Development and Evaluation of Teaching Materials for University Students on Biodiversity Conservation: A Case Study

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Abstract

Biodiversity, the foundation on which we live, is threatened by the negative impact of human activities on nature. It has been pointed out that in order to improve the current situation, each of us needs to change our way of thinking and behavior. We have therefore developed a curriculum for this purpose. This case study aimed to achieve two main objectives: (1) to develop and evaluate a curriculum (aimed at university students aspiring to become childcare and primary school teachers in Japan) to promote knowledge acquisition and behaviour change in biodiversity conservation; and (2) to examine its international versatility by implementing and evaluating the curriculum for Turkish and Indonesian to implement and evaluate the curriculum with university students. The sample for this study consisted of (1) 126 university students from four Japanese universities, (2) 22 university students from one Turkish university and 20 university students from one Indonesian university. The results of the evaluation by the Japanese class participants revealed that the curriculum stimulated interest and understanding of biodiversity conservation and triggered behavioural change. Evaluations in Turkey and Indonesia showed similar results, with Turkey revealing that it provided an opportunity to deepen awareness of the nature of science. This curriculum could be made internationally useful by adapting it to take account of local realities.

Keywords: biodiversity conservation, university students, curriculum development

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Introduction

Biodiversity, the foundation on which we live, is in crisis due to the negative impacts of human activities on nature. However, none of the 20 individual targets in the Aichi Biodiversity Targets 2011-2020 has been fully achieved, and the successor Kunming-Montreal Biodiversity Framework has reiterated targets to reduce threats to biodiversity in order to realise a world in harmony with nature (UNEP, 2022). Species and gene conservation and measures against invasive alien species are examples, but the values and behaviours of society have been identified as the underlying causes of these problems (IPBES,2019). In other words, changing our thoughts and behaviours is essential to improve the current situation. Education and awareness-raising is one of strategies, and pre-school and primary school education is no exception. If teachers have the right knowledge and mindset and take action towards conservation, they will have an impact on children, directly and indirectly. The development of educational programmes for students who will be responsible for this practice in the future has been cumulative, and our attempt is a continuation of this.

The study developed a curriculum based on the results of a survey on biodiversity conservation among Japanese students who wanted to become nursery and primary school teachers (Doi et al., 2022) and evaluated whether the curriculum provided class participants with the opportunity to acquire knowledge and change their behaviour regarding biodiversity conservation.

Our research has 2 objectives. The first is to develop and evaluate a curriculum (aimed at university students who want to become nursery and primary school teachers in Japan) to promote knowledge acquisition and behaviour change in relation to biodiversity conservation. And secondly, to implement and evaluate the curriculum with university students in Turkey and Indonesia to test its international generalisability.

Method

The curriculum was developed based on the findings of Doi et al. (2022) and the benefits of treating the science-related content and its social impact as a series of interlocking narratives as noted by Levinson (2009). It is in an interactive lecture format with slide material developed in PowerPoint. The slides were based on the importance of "future thinking" and its elements (picturing, predicting and planning) (Ardh & Fujii, 2022) and the theoretical ladenness of observation (Hanson, 1958) in order to become "shapers of a sustainable society", The following content and sequence was used. (1) What is biodiversity? (2) Four crises that threaten it, (3) What are alien species? (4) Examples of alien species causing unexpected situations (Mongoose in Japan), (5) Merits and Demerits of Agriculture, (6) Examples of insecticides causing unexpected situations (Lake Shinji, Japan), (7) Impacts on biodiversity from "deforestation of tropical rainforests", "burden from livestock farming" and "burden from cultivation of single crops", (8) Collapse of the ecosystem pyramid due to the increase in human presence, (9) the question: can we abandon our convenient and comfortable lifestyles?

Curriculum evaluation was carried out by analysing class participants' responses (Japan 126, Turkey 22, Indonesia 20) to the questionnaire. Choice responses were asked for using the five-choice method. Open-ended responses were analysed and evaluated using after-coding. It was conducted and reviewed by the first and fourth authors to establish reliability.

