REVISITING TEACHING METHODOLOGY IN BIOLOGICAL SCIENCES ON NEP 2020 PERSPECTIVE

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Abstract

There are very few studies concerning the importance of teaching methods in biology education and environmental education including outdoor education for promoting sustainability at the levels of primary and secondary schools and pre-service teacher education. The material was selected using special keywords from biology and sustainable education in several scientific databases. The foci of the analyses were teaching methods, learning environments, knowledge and thinking skills, psychomotor skills, emotions and attitudes, and evaluation methods. Additionally, features of good methods were investigated and their implications for teaching were emphasized. In total, 22 different teaching methods were found to improve sustainability education in different ways. The most emphasized teaching methods were those in which students worked in groups and participated actively in learning processes. Research points towards the value of teaching methods that provide a good introduction and supportive guidelines and include active participation and interactivity for learning biology. The New education Policy (NEP- 2020) which opens a wide arena to learn the biological science with many educational softwares, IOTs hence the transformation of teaching has become imaginary to reality among the students and faculties. The present paper also establishes the available resources that enhance the Biological science education to next level in forthcoming years.

Keywords: Biology education; Environmental education; NEP 2020, IOTs

Introduction

Education is one of the goals for the future is the construction of a sustainable society [Gladwin, 1995]. A sustainable society is considered to be a society that has reached sustainability through a process called sustainable development. Sustainable development as a concept is heavily context-dependent in social, cultural, and environmental situations [Kopnina, 2012]. Brundtland's report defines sustainability as ―development that meets the needs of the present without compromising the ability of future generations to meet their own needs‖ [United Nations Report, 1987]. According to [Diesendorf, 2000], this definition emphasizes the long-term aspect of the concept of sustainability and introduces the ethical principle of achieving equity between the present and future generations. It does not mention the natural environment explicitly, focusing only upon human needs or wants. However, the report makes it clear that these ―needs‖ include the conservation of the natural environment. More recently, it has been given a broader definition which conveys that there are three principal dimensions: an ecological, economic and social. In the teaching and learning of sustainable development, the ecological dimension refers to the natural one and includes all living things, resources and life-supporting systems. Its goal is conservation. The economic dimension comprises jobs and income, and its goal is appropriate development. The social dimension involves people living together. Its goal is peace, equality and human rights. In addition to these three dimensions, there is also a fourth one, the political dimension. It has to do with politics, policy and decision-making as a goal of democracy [Fien, 2009]. The ecological issues are important in biology education, e.g., in Finland, Sweden and Denmark, they form the core content in the curricula of biology for basic education. All biology curricula emphasize different biotopes and ecosystems, lifecycles of plants and animals, and life-supporting processes, such as photosynthesis, respiration and biodiversity, but they do not mention the other dimensions of sustainability [Skolverket, 2000]. For this reason, we stress the ecological aspect in this study. Our aim is to find out and describe useful teaching methods in biology education and sustainability education (SE) including outdoor education (OE) for promoting sustainability in primary and secondary schools and teacher education. As far as we know, there are no previous studies from these perspectives.

An ongoing debate over the last three decades has been how the role of education should be conceptualized when creating sustainability and a sustainable future. Sustainability and a sustainable future are here understood as the goals of sustainable development. The relationships between environmental education, education for sustainable development, and sustainable development education have been discussed. Environmental education and education for sustainable development are interpreted in different ways around the world, according to context [Wessellink, 2011]. Some authors argue that education for sustainable development is a part of environmental education [Mckeown, 2003] or a perspective of environmental education [Suave, 2005], or that environmental education has developed into education for sustainable development [Eilam, 2010]. In Agenda 21, it has been stated that environmental education is a continual, life-long learning process to raise public awareness and action globally, nationally and locally in

every area in which humans impact the environment. Important distinctions between the goals of environmental education were made by [Lucas,1979]—‖in,‖ ‖about‖ or ‖for‖ the environment—in order to avoid misunderstandings about the intended type of environmental education.

According to [UNESCO, 2016], education for sustainable development is about enabling people to constructively and creatively address present and future global challenges and create more sustainable and resilient societies. Learning in education for sustainable development often includes only knowledge, values and theories related to sustainable development. However, it also means ‖learning to ask critical questions; learning to clarify one's own values; learning to envision more positive and sustainable futures; learning to think systematically; learning to respond through applied learning; and learning to explore the dialectic between tradition and innovation‖. Thus it offers learners a context for developing active citizenship and participation, embracing the complexity of the interdependencies of ecological, societal, and economic systems. The overall goal of the UN Decade of Education for Sustainable Development (2005–2014) was to integrate the principles, values, and practices of sustainable development into all aspects of education and learning [UNESCO, 2009]. In Finland, sustainability is included in the curriculum for basic education at all educational levels. How this has been done is described in more detail in another article of this special issue [Wolff, 2016].Sustainable development education again is based particularly on environmental and ecological sciences and focuses on the interaction between ecological and social systems. It encourages students to critically reflect on the ideas of sustainable development and the values that underlie them, and to create solutions to achieve concrete goals in a variety of unpredictable situations [Dale, 2005].As noted above, both environmental education, education for sustainable development, and sustainable development education share a vision of quality education and a society that lives in balance with Earth's carrying capacity. They are thus integrated and represented in all dimensions of sustainable development. In this study, we use the term sustainability education (SE) [Sterling, 2010] because it catches all forms of environmental education, education for sustainable development, and sustainable development education.

Methods

The study is a qualitative survey with quantitative features [Morse, 2010 and Collins, 2010]. At first, we examined the selected 17 journals concerning biology education and SE. They included in total 29 articles that mentioned teaching methods. From these, we selected 16 journals with 24 articles to be analyzed in detail.

