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# Methods

In my analysis I ask how a participative SDE-intervention influences attitudinal, behavioural and self-efficacy components of sustainability competences over time. I assess variation in the level of involvement of the students. To quantitatively test the impact of SDE-interventions, I will assess long-term effects by using existing data from a before-after self-reported survey on behavioural and attitudinal data and proceeding data collection with the same survey at approximately one year after the last assessment. Furthermore, I will complement data collection with a survey on self-efficacy.

## Project description KlimaRatSchule

### Aims project, project description and relevance ESD

For analysing the changes of sustainability competences over time, I chose the SDE-intervention KlimaRatSchule (KRS). A blue and green logo

Description automatically generatedThe KRS project aims to promote and establish an active climate protection culture in schools through democratic participation processes. The students deal with the carbon footprint of their own school and carry out a democratic participation process, the results of which are used to develop the school's own climate protection concept (KRS Projektbeschreibung, 2024).

* The project was piloted at two schools in Freiburg in January 2023.
* Project was designed by Solare Zukunft, etc..?
* Project can be divided into 3 phases: group of volunteers form and collect data, micro citizen report for schools with randomly drawn students and development of roadmap with concrete aims and steps at school. 🡪 aim of real impact of CO2 reduction and at same time climate and democratic education
* Project under SDE criteria needed?

## Databases/ Quantitative data collection

### Study design

#### Measurements at three time points (empirical and long-term)

* Include table with Befragungszeitpunkte?

#### Level of involvement for comparing groups

One paragraph about involvement of students (starting with that) 🡪 at study design

*The levels of involvement are resulting from the different project phases and are summarised in the table below. The tables and figures below are copied from* (Pauli, 2023)*.*

*A white rectangular box with black text

Description automatically generated*

The involvement of the three different groups of involvement was not possible due to too small sample sizes of group one in the data collection. I then excluded this group from all analysis.

### Course of data collection

#### Facts (who, what, where, when)

Only classes 10 and 11 at mzp3, because of limited resources

#### Description school and permits?

🡪 or in project description?

Put table with dates and by whom?

To test for long-term effects of an ESD intervention, it is necessary to collect continuous empirical data. The KRS project was piloted at a Freiburger school, the Angell-Montessory School. The project start was January 2023 with the main phase of the project up until the end of the school year in July 2023. To test the long-term effects data was collected at three different points during the ESD intervention: at the beginning of the project (Feb 2023), at the end of the active phase of the project (Jun23) (within the Master thesis of Pauli, 2023) and one year later at May/June 24. At all three data collection points, the same self-reported survey was conducted with the idea of surveying the same students at three different time points.

The data was collected within a Master thesis project and in collaboration with the IZT, which is responsible for evaluating the impact of the funding and the project. Based on the theory of planned behaviour, a quantitative before-after survey questionnaire survey was designed and conducted at two participating schools. The surveyed students were divided into three distinctive groups, according to their level of participation (see description of level of involvement in the project description in annex XX). The data collection was conducted between February and Mai 2023 (the later date also marking the official ending of the project from the view of the students) (Pauli, 2023). Thereby, the next data collection point will be approximately one year after the end of the project.

A screenshot of a puzzle

Description automatically generated

### Data collection/ Surveys

#### Climate attitude and behaviour

Same as Pauli + comparison to other surveys?

