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TRANSDISZIPLINÄRE FORSCHUNG KONTrovers
CLIMATE CHANGE EDUCATION
Changing Climate Change Education
Exploring moderate constructivist and transdisciplinary approaches through the research-education co-operation k.i.d.Z.21

GAIA 28/1 (2019): 35 – 43

Abstract
The COP21 Agreement 2015 sets very high targets, which cannot be reached by political agreements or technological progress alone. Within this context, Education for Sustainable Development (ESD), and particularly Climate Change Education (CCE), play an even increasing role regarding a holistic societal transformation towards a sustainable world. Creating ESD/CCE learning settings and delivering scientific evidence for their success has turned into a vital challenge in order to meet the high expectations. In this longitudinal study, based on the research project k.i.d.Z.21 – Competent into the Future, we deliver scientific evidence of the success of CCE when based on transdisciplinary and/or moderate constructivist theories, and show that the impact is even higher when both approaches are combined. The data presented derive from scientific surveys and tests, involving 343 teenagers before and after intensive collaboration with a high number of experts, including renowned climate change scientists.

Keywords
Climate Change Education (CCE), Education for Sustainable Development (ESD), moderate constructivism, scientific evaluation of Education for Sustainable Development (ESD) and Climate Change Education (CCE), societal transformation, transdisciplinarity

Increasingly, scientific evidence has been brought forward in recent years that human impact on the various spheres of the earth has grown to an extent that actually threatens the overall resilience of the earth system and thus the basis for the existence of current societies (Steffen et al. 2018, Rockström et al. 2016). Among the various Grand Challenges of the 21st century (ICSU 2010, Reid et al. 2010), anthropogenic climate change (CC) plays a prominent role, and there is a pressing need for successful mitigation, adaptation, and transformation (IPCC 2018, 2014). The agreement reached at the United Nations Climate Conference COP21 in December 2015 in Paris (United Nations Framework Convention on Climate Change, UNFCCC 2016) sets extremely ambitious targets, and it is important to realise that neither political agreements nor technological advances alone will be enough to meet them (United Nations Task Team on Social Dimensions of Climate Change 2011). What is really needed is rapid and profound societal transformation toward sustainability (Feola 2015, WBGU 2011).

In this context, the strong and direct interrelation of both sustainable development and Education for Sustainable Development (ESD) is now universally acknowledged (UNESCO 2014a), and ESD has found its way into many central current documents, for example, the latest full series of reports of the Intergovernmental Panel on Climate Change (IPCC) (2014, and the latest full series of reports of the Intergovernmental Panel on Climate Change (IPCC) (2014), and the Paris Agreement (UNFCCC 2016). ESD is an integral part of the Sustainable Development Goal (SDG) on education, and it is said to hold the key for achieving all other 16 SDGs (UNESCO 2017). This is particularly true for the SDG 13 Climate Action, and thus Climate Change Education (CCE), which is now understood to play a central role in

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UNESCO’s ESD efforts (UNESCO 2010), and in educational research in general (Henderson et al. 2017). CC and its consequences call for a rigorous educational response aimed at increasing (young) people’s competencies and critical engagement, thus empowering individuals to deal with the complexity and dimension of the subject (Corner et al. 2015, Mochizuki and Bryan 2015).

A vital point in relation to this is a revolution of the understanding of learning. As ESD holds the potential of “galvanizing pedagogical innovation” (UNESCO 2014b, p. 30), its main goals are dealing with critical topics (e.g., CC), and helping learners to ask critical questions, to draw critical conclusions, and to make their own decisions (UNESCO 2014a). Innovative pedagogical approaches to learning are expected to bring about “specific cognitive, socio-emotional and behavioural learning outcomes that enable individuals to deal with the particular challenges of each SDG” (UNESCO 2017, p. 8) and lead to “changes in knowledge and understanding among learners that will support sustainable development in the future” (UNESCO 2014b, p. 30). Learner-centred, interactive, action-oriented, and problem-based learning settings are described as particularly valuable for transformative learning via ESD (UNESCO 2017).

