues_to = "SD"), by = c("Item")) %>%
  left_join(skewness.data.nor %>% pivot_longer(cols = everything(), names_to = "It
em", values_to = "Skewness"), by = c("Item"))
nor.desc <- nor.desc %>% mutate_at(vars(Mean, SD, Skewness), ~ round(., 2))
write.table(nor.desc, "nor.desc.csv", quote = F, sep = ";", col.names=NA)

# SWE
# Mean, Standard Deviation and Skewness
mean.data.swe <- subset.swe %>% select(cols) %>%
  summarise(across(everything(), mean))
sd.data.swe <- subset.swe %>% select(cols) %>%
  summarise(across(everything(), sd))
skewness.data.swe <- subset.swe %>% select(cols) %>%
  summarise(across(everything(), psych::skew))

# Creating table
swe.desc <- mean.data.swe %>% pivot_longer(cols = everything(), names_to = "Item",
values_to = "Mean") %>%
  left_join(sd.data.swe %>% pivot_longer(cols = everything(), names_to = "Item", v
alues_to = "SD"), by = c("Item")) %>%
  left_join(skewness.data.swe %>% pivot_longer(cols = everything(), names_to = "It
em", values_to = "Skewness"), by = c("Item"))
swe.desc <- swe.desc %>% mutate_at(vars(Mean, SD, Skewness), ~ round(., 2))
write.table(swe.desc, "swe.desc.csv", quote = F, sep = ";", col.names=NA)

### Correlation Table ####
correlation.nor <- round(cor(subset.nor), 2)
rownames(correlation.nor) <- colnames(correlation.nor)
write.table(correlation.nor, "correlation.nor.csv", quote = F, sep = ";", col.name
```

```
s=NA)

correlation.swe <- round(cor(subset.swe), 2)
rownames(correlation.swe) <- colnames(correlation.swe)
write.table(correlation.swe, "correlation.swe.csv", quote = F, sep = ";", col.name
s=NA)

### Fit measures, one factor models ####
SWE.ONEFACTOR.TABLE <- data.frame(
  Model = c("SWE.KAP.FULL", "SWE.COI.FULL", "SWE.WTA.FULL"),
  CFI = round(c(fitMeasures(SWE.KAP.FULL, "CFI"), fitMeasures(SWE.COI.FULL, "CFI")
, fitMeasures(SWE.WTA.FULL, "CFI")),3),
  TLI = round(c(fitMeasures(SWE.KAP.FULL, "TLI"), fitMeasures(SWE.COI.FULL, "TLI")
, fitMeasures(SWE.WTA.FULL, "TLI")),3),
  RMSEA = round(c(fitMeasures(SWE.KAP.FULL, "RMSEA"), fitMeasures(SWE.COI.FULL, "R
MSEA"), fitMeasures(SWE.WTA.FULL, "RMSEA")),3),
  SRMR = round(c(fitMeasures(SWE.KAP.FULL, "SRMR"), fitMeasures(SWE.COI.FULL, "SRM
R"), fitMeasures(SWE.WTA.FULL, "SRMR")),3)
)

NOR.ONEFACTOR.TABLE <- data.frame(
  Model = c("SWE.KAP.FULL", "SWE.COI.FULL", "SWE.WTA.FULL"),
  CFI = round(c(fitMeasures(NOR.KAP.FULL, "CFI"), fitMeasures(NOR.COI.FULL, "CFI")
, fitMeasures(NOR.WTA.FULL, "CFI")),3),
  TLI = round(c(fitMeasures(NOR.KAP.FULL, "TLI"), fitMeasures(NOR.COI.FULL, "TLI")
, fitMeasures(NOR.WTA.FULL, "TLI")),3),
  RMSEA = round(c(fitMeasures(NOR.KAP.FULL, "RMSEA"), fitMeasures(NOR.COI.FULL, "R
MSEA"), fitMeasures(NOR.WTA.FULL, "RMSEA")),3),
  SRMR = round(c(fitMeasures(NOR.KAP.FULL, "SRMR"), fitMeasures(NOR.COI.FULL, "SRM
R"), fitMeasures(NOR.WTA.FULL, "SRMR")),3)
)
write.table(SWE.ONEFACTOR.TABLE, "SWE.ONEFACTOR.TABLE.csv", quote = F, sep = ";",
col.names=NA)
write.table(NOR.ONEFACTOR.TABLE, "NOR.ONEFACTOR.TABLE.csv", quote = F, sep = ";",
col.names=NA)

