# Discussion

## Overview

My analysis of XXXX self-reported surveys demonstrates complex heterogeneity of the influence of an innovative ESD intervention on changes of sustainability competencies. Contrary to my predictions, I revealed that one year after the end of the intervention, sustainability attitude and behaviour did not increase (Figure XX) FOR INVOLVED GROUP, suggesting a rejection of my alternative hypothesis of a positive relationship. This highlights the importance of long-term empirical data collection when analysing the effects of ESD interventions. Simultaneously, in line with my predictions, I demonstrated that the involvement of the students (n= 7) led to overall higher SA and SB, for SB (??) even one year after the intervention (Figure XX), highlighting the positive effect of innovative ESD interventions on changes of sustainability competencies. Careful considerations in terms of the generality of the results should be made, due to the very low sample size (n=7) of involved students. I found a strong positive relationship between the sustainability attitude and sustainability behaviour with the underlying construct of the theory of planned behaviour and the sustainability competences based on the underlying construct of (individual) self-efficacy beliefs (Figure XX), pointing towards the reciprocal validation of both scales to capture the same latent constructs of sustainability competencies and their usefulness (RELATED TO BEHAVIOUR?). I uncovered no differences between individual and collective self-efficacy beliefs within and between the involved and the control group (Figure XX), HIGHLIGHTING THE NEED FOR INTEGRATION OF COLLECTIVE SELF-EFFICACY AS GOALS IN ESD INTERVENTION. In line with my predictions, I found that the involved students reported higher aim focussed self-efficacy beliefs (Figure XX), indicating the stabilisation of the formation of intentions and at the same time highlighting the importance of also considering outside barriers. *The lack of sufficient data prevented me from to answer my original questions of comparing the outcomes to a participative group as well, which highlights the challenges of collecting comprehensive data in a school context.* Measuring the outcome of ESD interventions requires many considerations and trade-offs - by using a quantitative, long-term, outcome-focussed approach, I uncovered heterogenous responses in sustainability competencies changes, challenging the assumption that innovative ESD interventions have real behavioural impacts or the assumption of their measurability.

**Summary of most relevant critiques and what they mean related to results**

Paragraphs about downsides measurement method, reflecting back to introduction, how I addressed them linking back to own methods/results/findings!

Order of paragraphs?

Following paragraph: critique operationalisation goals and types of competencies?

Sustainability competencies measurement have been criticised for various reasons with important implications for the interpretation of the results. HERE OR LIMITATIONS*? While this research can add to a more comprehensive understanding of sustainability competences, their continuous development, as well as possibilities of measurement, the interpretation of the outcomes of this research needs to be treated with caution. The generalisability of the findings are heavily impaired by the lack of data availability.* END The question remains how ESD and the outcomes are most appropriately operationalised, including the goals behind. *The presented method and instrument for operationalization of sustainability competencies picks up core competencies for students to enable them to shape a sustainable future. However, when dealing with competency models, this concurrently raises general questions about the possibilities of evaluation, definition and the seemingly antithetical need of openness of the ESD concept in order to stay adaptable to sustainability related challenges in the future. As Wals et al. conclude, “[t]he main point is that there is no single model of education and learning for environmental sustainability, nor should there be” [*[***112***](https://www.mdpi.com/2071-1050/11/6/1717#B112-sustainability-11-01717)*]. The conception of an adaptive and flexible concept of ESD, nevertheless, should not hinder our duty in the field of empirical research to create evidence via research programs, to verify if the undertaken programs of ESD show (the wanted) outcomes. We still argue that a focus on the ESD effects and learning outcomes is highly necessary to evaluate and improve the measures taken to enable learners to shape a sustainable future. Only if these further steps are taken can the compatibility of ESD with empirical research programs be guaranteed, and hence, its success be assessed.* This fact is even emphasized, when differentiating between ESD1 (instrumental) and ESD 2 (emancipatory) approach, where latter could be argues to be more about the process, than the outcome. Similarly, the discussion should continue, whether behavioural change should be the outcome of this study (REFS WHERE FROM AND WITH WHAT ARGUMENTS?), given the complexity of behaviour, its multitude of influences, including factors outside the individual, especially for young people. Adding to the not answerable question of goals of ESD, project-specific goals also play an important role of this ESD intervention. In the KRS project, democracy education is also explicitly stated, which on the one hand could also be considered within the ESD framework (and also a good example of ESD2 approach), but with the current approach focussing on sustainability friendly attitudes and behaviour is not really captured. I tried to address some of the criticism by incorporating the dimension of self-efficacy beliefs as an outcome indicator. With the new Triple A framework of self-efficacy beliefs, I tried to partly address those challenges, as the limited empirical research points towards better prediction of real-world behaviour. Furthermore, the addition of the indicator for collective efficacy seems relevant as an outcome indicator. Addressing part of the critique about non-instrumental ESD, not specific behavioural focussed outcomes (*While behavioural change is an important indicator, it should be complemented by other measures that capture the complexity of human motivations and the broader educational goals of fostering critical thinking, empowerment, and intrinsic motivation. This comprehensive approach ensures that interventions not only change behaviour but also cultivate the underlying values and beliefs necessary for sustained and meaningful engagement with sustainability issues.)*, and incorporating the aspects of deciding on desirability of aim by the agent itself. While the empirical findings regarding changes in sustainability competencies of my research are to be considered cautiously due to impaired data availability, I still believe that my research can add to the ongoing debates on finding suitable indicators for sustainability competencies by including self-efficacy beliefs of students.

