Raising Environmental Worldview of Pre-service Teachers in a Biology Course: An Evaluative Study

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Abstract

Teacher education programme can be capitalised to raise awareness of teachers to have a positive environmental worldview to serve the purpose of teaching environmental education across different subjects. 'Biological Diversity' is a compulsory course for pre-service teachers whose major is Science in the Malaysian teacher education institute. This course was conducted in blended learning mode in which Facebook was used to complement face-to-face interactions between lecturers and pre-service teachers. This article elaborates on the structure and objectives of a technology-enhanced 'Biological Diversity' course in raising environmental worldview of pre-service teachers and evaluation of Facebook as a learning tool. New Ecological Paradigm (NEP) survey items were used to evaluate the effectiveness of the course to improve pre-service teachers' environmental worldview. Qualitative framework analysis was performed on respondents' open-ended responses in a pen-and-paper survey, and posts on Facebook, a social media platform to interpret pre-service teachers' feedback on the use of Facebook for blended learning. The change in the mean scores of the NEP scale before and after the course revealed improvement in the pre-service teachers' *pro-environmental worldview. Their response posted on Facebook also indicated that the 'Biological Diversity' course had made them more environmental conscious. However Facebook was not found to be a favourable learning tool for this course. The findings in this study provide insight on embedded environmental education in teacher training programmes and the use of online learning platform in supporting environmental education.*

Keywords: Blended learning; Environmental education; Teacher education

Introduction

Background and Overview

Technology is becoming more prominent in today's classrooms, and one thing which is surely undeniable is that it brings the usual classroom set up of students and teachers into a more engaging, interactive and fun venue where a meaningful teaching – learning process could

take off. It has become an essential tool for many educational institutions in today's world, and thus, it is vital for improving both instructional competencies of teachers and significant learning outcomes from among the students at all levels (Association of Mathematics Teacher Educators, 2006).

With the rapid emergence of digital instructional resources and access to high-speed bandwidth as well as devices, educational leaders and researchers are experimenting pedagogies of combining online and regular classroom learning venues to make variations on how instruction is provided, to improve the learning performance of the students. As a result, many institutions are already creating new administrative positions and teams combining expertise in instruction, technology, and subject area content to help their schools investigate appropriate digital resources, as well as planning for technology upgrades and professional development (Murphy et al., 2014).

The New Ecological Paradigm (NEP) scale is a revised version of the New Environmental Paradigm which was originally introduced by Dunlap and Van Liere in 1978 to measure pro-environmental orientation (Dunlap Van Liere, Mertig & Jones, 2000). The conceptualisation of the former paradigm which focused on mankind upsetting the balance of nature, limitation to human population expansion and the right of mankind to rule over nature, resulted in a 12 Likert-item scale. The revised version consists of 15 items to tap on five facets of the ecological worldview, namely (a) limitation to the human population, (b) anthropocentrism, (c) balance of nature, (d) exemptionalism, and (e) ecocrisis.

The underlying theoretical framework of the NEP scale was the authors' contention of a measurable ecocentric belief system that opposes the Dominant Social Paradigm (DSP) (Hawcroft & Milfont, 2010). Agreement to even-numbered items in the revised NEP Scale is meant to endorse the DSP, whereas agreement to odd-numbered items is meant to reflect the NEP (Dunlap, Van Liere, Mertig & Jones, 2000). The DSP views humans as independent creatures who are above other organisms. Consistent with the views which emphasise on human domination over nature, humans could strive to use and modify earth resources.

The DSP is supported by innovative technologists and political opponents of environmentalism. The worldview of DSP is comprised of the following basic beliefs: (a) technology can prevent the deterioration of earth due to industrial development can resolve the detrimental effect of industrialisation; (b) economic prosperity can appease the society of their qualms, and (c) only politicians can formulate policies for the benefit of the society. On the other hand, the NEP evolves around the eco-centred conviction, considering humans as part of the environment and therefore are endowed with certain limitations. Contrary to the materialist DSP worldview, NEP looks for environmental protection through restrictions on industrialisation and population growth. NEP also recognise that the collapse of the biosphere is a direct consequence of human-centred interactions with nature.

