# 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 competencies which enable the learner to contribute to sustainable development through their competencies 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 ELIGIBILITY, impact and effectiveness of ESD is often questioned (Ssossé et al., 2021). SENTENCEC TRADE\_OFF AIM EDUCATION AND NEED FOR MEADUREMENT (The complexity of the educational process makes it challenging to define outcomes and measure success accurately). If the aim of ESD is to make real contribution to urgently needed changes in society, appropriate evidence-based recommendations are needed. When looking at the empirical data on the impact and outcome of ESD interventions within educational settings is very little. Disentangling the goals, methods and outcomes of ESD and establishing effective education without instrumentalising education is an urgent issue. Currently, we only have a limited quantitative understanding on how education, such as ESD interventions, influence the development of sustainability competencies over time on the micro-level. Despite the call for more encompassing test for measuring and operationalising ESD research, namely shifting form an input to an outcome orientation (Waltner et al., 2022), research has mostly focussed on “old” methods (BUGEN), and uncomprehensive dimensions (PAULI, ..?)// *actual changes in development of sustainability competencies that can contribute to real world change on students level*. *In this analysis, we focus on the school level of Education for Sustainable Development (ESD) measures. Though the students who are taught in our schools right now are not the decision-makers of today, they eventually will be the decision-makers of tomorrow.* Recent theoretical advances of sustainability competencies, such as the triple A framework of self-efficacy beliefs (SW), together with the opportunity to capture long-term empirical data (Pauli) in a quasi-experimental design allow us to quantitatively test ESD interventional effects on students’ sustainability competencies. Sustainability competencies measurement linked to effective ESD education can provide the information and educational design instructions needed for better educational policy making in the light of our rapidly changing Anthropocene.

## Theoretical and conceptual context

FROM CHAT GPT – in what way to include? Include SC here

Education for Sustainable Development (ESD) aims to empower individuals to contribute effectively to sustainable development by fostering critical engagement with societal complexities and contradictions. This educational approach, endorsed by UNESCO, is divided into two streams: ESD 1, an instrumental approach promoting specific sustainable behaviors as defined by experts, and ESD 2, an emancipatory approach that equips learners with the tools to critically evaluate and identify sustainable practices themselves (Vare & Scott, 2007; Wals, 2011). While ESD 1 focuses on measurable behaviour changes, ESD 2 emphasizes the development of competencies necessary for navigating and influencing complex, ambiguous issues. Both approaches can complement each other, particularly in educational settings where ESD 1's behavioural focus is justified due to the shared educational and parental responsibilities in schools (KMK, 2018). However, the emphasis in higher grade levels should be on ESD 2 to cultivate critical thinking and autonomous action (Rieckmann, 2021b). This shift aligns with the broader educational trend towards competency-based learning, which prioritizes skills and abilities over specific content knowledge, thus increasing the likelihood that students will internalize and apply sustainable practices (de Haan, 2006; Pant, 2016). Despite the widespread consensus on the importance of Education for Sustainable Development (ESD) for promoting sustainable development, the concept remains abstract and difficult to measure, with no universally agreed definition. The complexity of the educational process makes it challenging to define outcomes and measure success accurately. This complexity is evident in the ongoing debate surrounding ESD and other transformative educational approaches. ESD, as an intentional educational intervention, has the potential to challenge existing social, economic, and political systems that perpetuate injustice and inequalities, aligning it with critical pedagogy and interpretivist or constructivist epistemological paradigms (Liddy, 2011). Given the sensitive nature of education and educational research, studies (O’Flaherty*) recommend building a mixed methods research design and other interpretivist approaches which lends itself to the existence of multiple realities and experiences that may be viewed differently (Moustakas 1994) and allows for thick descriptions and complex nuanced findings (Dumas and Anderson 2014),* much of the research is still based on predominantly positivist epistemologies (O’flaherty), with quantitative measures, such as pre/post surveys being commonly used to assess educational interventions. Due to resource constraints, I also decided to choose a solely quantitative approach, thereby reflecting a positivist epistemology. NEED FOR MEASUREMENT OF ESD AS CONCLUDING SENTENCE

### Goals of ESD

Make importance measurement clearer here as well or above??  
NEED FOR GOALS TO CHECK AGAINST (THEN ALSO INCLUDE POTENTIAL OTHER GOALS FROM PROJECTS

