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Malaysian geography teachers' knowledge about environmental concepts

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Abstract

This paper is based on a study focused on the geography teachers' knowledge of environmental concepts. Geography is considered as an ideal discipline to study the environment, as it involves the study of human-environment interaction. The study was conducted in two phases using sequential explanatory mixed-method design. In Phase I (quantitative), a set of the questionnaire was developed and administered to 365 teachers in the state of Kedah, a region north of peninsular Malaysia. Rasch Measurement Model was used to assess internal validity of the items, unidimensionality of each construct, and item arrangement in each scale in the questionnaire. In Phase II (qualitative), interview protocols were developed based on the outcome sequence of items in Phase I. Nine teachers were interviewed and have their teaching sessions video-recorded. The quantitative findings indicated that teachers' knowledge of concepts of the environment was generally high. However, there were concepts that they highly understood as well as concepts that were less understood. The qualitative results from interview and video-recorded teaching sessions confirmed the results based on the questionnaire, and provide explanations by teachers on their level of knowledge. This study suggests that concerted efforts be made to provide adequate knowledge of environmental education through pre-service and in-service training for geography teachers.

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1. Introduction

For teachers to succeed in helping students to learn, understanding the subject matter to be taught is a central requirement of teaching [1]. Teachers need to have the knowledge - the facts and concepts - that is to be taught. Teacher knowledge has always been an integral component in developing environmentally literate students and thus, the success of a formal environmental education in schools highly depends on the knowledge teachers have. In order to promote and teach environmental education across the curriculum, regardless of their area of specialization, teachers should have adequate knowledge and understanding of the relevant environmental concepts. In Malaysia, geography is one of the school subjects that has always been closely tied to environmental education. This paper is based on a study focused on the Malaysian geography teachers' knowledge of environmental concepts.

2. Teachers' Knowledge on Environmental Education

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Teachers who have higher content knowledge of environment education and a deep understanding of the philosophy of environmental education are in good condition to convey the message of environmental quality to the nation as a whole [2]. In order to implement environmental education in schools, it is important to ensure that teachers have the knowledge and understanding of the environmental concepts to be taught [3]. When teachers have the knowledge, it affirms their commitment to “environmentalize their curriculum” that will likely produce environmentally literate students [4]. When teachers have content knowledge of the environment, students see them as the embodiment of knowledge and learning [5], and as models for students to learn about and behave responsibly towards environment.

Research in various countries has shown that knowledge about environment is related to teachers’ attitude, confidence and willingness in implementing environmental education in their teaching. Kunz [6] found that teachers who have knowledge of the concepts of the environment have a positive attitude toward teaching environmental education. On the other hand, in their study on secondary school teachers in Nigeria, Mansaray et al. [7] found that teachers who had poor knowledge about environmental issues, showed a bad attitude towards the environment. Teachers’ knowledge about the concepts of the environment also directly affects the confidence and willingness of teachers to teach the subject. Lee [8] found that teachers in Hong Kong are less efficient in teaching environmental education due to their lack of knowledge and skills required. When teachers clearly have a negative attitude towards the environment, they show less confidence when teaching environmental concepts [9]. In contrast, teachers who received training in environmental education and have a better understanding of the concepts involved have a positive attitude towards teaching and willing to integrate environmental education in the curriculum compared to teachers who do not receive training [10].

Previous studies also indicate that teachers do not have the knowledge or right conceptions about environment, and their knowledge is also insufficient. Skanavis [11] in his study found only a few teachers really know what environmental education is and how to implement in the formal classroom. Study conducted by Cutter [12] on primary school teachers in Queensland, Australia found that there is misconception among teachers about environmental concepts, and teachers have a n easy understanding only of familiar environmental concepts such as the greenhouse effect. Most of the respondents interviewed admitted they could not explain certain concepts in detail. Samuel [13] found that although environmental awareness among school teachers exists, knowledge about the environment is not sufficient. According to Samuel, many teachers are aware of the issues that receive a high publicity, but they do not know them in depth, as most of the information about environmental issues is learned through the media.

