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Merging Earth Science with Environmental Education for Teachers through Inquiry, Constructivist and Place-based Learning

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Summary

In 2016, the British Columbia Science Curriculum for schools was updated HYPERLINK "https://curriculum.gov.bc.ca/curriculum/science/core/introduction" to be concept-based and competency driven. To increase the exposure of emerging teachers to Earth science, topics including natural hazards, Earth processes, geological history and resources were incorporated into 3 of the 6 modules (Education 'In' 'For' and 'About' Environment; Managing A Slippery Resource; Land Use Issues – Living with What We Have) of an Environmental Education course (EDU452) at Simon Fraser University for pre-service and in-service teachers, through inquiry, constructivist and place-based learning. EDU452 seeks to establish connections to place, increase awareness of environmental issues, and empower students to effectively teach about the environment. The incorporation of Earth science into the course followed the Complexity, Aesthetics, Responsibility and Ethics (CARE) framework, suggested by the Ministry of Education of British Columbia as an interdisciplinary guide for teachers, to quickly draw students' attention and establish connection to nature.

Inquiry and constructivist learning are adopted to engage learners in questioning and experiencing, simulate professional scientific investigations, and deepen understanding while revealing misconceptions. Place-based learning is also implemented to mix content with multiple aspects of a locality to engage students with outdoor activities and environment. The case study examines the effectiveness of the redesigned EDU452 and evaluates the pedagogies adopted for incorporating Earth science.

Method

The research encompasses two pilots with 52 participants in summer 2018 and 2019, preceded by the completion of an ethics review representing the permission of the Office of Research Ethics at Simon Fraser University. Data acquired from the first pilot were used to modify the course curriculum and surveys for the second pilot. The data collected include researcher's field observations, students' informal interviews at the end of each Earth Science involved modules, final portfolios, students' focus group interviews and course evaluations upon completion of each pilot, the pre- and post-course Merging Earth Science with Environmental Education Surveys (MESEES), instructors' debrief meeting and pre- and post-course interviews. Due to the small sample size, a mixed methods approach to triangulating the quantitative data was used. Student comments were used to substantiate trends or patterns made apparent in the survey data. While data from the students' perspective and the observer's perspective would focus on the effectiveness of the course, data from the instructors' perspective focuses on the pedagogy and learning environment of EDU452.

Results & Conclusions

EDU452 increased students' recognition of Earth Science being fundamental and relevant. Interview feedback suggests that learning attitude may be enhanced when the "interface" between subjects is highlighted, demonstrating the usefulness of ES in interdisciplinary education, and learning interest in ES is promoted when ES is taught through engaging, student-driven pedagogies. EDU452 caused students to be more likely to use ES activities in their teaching by providing an opportunity to be exposed to and learn about ES. Yet, the incorporation of ES in only 3 of 6 modules, at an introductory level, was not enough to make the students feel confident in teaching ES as a subject.

Inquiry learning promoted student engagement, however careful design of overarching questions and guidance adjusted according to individual's pre-existing knowledge and the conceptual difficulty are recommended. Reconnaissance trips and pre-planning of detailed inquiries add to the coherence of activities. Constructivist and place-based learning are widely accepted by the participants for offering personal ownership of learning, engaging experiences, impactful visuals, and local relevance of knowledge. It is recommended that explanations on the benefits of constructivism both at the start of the course and during learning be carried out in future to ensure positive motivation and engagement. The instructors also should explicitly explain the value of increased cognitive efforts early during the constructivist process to persuade students that active instruction is beneficial. It is also recommended that, if possible, teachers have the opportunity to collaborate and co-teach in order to experience a variety of teaching approaches, receive feedback on their own teaching and learn that different pedagogies are not mutually exclusive.

In EDU452, conceptual and experiential learners have different understandings of the role of Earth Science. The "ideal order" of introducing EE and ES depends on the learners themselves and the purpose of the activity. Either a "happy median" needs to be set for different styles of learners, or the instructors should support learners by personalizing their learning. An integrated teaching strategy is believed to enhance the congruency across subjects. In future, ES is suggested to be broadly incorporated across all modules of EDU452, and formalized as an integral part of all aspects of the course.

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