However, with regards to the engagement of education in transformation, it is also important to reflect upon the criticism expressed during the Decade of Education for Sustainable Development (2005 to 2014), and revolutionise the various approaches for the post 2015 Global Action Programme on Education for Sustainable Development (UNESCO 2014a). Among the most pressing concerns has been the fear of indoctrinating students with the ideals of ESD without knowing any solutions; instead, it is argued, it is of utmost importance to prepare students to actually working them out (Jickling and Wals 2012). Equally as important is the argument that, from a scientific point of view, the translation of the theoretical claims of ESD into educational practice has so far not delivered more than the odd piece of anecdotal evidence (UNESCO 2012). In fact, if ESD is expected to fulfil its potential and lead to transformational education towards a sustainable world (Mochizuki and Bryan 2015), the contributions of science to monitoring and evaluating ESD, and thus help develop successful ESD settings, must be heavily intensified in the future (UNESCO 2017, 2014b).

This study, therefore, aims to begin to fill the huge research gap by focusing on the value of moderate constructivist and transdisciplinary approaches taken in the research-education co-operation k.i.d.Z.21 – kompetent in die Zukunft (k.i.d.Z.21 – Competent Into the Future. Preparing Austria’s Youth for Climate Change Challenges of the 21st Century). The co-operation advocates a moderate constructivist approach (primarily going back to Jean Piaget and John Dewey), which begins learning processes from every individual’s own conceptions (Sinatra et al. 2014, Duit et al. 2013). These conceptions can be of vital importance in the context of ESD. There is evidence that young people’s conceptions and their ability to solve problems – and thus conceptions and actions – are closely related to, and dependent upon each other (Duit 1996). Learning processes, in moderate constructivist theories, are seen as individually constructed, self-determined, and situated (Duffy et al. 1993).

Learners actively produce their own learning outcomes/their own changes of conceptions by researching, using their analytical skills and individual creativity, and making their own decisions. Learning processes in moderate constructivist thinking are seen to be particularly effective when they happen in authentic learning environments, closely interlinked with real-life problems (Herrington et al. 2014, Jonassen 2009). k.i.d.Z.21 as an attempt of linking scientific reasoning and teenagers’ real-life concerns both in in-school and out-of-school settings (Körfigen et al. 2017) aims at following all of these underlying ideas.

Transdisciplinarity is the second pillar upon which the project k.i.d.Z.21 is based. On the one hand, seen from the sustainable development point of view, transdisciplinarity is considered to be essential in tackling the Grand Challenges (Mertens and Barbian 2015). Alternatively, seen from the ESD perspective, bringing real-life problems onto the scientific agenda also requires “the involvement of actors from outside academia into the research process in order to integrate the best available knowledge, reconcile values and preferences, as well as create ownership of problems and solution options” (Lang et al. 2012, p. 25, see also Egner and Schmid 2012), and will lead to the creation of new types of knowledge, individual and societal decision making, and, above all, will tackle sustainability issues as they ought to be tackled in democratic societies, that is, bottom-up instead of (just) top-down. Small
wonder that it is mostly in the context of sustainability that science tries to “understand and explain transformation processes at the science-society interface” (Weichselgartner and Truffer 2015, p. 89). All in all, it can be summarised, that both moderate constructivism and transdisciplinary action appear to perfectly fit the requirements of ESD/CCE.

This study aims to provide scientifically reproducible evidence of the comparable success of the various educational modules of k.i.d.Z.21, when delivered in three ways: in line with moderate constructivist theories, in line with transdisciplinary theories, and, thirdly, delivered via a combination of both theories. The central research questions are as follows: does the project k.i.d.Z.21 raise the young participants’ preparedness for CC and its consequences? Do they find that moderate constructivist theory and transdisciplinary theory when practised in CCE settings play vital roles in enhancing their deeper understanding of CC and its consequences? Is there an even greater impact on the participants’ learning experience by combining both moderate constructivist and transdisciplinary approaches? Are the teenagers able to produce detailed responses regarding their CCE experiences?

The central ideas and goals of the research-education co-operation k.i.d.Z.21 are presented in Stötter et al. (2016). Thus, in what follows below, the focus lies on the moderate constructivist and transdisciplinary approaches of the central modules of the research project k.i.d.Z.21, the understanding of which is vital for this study.

Approximately two thirds of the overall project time per participating student per year is spent on the module classical school lessons on CC (figure 1). All of the teachers of the various disciplines who teach the participating year groups are asked to include the topic CC in their lessons. The project team invests a lot of time on the in-service training of the project teachers in both CC issues and innovative ESD/CCE pedagogies (by means of formal and informal meetings, seminars, workshops, etc.). At the end of the day, however, the decision regarding how to organise their actual CC lessons, has to be left to the autonomy of the respective teachers. From the teenagers’ research diaries, we have concluded the dominance of traditional teaching styles and of extrinsic motivation based methods, which remain generally typical in school contexts.