Identifying effective means// Sustainability competences depend on the goals and objectives/ competencies (REFS). On an international stage, the goals are set by for example the Agenda 21. They provide a normatively well founded framework, but there is no operationalisation of the ESD output. On the local scales regional education plans exists, give example BaWü?. see, e.g., the definition of ESD on the local level: Education for Sustainable Development enables learners to make informed decisions and act responsibly for the protection of the environment and for a functioning economy and a just world society for current and future generations (Ministry of Education BadenWürttemberg, 2016, translated by the authors). Educational goals, which are personal characteristics to promote in learners, should include a normative test and an empirical test (UHL). Critical analyses of prominent ESD goal recommendations proposed sustainablity competences, as „cognitive abilities and skills as well as associated motivational, volitional, and social readiness needed to be able to solve sustainability-relevant problems and shape sustainable development in private, social, and institutional contexts. (WEINERT)”. Although some ESD learning goals exist, there is still a lack in terms of operationalisation of ESD output (RIESS/MISCHO) to be translated into measurement models and tools. Drawing on empirically verified measuring instruments and approaches from related disciplines, allows to integrate operatinalised facets of competencies into ESD context. As such, ESD learning goals need to be structured and related to each other. One prominent framework is the tripartite frame-model for sustainability competencies (RIESS) which comprise of cognitive, affective motivational and the behavioural aspects (e.g., Rieckmann, 2018; Waltner et  al., 2019). DESCRIBE EACH DIMENSION BRIEFLY HERE. The framework has the advantages of including the behavioral dimensions (Lambrecht et al), being adaptable to different contexts and counteracts criticisms of the dominance of cognitive dimensions. Thus, to **measure/foster** sustainability competencies and identify effective means, it is important to understand changes on the goal dimensions of cognitive, affective motivational and behavioral aspects //use the tripartite frame model as goals and objectives.// // Goal of ESD are SC with goal dimensions x/y/z. When aiming to measure SC, it makes sense to countercheck against the goal competencies in the sustainability specific dimensions of knowledge, behaviour, and attitude.

### Operationalisation ESD output

TALK ABOUT INDICATORS FIRST

*Research offers many possibilities for mapping the goal dimensions of ESD. For empirical measurement, the competencies must be defined with sufficient precision. Such a specification allows, in principle, the operationalization of the competency of interest in an appropriate measurement procedure (see Klieme & Hartig, 2007). There is still a need for developing adequate measurement instruments for the various dimensions of SC. Connecting ESD research to well-established measurement procedures facilitates the integration of already operationalized facets of competencies (e.g., environmental attitude) into the larger construct of SCs (sustainability competencies). Some operationalization approaches in the field of ESD exist for specific regions, applying mainly qualitative methods (for example [*[***13***](https://www.mdpi.com/2071-1050/11/6/1717#B13-sustainability-11-01717)*]).* When considering related disciplines, for each of the three goal dimensions examples of measuring approaches exist (REF), for example in the cognitive dimensions of sustainability knowledge (REF) 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)., the Greenpeace Sustainabiltiy Barometer for the affective motivational domain, General Ecological Behavior Scale for behavioral dimension. Recent research has tried to combine these scales and adapt them to school context.