Checking for real impact and shift of powers 🡪 impact-focussed research (Nielsen et al 21)// Interesting, whether real lief outcomes for individuals and society (REF Kurz und Kubeck , 2021) 🡪 here or later with collective efficacy?

Following paragraph: critique global vs regional indicators

Another big discussion within the field of ESD measurement and research is the context variability. Behavioural outcomes can vary significantly across different contexts and cultures. An intervention that promotes sustainable behaviour in one setting might not have the same effect in another due to varying social norms, economic conditions, and cultural values. This variability challenges the universality of behaviour-focused outcomes. When using indicators, there is an inherent trade-off between wanting to achieve a global scope, to allow for comparisions, contradicting the need for context-specificity. Given the resource limitations and the scope of this study, I did not research beyond the western perspective. All of the underlying theories stem from a western context and so does most of the empirical research of cited studies. Given western dominance in research, caution should be paid to global claim of the indicators and their relevance in different (also non-western contexts). Within the limited context of a western, given the Freiburg context wealthy, and private school, *I tried to validate the ESD outcome measures through the use of a second scale, yet they still remain a mere proxy for reality.* A very first step I see to try and overcome western hegemony in research is to state the own positionality and set the research in the context, which I tried to do here. Furthermore, considering context-specificity I would argue that the TPB-based scale used (built on the work on Pauli, 23) has limited fit for young people and students, as many of the questions used are neither age-appropriate, not necessarily in the hands of the students, especially the behavioural intentions ones (e.g. I support an in-crease in fuel taxes to reduce fossil fuel consumption OR I mainly drive or am driven by a car or a motor-scooter.). Furthermore, the challenge remains to try and exclude the social desirability of the results as much as possible. For young people, there is scientific agreement, of the magnitude of influence of the media, which is not considered here. In terms of using indicators for young people and students, better alternatives, than the one here used exist, for example in the project ProBiKlima. Qualitative methods of ESD research could start to address these challenges, by also integrating different research fields, such as environmental psychology, environmental sociology, science teaching, and empirical educational sciences. Especially, in this study, with its western background, only tested at one school, questionable fittingness to students, the scalability of the results is seriously questioned.

## Sustainability competencies as sustainability attitude and sustainability behaviour (TPB-based) ~~over time and level of involvement~~ (Research Question 1a)

Contrary to my prediction, I found that sustainability attitude and sustainability behaviour did not increase one year after the ESD intervention (Figure XX). I did find a peak at the second point of measurement (straight after the ESD intervention) for the involved group, being significantly higher for both SA and SB (Figure XX). These difference of SB with significant higher scores for the involved group was constant even one year after the ESD intervention (Figure XX). At the same time SB was reported even significantly higher at the first point of measurement (before the start of the ESD intervention), raising the question of attribution of changes of SC to the ESD intervention (Figure XX). The observed findings could be due to various reasons.

Split into over time and level of involvement?  
currently, only limited understanding of, determining coincidence could be that..