FIGURE 2: Participants of the Alpine research week 2015 at Hohe Mut/Tyrol (2,659 m a.s.l.): accompanied and supported by 14 teachers, twelve climate change experts, five university students, and five members of k.i.d.Z.21 staff, about 120 pupils became active climate change researchers and studied interdependencies of climate change with tourism, environmental ethics, and Alpine vegetation and glaciers.

The moderate constructivist and transdisciplinary approaches in central modules of k.i.d.Z.21

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The submodule **CC and environmental ethics** focuses on human-natural environment interactions and relations, values and ethical questions in light of CC conditions, with the content being adapted according to the students’ individual research questions. The general research area is the change between pristine areas and anthropogenically engineered areas (ski pistes, cleared areas; see figure), specifically the Natural Monument Zibens Wald (stone pine forest Obergurgl, about 2,000 to 2,300 m a.s.l.), bordering ski pistes, and the village of Obergurgl.

In the research process, the teenagers turn into active CC researchers, while CC experts offer consultancy and assistance when needed. Stages of the research process are:

- going on solitary hike (five minutes distances between participants) through stone pine forest (pristine area) and ski piste (anthropogenically engineered area);
- completing an emotional mapping to capture individual pre-concepts and perceptions on human-natural environment relationships, sharing observations;
- developing models on human-environment relations with various artistic representations (“human” in various sizes, “earth ball” in various sizes, etc.) under specific focus of CC;
- finding their own research questions and methods to dig deeper (e.g., photo documentation about traces of anthropogenic impacts on the landscape, investigating increasing threat of natural hazards to humans under CC conditions, comparing time spans of naturally and anthropogenically caused changes to the environment, etc.);
- carrying out field research in small research groups in and around Obergurgl (tools: maps, research notebooks, human-environment models, etc.);
- analysing and interpreting data, preparing short presentations;
- sharing findings, final discussion, future outlook.

**FIGURE:** Anthropogenic impacts on natural environment: observing human re-shaping of landscape in ski area of Obergurgl/Tyrol.

The first time the transdisciplinary character comes to life in **k.i.d.Z.21** is during the various classroom workshops and school hall lectures at an early stage of every project year. This module is labelled *kick-off workshops + lectures with CC experts* (figure 1, coloured in red). *Lectures, workshops + debates with CC experts* also occur at a later stage in the project (see figure 1), yet in the online survey all these activities are subsumed in order to avoid confusion among the surveyed teenagers (see figure 4, p. 40, figure 5, p. 42, and table 1, p. 41). At a later stage of the project, during the *Alpine research week* in Obergurgl/Tyrol (1,900 m a.s.l.) (figure 2), the teenagers also have intensive contact with CC experts. On the second and third day, the transdisciplinary and the moderate constructivist approaches of **k.i.d.Z.21** are combined in the module *CC research students + CC experts in high Alpine setting* (figure 1, coloured in purple). The teenagers are given the opportunity to become active CC researchers in various fields of study: CC + tourism, CC + environmental ethics (box 1), CC + Alpine vegetation, CC + glaciers (see also online supplement,1 table 1, for a short description of all four submodules). They raise their own research questions, find feasible research methods, perform fieldwork and collect, analyse and interpret data, while the experts offer consultancy...
and assistance during the whole research process, and contribute to the discussions when required. Due to the fast changes of environmental conditions within short distances, a high level of biodiversity, an observable shift of boundaries of ecosystems and cryosphere systems linked to CC, but also its high vulnerability with respect to socio-economic change, the high Alpine environment offers an authentic and problem-based setting for all manner of (combinations of) natural as well as human and social sciences research (Monreal and Stötter 2014).

All modules are accompanied by an ample array of scientific monitoring and evaluation tests and methods prior to the start, during, and directly after the project (figure 1). Each participating school has its own logo competition for the respective project.

