



Using sustainability Indicators In University Teacher Training Course

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Abstract

Sustainability is included in numerous European primary and secondary school curricula, and science is one of their mandatory subjects [1]. In this context, sustainability education scholars seek to uncover ways to effectively transfer knowledge to students while simultaneously looking for appropriate contexts to present science topics [2,3]. Moreover, these experts pursue methods for helping students develop skills such as critical thinking, scientific thinking and reasoning or analytical thinking. Yet, despite the consensus on the advantages of combining sustainability and science teaching, connecting scientific knowledge to environmental issues and conveying these links to teachers remains a challenging task [4]. For this reason, we argue that approaches aimed at helping students gain knowledge and develop skills by combining science and sustainability education content and methods should start with teacher training at the university. In our paper, we present the results of our three-year action research on a teacher training university course. Based on our findings, sustainability indicators are the most effective ways to connect often isolated knowledge about sustainability themes and science knowledge. Sustainability indicators also enable us to show university students how to appropriately develop more general skills such as analytical or critical thinking in a natural way.

Keywords: *science education, sustainable development indicators, pre-service teachers, action research, curriculum development*

1. Introduction

Transitioning towards sustainability requires searching for new strategies for improving the social capacity to guide interactions between nature and society. One such crucial approach in this transition is Education. However, sustainability education can only be effective when fostering informed, skilled behaviours and ways of thinking while simultaneously promoting critical thinking about scientific evidence and policies, in addition to testing ideas and exploring dilemmas and contradictions inherent to sustainable living [5]. For such purposes, higher education may offer an effective response to these transition challenges because universities training pre-service teachers are key potential mediators of social transformation [6].

Specific sustainability training courses can address scientific knowledge related to sustainability connected to new real-life contexts and to effective teaching methods. Some studies have shown that such courses enable a balanced perspective of sustainability [7]. Furthermore, these courses lead to at least short-term pro-sustainable development beliefs and norms among pre-service teachers [8].

In sustainability high school courses, sustainable development indicators can play a key role. Sustainable development indicators help to communicate complex information about sustainable development in various contexts with different types of stakeholders in a simplified manner [9]. Indicators provide important information on sustainable development, which can be transformed into knowledge and simultaneously into an information platform for analytical and critical thinking development. However, different sources provide both social and natural environment indicators in different ways; quantitative indicators are expressed or described by measuring, statistically analyzing, or modelling data, while qualitative indicators are verbal or visual expressions. [e.g., 10]. Therefore, indicators can be easily used in university courses for pre-service teachers in social sciences education, as well as in science education or engineering and mathematics.

From our perspective, the best approach to tapping into this high potential consists of connecting all (social, economic, and environmental) views on sustainability issues. Accordingly, in our sustainability-science oriented course, we are looking for ways of showing pre-service teachers



appropriate sustainability contexts for presenting science topics often regarded as challenging by most authors [e.g., 2, 3 and 4].

In our paper, we present the results of our three-year action research on a teacher training university course (primarily intended for master students) where different types of sustainability indicators for each science topic were used to varying extents and in different formats. All these indicators are linked to science education issues covered in the Czech national curricula. Based on this research, we argue that sustainability indicators are highly effective in connecting often isolated knowledge about sustainability themes and science knowledge, albeit requiring using appropriate (topical) indicators and methods.

2. Method

Action research is a process involving cycles of action and reflection that may be used to improve instructional practice. Action research usually occurs in the natural setting of a classroom or school, and its results produce practical knowledge, which can lead to meaningful change when based on rigorous (systems thinking) research procedures [see e.g. 11, 12]. In our action research, the researcher-university teacher applied two complementary methods - participatory observation followed by a focus group approach, offering powerful insights into student's feelings and thoughts. We were able to use these methods because fewer than 10 students attended the course. Moreover, the course was attended primarily master by students who started real teaching within a few months and were highly motivated to get as many as possible sources of information and to learn methods for appropriate science-sustainability knowledge transfer to their future students. Thus, they were willing to share their views and opinions with the teacher-researcher.

3. Results

The first finding answers the question as to whether covering science topics with multiple sustainability indicators is better than merely using one (key) indicator or index. Based on the observation of the teacher-researcher, using more indicators to connect science and sustainability topics confuses students and inhibits debates on a specific issue or renders the debate endless. During the focus group experiment, wherein the students were asked about the appropriateness of having one or more sustainability indicators, the students agreed that more indicators sometimes seem misleading and make the communication about the information overly complicated. They stated that using one key indicator to link science and sustainability was more convenient despite understanding that finding the best indicator is extremely difficult. Only when the phenomenon can be described by both a subjective and an objective indicator do students find it interesting. In such a case, possible differences between people's perceptions and objectively measured data can be identified. As a case in point, differences between data on air quality objectively collected by an air quality monitoring system and the data collected by a mobile application City air [13] mapping peoples' air-quality perception are discussed in the course.