3. Environmental Education and Teachers’ Knowledge in Malaysia

In Malaysia, environmental education has been introduced in primary and secondary schools since 1998 and has been implemented across the curriculum by integrating them into all subjects. As teachers might not be able to develop EE activities, they were exposed to the EE curriculum by providing them with a curriculum guide containing suggested teaching activities for all subjects. However, the implementation of EE in schools is not uniform among teachers of different subjects, as some teachers seldom use the guidebook [14]. Two subjects that place emphasis on EE in Malaysian secondary schools are Biology and Geography, of which geography teachers are expected to be more regular in integrating EE in their teaching. Geography is considered as an ideal discipline to study the environment, as it involves the study of human-environment interaction. After all, geography has been traditionally the subject that teaches about the environment [15].

In a study by Aini et al. [16], Malaysian teachers (including geography teachers) in their study have a good score on knowledge on environment (25 out of 30) and are aware of the many environmental problems, although they have less knowledge about the factors that cause environmental problems. Another study by Periasamy [17] in the states of Perak and Selangor however shows that geography teachers have insufficient knowledge about environmental education and its geographic basis. This has lead geography teachers to become less involved in integrating environmental education in the teaching of geography.

Malaysian geography teachers presumably have ample knowledge of environmental concepts for them to teach about EE. They should understand certain concepts above others, though they may not know concepts that are new to them. Hence this study aims to determine the knowledge geography teachers have about environmental concepts. Specifically, the focus of this study is on the following questions:

- What is the level of geography teachers’ knowledge about environmental concepts?
- What are the least and most known environmental concepts to the Geography teachers?
- Why are the concepts least known or most known to the Geography teachers?

4. Methodology

The study was conducted in two phases using sequential explanatory mixed-method design [18]. In Phase I (quantitative), a set of the questionnaire was administered to 365 geography teachers in a state north of peninsular Malaysia. Rasch Measurement Model was used to assess internal validity of the questionnaire items, unidimensionality of each construct, and item arrangement in each scale in the questionnaire. In Phase II (qualitative), interview protocols were developed based on the outcome sequence of items in Phase I. Nine teachers were interviewed and have their teaching sessions video-recorded. Triangulation was done for the purpose of validating the results obtained from both qualitative and quantitative methods. Quantitative data through questionnaire provides an overview of teachers' knowledge, while the qualitative data help to refine, expand and clarify the general picture their knowledge.

The questionnaire used in Phase 1 was developed by the first author. Respondents were asked to indicate their knowledge level of 15 concepts related to the environment. Responses were scored based on a five-point Likert scale range from "Do not know"(1) to "Really know"(5). These concepts are selected based on related literature on EE and the Malaysian *Teachers' Handbook of Environmental Education across Curriculum in Secondary Schools* [19]. Results of pilot study on 164 Geography teachers shows that the questionnaire items have high internal consistency or reliability (Cronbach Alpha = 0.93) with 'item-to-total correlation' range between 0.46 to 0.79. The contribution of each item to the construct was also inspected to ensure that every item has *item to total correlation* value at least 0.2 [20],[21].

5. Results

5.1. Geography Teachers' Knowledge of Environmental Concepts (TKEC)

The scores on teachers' knowledge of environmental education were converted into percentile scores. Based on the percentile scores, teachers are grouped into four clusters. Teachers who score lower than P_{25} were grouped as having low knowledge of environmental concepts and teachers who score more than P_{75} were grouped as high knowledge of environmental education. While teachers who score is between P_{25} and P_{75} are grouped as having medium level of knowledge on environmental concepts, which were then divided into two: high medium (percentiles $P_{50} - P_{75}$) and low medium (percentile $P_{25} - P_{50}$).

Data analysis found that the raw score on TKEC range from 33 to a maximum of 75. Table 1 shows that none of the teachers score below P_{25} . Only four teachers (1.1 percent) are in the low medium group, while 73 teachers (20.0 percent) fall into the high medium groups. Majority (78.9 percent) of the teachers were in the high group. This indicates that the level of geography teachers' knowledge about the concepts of environmental education is mostly high. This means that respondents in this study (Geography teachers) have a high level knowledge of environmental concepts.