At the same time, the question remains in how far the indicators can capture the ultimate normative goal of ESD: the actual development of a more sustainable society through sustainable behaviour (see also local definition!). *Theories of action from the field of psychology are based on the basic assumption that various forms of knowledge and motivational factors (including subjective and social norms, attributions of responsibility) can interact and lead first to the formation of behavioral intentions and then to behavior that is relevant to sustainability [*[***46***](https://www.mdpi.com/2071-1050/14/7/3708#B46-sustainability-14-03708)*] In addition to these internal factors, external conditions (e.g., behavioral offers, situational conditions, social norms, and lifestyle of the social environment) also influence sustainability-relevant behavior. Thus, by promoting knowledge and motivational orientations, in turn, the desired behavior can also be promoted. Nevertheless, research has repeatedly demonstrated a considerable gap between knowledge, motivational orientations, and actual sustainability-promoting behavior [*[***47***](https://www.mdpi.com/2071-1050/14/7/3708#B47-sustainability-14-03708)*].* Especially, when looking at the cognitive goal dimension, sustainability knowledge is found to be positively related to sustainability attitudes Arcury, 1990)., but the behavioral prediction is quite low (Fricke 2004). Knowledge can be considered as a more indirect predictor of behaviour, as a basis, but it is missing the relevant motivational factors. The often cited knowledge-behviour gap. *In this regard, Kagawa states that “[t]here are multiple factors which influence the process of behavioral change and further investigation of dissonance between students’ perception of sustainability and their individual actions needs to be explored” [*[***106***](https://www.mdpi.com/2071-1050/11/6/1717#B106-sustainability-11-01717)*]. See, for example, research on the attitude–behavior gap [*[***103***](https://www.mdpi.com/2071-1050/11/6/1717#B103-sustainability-11-01717)*,*[***107***](https://www.mdpi.com/2071-1050/11/6/1717#B107-sustainability-11-01717)*,*[***108***](https://www.mdpi.com/2071-1050/11/6/1717#B108-sustainability-11-01717)*] or cognitive dissonance [*[***109***](https://www.mdpi.com/2071-1050/11/6/1717#B109-sustainability-11-01717)*,*[***110***](https://www.mdpi.com/2071-1050/11/6/1717#B110-sustainability-11-01717)*]*. *Accordingly, for the affective-motivational and behavioral dimension, a very close connection has been proven by various studies. Affective goal commitment or a positively valued sequence of actions is the core of every motivation. An action is not carried out if the costs are perceived as too high when compared to the affective goal commitment. This attitudecost relationship is modeled in the Campbell paradigm (Kaiser et al., 2010), which implies a solid link between a person’s attitudes and his or her behavior. Consequently, in the framework of the Campbell paradigm, behavioral self-reports are used as indicators for a person’s attitudes.* PUT EXAMPLES INDICATORS HERE (SEE APPLICATION OPERATIONALISATION). When operationalising the SC most relevant to real-world behaviour, the dimensions of sustainability attitude and self-reported sustainability behaviour are the most relevant.

Campbells paradigm vs TPB?

Make critiques more explicit (e.g. include critique specific behaviours here?)

Sustainability competencies as behaviour is bringing up the question on underlying theories of behaviour. Empirically, some of the most often used models for sustainability relevant behaviour were the theory of planned behaviour (TPB) and the NAM (Bamberg, Möser, 2007; Sopha 2011, Klöckner 2013). The TPB is also one of the most prominent approaches from the from-within side (ertz, 2016). *Intention and perceived behavioural control (PBC) are seen as direct determinants of behaviour (Ajzen, 1991, p. 184). Intention, in turn, is also influenced by the PCB, but also by two other factors. Firstly, the attitude towards the behaviour in question and secondly, subjective norms have an effect on behavioural intention (ibid., p. 188). Behind these determinants are beliefs or convictions that relate to behaviour, norms and control (ibid., p. 189). TPB being a rational choice theory, the focus here is on the self-interest of the person, who weighs up what consequences the action will have for them (Kaiser et al., 2006, p. 2151). Kaiser et al. tested the explanatory power of the TPB for pro-environmental behaviour (2006, p. 2160). According to this study, the three "[...] determinants, attitude [...], subjective norms [...] and perceived behavioural control [...] explain 76% of the variance in behavioural intention" (ibid.), while these in turn explain "[...] 95% of the variance in a person's environmental protection behaviour" (ibid.). However, in a meta-analysis by Armitage and Conner, this average is significantly lower at 27% variance clarification (Armitage & Conner, 2001, p. 471). On the downside, the directions of effect between attitudes, subjective norms and perceived behavioural control remain incompletely identified in the TPB (Kaiser et al., 2006, p. 2165).* Furthermore, it is critiqued for the focus on internal factors, such as knowledge and attitudes and comes short in considering structural barriers, power relations and inequalities, that pose systemic barriers to an individual (Bamberg, 2021), as well as moral and normative considerations (Kaiser, 2006). *With regard to the link between the operationalised goal dimensions of sustainability attitude/ affective-motivational and sustainability behavioural dimensions, the attitudes and subjective norms can be assigned to the affective dimensions, while PBC and intentions represent motivational aspects (Weber, 2008). For the operationalisation in the context of this study, (due to previously existing data) the TPB was used. The Theory of Planned Behavior, which predicts behaviour by capturing four variables, is used for operationalisation. The four variables on the first and second causal levels are summarised here as climate attitude/ affective-motivational dimensions.* Therefore, sustainability competences and the dimensions of climate attitude and climate behaviour can be operationalised with the components of the theory of planned behaviour.