Study methods

Participants

The research project k.i.d.Z.21 has been approved by the ethics committee of the University of Innsbruck, and all participants, and for minors also their legal guardians, gave their informed written consent prior to the study. During the three school years 2012/13 (51 females, 56 males), 2013/14 (61 females, 57 males), and 2014/15 (54 females, 64 males), an overall number of 343 students aged between 13 and 15 participated in the project. In the different analyses, individual subjects have to be excluded because of missing data. These arise from students not taking part in important phases of the project, missing the whole pre- or post-test, skipping individual questions on either pre- or post-test, or obvious errors in the questionnaire completion. Dropouts are not found to introduce a bias into the data. All in all, k.i.d.Z.21 has so far enjoyed the support of over 70 CC experts altogether, 32 experts (5 females, 27 males) have contributed to this study (online supplement, table 2). Their participation in lectures, workshops, debates, or during the Alpine research week has been entirely voluntary, and no financial compensation has been provided (except for travelling expenses). In addition, 60 teachers (35 females, 25 males), and 4 head teachers (1 female, 3 males) have taken part.

Study Design

The study is designed as a longitudinal case study of individual students. Each of the three study periods lasts one full school year (beginning of September to end of July). The students’ pre-test data is collected prior to the start of the project, the post-test data directly after completion of each school year study period. Data collection takes place online via the platform SoSci Survey.2 The pre-test questionnaire consists of 30 items, and the post-test of 34 items, mostly of quantitative character, using Likert scales ranging from 1 (best rating) to 6 (worst rating), corresponding to the school grade system which is familiar to the students. Open questions for qualitative data collection are also given. Questionnaires take between 30 to 40 minutes to complete. The students and teachers are not given the labels of the modules as in this study in order to avoid bias (e.g., the label classical school lessons may have negatively influenced the students’ answers).

Moreover, the temporal input for the interventions (modules) studied is gained from a teachers online survey and via structured interviews with the head teachers (for the module classical school lessons on CC), and from a pencil-and-paper survey completed by students (for the module every student’s two individual CC research projects). Results are validated communicatively (Kvale 1995) between researchers and a selected group of students, teachers, and head teachers. All other modules (see figure 1) have been organised and put into practice by k.i.d.Z.21 team members; thus, the temporal input is known.

Regarding the limitations of this study, it should be noted that there was no control group being taught just classical school lessons on CC. It is also worth noting that the results do not refer to an increase in objective knowledge, but rather rely on subjective (but authentic) teenagers’ statements of their own perceptions. All participants were given the opportunity to take part in all modules, so the results showing the learning success of the various project modules have not been deducted from different groups.

Statistical analysis

Both the qualitative and the quantitative data analyses are performed by a combination of the software packages MAXQDA 12®, Excel 2010®, and SPSS 21®. T-test for dependent samples, and ANOVA with Games-Howel post-hoc tests are used for analyses from Likert scale data. Nominal data are analysed using Chi square tests. P smaller than 0.05 is considered significant in all analyses. The analysis of the qualitative data follows a deductive approach, which applies a theoretically developed set of categories (i.e., the central project modules) to the data by quantifying the frequency of qualitative codes and subcodes (Kuckartz 2014). After a first phase of individual coding by three researchers, anchor examples and coding problems are discussed, and specific coding rules are defined. Two subcodes are established, that is, “reason given”, as, contrary to our expectations, many students offered detailed comments. Per student only one subcode per category is determined (Mayring 2014). As the subsequent actual process of coding itself is again done by three researchers independently, the reliability of the results is then secured by using two methods, that is, 1. the rather simple reliability value after Holsti (1969), and 2. the randomly adjusted coefficient of Krippendorff’s alpha by means of an SPSS-Macro (Hayes and Krippendorff 2007). Both results clearly show a high reliability (Holsti’s reliability value: 0.90157, Krippendorff’s alpha: between 1.0 and 0.8781, see online supplement, table 3).

As for the central statements on when and how the students actually understood CC and its consequences, the results of quantitative analysis and qualitative analysis are interpreted in a mixed methods approach. Thus, both reliability and validity of the knowledge gained are strengthened (Creswell and Plano Clark 2017).
Climate Change Education efforts with varied success

With regards to the success of CCE efforts in *k.i.d.Z.*21, initially, we analyse one of our pre-/post-test items, in which the teenagers are questioned as to their preparedness for CC and its consequences (figure 3). The group of those who rated themselves as well prepared (score 1 to 3 on a Likert scale) is 51 percent (155 out of 301 participating teenagers) prior to the start of the project. This rises significantly to 71 percent (213 out of 301 participating teenagers) following participation in a full project year (Chi square test, p < 0.001). Overall, *k.i.d.Z.*21 holds enormous potential to significantly raise the participants’ preparedness, which is documented by the more positive overall rating in the post-test compared with the pre-test questionnaire (t-test, p < 0.001). This raises the question, what are the young participants’ judgements/ratings based upon?