Table 1. The level of teachers' knowledge of environmental concepts

Level	Groups	Number	Percent
Low	< 18.75	0	0.00
Low Medium	18.75 - 37.50	4	1.10
High Medium	37.50 - 56.25	73	20.00
High	56.25 - 75.00	288	78.90

5.2. Least Known and Most Known Environmental Concepts by Geography Teachers

Rasch measurement model was employed to find the concepts least and most known to the geography teachers. Table 2 shows all the 15 items organized according to their measure (in logits). Items with high logits score indicates that teachers least known about the concept compared to item with low logits score. Item 1 (3.95 (0.10)) the concept of 'biodiversity', was an item or concept of the environment that least known by teachers, followed by Item 2 (2.43 (0.11)) known as 'deforestation' and Item 15 (2.12 (0.11)) about 'sustainable development'. Meanwhile, item 5 (-2.09 (12:15)) the concept of environmental pollution was the easiest item or most known by many teachers. This is followed by item 7 (-1.43 (00:14)) about the concept of 'natural resources' and Item 9 (-1.37 (0.14)) about 'over population'.

Analysis of interviews and video recordings shows similar pattern about teachers' knowledge of

environmental concepts. The findings of interview with nine teachers confirmed that the teachers did not know or understand the concept of biodiversity, as shown in the following excerpts;

I had little knowledge too ... If a teacher did not attend the environment course... things like this (referring to the term biodiversity) will be a new thing... (A1)

Biodiversity... I admit that I have heard.... But ... if people want me to explain the meaning of his words ... I am not sure which the definition.... (B1)

Similarly, the teachers indicated that they did not understand the concept the concept of deforestation. For example,

R: *What about the term...deforestation....*

T: *Ha... I do not know the word... We throw away the forest... like it was probably meant... I am not sure...* (A2)

Table 2. Environmental concepts based on Rasch Measurement Model

Entry Num.	Concept	Model	Infit		Outfit		Ptbis Corr.	
		Measure (Logits)	Error	MNSQ	ZSTD	MNSQ		ZSTD
1	Biodiversity	3.95	0.10	1.01	0.20	1.10	3.60	0.70
2	Deforestation	2.43	0.11	1.21	2.20	1.09	4.00	0.73
15	Sustainable development	2.12	0.11	1.23	2.40	1.26	4.20	0.71
12	Land resources	0.47	0.12	1.03	0.30	0.99	-0.10	0.74
3	Ozone depletion	-0.21	0.13	0.84	-1.70	0.78	-1.60	0.78
11	Endangered species	-0.26	0.13	0.81	-2.10	0.81	-1.30	0.77
6	Ecosystem	-0.42	0.13	0.95	-0.50	1.02	0.10	0.78
4	Green house effect	-0.44	0.13	0.72	-3.10	0.62	-2.70	0.81
14	Recycle	-0.60	0.13	0.92	-0.80	0.71	-1.80	0.74
10	Waste disposal	-0.62	0.13	0.89	-1.10	0.93	-0.40	0.76
13	Reforestation	-0.64	0.14	0.92	-0.80	0.80	-1.20	0.76
8	Renewable resource	-0.90	0.14	1.34	3.10	0.98	-0.10	0.78
9	Over population	-1.37	0.14	0.98	-0.20	0.97	-0.10	0.74
7	Natural resources	-1.43	0.14	0.64	-4.20	0.46	-2.80	0.84
5	Environmental pollution	-2.09	0.15	0.87	-1.50	0.65	-1.20	0.77
	MEAN	0.00	0.13	0.96	-0.50	0.94	-0.10	
	S.D.	1.57	0.01	0.18	1.90	0.30	2.20	

T: *Deforestation... I do not understand... With sustainable... I never see before...*

R: *The word...*

T: *Ha...a new concept...but deforestation and sustainable...I have but I cannot remember... cannot remember whether I read or not, so I cannot tell you now...* (F1)

From the interviews with A2 and C2 teachers, the impression was they did not understand the concept of sustainable development. Their response on the concept represents their misconception of 'sustainable development'. A2 teacher refers sustainable development as development without planning, while C2 teacher refers it as 'the large development'.