Aim and Research Objectives

Due to the lack of studies on environmental worldview within the context of teacher education, this article elaborates on the structure and objectives of a technology-enhanced 'Biological Diversity' course in raising environmental worldview of pre-service teachers.

Additionally this study was also intended to evaluate if Facebook was effective in facilitating learning of this course.

Review of Related Literature and Programme of Study

The Role of Biology in Environmental Education

A good grounding in Biology could help students to develop a clearer understanding of environmental issues as the concerns and impacts of environment-related issues revolve around living things (Lee, Tan, & Lim, 1995). The importance of Biology lesson in environmental education is further underpinned by the well-elaborated analyses by Lee et al. (1995) on the ten environmental issues highlighted at the United Nations Conference on the Environment and Development in June 1992 (Saint-Laurent, 1992). More recently, most of the 17 Sustainable Development Goals (Sustainable Development Knowledge Platform, n.d.) can also be connected to biology-related themes. The Biology Science Inquiry Model (adapted from Joyce, Weil, & Showers, 1992) was designed to facilitate students in mastering biological principles and concepts, and subsequently to nurture students' scientific inquiry and applications in environmental issues. Changes in students' environmental worldview after biology-related courses were reported among university students (Dagiliūte & Niaura, 2014).

The Role of 'Biological Diversity' Course in Raising Awareness on Environmental Worldview

'Biological diversity' is a compulsory course to be taken by pre-service teachers who major in Science in their first year of teacher education degree programme. This course offers pre-service teachers to understand the diversity in organisms and their general characteristics. Discussions on the importance of biodiversity and developments in genetic technology enable pre-service teachers to realise their responsibilities in managing biodiversity for the survival of the other species in the future.

There is a total of 127 hours of guided and independent learning. Face-to-face interaction consists of 30 hours of lecture, 15 hours of tutorial, 12 hours of practical and 3 hours of assessment. Non face-to-face interactions consist of 30 hours lecture, 15 hours tutorial and 22 hours assessment. Pre-service teachers' assessment is determined by two methods: examination (40%) and coursework (60%). The coursework comprised of quiz, essay writing and practical reports.

The following are the course learning outcomes:

(a) Describe the concept of speciation and various methods of species classification.
(b) Study the general characteristics of virus and organisms found in the Domain of Archaea, Eubacteria and Eukarya through practical.
(c) Analyse the presence of genetic diversity.
(d) Study the latest products of biotechnology in the market using multiple sources of information.
(e) Discuss the threats and issues related to the management and protection of genetic diversity to handle the pressures upon the survival of species based on moral values and ethics.

There are six chapters that were delivered in this course. Chapter one discusses types of speciation, models of speciation and systems of classification. Chapter two explains the general characteristics of organisms in the domain of Archaea, Eubacteria and Eukarya. In chapter three, students learn genetic diversity and population genetics. Chapter four analyses threats to genetic diversity such as small population, destruction of habitats, diseases and human activities. Chapter five discusses the application of biotechnology in genetics, including stem cell research, DNA cloning, Human Genome research, gene therapy and products of

biotechnology (i.e. transgenic bacteria, transgenic plants and transgenic animals). In chapter six, students analyse issues related to management and protection of genetic diversity. Students will also consider legislation and enforcement of bioethics.

Methodology and Implementation

Research Design and Sampling Technique

This evaluative study involved qualitative data analysis techniques including descriptive comparison of pre- and post- mean score in a questionnaire survey as well as framework analysis of data provided by respondents selected through convenient sampling technique. A class of ten pre-service teachers who took 'Biological Diversity' course were selected as samples of study and they worked closely with the first author as participant observer and trainer for them to raise environmental worldview through 'Biological diversity' course that lasted for fifteen weeks.

Evaluation is a form of systematic inquiry that has taken an increasingly important role in decision making (Virtanen & Uusikylä, 2004). Evaluative study is an applied research carried out to assess the worth of effort and resources spent to achieve the desired goals. The need for evaluation research as a measurement of performance and accountability is on the rise. Effective evaluation can significantly reinforce programmes and institution (Kells, 1992). The outcomes of evaluation research improve decision-making through measurable feedback and thus are very useful for practical applications. The concept of education evaluation was expounded by Ralph Tyler in 1930s (as cited by Joyce, 2010). Tyler's concentration on explicitly stated objectives gave rise to behavioural objectives movements which have profound influence on curriculum design. Tyler's emphasis on direct measures of achievement resulted in development of standardised tests to measure the learners achievements based on the curricular content and objectives. Such approach was disputed for lack of relevance and utility, and was revised to facilitate a 'democratic and pluralistic process' of evaluation (Cronbach et al., 1986). More recent assessment and classification of various evaluation approaches has been analysed by Stufflebeam and Shinkfield (2007).