Within the Campbell paradigm, a person’s attitude becomes transparent in the amount of behavioral cost said person is willing to overcome in order to pursue their goal (Byrka et al., 2017). So far, research on people’s attitudes toward the environment has demonstrated that the Campbell paradigm – and thus its conceptual account of individual behavior  – holds true for approximately 95% of the people in a given society (Kaiser et  al., 2014). For more information about the derivation of attitudes from various types of manifest indicators attitudes (e.g., evaluative verbal statements and behavioral selfreports), see Kaiser and Wilson (2019).

### Methods operationalisation/ Adequate methods

Operationalised sustainability competencies and their attribution to an ESD intervention can be assessed using different methods. Generally speaking, there is little empirical data (REFS). *Methodologically quantitative research projects can make a very important contribution to the normative debate, through empirical insights.* *The exemplary outcome indicators shown in this study, with the longitudinal data at the level of the pupils, provide ESD stakeholders with a useful information base (cf. e.g., DIPF, 2007; Oekes, 1989).* (ESD stakeholders also including teachers) Importance of not only referring to plausible and normative considerations and assumptions). *Some effects of the educational measures (e.g., teaching, whole institutional approach) might only be empirically verifiable in the long term or in general not clearly be attributable to a specific measure, due to the complexity of the interaction of many variables affecting, for example, sustainability awareness. These considerations show that when shifting the attention from the Input to the Output orientation of ESD measures, we might need more long-term assessments and additional method orientations to evaluate the impact. Until now, empirical data on the long- as well as the short-term impact of ESD initiatives within educational settings is scarce.*

EXISTING MITMATCH BETWEEN RECOMMENDED ESD LEARNING METHODS AND EMPIRICAL RESEARCH  
The existence of empirical data is limited to certain types of learning/teaching methods of ESD. While there is a big call for alternative and innovative methods for conducting ESD, especially their effectiveness is not evidenced empirically. So far innovative ESD intervention’ studies only/mostly comprise of results of studies in form of self-reports, self-assessments and expert surveys (REF MONI), which are non-experimental research methods. *In contrast to the non-experimental research methods stated above, quasi-experimental studies can be used for testing hypotheses and thus provide evidence for the effectiveness of methods.* So far these robust scientific methods have only been used for ESD intervention methods with a high degree of guidance by the teacher*. In addition, the validity of quasi-experiments can also be increased with experimental control (e.g., pre–post or control-group test design, two or more treatment groups, control of possible confounding variables, and documentation of the reliability of the measuring instruments) [*[***38***](https://www.mdpi.com/2071-1050/14/7/3708#B38-sustainability-14-03708)*].* Based on the lack of empirical data, no concluding statements about the “best” teaching/learning methods can be made yet, recommendations exist from the empirical educational and teaching research. To promote motivational/attitudes*, role playing, simulation games, learning from models (observation and imitation learning), value clarification, projects and internships in contexts relevant to sustainability, and the formation of student parliaments in which the learners participate in decisions on matters relevant to sustainability are recommended.*  Methods for promoting behavioural readiness?. Given the mismatch of unevidenced-based recommendations of type of ESD interventions with sound methods and availablitliy of research, empirically and quantitatively measuring innovative ESD methods, with quasi-experimental design (which allows for contribution to intervention through control group) is highly needed.