The second finding answers the question as to which context the students find most attractive. Based on the results from participatory observation and from the focus group, contexts related to everyday and topical situations are the most attractive and relevant. For example, before the Covid pandemic, on the web page "Our World in Data", the students were especially interested in health and climate change data. However, during the pandemic, they were only interested in health data, including those related to Covid comorbidities. Recently, Russia's invasion of Ukraine has been the dominant theme in media, so World resources became the most relevant and interesting for the students. However, these currently most popular indicators are not discussed just in the context of current affairs but in a broader sustainability context, thereby becoming even more interesting and relevant for them. In the long run, regardless of current events, students are interested in indicators related to food waste, climate change and health related indicators. Gap Minder indicators are also highly popular.

The last finding related to indicator formats is not surprising. The students preferred indicators/ data displayed in interactive formats (at least an animation of trends should be shown). All the calculators (e.g., footprint calculators, water calculators) and short video presentations accompanied by indicators were also popular (e.g., excerpts of Ted talks). Based on the teacher-researcher observation, tables, graphs, and other representations should be limited as students' attention declines after a while although they are encouraged to discuss the topic.



4. Conclusion and discussion

Pre-service teachers perceive indicators as an effective strategy for science-sustainability knowledge transfer. Moreover, by using these indicators, they uncover a new way of thinking about sustainability and science while identifying the pros and cons of using sustainability indicators in their future lessons. The results from this study cannot be generalized, but efforts to make sustainability indicators attractive and presentable can undeniably benefit education. We argue that their potential should be exploited in teacher training courses for pre-service teachers and in further education courses for in-service teachers, thereby facilitating the transition towards sustainability.

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References

- [1] Stratilová Urválková, E.; Blaško, M.; Janoušková, S. (2021) Sustainability as a core concept of an integrated curriculum: Can the Czech curriculum follow the western countries? In Proceedings of the ICERI2021, Florence, Italy, 8–9 November 2021; pp. 7092–7100.
- [2] Seatter, C.S.; Ceulemans, K. (2017) Teaching Sustainability in Higher Education: Pedagogical Styles That Make a Difference. *Canadian Journal of Higher Education*. 2017, 47, 47–70.
- [3] Dima, A.M.; Meghisan-Toma, G.M. (2018) Research on implementing education for sustainable development. In Proceedings of the 12th International Conference on Business Excellence 2018, Bucharest, Romania, 22–23 March 2018; Volume 12, pp. 300–310. Available online: <https://sciendo.com/article/10.2478/picbe-2018-0027>
- [4] Kioupi, V.; Voulvoulis, N. (2019) Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability* 2019, 11, 6104.
- [5] Vare, P., Scott, W. (2007). Learning for a change: Exploring the relationship between education and sustainable development. *Journal of Education for Sustainable Development*, 1(2), 191-198.
- [6] del Carmen Pegalajar-Palomino, M., Burgos-García, A., Martínez-Valdivia, E. (2021) What does education for sustainable development offer in initial teacher training? A systematic review. *Journal of Teacher Education for Sustainability*, 23(1), 99-114.
- [7] Zeegers, Y., Clark, I. F. (2014). Students' perceptions of education for sustainable development. *International Journal of Sustainability in Higher Education*, 15(2), 242-253.
- [8] Andersson, K., Jagers, S. C., Lindskog, A., Martinsson, J. (2013). Learning for the future? Effects of education for sustainable development (ESD) on teacher education students. *Sustainability*, 5(12), 5135-5152.
- [9] Stanners, D.; Bosch, P.; Dom, A.; Gabrielsen, P.; Gee, D.; Martin, J.; Rickard, L.; Weber, J.-L. (2007) Frameworks for environmental assessment and indicators at the EEA'. In *Sustainable Indicators: A Scientific Assessment, Scientific Committee on Problems of the Environment*; Hak, T., Moldan, B., Dahl, A., Eds.; SCOPE 67; Island Press: London, UK, 2007; pp. 125–144.
- [10] Urválková, E. S., Surynková, P. (2021). Sustainable Development Indicators—Untapped Tools for Sustainability and STEM Education: An Analysis of a Popular Czech Educational Website. *Sustainability*, 14(1), 121.
- [11] Barcelona, A. B. (2020). An Analytic Hierarchy Process for Quality Action Researches in Education. *International Journal of Evaluation and Research in Education*, 9(3), 517-523.
- [12] Reason, P., & Bradbury, H. (Eds.). (2001). *Handbook of action research: Participative inquiry and practice*. Sage.
- [13] City Air. Available online (accessed on 6th May 2022): <https://play.google.com/store/apps/details?id=io.cordova.CityAir&hl=cs&gl=US>