Needed to use the same as Pauli! Based on TPB

The survey was designed based on the theory of planned behaviour. It included elements of attitudes, subjective norms, perceived behaviour control, intentions, and behaviour (Pauli, 2023).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Scale | Item | Question | Source |
| 1 | **Einstellungen zu klima-schützendem Verhalten** | AT | Die Umwelt in Deutschland ist durch den globalen Klimawandel gefährdet. | Masud et al. 2016 |
| 2 |  | Die derzeitige globale Erwärmung ist NICHT vom Menschen verursacht, sondern ein natürlicher Vorgang. |
| 3 |  | Der Klimawandel schadet der natürlichen Umwelt und der Tierwelt in Deutschland. |
| 4 |  | Ich bin bereit, einen gewissen Betrag zu bezahlen, um die Auswirkungen des Klimawandels zu verringern. |
| 5 | **Subjektive Normen** |  | In meiner Familie wird oft über den Klimawandel oder die globale Erwärmung diskutiert. | Lin 2013 |
| 6 |  | Meine Mitschülerinnen und Mitschüler diskutieren oft über den Klimawandel oder die globale Erwärmung. |
| 7 |  | Meine Mitschülerinnen und Mitschüler könnten mich kritisieren, wenn ich keine Maßnahmen zum Klimaschutz ergreife. |
| 8 | **Wahrgenom-mene Verhal-tenskontrolle** |  | Ich glaube, dass ich dazu beitragen kann, die Auswirkungen des Klimawandels abzuschwächen. | Pouya und Niyaz 2022 |
| 9 |  | Durch mein Handeln im Alltag kann ich zur Verringerung von CO2-Ausstoß beitragen. |
| 10 | **Intentionen** |  | Es liegt in meiner Verantwortung, meine Mitbürgerinnen und Mitbürger zu ermutigen, den Klimawandel zu beachten. | Pouya und Niyaz 2022 |
| 11 |  | Ich bin bereit dazu, mich in meinem täglichen Leben umweltfreundlicher zu verhalten. |
| 12 |  | Ich bin bereit, alles zu tun, um die Auswirkungen des Klimawandels zu mindern. |
| 13 | **Verhalten** |  | Ich habe meinen Fleischkonsum in den letzten Monaten bewusst reduziert. | Lin 2013 |
| 14 |  | Ich kaufe in Deutschland produziertes Obst und vermeide den Kauf von importiertem Obst (z. B. Bananen, Kiwis). |
| 15 |  | In meinem Kühlschrank lagere ich oft Lebensmittel, die das Haltbarkeitsdatum überschritten haben. |
| 16 |  | Beim Kauf von Elektrogeräten achte ich am meisten auf den Preis der Geräte. |
| 17 |  | Ich kaufe Elektrogeräte, die ein Energiesparlabel haben. |
| 18 |  | Ich schalte Lichter und Wasserhähne so oft wie möglich aus. |
| 19 |  | Ich ziehe den Stecker von Geräten, die vorübergehend nicht in Gebrauch sind. |
| 20 |  | Ich fahre hauptsächlich mit einem Auto oder einem Motorroller, beziehungsweise werde gefahren. |
| 21 |  | Ich nutze Aufzüge und steige selten Treppen. |
| 22 |  | Ich unterstütze eine Erhöhung der Besteuerung von Kraftstoffen, um den Verbrauch fossiler Kraftstoffe zu reduzieren. |

#### Self-efficacy beliefs

* Based on literature, following questions should have been conducted in 7-point likert scale, but in order to be able to compare it to climate attitude and behaviour scores, it was also conducted in 4-points likert scale.
* Check Table 9 in article!
* Differentiating Individual and collective self-efficacy
* Adding “if I want to”
* Check part implications for operationalising self-efficacy in article!
* Capability marker “can”
* Agent-action-aim self-efficacy included the phrasing “by” or “through”
* No difficulty phrases, no control-related phrases
* No future tense, conditional phrasing
* Include both agents as social identity is central tot he context oft he study

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Scale | Theoretical classification question | Item | Question | Source |
| 1 | Individual self-efficacy beliefs | Agent-Aim | SW01\_01 | Ich glaube, dass meine eigenen Handlungen einen Beitrag zum Klimaschutz leisten können, wenn ich das möchte. |  |
| 2 | Agent-action-aim | SW01\_02 | Ich glaube, dass ich den Klimaschutz vorantreiben kann, indem ich in meinem Umfeld über den Klimawandel aufkläre, wenn ich das möchte. |  |
| 3 | Agent-action | SW01\_03\_inverse | Ich glaube nicht, dass ich in der Lage bin, mich für den Klimaschutz einzusetzen. |  |
| 4 | Agent-action-aim | SW01\_04 | Ich glaube, dass ich dazu in der Lage bin, andere davon zu überzeugen, sich für mehr Klimaschutz einzusetzen, wenn ich das möchte. |  |
| 5 | Agent-aim | SW01\_05\_inverse | Ich glaube nicht, dass ich Möglichkeiten habe, einen Einfluss auf den Klimawandel zu nehmen. |  |
| 6 | Agent-action | SW01\_06 | Ich glaube, dass ich beeinflussen kann, wie meine Schulleitung oder meine Schule bezogen auf den Klimaschutz handelt, wenn ich das möchte. |  |
| 7 | Agent-action-aim | SW01\_07 | Ich glaube, dass ich meine Schulleitung oder Schule dabei unterstützen kann, sich für Klimaschutz einzusetzen, wenn ich das möchte. |  |
| 8 | Agent-aim | SW01\_08 | Ich glaube, dass ich mich in Zusammenarbeit mit anderen sinnvoll für den Klimaschutz engagieren kann, wenn ich das möchte. |  |
| 9 | Collective self-efficacy beliefs | Agent-aim | CS01\_01 | Wir, als Schülerinnnen und Schüler, können durch unsere Handlungen einen Beitrag zum Kllimaschutz leisten, wenn wir das möchten. |  |
| 10 | Agent-action | CS01\_02 | Wir, als Schülerinnen und Schüler, können beeinflussen, wie unsere Schulleitung oder Schule bezogen auf den Klimaschutz handelt, wenn wir das möchten. |  |
| 11 | Agent-action-aim | CS01\_03 | Wir, als Schülerinnen und Schüler, sind in der Lage, andere davon zu überzeugen, sich für mehr Klimaschutz einzusetzen, wenn wir das möchten. |  |

#### General remarks data collection

The survey was conducted in German. The items of a scale were asked together in a block. The items were all in the form of statements and were to be answered on a 4-point Likert scale (0 = strongly disagree, 1 = somewhat disagree, 2 = somewhat agree, 3 = strongly agree). An "I don't know / Don't know" option was given for each item. The completed questionnaire was entered into the online survey application Sco-Scie and was answered online by the students.

