

Promoting critical, creative, and caring thinking skills within the context of environmental issues

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Abstract. The study aims to develop interdisciplinary teaching units focusing on environmental issues like sea level rise and ocean acidification to promote critical, creative, and caring thinking skills among 9th and 10th-grade German students. The development of the teaching units is inspired by the socio-scientific issues (SSI) framework and Lipman's model on thinking. Teaching materials are developed using hypothetical learning trajectories (HLT). The effectiveness of the courses is evaluated by comparing actual learning trajectories with HLTs, as well as analyzing students' answers to pre-post questionnaires, including open-ended questions. The study offers insights into effectively integrating environmental education with promoting thinking skills.

Introduction

Climate change is a major concern for many young people and is causing anxiety about their future. To fully comprehend the climate crisis, it is essential to understand the science behind it. However, addressing climate change in an educational setting should offer more than just an understanding of the physical, chemical, and geological processes involved. Teaching about climate change should enable students to explore the complexity of underlying eco- and climate system, as well as its political, ethical and social complexities [1]. Moreover, it has the potential to promote students' critical, creative, and caring thinking [2]. The study investigates the problem: how teaching units in the context of environmental issues can be designed to promote students' critical, creative, and caring thinking skills?

Theoretical framework

The study employs the socio-scientific issues (SSI) framework for environmental education [3]. The SSI framework aims to promote functional scientific literacy, enabling students to make well-founded decisions based on science while considering moral and social aspects [3]. The skills addressed in the SSI framework can be linked to Lipman's thinking model for education [2]. Lipman considers critical, creative, and caring thinking necessary for enhancing reasonableness in personal character and democracy in social character [2]. In the context of environmental issues, training people to respect the environment and appreciate its worth (caring thinking), evaluate and reflect on their thinking process and its outcomes (critical thinking), and take creative actions (creative thinking) is important.

Methods and findings

Employing the SSI framework [3], an interdisciplinary approach is used to develop teaching materials for German 9th and 10th grade students, focusing on ocean acidification and sea level rise. Within each context, relevant aspects from physics, chemistry, geography, as well as social studies are integrated to address the multifaceted nature of environmental issues. The teaching units are problem-oriented, offering students opportunities for discussion and reflection. The materials are developed based on hypothetical learning trajectories (HLT), which map out the sequential development of students' learning of thinking skills over time. Table 1 exemplifies the learning goals for teaching the impact of Arctic melting on the environment within the context of sea level

rise. In addition to promoting critical thinking, the teaching aims to encourage holistic thinking by addressing ecosystem complexity (creative thinking) and fostering empathy towards other living beings, even if the issue may not directly affect students (caring thinking).

Table 1. Example learning goals in teaching the impact of Arctic melting on the environment.

Thinking skill	Learning goal
Holistic	Recognizing while the Arctic melting does not affect sea level rise, it can still have significant effects on the eco- and climate systems
Empathic	Recognizing negative effects of the Arctic melting on life on earth, such as the loss of polar bear habitat

To evaluate teaching unit effectiveness, HLTs are compared with students' actual learning trajectories [4], using data collected in the implementation (work sheets and observation protocol). Additionally, pre-post questionnaires with open-ended questions are used to evaluate thinking skill development, quantified using predefined levels. Table 2 shows an example scoring rubric for the evaluation of empathic thinking regarding sea level rise.

Table 2. Example scoring rubric for the evaluation of empathic thinking in sea level rise context.

Open question: Estimate the challenges of sea level rise.	
Level 1	The answer is self-centred and reflects considerations limited to one's own environment (e.g., "I live in Germany, so I am (not) impacted by sea level rise").
Level 2	The answer includes considerations about the issue beyond one's own environment (e.g., "Sea level rise is a significant problem for people who live on islands and lose their homes").
Level 3	The answer includes reflections on the potential future impact of sea level rise on life on earth (e.g. "many people may lose their homes and be forced to flee due to rising sea levels").

Conclusion

The project has been already developed and currently is running in the schools. The presentation will feature the developed materials and provide an overview on how the SSI framework can assist in developing materials on environmental issues. Additionally, it will present the initial results of the implementation to discuss the effectiveness of teaching units in promoting students' critical, creative, and caring thinking. The study offers insights into effectively integrating environmental education with promoting thinking skills.

References

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