Results

The choice answer questions were as follows; (i) I felt the importance of thinking critically (ii) I felt the importance of predicting the future, (iii) I felt the importance of thinking about connections, expansion, and relationships with other regions, including foreign countries, (iv) I felt the importance of not losing "bio-diversity", (iv-1) I felt the importance of not losing "genetic diversity", (iv-2) I felt the importance of not losing "species diversity", (iv-3) I felt the importance of not losing "ecosystem diversity", (v) I realized that agriculture has a big impact on the environment, (vi) I felt that there is a big connection between preserving biodiversity, our economic activities, and human society, (vii) There were connections between living things that I didn't know about until I took the class, and (viii) I felt an aspect of science (e.g., pesticides deprive organisms other than specific species of habitat) that I didn't know about until I took the class. Responses were requested using the five-case method (5– Extremely Likely; 4– Likely; 3– Neutral; 2– Unlikely; 1-Extremely Unlikely). The open-ended questions were (A) what you, as a citizen, can do on a daily basis to conserve biodiversity, (B) impressions, questions and things you would like to know more about after taking this class. The results of responses to the choice questions are presented Table 1.

Table 1
The Results of Responses to the Choice Questions (percentage of 5s and 4s)

	JPN	TUR	IDN
(i) thinking critically	93.6	100	85
(ii) predicting the future	100	90.9	80
(iii) relationships with other regions	100	86.3	90
(iv) not losing "bio-diversity"	98.4		95
(iv-1) not losing "genetic diversity"		81.8	
(iv-2) not losing "species diversity"		90.9	
(iv-3) not losing "ecosystem diversity"		100	
(v) agriculture has a big impact	96	90.9	90
(vi) our economic activities and society	97.6	100	95
(vii) connections between living things	94.5	77.3	60
(viii) aspect of science	92.1	72.7	65

Source: Original research results

More than 95% of respondents in all countries selected "the main relevance of environmental issues to our society and economy", and more than 90% in all countries selected "the importance of not losing biodiversity" and "the main impact of agriculture on the environment".

The results of the free text responses are as follows. The results of the after-coding of students' responses to comments, questions and what students would like to know more are presented in Table 2.

Table 2

The Results of the After-Coding of Students' Responses to Comments, Questions and What Students Would Like to Know More

JAPAN		TURKEY		INDONESIA	
Transformation of consciousnes Deepening of awareness	44	The relationship between science and society	14	environmental problem	14
Interesting learning experiences	38	Personal Growth	8	biodiversity	12
Importance of biodiversity / ecosystems	36	environmental awareness	8	awareness-raising activities	7
introduced (non-native) species	27	Changing perspectives	6	Role of the individual	3
Human impact	18	biodiversity	5	plastic waste	2

Source: Original research results

There were differences between countries in terms of comments, questions and what they wanted to know more about. Japanese students were significantly more likely to comment on non-native species (There were scattered comments on this among Turkish students, but none among Indonesian students.). Turkish students were significantly more likely to comment on the nature of science, such as the relationship between science, technology and society. Indonesian responses were mostly questions (often about environmental issues, especially those related to plastics). On the other hand, a commonality was found in the Japanese and Turkish responses. It was the joy of gaining new knowledge and previously unthought-of new perspectives, and an awareness of the deepening of one's own awareness, described by a large number of students.

The results of the after-coding of students' responses on what could be done in daily life are shown in Table 3.

Table 3

The Results of the After-Coding of Students' Responses on What Could Be Done in Daily Life

JAPAN		TURKEY		INDONESIA	
Avoiding environmental impact in daily life	57	Raising awareness and updating knowledge	19	Avoiding environmental impact in daily life	17
Raising awareness and updating knowledge	32	Avoiding environmental impact in daily life	11	Take action	2
keep and cultivate living things until the end of their lives	17	Take action	10	Do not kill a living things unnecessarily	1
Do not kill a living things unnecessarily	15	Social reforms	7		
Take action	5	Focus on education	3		

Source: Original research results

"Avoiding environmental impacts in daily life" and "Take action" were common categories across the three countries (with some differences in description). The more common responses from Japan and Turkey were "Raising awareness and updating knowledge". The most common statements in Japan alone were "keep and cultivate living things until the end

of their lives" and "do not kill living things unnecessarily". The latter was also mentioned once in Indonesia. The most common statements in Turkey alone were "Social reform" and "Focus on education".