NECESSARY? WHERE TO PUT? INTEGRATE WITH PARAGRAPH BEFORE  
Empirical findings on CHANGES of climate attitude and climate behavioural change with ESD methods. Promoting personal characteristics with high affective–motivational components, such as attitudes toward sustainable development and intergenerational justice, requires methods that can effectively engage complex human traits. Despite the inherent stability and resistance to change in attitudes, integrating principles from general motivation and social psychology may prove beneficial. Techniques like inducing cognitive conflicts, role-playing, simulation games, and experiential learning activities including projects and internships in sustainability contexts, have shown potential in enhancing motivation and altering attitudes. These methods facilitate deeper engagement with different perspectives and arguments, essential for fostering sustainable behaviours. Additionally, supporting the intrinsic motivation of students by enabling experiences of competence, autonomy, and social connectedness, such as choosing between different types of food in a school cafeteria and engaging in group learning, can significantly enhance the effectiveness of these educational strategies [Mischo, 2004; Deci & Ryan, 2008]. Promoting sustainability-relevant behaviours necessitates a multifaceted approach that addresses both internal and external factors influencing individual actions. Psychological theories of action suggest that a mix of knowledge, motivational factors, subjective and social norms, and attributions of responsibility can lead to the formation of behavioural intentions and ultimately drive actual behaviour. However, despite the availability of knowledge and motivational orientations, there is often a significant gap between these elements and the manifestation of behaviours that promote sustainability. To bridge this gap, methods from volitional psychology are recommended. These methods include making individuals aware of and challenging their guiding assumptions and beliefs, forming concrete action plans, encouraging self-commitment, visualizing the outcomes of actions, and using reminders. In educational settings, teachers play a crucial role in promoting behavioural readiness by raising awareness about students' subjective theories and fostering self-efficacy, thereby enabling students to see the impact of their actions and motivating them to commit to sustainable practices.

Measuring outcome changes of SC requires validity criteria to *ensure that the measurement instruments capture the achievement of the goals - in our case, the competencies which enable the learners (among other things) to contribute to real-world change.* Ideally, one would obtain observational data, to see whether actual behaviour changed. In reality, self-reports are more frequently used, as they are easier to obtain, especially in large quantities and they also allow for a broader assessment of different behaviours (REF EWM). The challenge is, that there is gap between self-reported and objective behaviour. To overcome this, measurement indicators have to be be validated with real-life behaviour outcomes. One reason for the gap could be the answer of socially-desirable answers (REF). There are different options to perform scale validations. One option would be to perform an ad hoc scale validation, comparing the items used in this study, to well-established measurement instruments which have been tested to be predictive of real-world behaviour. Another option would be to validate using a criterion outside the measurement process (Whitley, 1977), that is regarded as a valid proxy for actual behaviour, using a simple dichotomous way ((e.g., Kaiser et  al., 2003; Kormos & Gifford, 2014). Regarding the first option using an already validated scale: an interesting option is to compare the TPB-based scale to one that is based on self-efficacy beliefs. By doing that, and there is high correlation, one could deduce, that they are measuring the same latent construct.

The newly developed triple A framework of self-efficacy beliefs complement the TPB-based scales in terms of its predictive power for behaviour and behavioural intentions. Given the higher degree of ability to differentiating different relevant aspects of self-efficacy that go beyond the somewhat fuzzy aspect within the TPB of perceived behaviour control, one study found that the TPB could benefit from applying aspects of the Triple A framework in terms of their explanatory power ([*Bamberg et al. (2015*](https://journals.sagepub.com/doi/10.1177/10888683231178056#bibr24-10888683231178056)*, see also*[*Huijts et al., 2013*](https://journals.sagepub.com/doi/10.1177/10888683231178056#bibr166-10888683231178056)*).* The triple A framework with its high degree of differentiation broadens the possibility of assessing different behavioural outcomes.

### Self-efficacy as desired Sustainability Competencies outcomes

When using self-efficacy as potential validation, it is also interesting to look at other aspects of the framework and its potential contributions to measure Sustainability competences. Self-efficacy beliefs can be defined as *belief in ones capabilities to organise and execute the courses of action required to produce given attainments (FIND BETTER ONE?).* Self-efficacy beliefs as Sustainablity competencies can complement by adressing several critique of the TPB. Firstly, Self-efficacy goes beyond the internal focus and inherently incorporates the outside factors as well, with a higher self-efficacy only emerging, if the person believes that they can actually change something. Secondly, as Triple A does not necessarily ask for specific behaviours, but more on meta-level whether the agent thinks that they can achieve their self-chosen goal, it is a nice way around the instrumentalising vs emancipatory debate of ESD. Furthermore, corresponds to recommendation methods, *to promote changes in behaviour, teachers at schools and universities should raise awareness (and problematize) their students’ action-guiding ideas and assumptions (subjective theories) and foster their self-efficacy so that they believe their actions have an effect (RIESS),* meaning desirable outcome of education to make students feel like they can actually have an impact*.* This could also address the issue of reported negative climate emotions, where problems are brought up to students, but no way of responding to that, leading to negative emotions and demotivation (SEE REF??).