Framework analysis is a tool of qualitative method originally introduced for applied policy research which typically has *a priori* issues to be resolved within limited time frame using existing sample respondents (Ritchie & Spencer, 1994). Although this qualitative method can potentially generate theories, the main focus is to describe and interpret what happens in a particular situation of interest. Typically data used for framework analysis are collected as participant observation (Creswell, 2003), focus group (Silverman, 2000) and interviews (Gubrium & Holstein, 2002). The flexible analysis process of this method permits researcher either to complete data collection before analysis or to perform data analysis even as data is being collected. Gathered data is analysed in a five-step process: familiarisation, identifying thematic framework, indexing, charting, and finally mapping and interpretation (Ritchie & Spencer, 1994). The outcome of framework analysis overcomes the limitation of quantitative research methodologies by mapping range and nature of phenomena, finding associations and providing explanations that reflect the respondents in the natural environment of a phenomena (Collis, Hussey & Hussey, 2003; Denzin & Lincoln, 2000). Framework analysis is increasingly used in multiple disciplines such as policy research (Srivastava & Thomson, 2009), health sciences (Swallow, Lambert, Santacroce, & Mafadyen, 2011; Yang, Narayanasamy, & Chang, 2012), early education (Patel & Agbenyega, 2013) and psychology (Parkinson, Eatough,

Holmes, Stapley, & Midgley, 2016), underlying it as a robust analytical approach for multidisciplinary research.

Instrumentation and Data Analysis Activities

The ten pre-service teachers involved as respondents were administered the revised New Ecological Paradigm (NEP) scale (Dunlap, Van Liere, Mertig & Jones, 2000) at the beginning of the course to examine their existing environmental worldview. Additionally there were two items to gauge pre-service teachers' response on the impact of the 'Biological Diversity' course on their environmental worldview and the use of Facebook as a learning tool in this course. Pre-service teachers' extend of agreement based on 5-point Likert scale was categorised as shown in Table 1.

Table 1
Categorised Response of Likert-Scale Mean Score

Mean Values	Indication
1.00 – 2.00	Strongly disagree
2.01 – 3.00	Disagree
3.01 – 4.00	Agree
4.01 – 5.00	Strongly agree

During the 15-week course duration, pre-service teachers' posts on Facebook group dedicated for this course was also interpreted based on framework analysis (Ritchie & Spencer, 1994). At the end of the course, similar analytical approach was performed on pre-service teachers' open-ended feedback on the use of Facebook for learning purpose.

Results and Discussion

Pre-service teachers' responses at the end of the 'Biological Diversity' course demonstrated improved endorsement for three NEP items (items 1, 3 and 11) and diminished support for two DSP items (items 2 and 10) (Table 2). Improved support for item 1 [increased score from pre-course Mean=2.80 and S.D.=1.48 to post-course Mean=3.70 and S.D.=0.82] implied that pre-service teachers were more ready to acknowledge that there is a limit to human population growth that can be supported by the carrying capacity of the earth.

Table 2
Pre- and Post-Course Mean Scores and SDs Comparing Pre-Service Teachers' Environmental Concern

	Items from NEP scale	Pre-/Post-Course		Agreement
		Mean	S.D.	
1	We are approaching the limit of the number of people the earth can support.			
	Pre-test	2.80	1.48	Disagree
	Post-test	3.70	0.82	Agree
2	Humans have the right to modify the natural environment to suit their needs.			
	Pre-test	3.20	0.92	Agree
	Post-test	2.90	1.10	Disagree