Sustainable development... I think... the development... cut all the forest... we build new housing... we do all that... unplanned development can cause environmental damage... (Laugh)...

(A2)

Yes... it's a new term... sustainable development. Sustainable usually large... I guess it is ... I am not very sure ...

(C2)

The data obtained from interviews also shows that the concepts of environmental pollution, natural resources and over population were concepts that are most known by the Geography teachers. The following quotes from the interviews shows that the Geography teachers mostly know about these concepts as these were general concepts also known by the public, which are more concrete, or have occurred within the teachers' environment. These concepts were also discussed in issues or themes already included in geography and other subjects across the curriculum.

T: *Environment pollution is easy compared to the other ... because it happens around us*

R: *Do you think that you have lot of knowledge about the pollution?*

T: *Ha..Ha.. Not only me... the students also have extensive knowledge about environmental pollution ...*
(A2)

When we said...environmental pollution ... in the Malay Language subject ... sometimes there are essays about environmental pollution ... the effects of environmental pollution on...in Science subjects we come across environmental pollution...
(C1)

Teachers' understanding of the concept of 'natural resources' is substantiated by examples of sources that are renewable and non renewable.

T: *This is a natural resource...people say that... We understand what are the resources and... understand what are natural resources, so we can explain to students...*

R: *What do you mean?*

T: *Natural resources... what we call... renewable... like water ...the other non-renewable resources... like oil fuel.*
(B1)

Quite simple... Things that are around us... The term itself I think it is easy to understand ... Natural resources. Resources that can and can not be renew... we shall give a simple example to students... but a specific topic is in Form 3...
(E1)

Teachers mentioned that over population concept was easily understood and explained to the students.

T: *Hmmm... over population... that even I can explain this ...*

R: *Can explain ...*

T: *Yes... I think students can understand about it...*
(B1)

There is no problem because we may have a over population ... for example ... our nearest neighbor... Indonesia... our neighbor...but ...Bangladesh, India, China, Vietnam... Vietnam we put aside... because it is far away...
(F1)

Video analysis also shows that teachers did not raise the concepts of biodiversity, deforestation, and sustainable development in their teaching. This shows that their limited knowledge of these concepts. A2, B1, C1, C2, E2 and F1 teachers taught in Form 1 with the title related to environment. That was part of the Theme 2: Weather and Climate and Their Influences; and Theme 3: Natural Vegetation and Wildlife (third recording). Although the themes include topics related to the impact of human activities, but there was no teacher who touched on the three concepts of environmental education (biodiversity, deforestation and sustainable development). For example, if the A2 teacher is aware and knows concepts of biodiversity and deforestation she can insert those concepts while teaching the topic Impact of Human Activities on Plants and Wildlife. The following A2 Teacher video excerpt confirms this.

Cut out all but no replanting ... that causes desolation ... soil not fertile soil. Can...? OK we look the second...logging. What are the effects of logging...? OK logging refers to timber harvesting in what way...is not under control ...The first is the extinction of flora and fauna. Which means that animals and plants becoming extinct. OK ...huh... for example ... if we run the logging ... OK we cut trees, ... so there are no trees... animals and wildlife have become extinct ...for what reason ... cover ... had lost ... had cut ... had destroyed ... indirectly ... flora and fauna will become extinct. Example....? (A2 V3 min 6-7)

The matters referred to in the lessons such as uncontrolled logging and extinction of flora and fauna can be attributed to widespread deforestation and caused decreasing biodiversity. This is due to deforestation caused by cutting of trees without sufficient reforestation, and result in declining in habitat and biodiversity [22], [23]. The situation in developing countries shows much forest loss due to urban development [24]. Teachers can also relate the topic to sustainable development. Similarly, the F1 teacher can relate to deforestation and biodiversity in teaching the following passage.