Sustainability competence measurement can benefit from a high degree of differentiation based on the new theoretical development of the triple A framework of self-efficacy beliefs. The Triple-A Framework offers a structured approach to enhance the somewhat fragmented field of self-efficacy research, particularly in the context of collective social and ecological aims. This framework is essential for addressing social and ecological crises more effectively through understanding how individuals and collectives can experience more self-efficacy. the framework builds on the foundational theories of self-efficacy, including Bandura, Ellen Skinner's, and Turner et al. and is structured around three core components—agents, action, and aims. The “self-categorised agent” can be an individual (personal self) or a collective group (an ingroup), where the group is part of an individual’s self-concept influenced by social and emotional group memberships. The distinction allows for the exploration of both personal and collective efficacy. *Individuals can flexibly shift from categorising themselves as individuals to members of groups (Coking, Fritsche, Tajfel) (different social identity underlying)*. The agentic aspect signals the possibility of being able to affect changes. The second aspect of the framework, intentional action, highlights that self-efficacy involves deliberate, measurable actions aimed at achieving specific outcomes. These actions are defined not just by their intentionality but also by their self-determined nature, the level of abstraction, and their content. This component underscores the proactive nature of self-efficacy in influencing and altering ecological and social conditions. Finally, the Triple-A framework focuses on the aims, which are cognitive representations of desired outcomes, whether personal or collective. Aims are essential as they direct attention, motivate, and foster persistence and skill development (LOCKE, Iathtam 2002). The framework stresses the bidirectional influence between self-efficacy and aims, where efficacy perceptions influence the selection of aims, and conversely, the nature of these aims affects the development and sustenance of self-efficacy beliefs. This highlights also the importance of the desirability of the aim. Overall, the Triple-A framework not only clarifies the structure of self-efficacy beliefs but also enriches the theoretical discourse by distinguishing the three self-efficacy links (agent-action, agent-action-aim, agent-aim), explicitly to both personal and collective contexts. This approach promises to advance the practical application of self-efficacy theory in addressing broader social and ecological challenges, emphasizing the interconnectedness of beliefs, actions, and objectives in achieving sustainable change.

**Collective vs individual self-efficacy**

FROM CHATGPT – check for sources and plagiat! And bring in more structure, incorporate other parts from chatgpt, sort out empirical findings and bring into discussion?

Explain wording individual and collective self-efficacy here!

Structure?

* In world we need collective action
* Individual private behaviour, collective activism
* Other links not yet understood
* Little research shows path form collective to individual
* Importance self-categorisation and fluent between self and groups?

Add how collective efficacy could be built? Refer back to design of innovative ESD method

FROM CHAT GPT CHECK

Sustainability competences are not only dependent on the individual. In 1997, Albert Bandura already described a collective sense of powerlessness in an increasingly interdependent world and claimed that there is a growing need for not just individual but also collective agents in the face of multiple crises. Many people do not act together against climate change or social inequalities because they feel they or their group cannot make a difference. Understanding how people come to feel that they can achieve something (a perception of self-efficacy) is therefore crucial for motivating people to act together for a better world. The nature of the ecological and social crisis also demands collective action. EXPAND HERE. Correlational studies have found individual self-efficacy to predict private behaviours and collective efficacy to predict activist behaviour (Hamann & Reese, 2020; Morton et al., 2011). Although the pathways and interlinkages between individual and collective self-efficacy beliefs are not yet fully understood, research can contribute to practical interventions based on this differentiation. Some research suggest a path from collective to individual self-efficacy to private behaviour, (Jugert et al. (2016), although not causally replicable yet. Experimental studies suggest that ingroup efficacy interventions outperform personal self-efficacy interventions in influencing actions (Jugert et al., 2016). Research could focus on which ingroup efficacy agents are more or less important in specific social and ecological crises, informed by social identity theory (Tajfel, 1978), which characterizes various ingroup efficacy agents. Given that collective efficacy was found to be a better predictor of pro-environmental behaviour than self-efficacy (M-F Chen, 2015), incorporating collective self-efficacy beliefs as an outcome indicator in measuring sustainability competencies could be highly beneficial. This comprehensive understanding, supported by the Triple-A framework, can provide nuanced research insights and practical advice, enhancing the impact of ESD interventions and promoting sustainable behaviours at both individual and collective levels. SC CAN BENEFIT FROM INCORPORATING COLLECTIVE SELF-EFFICACY AS OUTCOME GOAL.