3	When humans interfere with nature, it often produces disastrous consequences.				
		Pre-test	3.70	1.49	Agree
		Post-test	4.10	0.99	Strongly agree
4	Human ingenuity will insure that we do not make the earth unliveable.				
		Pre-test	2.90	0.88	Disagree
		Post-test	2.80	1.32	Disagree
5	Humans are severely abusing the earth.				
		Pre-test	3.80	1.14	Agree
		Post-test	4.00	0.82	Agree
6	The earth has plenty of natural resources if we just learn how to develop them.				
		Pre-test	4.60	0.52	Strongly agree
		Post-test	4.40	1.26	Strongly agree
7	Plants and animals have as much right as humans to exist.				
		Pre-test	4.20	0.92	Strongly agree
		Post-test	4.20	0.63	Strongly agree
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.				
		Pre-test	2.40	1.08	Disagree
		Post-test	2.10	1.10	Disagree
9	Despite our special abilities, humans are still subject to the laws of nature.				
		Pre-test	3.60	0.97	Agree
		Post-test	4.00	1.25	Agree
10	The so-called "ecological crisis" facing humankind has been greatly exaggerated.				
		Pre-test	3.10	1.44	Agree
		Post-test	2.10	1.20	Disagree
11	The earth is like a spaceship with very limited room and resources.				
		Pre-test	2.50	1.35	Disagree
		Post-test	3.30	1.49	Agree
12	Humans were meant to rule over the rest of nature.				
		Pre-test	2.90	1.45	Disagree
		Post-test	2.50	1.35	Disagree
13	The balance of nature is very delicate and easily upset.				
		Pre-test	3.60	1.43	Agree
		Post-test	3.80	1.03	Agree
14	Humans will eventually learn enough about how nature works to be able to control it.				
		Pre-test	3.30	1.16	Agree
		Post-test	3.80	1.14	Agree
15	If things continue on their present course, we will soon experience a major environmental catastrophe.				
		Pre-test	4.60	0.70	Strongly agree
		Post-test	4.40	0.84	Strongly agree

Increased endorsement for item 11 (improved score from pre-course Mean=2.50 and S.D.=1.35 to post-course mean= 3.30 and S.D.=1.49) was consistent with the awareness of the limitation of earth resources to meet the ever-growing demand of increasing human population. This was a huge shift in pre-service teachers' thought which was initially more inclined to consider the earth resources as inexhaustible. Item 3 is related to a notion in NEP about the balance of nature and anthropogenic activities that could upset this balance. Pre-service teachers' agreement to item 3 at the beginning of the 'Biological Diversity' course (Mean = 3.70 and S.D.= 1.49) has increased at the end of the course (Mean = 4.10 and S.D.= 0.99), indicating that their awareness of direct consequences of man-made disasters has become more apparent.

Among the DSP statements, pre-service teachers had shown decline in their agreement that people on earth have the right to modify the nature for their needs (declined score for item 2 from pre-course mean=3.20 and S.D.=0.92 to post-course mean= 2.90 and S.D.=1.10). Such shift in pre-service teachers' thought reflects an anti-anthropocentrism perspective in which humans should not harvest the earth resources as if these resources are meant solely for human consumption. Incidentally, pre-service teachers strongly agreed that plants and animals have the equal right to existence (item 7), which was also anti-anthropocentrism in essence. Another huge shift in pre-service teacher's response was found in item 10 (declined score from pre-course mean=3.10 and S.D.= 1.44 to post-course mean=2.10 and S.D.=1.20), indicating that pre-service teachers no longer consider that the much talked about eco-crisis was an exaggeration at the end of the 'Biological Diversity' course.

Pro-environmental worldview of the pre-service teachers before being introduced to 'Biological Diversity' course was indicated by nine of the 15 items on the NEP Scale (item 3, 4, 5, 7, 8, 9, 12, 13, 15). At the end of this course, the mean score of 13 of the 15 items demonstrated perspective that is consistent with the NEP (four additional items: 1, 2, 10, 11). This finding implies that the content of 'Biological Diversity' course was effective in promoting a pro-environmental worldview among pre-service teachers in teacher education.

Endorsement of the NEP reflects a pro-environmental orientation in terms of environmental attitudes, beliefs and values (Dunlap, Van Liere, Mertig & Jones, 2000). Despite the cautious approach of attitude theory against simplistic interpretation of individual items as indication of attitudes or beliefs, NEP items are seeking out 'primitive beliefs' on the nature of the earth and the position of human in nature. These primitive beliefs constitute the core of a person's belief system and embody the person's basic truths of both the physical and social realities (Rokeach, 1968). The measured beliefs about nature and the relationship of humanity with nature by NEP items could correspond to the fundamental of pre-service teachers' belief system about the environment.