T: *As a result of human greedwithout living up.... whatever tree he cut it out ...who are directly affected?*

S: *Human...*

T: *Human well.. as a result of irresponsible actions So even if the tree be cut down do not cut all the trees ... but what happens if all are cut down ... Is it harmful to us?* (F1 V3 min 17.10-17.52)

From the above description, it was found that the qualitative results match the findings of quantitative phase about the three concepts understood by the teacher, i.e. environmental pollution, natural resources and over population, and the three concepts least known to the teacher: biodiversity, deforestation and sustainable development. Interviews showed that most teachers had lack of knowledge about the concept of biodiversity, deforestation and sustainable development. There were teachers who have never heard and know about the

concept of biodiversity, deforestation and sustainable development. Recordings showed that teachers failed to use these concepts even though they had come across the concepts in their teaching.

5.3. Factors that influence Geography Teachers' Knowledge About the Environment concepts

The findings from the interviews also explain why teachers have such pattern of their knowledge about the concepts of environmental education.

5.4. Factors on Teachers' Least Known Environmental Concepts

Based on teachers' responses, three factors that resulted lack of teachers' knowledge about the concepts of the environment were identified:

Concepts new to teachers. Concepts which are least known to teachers are new to them. The reason given by teachers on their lack of knowledge on concepts of biodiversity and deforestation are: they are new words for them. Lack of teachers' knowledge about such concepts of environmental education can be seen in the interview excerpt. For example, the concept of biodiversity, Teacher A1 describes,

For biodiversity and deforestation... aaa... this year I've heard that word... I heard this year. A new concept in Geography ... (A1)

Sustainable development ... aaaaaa... this one I do not really understand this concept... about this concept... it is new to me... (D1)

Teachers' experience. Findings from the interview also show that experience is a factor that helps Geography teachers to understand the concepts of environmental education. For example, D1 teacher expressed,

For me... I'm new teacher... new... I've just heard... word of biodiversity... a new concept ... for me... perhaps for others... experience teachers... has been possible for them... no problem ...

(D1)

Abstract concept. Among the teachers interviewed, some stated that the word biodiversity is an abstract and difficult concept to be explained to the students.

T: *For me, biodiversity is... a new concept... it is true... Ha... a bit difficult compared with other concepts ... cannot show a clear ... things can not seen...*

R: *What does it mean you cannot show clearly?*

T: *The concept is... abstract...* (A1)

Similarly, F1 teacher recognize that concept of biodiversity is a new and abstract.

.... It is not clear ... some concept that we can show such as pollution ... if pollution we can show... What we call...? Hha... abstract... (F1)

Findings from interviews indicate the reason teachers are less known about the concepts of environmental education such as biodiversity, deforestation and sustainable development is to be considered new by the Geography teachers. Three main reasons are found that is lack of knowledge, experience and abstract concepts. The findings of these interviews were to verify the findings from the questionnaire on the concepts of environmental education about the teacher. This finding also explains why teachers have limited knowledge about these concepts.

5.5. Factors on Teachers Most Known Environmental Concepts

The finding from questionnaires and interviews also shows that Geography teachers know some of the concepts of environmental education, such as environmental pollution, natural resources and over population. From interviews, teachers were more aware of these environmental concepts, due to several factors.

Various sources of information and knowledge. Interview findings indicate that information about certain environmental concepts was derived from various sources that helped to improve teachers' knowledge about environmental education. Sources of knowledge include from the mass media and public discussion on environment issues.

Ha ... environmental pollution.... I know that much,... we always discuss this issue... even the term ... The term was not a kind of strange, really... hmmm... what we always hear.... on TV, newspaper....

(B1)

Yeah... We often hear the word pollution... in the news on TV or... in the newspaper ...have discussed about pollution here and there... This term is quite common... (E2)

In addition, teachers' knowledge about the concepts of environmental education is also articulated with contents of other subjects. For example, subjects such as Science and Malay Language are described by teachers as a resource that helps teachers to understand concepts such as environmental pollution. In the following interview excerpts, teachers submit statements regarding this matter.

environmental pollution ... in the Malay language subject... sometimes discussed about environmental pollution ... the effects of environmental pollution... and in Science... described on air pollution, water pollution ... explained all about environmental pollution ... a lot of discussion... so we know better from the other ... (C1)