BASED ON WHAT? *Enhancing group identity and cohesion through activities that build a strong sense of belonging and shared purpose can significantly boost collective efficacy. Providing opportunities for groups to experience success in smaller, manageable tasks can build confidence in their collective capabilities. Effective leadership and clear, achievable goals also play a crucial role, as they help guide the group and provide direction. Ensuring that the group has access to necessary resources and support systems, including financial resources, information, and external support, can further enhance their collective efficacy. Additionally, offering constructive feedback and opportunities for reflection on past performances can help groups understand their strengths and areas for improvement.*

INTRO? Other studies have found reciprocal reinforcement of individual and collective self-efficacy beliefs. individuals can derive personal benefits (e.g., self-efficacy beliefs) from social groups because groups can make them feel personally capable and in control [[**31**](https://www.mdpi.com/2071-1050/9/2/200#B31-sustainability-09-00200),[**32**](https://www.mdpi.com/2071-1050/9/2/200#B32-sustainability-09-00200)]). In fact, Jugert et al. [[**12**](https://www.mdpi.com/2071-1050/9/2/200#B12-sustainability-09-00200)] could show that through collective efficacy, individuals came to feel in control of their outcomes: People’s intention to act was enhanced through providing a sense of efficacy transferred from the group to the self. Similarly, using a qualitative research approach, Cocking and Drury [[**11**](https://www.mdpi.com/2071-1050/9/2/200#B11-sustainability-09-00200)] found that collective efficacy led to a feeling of personal empowerment. Thus, with collective and self-efficacy being strong and closely intertwined predictors of pro-environmental action.

Furthermore, *through specific collective and self-efficacy perceptions, sustainable intentions were gauged—even when controlling for attitudes and social norms, suggesting collective efficacy beliefs to be particularly relevant for attaining environmental goals (REESE, JUNGE).*

*However, for research on spillover effects (for a review, see [47]), it is helpful to know that task difficulty of a topic-specific challenge (as in our case, a plastic reduction task) can also increase general collective efficacy beliefs that might in turn enhance pro-environmental behaviour in other domains—a finding in line with [26], who show that self-efficacy beliefs mediate between less difficult and more difficult behaviours. Our findings nicely complement this research, suggesting that such spill-over can also be mediated via collective efficacy beliefs*

For example, collective efficacy beliefs were more strongly connected to environmentally sustainable travel choices than self-efficacy beliefs (Homburg & Stolberg, 2006). These authors also showed environmental collective efficacy beliefs to be a stronger predictor of people's willingness to pay for environmental protection than self-efficacy and attitudes. Morton and colleagues assessed collective efficacy as an individual’s perception of their group's efficacy in mitigating climate change, finding it a significant predictor of private-sphere environmental actions (Morton et al., 2011).

Understanding these dynamics is essential for designing effective campaigns, making informed political decisions, and building cohesive teams working against social and ecological injustice.

**Aim vs action**

FROM CHAT GPT, check for sources and plagiat! And bring in more structure, incorporate other parts from chatgpt, sort out empirical findings and bring into discussion?

Structure – change order? Check also other paragraph from chatpgt

The relationship between action- and aim-focused self-efficacy is complex and interdependent. Action-focused self-efficacy refers to the belief in one's ability to perform specific actions, while aim-focused self-efficacy pertains to the belief in one's ability to achieve desired outcomes. These two facets are interconnected; effective actions often lead to the attainment of aims, and the belief in achieving aims can motivate individuals to perform necessary actions. For example, someone with high action-focused self-efficacy in environmental behaviors (like using public transport) may also develop high aim-focused self-efficacy in achieving broader environmental goals (like reducing carbon footprint). The Triple-A Framework integrates these concepts, suggesting that efficacy beliefs should consider both the actions and the aims to provide a comprehensive understanding of how individuals and groups approach and solve complex social and ecological issues.

