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# Introduction

Globally, we as humankind are facing many ecological and social crises at the same time. Despite extensive and continual efforts aimed at transitioning towards a more sustainable society, environmental and social challenges persist or have even exacerbated in various aspects (IPCC, 2023). In transition towards a more sustainable and just society, Education for Sustainable Development (ESD) is seen as one key aspect (BMBF, 2020). ESD is a holistic educational approach, focusing on the development of sustainability competences which enable the learner to contribute to sustainable development through their competences of knowledge, skills, motivation, attitudes, and values (Rieckmann & Barth, 2022). Following the Brundtland Report and the Agenda 21 conference in Rio, numerous programs for Education for Sustainable Development have been initiated (Hoffmann, 2020). However, the impact and effectiveness of ESD is often questioned (Ssossé et al., 2021). When looking at the empirical data on the impact and outcome of ESD interventions within educational settings is very little. Despite the difficulty of attributing the desired outcome to a specific measure and the complexity of many interacting variables, the call for different approaches of measuring and operationalising ESD research, namely shifting form an input to an outcome orientation is becoming more present (Waltner et al., 2022). Basing the understanding how education interventions can be designed on empirical data, to foster sustainability competences while considering the complex modes of action, is a key topic on the agenda of educational decision makers all over the world. We currently only have a limited understanding of how participative ESD interventions, as potential enablers towards a more sustainable and just society, are contributing to sustainability competences of students.

## Education for sustainable development

Paragraph Importance/ Relevance ESD

🡪Important, but also controversial

* Education as crucial element in the shift towards more sustainability
* Educational efforts for this summarised under Education for sustainable development (ESD)
* ESD at the centre of the 2030 SD Agenda, key enabler of SD
* Important role ESD but also criticism

Approach to ESD so far 🡪 importance of measuring outcomes ESD

* Input level: Polics level on intl, national, local levels: how succesful were those/ desired effect?
* Not easy to measure, but important – if we want ESD to make real contribution to urgently needed changes in society
* Focus on micro-level and how to measure learning outcomes

Controversy ESD based on aims 🡪 importance to keep critical reflection

* Paragraph instrumental vs emancipatory ESD here?
* General importance BNE and controvery
  + Def ESD on local level (see EWM p.2)
  + Output orientation: achievement of these goals? – competencies which enable the learners to contribute to real-world change
  + Measurement instrument, which has proven to be predictive of real-world behaviour impact
* SCs, their development, sustainability and educational governance through policy-making 🡪 appropriate evidence-based recommendations for development of ESD research and implementation of ESD in school practice
* No goals/ methods defined 🡪 without operationalisation, no existent mesauring instruments, needs for ESD and effects of ESD-related interventions cannot be defined empirically
* Objectives and competencies not empirically verified 🡪 impedes effective development of ESD
* Focus of article?

## Theoretical and conceptual context

### Goals of ESD

* According to goals (behavioural, motivtional-affectional dimensions)
  + Need for goals and operationalisation! Recourse to exisintg disciplines
  + Goals should be structured and related to each other (Frame model from Riess)
  + Based on three dimensions (Rieckmann, Waltner)
    - Regional education plans or
    - International framework SDGs (Agenda 21), but no operationalisation ESD output, but normatively well founded
  + Definitions
    - Based on Weinert’s concept of competency [[**25**](https://www.mdpi.com/2071-1050/11/6/1717#B25-sustainability-11-01717)], we determine “sustainability competencies as the overarching goal of ESD. Sustainability competencies compromise the entirety of cognitive abilities and skills as well as related motivational, volitional and social readiness in order to solve sustainability-related problems and to shape sustainable development in private, social and institutional contexts” ([[**14**](https://www.mdpi.com/2071-1050/11/6/1717#B14-sustainability-11-01717)], p. 299). This is largely consistent with the following understanding of sustainability competencies: “Sustainable development and social cohesion depend critically on the competencies of all of our population—with competencies understood to cover knowledge, skills, attitudes and values”, defined by the OECD Education Ministers [[**26**](https://www.mdpi.com/2071-1050/11/6/1717#B26-sustainability-11-01717)] and other literature on (E)SD competencies (see for example [[**27**](https://www.mdpi.com/2071-1050/11/6/1717#B27-sustainability-11-01717),[**28**](https://www.mdpi.com/2071-1050/11/6/1717#B28-sustainability-11-01717)]).
  + Behavioral dimension absent! (Lambrechts et al)
  + Model: That’s why three dimensions of model (+ allows allows daaptivity for specific contexts) + counteracts the prominent dominance of cognitive dispositions
    - Level of model?
    - At each level, a distinction is made between cognitive (a), affective-motivational (b), and behavioral (c) aspects, and additional subcompetencies (d).
    - Description of each dimensions? See EWM development
    - Differentiation from non-sustainability related competences