We can deliver evidence that the two supporting pillars of the project, that is, moderate constructivism and transdisciplinarity, play vital roles. The results of a quantitative analysis of one of the post-test items, asking the teenagers how much the various modules of the project helped them understand CC and its consequences, speak a clear language (figure 4): all of the innovative approaches are rated to convey a much better understanding than classical school lessons (*ANOVA*, p < 0.001; post-hoc tests, all p values < 0.001). For instance, the module *classical school lessons on CC* is given the highest rating 1 by only five percent of participating students, whereas both the modules *lectures, workshops + debates with CC experts* (19 percent), and *every student’s two individual CC research projects* (21 percent) are rated approximately four times higher. Combining transdisciplinary and moderate constructivist approaches, the module *CC research students + CC experts in high Alpine setting* shows the most profound influence on CC understanding (33 percent) compared to the other modules (Chi square test, p < 0.001).

Table 1 is a synopsis of the results of a qualitative analysis of the post-test item asking the teenagers to retrospectively write down the point(s) in the project at which they really began to understand CC and its consequences. Here, the lack of impact of classical school lessons, and the success of moderate constructivist and transdisciplinary approaches become even more evident. Interestingly enough, many teenagers give detailed reasons for their answers, and they stress the positive impact their own research activities, the authentic learning setting, the collaboration with experts, and the possibility of experiencing CC in reality and in its true dimensions have had on their understanding of CC and its consequences. Once again, and even more visible than in the quantitative analysis, the results reveal that maximum learning occurs when both approaches are combined (module *CC research students + CC experts in high Alpine setting*).

Achieving improvements in Climate Change Education through innovative approaches

It is interesting that more traditional education approaches have always shared some of the central goals with more innovative ones, but have tried (and keep trying) “to address them with teaching and learning methodologies that have proven unsuitable for that purpose in numerous empirical studies” (Duit 1996, p. 67). At the same time, it is true that what is still considered as “innovative” often proves to have been known for a long time. In the context of this study, many suggestions for “pedagogical innovation” (UNESCO 2014b, p. 30, see introduction above) could also be regarded as not completely new.
TABLE 1: Analysis of post-test online survey open question: “Write down the point(s) in the project at which you really began to understand climate change and its consequences”. The table shows the percentages of various codes and subcodes, plus selected qualitative example quotations illustrating the meaning of the respective category (N=302). Once again, it shows maximum learning is best achieved when transdisciplinary and moderate constructivist approaches are combined.

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBCODE</th>
<th>RELATIVE NUMBER OF CODINGS</th>
<th>EXAMPLE QUOTATIONS, ILLUSTRATING THE MEANING OF THE CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>classical school lessons on CC</td>
<td>no reason given</td>
<td>2.1%</td>
<td>“in our normal lessons” (2015020); “in our Geography lessons” (2013060)</td>
</tr>
<tr>
<td></td>
<td>reason given</td>
<td>0.7%</td>
<td>“[...] and by the film An Inconvenient Truth, because I suddenly realized that the main problem was not only a lack of information, but, most of all, the missing willingness of the people.” (2013046)</td>
</tr>
<tr>
<td>every student’s two individual CC research projects</td>
<td>no reason given</td>
<td>4.3%</td>
<td>“when I prepared my very own project” (2015029); “in our projects at school” (2014099)</td>
</tr>
<tr>
<td></td>
<td>reason given</td>
<td>3.2%</td>
<td>“I have learnt most during my own projects [...], because I had to do the research all by myself and did not have to listen to other people.” (2014067); “During my own projects, because you could work things out all by yourself and so get into the topic much more intensively. For me, working actively is the best way to learn.” (2014115)</td>
</tr>
<tr>
<td>lectures, workshops + debates with CC experts</td>
<td>no reason given</td>
<td>13.1%</td>
<td>“I learnt most during the lecture by Prof. XXX.” (2013005); “I have learnt a lot during the day through the many and long lectures.” (2014080)</td>
</tr>
<tr>
<td></td>
<td>reason given</td>
<td>10.0%</td>
<td>“I learnt most during the lecture by Professor ZZZ, because he explained and showed climate change in its diversity.” (2014109); “During the conversation with Prof. WWW, I suddenly realized what actually is the problem of climate change, what is actually happening, I understood what exactly has to be prevented.” (2015064)</td>
</tr>
<tr>
<td>CC research students + CC experts in high Alpine setting</td>
<td>no reason given</td>
<td>23.4%</td>
<td>“by the research modules in Obergurgl (glacier, vegetation, forest, tourism)” (2014025); “during the modules glacier and vegetation” (2013023); “glacier near the moraines” (2013081); “outside in nature” (2015073)</td>
</tr>
<tr>
<td></td>
<td>reason given</td>
<td>43.2%</td>
<td>“during the modules glacier, vegetation [...], because I could see everything and the evidence myself” (2014034); “I have learnt a lot during the research module vegetation, as I could find out a lot myself, and this is why I can remember it well now.” (2014041); “During the week in Obergurgl, because we could see the whole theory and all the things which we had been talking about at school in reality.” (2014005); “When dealing with tourism, because we had our own rather good questions, and so we got interesting answers back as well.” (2014118); “The module glacial history was extremely helpful and informative, and it showed us how present climate change actually is. When all that water from the glacier was running downhill between our very feet, I realized how urgent the whole matter actually is.” (2015007); “During all research modules up the mountains, because you didn’t have to sit around all day and listen, but you could find the answers to your own questions yourself.” (2015077)</td>
</tr>
</tbody>
</table>