Differentiating action- and aim-focused self-efficacy beliefs is interesting and relevant because it provides a clearer understanding of how beliefs about personal and collective capabilities translate into behaviour and goal attainment. Changes in sustainability competencies, particularly self-efficacy beliefs, are dependent on feedback from the environment. The Triple-A Framework allows for a distinction between action and aim-focused self-efficacy links, with agent-action self-efficacy being more connected to actual behavioural costs, socioeconomic circumstances, and impactful behaviour, while agent-aim self-efficacy is more closely related to attitudes, goals, visions, and intentional behaviour (Bain et al., 2013; Bamberg & Rees, 2015). Perceived behavioural control in the theory of planned behaviour (Ajzen, 1991) predicts intention and moderates intention-outcome relations, suggesting that action-focused self-efficacy might function similarly by capturing constraints like time, money, or social resources that may prevent intention follow-through. In contrast, aim-focused self-efficacy is more involved in intention formation and less influenced by these constraints. The field of collective social and ecological aims is especially prone to an aim-focused understanding of self-efficacy due to the complex nature of collective crises (Zomeren, 2019). For collective aims, the challenge lies not in performing actions (e.g., going to a protest) but in achieving social change through these actions. Given the fact that to achieve an ecological or social aim, many actions are possible, but potentially also not successful, recognising the looser action-aim contingencies, emphasises the importance of distinguishing between action- and aim-focused self-efficacy. Individuals have limited control over collective outcomes, with many barriers stemming from external factors and the actions of others (Hornsey et al., 2021; Jugert et al., 2016). Feedback is harder to obtain as aims are often distal (e.g., the impact of an awareness campaign on public opinion). IMORTANCE AIM CONTENT. Hornsey et al. (2006) found that, depending on aim content, self-efficacy predicted action intentions differently among protest group members and non-members. Studies that included diverse aims in their efficacy measures revealed that ignoring aim content could lead to incoherent findings and obscure underlying principles (Koletsou & Mancy, 2011). The desirability of an aim is crucial; if an aim is not desirable, self-efficacy measures may trigger defensiveness and only reflect the value of the aim (Castiglione, 2021). By acknowledging the desirability of aims and the flexibility of self-categorization (individual vs. collective), this framework helps in creating a cohesive approach to studying and enhancing self-efficacy in various contexts. Measuring sustainability changes on both action- and aim-focused levels allows for a greater understanding of the influence of external and structural factors on behaviour.

## Objectives and research questions

My aim is to quantify how ESD interventions influence students’ sustainability competences over time. Existing empirical data of innovative 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 competencies 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 competencies of high school students.

* 1. How do sustainability attitude and sustainability behaviour of students change over time (including one year after the end of a ESD intervention) and level of involvement?
  2. How is sustainability attitude and sustainability behaviour influenced by self-efficacy beliefs?
  3. How do individual and collective self-efficacy beliefs (aim-and action-focussed) respond to levels of involvement of the students?

+ overview?

*In order to answer these questions, we resorted, as described above, to existing measuring instruments for the assessment of sustainably significant attitudes, behavioral readiness, to solve partial problems of sustainable development. Finally, items on such facets of sustainability competencies for which we could not find any operationalization in the literature were newly formulated. In the following section, the procedure of the construction of the test and novel data of the results from the first assessment period will be reported. In so doing, we will also investigate whether the test adequately meets important quality criteria of a quantitative measuring instrument. In the discussion of the results, we want to explore the opportunities and limits for the further development of ESD, arising from the use of appropriate assessment instruments.*

## Research hypotheses and predictions

1. Predictions

A diagram of a recycle and a recycle symbol

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**B)** Workflow

A diagram of a diagram

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Figure XX: **Influence of an innovative ESD intervention on changes in sustainability competencies.** I tested how an innovative ESD intervention can influence the sustainability attitude, sustainability behaviour, and self-efficacy beliefs of high school students at three different time points of the intervention: before the start (t0), straight after the completion of the intervention (t1), and one year after the end of the intervention (t2), comparing an involved group to a control group. **A** Conceptual diagram of my predictions, outlined with respect to sustainability attitude, sustainability behaviour, and self-efficacy beliefs. **B** Analytical workflow.