While this study did not investigate the impact of each chapter of the 'Biological Diversity' course on the pre-service teachers' environmental worldview, the course content in chapter 4 and chapter 6 on impact of human activities on the environment as well as issues related to management and protection of genetic diversity could have provided the necessary knowledge and exposure for pre-service teachers to strengthen their NEP worldview. The importance of curriculum in environmental education has been discussed by Conde and Sánchez (2010). Consistent with the aim of environmental education to produce environmentally literate individuals who have the values, attitudes and skills to translate knowledge into behaviour (Goldman, Yavetz & Pe'er, 2006; Hart, 1981), curriculum used must be able to develop the capacity for learners to act as the result of immersing learners in contexts that compel them to

practise what they preach. Curriculum in use should also provide the experience of social interaction as the desire to act for sustainability is essentially the result of social engagement by sharing of feelings and emotions.

While acquiring knowledge on environmental related field and issues is essential in environmental education, learning outcome or attainment from curriculum for environmental education should not be too concentrated on the cognitive domain. Cognitive-driven curriculum in secondary and primary education related to environmental education has been observed by Erdoğan, Bahar, and Uşak (2012) as well as Erdoğan, Kostova, and Marcinkowski (2009), respectively. Although relationship exists between environmental knowledge and environmental behaviour, knowledge that results in action is not a guaranteed outcome (Cottrell & Graefe, 1997; Maleki & Karimzadeh, 2011). Therefore learning domains in environmental literacy such as knowledge, skills, affective disposition and behaviour proposed by Hsu (1997) offer an appealing alternative to the conventional learning domains (i.e. cognitive, affective and psychomotor) in designing and reviewing curriculum for environmental education.

In this study, Facebook was used in the 'Biological Diversity' course to share learning materials such as video clips (Figure 1) and lecture notes (Figure 2). Pre-service teachers were encouraged to give feedback and have discussions based on the learning materials posted in the Facebook group (Figure 3).