Firstly, as discussed before, the design of SC measurement plays a crucial role. To allow for long-term data collection, I used a scale developed for a master thesis by Pauli, 2023 based on the theory of planned behaviour in order to capture sustainability attitudes and sustainability behaviour. Although Pauli, tried to partly adjust the scale to students, better age-appropriate measurement tools for students exist (ProBiKlima). Furthermore, the goals of the project were only partly aimed at enhancing students’ competencies toward attitudes and behaviours. Rather the focus was also on enhancing democracy education KRS). As the scales I used did not capture these dimensions at all, it becomes difficult to make statements about attributing changes of the ESD intervention to changes in SA and SB. Both these factors could explain the lack of increase in SA and SB for the involved group one year after the ESD intervention. When looking at the effectiveness of other ESD interventions, a meta study from 2021 has found: *Results found in studies demonstrate that ESD has brought about encouraging outcomes in students, including greater environmental sensitivity [71], a reconsidering of preconceptions [78], an improved ability to solve complex problems related to the environment [75], a greater likelihood of naming environmental issues as personal concerns [73] and a relative maintenance of the new positive practices acquired [76]. (SOSSE),* while also addressing the challenges of measuring SC impact*, including focusing mainly on small groups and being difficult to compare*. They highlight the need for quasi-experimental measurement, In order to confirm the more positive results, the literature agrees on the need for long-term longitudinal impact studies, taking into account other types of concrete ESD results that can be realized in a sometimes more distant horizon than what current studies can cover (activism in particular). Little or none quantitative empirical research exists on the effectiveness of innovative ESD interventions, as the KRS project was. This highlights that sustainability competencies measurement can benefit from using empirical, long-term data.   
INCLUDE FINDINGS OF SHORT TERM PROJECTS HERE? AND THEN LITERATURE NEED FOR LONG TERM

When considering other long-term empirical research (unrelated to a specific ESD intervention), these could explain the control group. **Detecting differences between control group and involved group, this could point towards actual effectiveness.** Recent long-term data (without ESD intervention, but based on inclusion of ESD in curricula) has found, that younger children tend to have a higher environmental attitude than older children ((Krettenauer, 2017; Leeming et  al., 1995; Liefländer et  al., 2013), which also revealed itself in SA going down through the course of one year (BUGEN). Their results were *the average school grade, sustainability-related attitudes at the beginning of the school year, participation in Fridays for Future, knowledge of the concept of sustainability and grade level were also significant predictors of sustainability-related attitudes. In contrast, the type of school had no statistically significant correlation with the development of sustainability-related attitudes within a school year,* all of which I did not account for. In the same study the SB remained constant throughout one school year. *The average school grade, the sustainability behaviour reported by the students at the beginning of the school year and participation in Fridays for Future were significant predictors. (BUGEN).*

Other factors that have been found to influence SA and SB were the social desirability (REF), the influence of the media, potentially having a greater influence than ESD intervention especially in this age group (REF), the participation *Participation in Fridays for Future was a positive predictor of both sustainability knowledge and students' attitudes and behaviour. Extracurricular learning environments (e.g. friends, family, social media) have a strong influence in adolescence, so the effectiveness of school-based ESD could be limited. (REF)* , and the role of the teacher or also in this case could be the role of the project conductor. Research has found that there seems to be negative relationship between the sustainability attitude and environmental consciousness leading to less SB of the students. *It can also only be assumed that if the teacher makes overly pointed statements about their own environmental and sustainability awareness, this could possibly lead to reactance (i.e. a kind of inner resistance) in the students' own attitudes. (BUGEN).* Another factor could be that with an experienced lack of self-efficacy (ALSO REF MONI?), frustration could have arisen, leading to a decrease in SA and SB. As my study did not investigate in how far the school implemented the roadmap, the lack thereof could have resulted in negative feelings of the involved students. This highlights the urgent need for whole-institution approaches of ESD. Overall, these findings highlight the importance of designing ESD intervention well thought out, with the appropriate target group in mind, the desired impact, and considering the place-based context as well.

### Validation for SA and SB (based on TPB) and self-efficacy beliefs (Research Question 1b)

I found a strong relationship between the scales used to capture sustainability competences with the underlying construct of the theory of planned behaviour and the underlying construct of (individual) self-efficacy beliefs (Figure XX). That indicates that they are capturing the same latent construct of sustainability competencies. This can be further emphasised if one considers the participation in the “expert group” as real-life behaviour. The question was asked in a simple dichotomous way, whether the students participated in the group (Kaiser). The data showed that the students of the involved group had higher sustainability intentions and behavioural intentions based on the TPB-scale (Figure XX) in the first measurement than the students in the control group. So one interpretation could be, that the higher intentions including behavioural ones) resulted in real-life behaviour, as the students expressed real-life behaviour by joining the group. The question remains in how far socially desirable answers played a role, as even for the first measurement point, the students perceived themselves as being part of the group, even if it had not started yet.Potentially, this could be considered as a validation for the TPB-scale through prediction of impact-relevant behaviour. *As a consequence, the competency differences which were assessed with this measurement instrument could point toward meaningful differences between the students which may have an actual impact on their future behaviour.* To my knowledge in the literature, I found no validation processes for either of these two scales. Given, on the one hand, the validation of the TPB-based scale through prediction of impact-relevant behaviour and thereby also a first step in the validation of the self-efficacy beliefs scale, and on the other hand, the already mentioned limitations of this scale regarding its usefulness for students, the interesting implication arises about the potential extension of sustainability competencies as self-efficacy beliefs and their usefulness and relevance.