In the analysis, we followed the method of qualitative content analysis. Inductive content analysis was used to analyze teaching methods, learning environments and features of useful teaching methods and implications. Deductive content analysis was used to analyze psychomotor skills, emotions and attitudes, knowledge and thinking skills and also evaluation methods [Mayring, 2000].

In order to ensure the reliability of the process, all three members of the research team first conducted the selection of information units, the categorization and the subsequent analysis independently. The analysis process was dialogical by nature. The final decisions were made through e-mail discussions where each researcher argued why the content of the article should be placed into a certain category or categories. The discussion continued until consensus was reached and clear arguments were found. The generalizability of results relates to the selection of analyzed data. To ensure that our categorization decisions were based on comprehensive understanding of the article, we decided to read the whole article before categorizing it. We also based our analysis on what the authors of the articles had explicitly written rather than what we in some cases thought we could read between the lines as being the authors' intentions. As such decisions always include elements of subjective interpretation, joint discussions about each article were essential in deciding which aspects of the instructional process the article emphasized. This procedure ensured that decisions were not based on a single person's first impression of an article but on well-argued joint discussions. Because of the dialogical nature of the analysis, we did not see a need for calculating an inter-rater reliability. Researcher triangulation was an essential part of our analysis process. Our research group consisted of experts from biology education, environmental education, sustainable development education, and educational sciences, and all researchers are experienced teacher educators and researchers.

Findings and Discussion

This article mainly concern over the teaching methods in relation to other issues in the studies of biology and sustainability education. Teaching methods can be seen as objective-oriented activities and flow of information between teachers and students. Studies of teaching methods are important because teaching methods influence all types of learning in the cognitive, affective and psychomotor domains [Karami et al., 2012, Prince, 2006]. The choice of teaching methods depends on what kind of teaching approach is preferred. Traditional instruction in biology is deductive and comprises the principles and methods used for instruction to be implemented by teachers to achieve the desired learning or memorization by students. In this kind of teacher-centered approach to learning, teachers are authorities and students' primary role is to passively

receive information through lectures and direct instruction. Learning is measured using objectively scored tests and assessments [Prince, 2006 and Eisner, 2004]. Alternative teaching approaches are inductive where instruction begins e.g., with observations, experimental data to interpret or a real-world problem to be solved. In this student-centered approach to learning, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of material. Learning is continuously measured using both formal and informal forms of assessment, including group projects, student portfolios, and class participation [Prince, 2006]. The selection of teaching methods is affected by the learning objectives. The clearly specified learning objectives also provide the goals at which the curriculum is aimed, they facilitate the selection and organization of content, and they make it possible to evaluate the outcomes of the learning [Eisner, 2004]. Several good features are emphasized in the analyzed teaching methods and have implications especially for developing curricula and teaching for sustainability.

Learning Environments

Since learning environments have been developed to support the selected teaching methods, they both have an effect on learners' achievements. The most often used learning environment were classrooms, which were mentioned in 22 out of 24 articles. Introductions, guidelines, and discussions concerning learning experiences and results of observations and experiments were often carried out in the classrooms, in addition to traditional teacher presentations and inquiries. Outdoor and field environments were mentioned in 14 articles. Different visiting places, such as museums, gardens, and nature parks, were the third most common learning environments (mentioned in 11 articles). Such places appear to be good learning environments because students' learning results are significantly better when they get first-hand experiences and studies in authentic learning environments [Smeds, 2015].

Laboratory environments were found to be more effective and although laboratories are places where students can meet real scientists and learn how research is done. In school laboratories, students can develop their experimentation skills when planning and carrying out small studies. The internet and electronic discussion forums were mentioned in two articles.

Features of Useful Teaching Methods and Implications

The article gives a clear endorsement for the provision of a certain kind of biology education approach. This research emphasizes the value of teaching methods which have a good introduction and supportive guidelines and include active participation and interactivity. The results support Rickinson's research . First-hand experiences, locality and place-based education, and OE are also emphasized. Conversely, systematic teaching of sustainable development, teachers as role models, continuing development of EESD (Environmental Education for Sustainable Development), positive feedback, and whole-school approaches were not popular (mentioned only twice). Moreover, neither continuous teacher and staff education nor differentiation were popular, having been mentioned only in one article together with the ideas that SE should be taken into account at all education levels, and that there should be enough time for SE. The reason could be similar to those that Rickinson reported in his study, e.g., that the aims of SE are not always realized in practice, the different types of barriers faced by individual students and teachers in learning and teaching SE, and familiarity with the SE setting [Rickinson, 2004].

Conclusion

The study aimed to identify and describe useful teaching methods in biology education and sustainability education (SE) including outdoor education (OE) for promoting sustainability. Although our analyses of recent research on teaching methods and their evaluation included several details, a holistic view of the educational processes is needed for the understanding of all effects. All teaching methods are, of course, context- and subject-dependent, and cannot therefore be arranged as a list of the most or least effective methods. The analyses, however, provide ideas of how to use these methods together for promoting sustainability aspects in teaching, and also of how to evaluate the whole process for the purpose of curricula development. The study emphasizes especially the value of inductive teaching methods with student-centered approaches in authentic environments with first-hand experiences. Like previous research the analyses also emphasized fieldwork and field trips, including problem-based activities, as factors increasing students' interest in and knowledge of sustainability. Fieldwork appeared to have positive effects also on students' attitudes and behavior concerning sustainability Students' relationships with and connectedness to nature, environmental consciousness, and interest in biology are all important factors in any attempt to create a sustainable future. Reviewing all the parameters the science is getting more popular and changing itself into an applied nature and the development in life science is also unavoidable. In this connection with the New Education Policy it is necessary to provide more field oriented study with live experiments, practical demonstrations. So students may get benefitted in learning new things.

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