### Factor loadings table, three sub-factors model ####
FL.TABLE <- inspect(SQ.FULL, what = "std")$lambda
FL.TABLE <- as.data.frame(FL.TABLE)
FL.TABLE <- round(FL.TABLE, 3)
write.table(FL.TABLE, "FL.TABLE.csv", quote = F, sep = ";", col.names=NA)

### Factor variance and correlations table ####
# factor variance
COV.MATRIX <- lavInspect(SQ.FULL, "cov.lv")
# factor correlation
COR.MATRIX <- lavInspect(SQ.FULL, "cor.lv")

COMBINED.MATRIX <- diag(diag(COV.MATRIX))
COMBINED.MATRIX[lower.tri(COMBINED.MATRIX)] <- round(COR.MATRIX[lower.tri(COR.MATR
IX)], 2)

COMBINED.MATRIX <- round(COMBINED.MATRIX, 3)
rownames(COMBINED.MATRIX) <- c("KAP","COI","WTA")
colnames(COMBINED.MATRIX) <- c("KAP","COI","WTA")

write.table(COMBINED.MATRIX, "COMBINED.MATRIX.csv", quote = F, sep = ";", col.name
s=NA)
```

```
### Measurement Invariance Table ####
mi.fit.table <- function(model, table) {
  table <- round(fitMeasures(model, c("RMSEA", "CFI", "SRMR")),3)
  table <- as.data.frame(table)
  table <- tibble::rownames_to_column(table, "fit")
  table <- t(table)
  table <- as.data.frame(table)
  names(table) <- table %>% slice(1) %>% unlist()
  table <- table %>% slice(-1)
  table <- table %>% mutate_if(is.character, as.numeric)
  return(table)
}
mi.fit <- mi.fit.table(SQ.SWE)
mi.fit[2,] <- mi.fit.table(SQ.NOR)
mi.fit[3,] <- mi.fit.table(CONFIG)
mi.fit[4,] <- mi.fit.table(METRIC)
mi.fit[5,] <- mi.fit.table(SCALAR)

# Calculate the change in RMSEA, CFI, and SRMR
mi.fit$RMSEA_change <- c(NA, diff(mi.fit$rmsea))
mi.fit$CFI_change <- c(NA, diff(mi.fit$cfi))
mi.fit$SRMR_change <- c(NA, diff(mi.fit$srmr))

# Select and reorder the columns in the desired order
mi.fit <- mi.fit[, c("rmsea", "RMSEA_change", "cfi", "CFI_change", "srmr", "SRMR_c
hange")]
rownames(mi.fit) <- c("Sweden","Norway","CONFIG", "METRIC", "SCALAR")

write.table(mi.fit, "mifit.csv", quote = F, sep = ";", col.names=NA)

## Modification indexes table
SWE.WTA.EPC <- SWE.WTA.EPC[1:5]
SWE.WTA.EPC <- SWE.WTA.EPC %>% mutate_if(is.numeric, ~round(., 3))

NOR.WTA.EPC <- NOR.WTA.EPC[1:5]
NOR.WTA.EPC <- NOR.WTA.EPC %>% mutate_if(is.numeric, ~round(., 3))

NOR.KAP.EPC <- NOR.KAP.EPC[1:5]
NOR.KAP.EPC <- NOR.KAP.EPC %>% mutate_if(is.numeric, ~round(., 3))

