

CLIMATE CHANGE

EDUCATION

EXECUTIVE SUMMARY

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Over just a few decades scientific research has enabled unprecedented advances in our understanding of Earth's climate processes – the changes taking place in our climate, the directions in which those changes could be headed, and the potentially significant consequences of human activities in intensifying versus minimising those changes.

But these developments in our knowledge of climate change have not been matched by our efforts to develop, update, co-ordinate, and disseminate educational initiatives in the general domain of climate, environment, and sustainability.

Because of this, the Policy Committee of the Academy of the Social Sciences in Australia (the Academy) formed a Climate Change Education Steering Group to examine current research relating to climate change education (CCE). The report summarised here marshals research that is aimed at helping education systems and teachers to align their policies and practices with advances in knowledge about the nature and significance of changes in our climate: What does research say about effective educational programs aimed at school students and teachers? And how might the efficacy of these programs be assessed?

To collect and interpret reliable and current answers to these questions the Steering Group drew together over 350 largely quantitative and true- or quasi-experimental studies of the effects of a variety of educational interventions focused on climate change. Studies were included that appeared in refereed journals, over the last decade or so, and that had attracted at least some moderate levels of citation relative to their recency of publication. From these the report summarises issues relating to the validity of a collection of assessments, surveys, tests, inventories, and models of learning progression.

Overview and summary of selected findings

The report outlines and discusses converging and diverging conclusions in four sections:

- some general features of the current state of research on effective programs in CCE, including the changing rate of published research over the last decades, the way these research efforts cluster in terms of

key concepts and interests, and the various educational settings on which they focus;

- reviews of effective educational interventions relating to teaching and learning, technologies and learning, teacher education and professional development, policy priorities, and skills- and competency-based approaches;
- studies that develop and validate instruments to assess climate change-related knowledge, skills, attitudes, and practices among school students and teachers; and
- discussion of the main conclusions to be drawn, gaps and problems related to research on this topic, and ways forward for educators and researchers.



The research corpus represents findings established for the most part through surveys, questionnaires, interviews, and observational studies. Overall, it displays a focus on middle-through-secondary years school students. For example, some of the reviews summarised in our report indicated that only about 6–8% of studies in their corpora dealt with students under the age of 9 years.

Here is a sample of specific conclusions supported by the research corpus:

- learners' understandings of attitudes and knowledge related to climate change were improved when teachers organised deliberative, structured discussion;
- activities were more effective when they drew learners in at high levels of engagement;
- learning about climate change was enhanced via projects that focussed on making climate change personally relevant and meaningful to learners;
- from research on valid, reliable rubrics and assessment protocols, it seems best to consider climate change as a multifaceted domain of knowledge, involving variable progressions in knowledge, skills, attitudes, and practices;
- in school or community settings, students were found to be highly engaged when given the opportunity to design and implement projects that set out to address practicable aspects of climate change;
- learning and positive, practicable attitudes were enhanced when students were provided with opportunities to interact with scientists and to experience for themselves the processes used by scientists in complex aspects of inquiry in climate change;
- various approaches that involve the use of advanced digital technologies were assessed and found to be effective in new learning, particularly when their use was explicitly shown to offer levels of understandings over and above more conventional teaching-learning settings;
- programs explicitly designed to uncover and address misconceptions about climate change were effective;
- students were sometimes found to be initially reluctant to discuss controversial aspects of climate change, being inclined at first to explore "safer" matters more likely to afford consensus;
- on the other hand, some studies showed that overt norms for engaging contentious matters in classroom settings gave rise to orderly and productive forms of disagreement and debate.

One unexpected but central issue arose in many studies in this corpus. Understandably, researchers tended to focus most of their attention on the learners and their engagement with a particular feature of the pedagogy or the materials. In most studies the role of the teacher in faithfully

maintaining, co-ordinating, and following up in knowledgeable ways was assumed, and appeared at first to be of secondary interest to the researchers. But the questions that emerged, regularly and at times dramatically, throughout these studies, and sometimes in the background, or as an afterthought in the explanation of results, included how much the participating teachers could draw on their knowledge of climate change, and how appropriately they applied that knowledge in their pedagogy and in their use of curriculum and assessment materials.

One review of research showed what the research reviewers found to be surprising levels of variability and outright inaccuracy among teachers on such central issues as the composition of Earth's atmosphere, the function and nature of atmospheric gases, and the greenhouse and enhanced greenhouse effects. So an urgent conclusion from this report concerns the need to strengthen pre- and in-service programs on the details of climate change and on how knowledge, skills, and attitudes relating to climate change can be taught with accuracy, clarity, and in light of the students' levels of understanding.

The report makes a number of observations about educational policy and its relationship to curriculum development, pedagogy, and assessment. One over-arching issue that emerged is that the current corpus includes work conducted mainly in developed countries. Many countries in South and Central America, Eastern Europe, North and West Asia, and North Africa were entirely unrepresented, and many of the countries that did feature in the corpus were represented by a single publication. This highly skewed distribution, the report asserts, has implications for how policy in CCE is construed, what major lines of local and global debate can emerge, and how climate change-related challenges can be defined and characterised in ways amenable to formal, institutionalised, but nonetheless culturally appropriate policy and practice.

Conclusions

In a complex educational field with the potential economic, cultural, and party-political reach of climate change, policy development needs to keep an eye on educational research that can show positive, replicable results in terms of a broad range of climate-supporting learning outcomes. From the research corpus, however, it is clear that it is also important to maintain

an appreciation of how past and current policy settings themselves can highlight some aspects of climate change and obscure other perhaps more complex or contentious issues.

As noted above, a key conclusion has consistently emerged regarding the inadequate preparation and ongoing support of teachers in this rapidly-growing and complex area of inquiry. But concerns about the quality, coherence, and currency of teaching and learning may well have even more to do with CCE's comparatively ill-defined nature and status: What sort of "educational object" is this? What relative weightings are assignable to its goals – knowledge, skill-sets, attitudes, and actions? What counts as "prioritising" it? It is only via explicit, shared answers to these questions that the details of pedagogy and assessment can be meaningfully addressed.

Finally, Australia seems well-placed to make distinctive advances in the social, cultural, and economic aspects of climate change-oriented curriculum in schools and pre- and in-service teacher support programs, having advantages that include:

- an Indigenous heritage, with a unique longevity, that includes traditions for land management and food sourcing;
- distinctive biodiversity profiles – ecosystem, species, and genetic – with many endemic native species in a variety of land and water habitats;
- six major climatic zones – equatorial, tropical, subtropical, desert, grassland, and temperate – and an extraordinary range of ecologies;
- a unique environmental footprint – a substantial carbon- and coal-reliant economy, with carbon dioxide potential that ranks as the third biggest fossil fuel exporter globally;
- a distinctive demographic profile, including a high level of urbanisation (third among the ten largest countries) and multiculturalism (~30% of the population foreign-born);
- and strong, moderately centralised school systems staffed by systematically trained and accredited teachers with access to ongoing professional development.

The report summarised here concludes by asserting, in light of these advantages, that Australia has both the opportunity and the responsibility to make a substantial, distinctive contribution to educational efforts in the area of climate, environment, biodiversity, and sustainability.