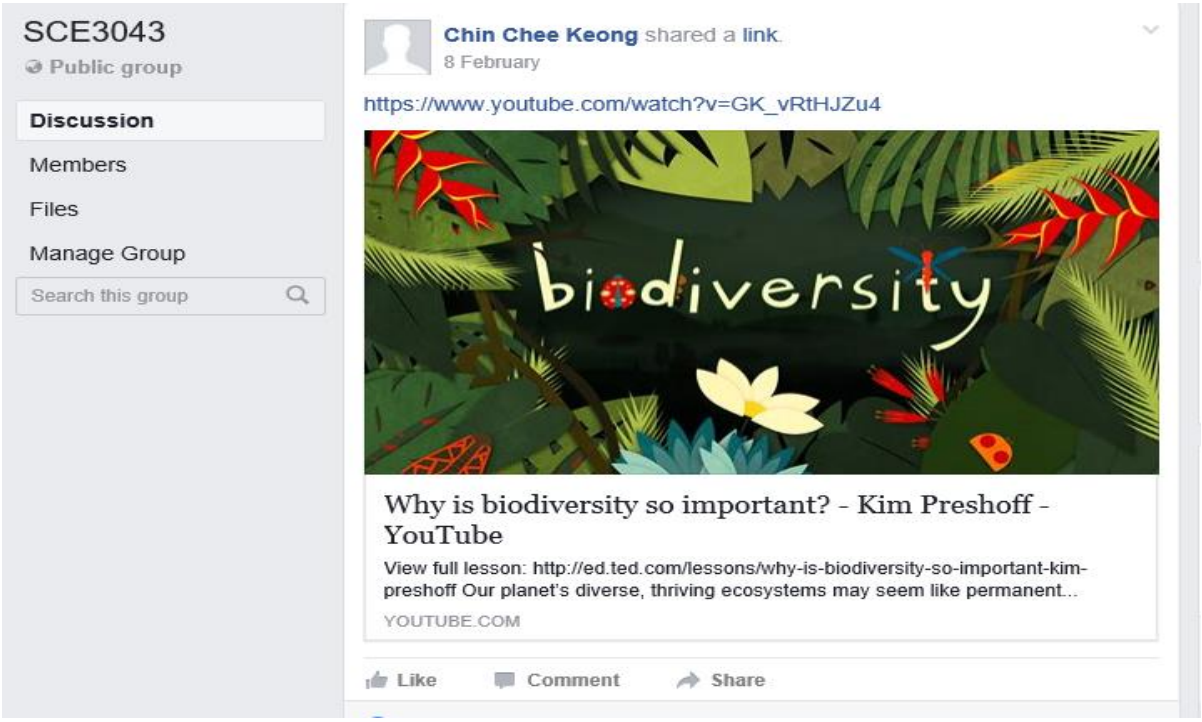

Figure 1. Shared video clip on the importance of biodiversity.

Figure 2. Shared lecture note on population genetics.

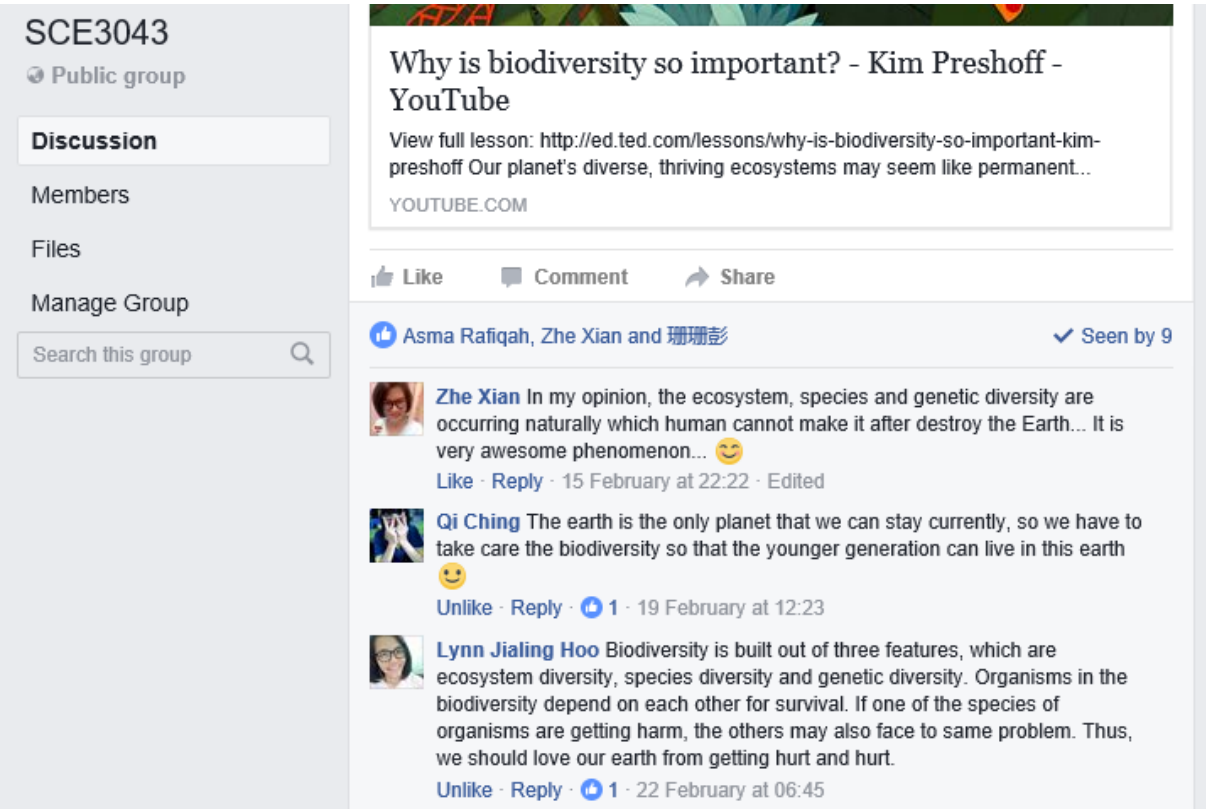

Figure 3. Feedback posted based on video clip on importance of biodiversity.