write.table(SWE.WTA.EPC, "SWE.WTA.EPC.csv", quote = F, sep = ";", col.names=NA)
write.table(NOR.WTA.EPC, "NOR.WTA.EPC.csv", quote = F, sep = ";", col.names=NA)
write.table(NOR.KAP.EPC, "NOR.KAP.EPC.csv", quote = F, sep = ";", col.names=NA)
```

Appendix C

Supplemental Material

Evaluation of modification indices and expected parameter change for one-factor models.

Fit measures indicated that the "willingness to act" one-factor model estimated using Swedish data, as well as the same model estimated using observations from the Norwegian pilot had poor fit. Additionally, the "knowledge of action possibilities" one-factor model estimated using Norwegian pilot data had poor fit. Table 1.3 shows the five highest modification indices and expected parameters change for each of these models. These results indicate that the fit of these models improve if two indicators are allowed to correlate. Based on this we estimated three new models. Two new “willingness to act” one-factor models based on Swedish and Norwegian pilot observations, where the items WTA3 and WTA4 were allowed to correlate. Further, a new “knowledge of action possibilities” model where item KAP1 and KAP3 were allowed to correlate. Fit measures for these new models indicated great fit. Swedish WTA model: CFI = 0.999, TLI = 0.992, RMSEA = 0.052, SRMR = 0.006. Norwegian pilot WTA model: CFI = 0.999, TLI = 0.994, RMSEA = 0.05, SRMR = 0.01. Norwegian pilot KAP model: CFI = 1, TLI = 1.012, RMSEA = 0, SRMR = 0.01.

The creators of the instrument meant to be used in the evaluation of the recent curriculum reform in Norway removed one item from each sub-factor. This means that we avoid the problem of having overly correlated indicators. It is however, worth nothing that allowing item WTA1 and WTA2 to correlate had the highest EPC for both groups, while neither of these items were removed for the final instrument.

Table C1

Modification indices and expected parameters change for WTA models based on Swedish and Norwegian pilot data, and KAP model based on Norwegian pilot data.

			MI	EPC
Swedish WTA model				
WTA3	~~	WTA4	76.62	0.224
WTA1	~~	WTA2	76.62	0.303
WTA1	~~	WTA3	30.11	-0.147
WTA2	~~	WTA4	30.11	-0.13
WTA2	~~	WTA3	3.946	-0.056
WTA1	~~	WTA4	3.946	-0.047
Norwegian pilot WTA model				
WTA3	~~	WTA4	15.922	0.236
WTA1	~~	WTA2	15.922	0.294
WTA1	~~	WTA3	5.913	-0.167
WTA2	~~	WTA4	5.913	-0.131
WTA2	~~	WTA3	1.402	-0.074
WTA1	~~	WTA4	1.402	-0.063
Norwegian pilot KAP model				
KAP2	~~	KAP4	2.964	0.157
KAP1	~~	KAP3	2.964	0.081
KAP1	~~	KAP4	2.413	-0.074
KAP2	~~	KAP3	2.413	-0.119
KAP3	~~	KAP4	0.001	-0.003
KAP1	~~	KAP2	0.001	-0.002

Note. ~~ = correlation. MI = modification indices, EPC = expected parameters change.

Supplementary tables

Table C2

The items and subscales of the self-perceived action competence for sustainability questionnaire.

Sub-scale/Item
Knowledge of action possibilities (KAP)
1. *I can see different points of view on issues when people think differently. (KAP1)*
2. I know how one should take action at school in order to contribute to sustainable development. (KAP2)
3. I know how one should take action at home in order to contribute to sustainable development. (KAP3)
4. I know how one should take action together with others in order to contribute to sustainable societal development. (KAP4)
Confidence in one's own influence (COI)
5. I believe I can influence global sustainable development through my actions. (COI1)
6. I believe I can influence sustainable development in my community. (COI2)
7. I believe I have good opportunities to participate in influencing our shared future. (COI3)
8. *I believe what each person does matters for sustainable development. (COI4)*
Willingness to act (WTA)
9. I want to take action for sustainable development in my community. (WTA1)
10. I want to take action for global sustainable development. (WTA2)
11. I want to engage in changing society towards sustainable development. (WTA3)
12. *I want schoolwork to be about how we can shape a sustainable future together. (WTA4)*

Note. Cursive items represents items removed for the Norwegian main study. Item code in parenthesis. Recreated from Olsson et al., (2020).

Table C3

Swedish study participants

Year	
6	22
7	102
8	93
9	73
10	267
11	267
12	210
Age	
11	7
12	39
13	94
14	86
15	108
16	261
17	236
18	176
19	19
20	7
21	1
Gender	
Boy	585
Girl	434
NA	15
Total	1034

Table C4

Norwegian pilot study participants

Year	
10	99
Age	
15-16	99
Gender	
Boy	49
Girl	50
Total	99

Table C5

Norwegian main study participants

Year	
9	2012
Age	
14-15	2012
Gender	
Boy	1009
Girl	1003
Total	2012