### Operationalisation ESD outcomes

* Operationalising ESD outcomes (Measurement and Sustainablity competences)
  + - Well established measurement procedures facilitate the itnegration of already operationalised facets of competencies (e.g. attitude) into the larger contruct of sustainablity competences
    - Cognitive/ knowledge dimension:
      * knowledge scales are already available. only specific parts of sustainability knowledge (e.g., environmental knowledge) as a significant subset of sustainability knowledge (e.g., Frick et al., 2004; Maloney & Ward, 1973; McBeth et  al., 2011; Roczen et al., 2014).
      * However, although environmental knowledge is found to be consistently and positively related to environmental attitudes, the relationship is not especially strong (e.g., Arcury, 1990).
      * Behavior prediction through knowledge quite low (Frick 2004), but also indirect (Kaiser, 2003). 🡪 knowledge basis for behaviour, but missing relevant motivational factors
    - Affective-motivational dimensions and behaviroal
      * Close connection
      * No behaviour if costs are perceived too high (Campbell paradigm)  
        🡪 behavioral self-reports used as indicators for a person’s attitudes
      * Operationalisation of attitude and behaviour dimensions in various scales (see Waltner p.2)
  + Campbells paradigm vs TPB

### Methods for measuring goal dimensions

* Methods for measuring goal dimensions:
  + Research exists for goals. But not for adequate measurement instruments
  + Operationalisatoin attempts availale from other research disciplines (+ exisint qualitative data)
  + Exising examples (and also using frame-model)
    - Knowledge covered in article
    - Affective-motivational domain
      * Greenpeace Sustainability Barometer [[**60**](https://www.mdpi.com/2071-1050/11/6/1717#B60-sustainability-11-01717),[**61**](https://www.mdpi.com/2071-1050/11/6/1717#B61-sustainability-11-01717)], the Sustainable Development Values-Scale [[**62**](https://www.mdpi.com/2071-1050/11/6/1717#B62-sustainability-11-01717)], the 2-MEV scale (or also the Preservation and Utilization-Scale) [[**63**](https://www.mdpi.com/2071-1050/11/6/1717#B63-sustainability-11-01717),[**64**](https://www.mdpi.com/2071-1050/11/6/1717#B64-sustainability-11-01717),[**65**](https://www.mdpi.com/2071-1050/11/6/1717#B65-sustainability-11-01717),[**66**](https://www.mdpi.com/2071-1050/11/6/1717#B66-sustainability-11-01717)]. Items from earlier measurement tools emerging from environmental science or environmental psychology may be helpful in the search, especially for the environmental dimension of SC, for example Kaiser et al.’s scale for Environmental Attitude or Connectedness to Nature [[**57**](https://www.mdpi.com/2071-1050/11/6/1717#B57-sustainability-11-01717),[**67**](https://www.mdpi.com/2071-1050/11/6/1717#B67-sustainability-11-01717),[**68**](https://www.mdpi.com/2071-1050/11/6/1717#B68-sustainability-11-01717)] or on environmental values, beliefs, and concerns, or environmental literacy [[**69**](https://www.mdpi.com/2071-1050/11/6/1717#B69-sustainability-11-01717),[**70**](https://www.mdpi.com/2071-1050/11/6/1717#B70-sustainability-11-01717),[**71**](https://www.mdpi.com/2071-1050/11/6/1717#B71-sustainability-11-01717)]; see also the revised New Ecological Paradigm (NEP) Scale [[**72**](https://www.mdpi.com/2071-1050/11/6/1717#B72-sustainability-11-01717)].Empirical data and self-reported
    - Behavioral dimension
      * In a societal context, it is first and foremost about promoting the ability to act. This is exemplified in the work undertaken mainly by researchers from environmental psychology [[**73**](https://www.mdpi.com/2071-1050/11/6/1717#B73-sustainability-11-01717),[**74**](https://www.mdpi.com/2071-1050/11/6/1717#B74-sustainability-11-01717),[**75**](https://www.mdpi.com/2071-1050/11/6/1717#B75-sustainability-11-01717),[**76**](https://www.mdpi.com/2071-1050/11/6/1717#B76-sustainability-11-01717),[**77**](https://www.mdpi.com/2071-1050/11/6/1717#B77-sustainability-11-01717)], for example, the General Ecological Behavior (GEB)-scale [[**67**](https://www.mdpi.com/2071-1050/11/6/1717#B67-sustainability-11-01717),[**68**](https://www.mdpi.com/2071-1050/11/6/1717#B68-sustainability-11-01717)].
    - Mention subcomepetencies?
    - Additionally, an important theoretical background for the test construction in the framework of our study, as well as for hypothesis formulation, were studies emerging mainly from environmental psychology that dealt with the interconnections and influence patterns of environmental knowledge, environmental attitudes, and environmental behaviors (see for example [[**57**](https://www.mdpi.com/2071-1050/11/6/1717#B57-sustainability-11-01717),[**64**](https://www.mdpi.com/2071-1050/11/6/1717#B64-sustainability-11-01717),[**65**](https://www.mdpi.com/2071-1050/11/6/1717#B65-sustainability-11-01717),[**66**](https://www.mdpi.com/2071-1050/11/6/1717#B66-sustainability-11-01717),[**67**](https://www.mdpi.com/2071-1050/11/6/1717#B67-sustainability-11-01717),[**68**](https://www.mdpi.com/2071-1050/11/6/1717#B68-sustainability-11-01717),[**69**](https://www.mdpi.com/2071-1050/11/6/1717#B69-sustainability-11-01717),[**70**](https://www.mdpi.com/2071-1050/11/6/1717#B70-sustainability-11-01717),[**71**](https://www.mdpi.com/2071-1050/11/6/1717#B71-sustainability-11-01717),[**72**](https://www.mdpi.com/2071-1050/11/6/1717#B72-sustainability-11-01717),[**73**](https://www.mdpi.com/2071-1050/11/6/1717#B73-sustainability-11-01717),[**74**](https://www.mdpi.com/2071-1050/11/6/1717#B74-sustainability-11-01717),[**75**](https://www.mdpi.com/2071-1050/11/6/1717#B75-sustainability-11-01717),[**76**](https://www.mdpi.com/2071-1050/11/6/1717#B76-sustainability-11-01717),[**86**](https://www.mdpi.com/2071-1050/11/6/1717#B86-sustainability-11-01717),[**87**](https://www.mdpi.com/2071-1050/11/6/1717#B87-sustainability-11-01717),[**88**](https://www.mdpi.com/2071-1050/11/6/1717#B88-sustainability-11-01717),[**89**](https://www.mdpi.com/2071-1050/11/6/1717#B89-sustainability-11-01717),[**90**](https://www.mdpi.com/2071-1050/11/6/1717#B90-sustainability-11-01717)]).
  + Ideal would be observational data
  + Reality:self-reports more frequently used
    - Advatanges: easier to obtain, especially large qunatities, broader assessment of different behaviours (aggregrated measurements of behavioral classes)
    - BUT Gap between self-reported behaviour and objective behaviour 🡪 indicators mesaure outcome of ESD have tob e validated as to their congruence with real-life outcomes (as real-life relevant for shift to more sustainable socieety/ decision)
    - Underlying: behaviour outcome can and should be goal of ESD??!
  + Long-term (longitudinal) data (from input to output orientation!)
    - Some effects (teaching, whole school approach) only visible long-term + commpexity of interaction of many variables
  + Comparision of design/ form of intervention (involvement of students), compared to research that just looks at development through a year
  + Measuring relevance
    - Bottom-up approach thorugh students and teachers and their decision of what is relevant – backing up through empirical data
    - Interdisciplinary SC