Benefits of using Facebook for learning have been widely reported (Siraj, Azman & Hussin, 2013; VanDoorn & Eklund, 2013; Roblyer, McDaniel, Webb, Herman & Witty, 2010). However, pre-service teachers' preference for the use of Facebook in this course could be viewed as unfavourable as they 'disagreed' that they liked using Facebook for this course (Table 2).

Table 2
Pre-Service Teachers' Post-Course Feedback on the Effect of 'Biological Diversity' Course and the Use of Facebook

	Survey Item Administered at the End of Course	Post-Course		Agreement
		Mean	S.D.	
1	This course has made me more environmental.	4.20	0.82	Agree
2	I like to use Facebook in this course.	2.80	0.98	Disagree

Open-ended feedback provided some explanations on how Facebook was found to be not helpful in learning for this course. Three samples of pre-service teachers' responses are shown here to represent their feedback.

> "... could not stand the radiation when I look at the laptop too long because it makes me dizzy/eyesight."
>
> (Open-ended survey response by ER1)

> "I could not digest what i read on laptop. I need a hardcopy. My eyes hurt when I look at laptop."
>
> (Open-ended survey response by DR2)

> "I hardly use FB for learning and seldom access the account. On top of that, internet connection makes it hard to open and download the materials."
>
> (Open-ended survey response by CR1)

The responses of ER1 and DR2 demonstrated that pre-service teachers did not favour using Facebook to read the learning materials posted as the glare from the laptop screen caused them eye discomfort. The response of CR1 indicated the underlying frustration of pre-service teachers having to wait for loading of the learning materials due to poor internet connectivity. The poor internet connectivity that affect access to online learning had been reported when pre-service teachers were using Edmodo as an online learning platform (Chin, Teh, Ng, Ling & Lay, 2016).

None of the pre-service teachers for this study mentioned any benefit of using Facebook during the course of their study. Our finding stood out in stark contrast to reported advantages of using Facebook to enhance learning (VanDoorn & Eklund, 2013). Research has shown that the use of Facebook in pedagogy enhances student-centered practices as well as helping teachers to be more creative in their teaching to improve students' performance (Roblyer, McDaniel, Webb, Herman & Witty, 2010; Siraj, Azman & Hussin, 2013). Teachers could use Facebook as a portal to share learning materials such as notes, videos, links to the rich internet resources, and digital access to classroom instruction (Davis, 2009).

Interestingly the finding related to the use of Facebook in this study was consistent with the finding of Benzer and Gül (2013). In a Turkish literature education class, 70.8% students did not like to have educational activities on social sharing sites as they preferred to use Facebook as a recreational site. Hew (2011) also found that very few Singaporean students use Facebook for educational purpose. Students' hesitation to use Facebook as part of formal learning purpose could be due to their concern in understanding the use of social and educational boundary, along with privacy concerns (VanDoorn & Eklund, 2013). While there are students

who are willing to use Facebook for academic purposes because of their familiarity with the social platform (Siegle, 2011), there are also students who are not comfortable with indiscriminate use of their social webpage. Taylor, Mulligan and Ishida (2012) reported that students prefer to have a division between their private Facebook and its use for academic tasks. Students are not in favour of mixing personal and academic matters is the main reason when they hesitate to use their social networking platform for academic matters. Based on review by González-Ramírez, Gascó and Taverner (2015), two other hindrances in the use of Facebook for teaching and learning purposes are:

(1) technological deficits among digital-natives who have been thought to be technologically skilful; and
(2) the risk of overloading Facebook with learning materials and thus overwhelming students with information overloads.

Conclusion

Summary and Implications

The analysis of findings from this study revealed that the content of 'Biological Diversity' course was effective to promote pro-environmental worldview among pre-service teachers. In the context of teacher education, it is important to illustrate that an effective curriculum was able to embed personal beliefs which is consistent with pro-environmental paradigm other than delivering pure content knowledge.

Limitation and Suggestions

However, this study also showed the negative response of pre-service teachers in using Facebook to facilitate their learning, as also concurred with other studies. Hence the suitability of Facebook to be used as part of formal learning through online platform should be recommended, despite the advantages of using Facebook in learning as reported in many studies. Nevertheless, this study was limited by the small number of samples which is not suitable for making any generalisation. The findings in this study provide insight for environmental education in teacher training programmes. Further research should be conducted to explore significant roles of social learning platforms such as Facebook and Edmodo in blended learning.

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