## Sustainability competencies as self-efficacy beliefs (Research Question 2)

INCLUDE CLIMATE EMOTIONS HERE?

### Collective efficacy beliefs as outcomes

Involved group perceived themselves as more individually SW than collectively 🡪 related to outcomes?

I found mixed results regarding the level of involvement of the students and the differentiated self-efficacy beliefs. Contrary to my predictions, I uncovered no differences between individual and collective self-efficacy beliefs within and between the involved and the control group (Figure XX). Although all the mean scores, including the ones of the control group, were very similar, interestingly, I found that for the involved group, the individual self-efficacy beliefs were higher than the collective self-efficacy beliefs (despite no statistically significant differences). The question arises in how far collective self-efficacy beliefs were the goal from this specific project. ARGUE HOW IT WOULD MAKE SENSE OR PUT THIS PART IN INTRO OR METHODS?. It could be argued that the design of the ESD intervention could have led to collective self-efficacy beliefs as an outcome of the involved group. *According to**[Bandura (1997)](https://www.sciencedirect.com/science/article/pii/S0272494415000237?via%3Dihub" \l "bib9), self-efficacy is strengthened when people master the specific skills required to engage in proenvironmental behavior and are verbally persuaded of their ability to perform such behavior. These sources of self-efficacy can be effective when people judge the effectiveness of proenvironmental behavior of their own groups. Therefore, if a group successfully masters a particular task and receives positive feedback about its proenvironmental performance,*[*group members*](https://www.sciencedirect.com/topics/social-sciences/group-members)*might be stronger in their belief that they can produce the desired results. A commitment to collective efforts is required to instill the belief in people that their actions can*[*influence*](https://www.sciencedirect.com/topics/social-sciences/influencer)*their surroundings; thus, people can become more willing to engage in proenvironmental behavior. (CHEN).* Given the findings that the involved group did not express more collective efficacy beliefs than the control group, the question comes up about the relevance of the chosen group and the desirability of the aims asked in the survey. The advantage of differentiation, being the option to self-categorise the agent, is undermined by the fact, that in a quantitative survey without a pilot study, the relevant self-categorisations could not be found out. Empirically, very little research exists, that differentiates between individual and collective efficacy. Furthermore, the very few existent studies that applied this differentiation between individual and collective efficacy beliefs found that collective efficacy was significantly stronger, when the task difficulty was intermediate – rather than easy or difficult. *Behaviours that are easy usually have a weaker environmental impact per se. It is likely that people believe actions that are too easy (e.g., refraining from plastic bags) to be unlikely to make a big difference in environmental issues, even if they are collectively practiced. In other words, when actions are too easy, the (potential) success may not translate into feeling collectively efficacious.* This could be an indication, that the aim of making the school emit less CO2 emissions, led by a student initiative was considered too difficult a task by the students and/or might have required more opportunities to influence structural aspects and/or receive more feedback from their environment. OR ALSO PARTICIPATIVE EFFICACY AS MODERATING BETWEEN INDIVIDUAL AND COLLECTIVE. Importance of group size and group cohesion This highlights the relevance of collective efficacy as an outcome indicator of ESD interventions.