* Infos given by slide? 🡪 annex
* Classification into comparison groups through question, whether they participated in KRS-expert group at beginning of questionnaire
* Permit data collection because only one school here?
* Time frame from 10 minutes?

Meethods

Testing time was 90 min with a short break after about half the time. Following the state’s educational research and data guidelines, parental and the school principals’ consent were obtained prior to the assessment. Participation was voluntary, i.e., students did not get any credit or monetary reward. Participants were assured of full confidentiality and anonymity.

## Data processing

I conducted all data processing and analyses in R v. 4.0.2. (REF R Core Team, 2021).

Based on method of Pauli (2023).

### Data cleaning

* Exclude incomplete survey sets
* Exclude data with more than 25% missing, 8 times or more “Ich weiß nicht/ keine Angabe” (I don’t know/ No answer).
* Time less than 2 minutes (120 sec). Different from Pauli, used 4 minutes, but also other extra questions and tested the time.
* Exclusion group1!!

### Data transformation

* Convert the answers from Likert-scale to numeric values. 0 = stimme gar nicht zu (strongly disagree), 1 = stimme eher nicht zu (somewhat disagree), 2 = stimme eher zu (somewhat agree), 3 = stimme völlig zu (strongly agree).
* Inverse for items which were formulated negatively: AT2, B3, B4, B8, B9, SW03, SW05
* Missing answers -100 🡪 needed?
* Metrical measuring level in order to be able to compute means
* Calculating means per scale (only using single items when there are unexpected results?)

## Data analysis

To quantify the relationship of sustainability competences and level of involvement and time, I used different statistical analysis methods.

* Inductive analysis with dependence analysis
  + Hypothesis testing with significance tests
* P values for significance and number of stars?
* To answer RQ1, comparing means
  + Preconditions data: distribution, no normal distribution given (using Shapiro-Willk, results in Annex)
  + Selection based on Uni Zürich Seite)
  + about group membership and sustainability competences, I conducted Wilcoxon. Because no normally distributed data. And only two values to compare
  + about sustainability competences over time, I conducted Kruskal Wallis. Because no normally distributed data. And three values to compare.
  + Measuring effects??
* To answer RQ2
  + Distribution of data (no pearson possible)
  + Correlation with Spearman
    - Values above blabla indicate strong relationship

Convergent validity is the degree to which the scale is related to other instruments that are designed to measure similar attitudes [[**98**](https://www.mdpi.com/2071-1050/11/6/1717#B98-sustainability-11-01717)]. Since no comparable measures exist that capture the presented dimensions of sustainability competencies, it is difficult to fully determine the convergent validity of the new scale.

1. Mowday, R.T.; Steers, R.M.; Porter, L.W. The Measurment of Organizational Commitment. *J. Vocat. Beav.* **1979**, *14*, 224–227. [[**Google Scholar**](https://scholar.google.com/scholar_lookup?title=The+Measurment+of+Organizational+Commitment&author=Mowday,+R.T.&author=Steers,+R.M.&author=Porter,+L.W.&publication_year=1979&journal=J.+Vocat.+Beav.&volume=14&pages=224%E2%80%93227&doi=10.1016/0001-8791(79)90072-1)] [**[CrossRef](https://doi.org/10.1016/0001-8791(79)90072-1" \t "_blank)**]

External validity refers to the relationships between the test scores and other measurements. These relationships should be theoretically and empirically sound. Although previous research primarily focused on environmental knowledge, beliefs, and behavior, the following relationships regarding sustainability related competencies can be expected:

1. (1) Students in higher grades should have higher sustainability related knowledge scores in the test than students in lower grades [[**99**](https://www.mdpi.com/2071-1050/11/6/1717#B99-sustainability-11-01717)].
2. (2) Conversely, students in lower grades should have higher values in affective-motivational beliefs and exhibit to a higher degree sustainability related behavior [[**40**](https://www.mdpi.com/2071-1050/11/6/1717#B40-sustainability-11-01717),[**100**](https://www.mdpi.com/2071-1050/11/6/1717#B100-sustainability-11-01717)]. The results regarding our newly developed instrument are summarized in [**Table 3**](https://www.mdpi.com/2071-1050/11/6/1717#table_body_display_sustainability-11-01717-t003).

## Quality Criteria testing

### Internal/ external validity

Internal not possible. External validity, see Pauli S. 69 + internet calculator

### Reliability of data (internal consistency)

Cronbachs alpha

See also study that also used it

Exclusion of certain data points, because weird formulation

The full R script, the link to my GitHub repository and preregistration, and description of sensitivity analyses can be found in the appendices.