Validation (through connection to established indicators)

* + - Conceptual examination
      * Newly developed measurement project and established ones
      * Campbell paradigm and the type of questions used! See Waltner p.213
      * For me: Validated through simililarity in questionnaires with validated „new“ measurement tool EWM?
    - Through other scale
      * Using other already validated scale
      * Competency differences which were assessed by mesaurement instrument could point toward differences between students
      * When using two scales (as I did, report r) 🡪 the two scales measure the same latent construct
    - Support for Campbell paradigm: attitudes can be derived from verbal acts and self-reports. Not necessary those specific ones, but could be any well-phrased ones 🡪 higher priority of specific objectivity within validation criteria for measurement in general
  + Validation through prediction of impact-relevant behaviour
    - Joining group as behavioral manifestation (in EWM case FFF participation)
    - Proxy for actual behaviour

Use joining group as actual behaviour in my case??

### Link to self-efficacy

* **What to measure and why? Individual and then collective behavior? (within framing of defining and measuring ESD outcomes?)**
  + **Why is it relevant to measure self-efficacy**
    - **Whole-institution**
    - **Better goal/ outcome (moral side) out education intervention(goal desirability)**
    - **Better predictor of behavior?**
    - **Importance of collective as well? Agencies!**
    - **To counteract negative climate emotions**
    - **Discussion: actual shift of power**
    - **Useful in terms of context sensitivity?**
    - **Method of project corresponds to recommendations methods Riess (importance feedback environment!)**

### Overview self-efficacy beliefs

### Self-efficacy as outcome

### Self-efficacy as validation

## Objectives and research questions

My aim is to quantify how ESD interventions influence students’ sustainability competences over time. Existing empirical data of a defined external ESD intervention project of climate attitudes and climate behaviour (Pauli, 2023) and the opportunity for continuous data collection allow for long term assessments of sustainability competences over time. Recent theoretical developments on self-efficacy beliefs provide a new possibility to enrich the measurements with these aspects. By integrating previous quantitative research from two schools with current, and theoretically comprehensive data collection at the same two schools, my analysis provides insights into the effectiveness of ESD projects in enabling human agency/ sustainability competences of high school students.

1. Blabla
   1. How do climate attitude and climate behaviour of students change over time (including one year after the end of a ESD intervention?
   2. How do climate attitude and behaviour respond to levels of involvement of the students?
2. BÖABÖÖ
   1. How do self-efficacy beliefs respond to levels of involvement of the students?
   2. How is climate attitude and behaviour influenced by self-efficacy beliefs?

+ overview?

## Research hypotheses and predictions

1. A graph with arrows pointing to a group

   Description automatically generatedPredictions

A diagram of a diagram

Description automatically generated **B)** Workflow