Yet, in this study, the closer assessment of the moderate constructivist and transdisciplinary approaches in ESD/CCE from a scientific perspective may well be considered to be innovative. The differentiated and more sophisticated answers from young people on their own CCE learning experiences in moderate constructivist and transdisciplinary approaches in k.i.d.Z.21 allow for deeper insights into individual conceptions of learning. Once again, these insights should and will have influence on future research-education co-operations and future ESD/CCE learning settings.

However, let’s go one step further. Comparing the relative number of codings identified in the qualitative analysis with the relative amount of time invested in the various modules of k.i.d.Z.21 (figure 5) can expound the results: classical school lessons take two thirds of the project time per student per year (66.6 percent, 100h/150h), but they are awarded less than three percent of the overall positive codings affirming learning by the students. Meanwhile, the remaining third of the project time (lectures, workshops + debates with CC experts 9.3 percent, 14h/150h, every student’s two individual CC research projects 13.3 percent, 20h/150h, CC research students + CC experts in high Alpine setting 10.7 percent, 16h/150h) is awarded 97.2 percent of the codings. Even more interesting, two thirds of the codings affirming learning appear to be achieved in little more than ten percent of the project time in a combined transdisciplinary and moderate constructivist approach. However, it remains unknown as to how much the classroom lessons may actually have contributed to setting the basis for any CCE action in the project, and whether the success of the moderate constructivist and transdisciplinary modules could have been reached without them after all.

The results presented should ultimately lead to fundamental changes in our (mental and actual) conceptions regarding how to organise ESD/CCE learning settings. These have been promoted by ESD/CCE for a long time. It is reassuring that the results show that improvements in ESD/CCE can be achieved with reasonable effort. All that is required for transdisciplinary cooperation is a couple of experts willing to deal with young people (volunteers are surprisingly easier to find than one may think). The moderate constructivist students’ projects merely require some creativity on the students’ side and a different understanding of learning on the teachers’ behalf.
Combining both approaches in creating authentic research-education co-operations over long periods of time, acknowledging moderate constructivist and transdisciplinary theories as in k.i.d.Z.21, however, requires a lot of energy on all sides to develop, prepare, complete, monitor, evaluate, adapt, etc. In our case study, 32 experts with various natural, social/human and educational science backgrounds, various headmasters, dozens of teachers, and, last but not least, hundreds of school students have participated actively in the process. The overall success clearly justifies the effort, as the results reflect the high impact of the project k.i.d.Z.21 leaves on its participants via relatively short, but very efficient modules.

k.i.d.Z.21 has developed into one of the most ambitious third-party funding CCE research projects in Austria, and one of the most dynamically evolving and promising with regards to the integration of CCE in school and university curricula. The next steps to expand k.i.d.Z.21 have already been taken. These include passing on the expertise to hundreds of teachers (Austria, Germany, Italy, etc.), creating further moderate constructivist research settings in various Alpine regions, enlarging the network between CC experts and schools, and, as in the case study, monitoring and assessing all efforts on a scientific basis. A great deal of time will also have to be invested into evaluating the long-term effects of k.i.d.Z.21, and especially how it influences the participants’ climate actions in the future.

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