Discussion

The analysis of the optional responses from three countries (Japan, Turkey, and Indonesia) shows that the lessons raised students' awareness of the interconnectedness of environmental issues, human society and the economy, as well as the significant impact of agriculture on the environment. More than 90% of the responses were positive, highlighting their awareness of agriculture's environmental impact and their commitment to reducing biodiversity loss. On the other hand, "the importance of thinking critically and predicting the future" item was answered positively by more than 90% of the respondents in Japan and Turkey, while the figure was slightly lower in Indonesia. In addition, the percentage of positive from Indonesia for question vii (There were connections between living things that I didn't know about until I took the class) and viii (I felt an aspect of science that I didn't know about until I took the class) are significantly low. This fact suggests that the contents of this material was a mismatch for Indonesian students.

The analysis of the open-ended responses is described below.

Analysis of "Thoughts, questions and things you would like to know more about" item shows that this lesson was very interesting for both Japanese and Turkish students as they were pleased to have gained new knowledge and perspectives. However, these students' perceptions were not the same. Many of the Japanese students focus on their own behaviour, saying "I thought that small daily actions lead to biodiversity conservation", "I wanted to know more deeply about the advantages and disadvantages of agriculture" and "I thought that perhaps we need to consider whether insects should be easily killed". On the other hand, Turkish students' statements were based on the "nature of science", such as "I realised how comprehensive science is" and "In the future I will pay more attention to the relationship between science and society and give it more importance". On the other hand, the Indonesian students' questions (e.g., about deforestation and plastic waste) do match with the country's specific socio-scientific context. Questions such as "How can we protect nature at a time when many industries are clearing forests for business?", "Can we completely eliminate plastic waste from Indonesia?" indicate the need of change to adapt materials and develop localized curriculum like suggested by Oludipe (2011) and Caballero-Serrano et al. (2017).

There were also some country-specific characteristics in terms of what could be done in daily life. Japanese respondents focus on keeping and cultivating due to the unique Japanese culture in which it is extremely common to see breeding cases lined up in the back of primary school classrooms for the continuous rearing and observation of insects and small fish, and people of all ages enjoy rearing insects from larva to adult. This aligned with previous studies, such as Schachat (2015), "positive perceptions of insects in East Asia have influenced Japanese artworks", and Doi and Ardh (2024), "the unique Japanese view of nature that reveres animals, insects, birds and plants has influenced culture and customs". In Turkey, comments referring to social change were prominent, such as "as a nation we can improve our recycling practices", "we will help enact laws to protect biodiversity" and "wrong land use must definitely be corrected". These perspectives aligned with research results from Gules-Bal and Karakas (2018) that suggested that Turkish students perceived biodiversity within social and political context. Indonesian students asked a notably high

number of "questions". Their free-response comments reflect the complexities of a variety of factors, such as the social conditions and views of nature in the country. These questions reflected the environmental issues in Indonesia including plastic pollution (Phelan et al., 2020). As discussed above, the programme was shown to have some versatility in terms of inducing behavior change in participants. On the one hand, the responses reflect the social and contextual situation in each country, indicating the need to adapt the materials accordingly.

Conclusion

The lesson using this material stimulated interest and understanding of biodiversity conservation. The lessons using this material also promoted understanding of the risks of biodiversity loss, and the importance of predicting the future, thinking critically, and considering links with other regions, as well as the significant links between environmental issues and human society and the economy. The effectiveness of dealing with familiar topics was apparent. Lessons using this material have the potential for international generalizability. However, it needs to be evaluated in many more countries and, in doing so, the content needs to be arranged according to the contextual issues in those countries.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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