### Aim-focussed self-efficacy beliefs as outcome

In line with my predictions, I found that the involved students reported higher action- and aim focussed self-efficacy beliefs (Figure XX), the aim-focussed being statistically significantly higher than the control group (Figure XX). That indicates, that the involved group manifested their formation of an intention. 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. Given the indication, that action-focused self-efficacy is more related to capture actual constraints such as time, money, social resources, this findings adds to the potential outside barriers the involved students encountered, that moderated their beliefs in being able to conduct their actions. Methodologically, it could also be that the actions chosen for the survey were not relevant, but which could also not be tested and found out in a pilot study. As the triple A framework allows for combining actions that are very concrete with very abstract (collective) aims, testing those concrete actions becomes more relevant. Given the lower scores of the control group, regarding both action- and aim-focussed self-efficacy beliefs, they could also indicate that the neither the aims, nor the actions were particularly desirable by the students. Little empirical research on aim vs action focussed self-efficacy beliefs exists. *Hornsey et al. (2006) discovered that the content of the aim significantly influenced how self-efficacy predicted action intentions among members and non-members of a protest group. This indicates that the relevance and desirability of the aim are crucial for understanding how efficacy beliefs translate into intentions and actions CHECK CHATGPT.* T*he desirability of aims plays a significant role in how self-efficacy beliefs are formed and acted upon. According to Fishbach and Ferguson (2007), aims are characterized by their desirability, which directly impacts whether people pursue certain actions. This means that for self-efficacy to translate into behaviour, the aim must be valued by the individual.* As for the self-efficacy beliefs, they were only surveyed at the last measurement point, one year after the ESD intervention, it is not possible to analyse in how far the ESD intervention had an effect on the formation of aim-focussed self-efficacy beliefs of the involved students, or whether they already experienced strong sustainability aim intentions. Assessing self-efficacy beliefs over longer time and in relation to the development and realisation of the project would be an interesting future research direction. Furthermore, distinguishing links between agents, actions, and aims enables better predictions about which characteristics of self-efficacy make it more or less predictive of relevant social and environmental outcome variables. (GIVE AN EXAMPLE). This differentiation could also inform ESD design depending on desired outcome.

## Study limitations

“Analyses of biodiversity change can be limited by insufficient and imbalanced taxonomic, spatial and temporal data.”

* Applicability in other contexts (Cultural etc)
* Limitations (DISCUSSION?)
  + Furthermore, we propose the distinction of three efficacy links (agent-action, agent-aim, agent-action-aim) based on operationalizations and labeling decisions. However, strong empirical evidence for such a distinction and possible moderators of the relation between various efficacy links is still missing. It remains a task for future research to investigate how interdependent these facets of self-efficacy actually are under which circumstances. Therefore, the triple-A framework should be understood as a theoretical proposition that conceptually fleshes out what is already practiced, highlights previously overlooked research questions, and helps researchers make more strategic decisions in the study of efficacy beliefs.
  + Constraints to generality

## Future directions

* the dominant form of assessment of impact from the educational intervention utilised quantitative measures, such as a pre/post survey or questionnaire, essentially reflecting a positivist epistemology.
* are forms of assessment employed relevant and appropriate? (epistemologically)
* A performance measurement approach to project management insists on the inclusion and development of indicators of expected change, assessment of baseline, stated targets and validation tools to provide evidence of change. This results-orientated approach emphasises efficiency and accountability in public spending, with clearly defined outputs, and results demonstrating value for money. (Oflaherty, Liddy, 2018)
* Consequently the development of indicators and outcomes is more complex and relates to the researcher/educators’ definition of development education, as addressed earlier. This product outcome focus misses the distinctiveness of DE/ESD/GCED, where the learning outcomes may be in the form of questioning and activism, rather than immediate or short-term goals.

On a policy level, the development of further indicators (see for example [[**114**](https://www.mdpi.com/2071-1050/11/6/1717#B114-sustainability-11-01717),[**115**](https://www.mdpi.com/2071-1050/11/6/1717#B115-sustainability-11-01717)]), or the evaluation of ESD programs (see for example [[**13**](https://www.mdpi.com/2071-1050/11/6/1717#B13-sustainability-11-01717),[**116**](https://www.mdpi.com/2071-1050/11/6/1717#B116-sustainability-11-01717)]), seem like helpful supplements to foster future steps and crucial insights in the implementation process of programs that aim to promote learner competencies to build a sustainable future.

Measuring self-efficacy beliefs over time?

# Conclusion

*My research adds to a growing understanding of SCs, their development, and the sustainability and educational governance through policymaking. On this basis, appropriate evidence based recommendations for the further development of ESD research and the implementation of ESD in school practice can be formulated. Through the possibilities of measurement presented and the data already generated, further insights into the successful implementation of ESD in schools and the associated conditions for success can be gained.*

* Need for closer collaboration between practicioners, interdisciplinary research and society
  + Achieving SDGs cannot remain at normative, vague statements/ target formulations
  + Ideally stimulate benchmarking processes
  + International monitoring system for ESD implementation efforts

Therefore my results can be interpreted as . While changes of sustainability competencies and their attribution to innovative ESD interventions is somewhat limited with my method, I still observed an impression on the long-term effects captured across levels of involvement of the students.