Because ... the title... and pollution is everywhere ... In the Malay Language, too... in science subjects there are related topics... (F1)

The concrete concept. Teachers were easier to find concepts such as environmental pollution and natural resources because these concepts are concrete, visible and easily obtained as examples. Teacher A2 state, *If we want to explain about pollution,... it was easier than... biodiversity ... ozone layer depletion... things that can not be seen ... easier to explain the things we see things that cannot be seen really hard to understand... (A2)*

Simple... Things that are around us... I think the term itself is simple... natural resources... resource that can and can not be renew... we shall give a simple example to students... (E1)

Geography curriculum content. The findings from the interviews also showed that geography curriculum itself is closely related to environmental education. The natural resources were a concept and topic of the syllabus for Geography Grade 3 of Topic 7.1: Primary Resources. For this concept, all the teachers admitted that it was an easy concept for them.

Natural resources were OK for me, I understand. It is related to natural resources... forests ... water ... land... in the syllabus. (E2)

... Natural resources... renewable resources and non renewable resource... This topic is in Form 3... but I know it... I usually teach Form 3... (F1)

The concept of over population was included in the geography curriculum, which helps teachers to understand the concept.

Because the form 2 syllabus... ha ... it is population ... is OK ... I know ... over population.. (C2)

I know... and simple... A lot of discussion in the form of two... I have learned about population when I was in University... (E1)

The result shows that the content of geography becomes a resource that helps teachers to understand the concepts of environmental education. Concepts such as environmental pollution, natural resources and over population are known by Geography teachers because the concepts are in the geography syllabus and textbooks.

Teachers' Experience. This study also shows that teachers' experience had helped teachers develop their knowledge about the concepts of environmental education. For example, teacher A1's long experience of teaching geography made him more knowledgeable about the concept of the over population.

Before I was involved with (teaching) geography and the environment... my knowledge is very shallow... When we were in this group... aaa... the exposure began. OK... why...the Canadian had low population?. Why do India had over population and less resources? Why...if we are not Geography teacher we will not know... they know only the composition of the population... he did not know what happened in a country... (A1)

Analysis from video recordings showed that environmental concepts that are most known is shown in their teaching. For example, A2 teacher was trying to explain to students the concept of pollution and the cause of the occurrence of this environmental phenomenon:

...OK. Firstly... what occurs is air pollution... For what? ... OK, if you cut all the trees... cut all the trees... we burn them... smoke cause air pollution. Air pollution caused what happen...? (A2 V3 min 4 - 5)

... So congestion in the city... lot of problem is occurring... pollution ... vehicle congestion is too much ... if the vehicles are too many... pollution there... and when there are a lot of people... rubbish pollution even more... what else? (E1 V3 min 21-22)

6. Discussions and suggestions

The findings show that the level of most Malaysian geography teachers' knowledge about the concepts of environment is high (about 80% of the teachers). However, among the concepts, their knowledge level varied. Concepts such as biodiversity, deforestation, and sustainable development are the least known, compared to concepts like environmental pollution, natural resources and over population which are more familiar to the teachers. Video recording of their teaching also showed they did not bring up the least known concepts even when the topics discussed would involve the concepts. Lack of understanding of the concepts does not allow teachers to introduce or discuss them with the students, even when there are opportunities to explain or discuss about the concepts. Teachers were not aware that the issues presented were associated with the concept of biodiversity, deforestation and sustainable development. It might seem that the teachers had to avoid using the concepts that they did not fully understand.

Several factors contribute to why teachers know certain environmental concepts less than others. Reasons given by the teachers were that the concepts were new and abstract to them. Some environmental concepts like sustainable development and biodiversity are new to many people, not only teachers. The relatively new concept of sustainable development was first coined by the Brundtland Commission in the United Nation in 1987, and were widely discussed only after the 1992 United Nations Conference on Environment and Development, known as the Earth Summit held in Rio de Janeiro. Although teachers may have come across or heard the terms, they do not have the in-depth details to explain them to the students. These concepts are mostly used widely by groups like the biologists, environmentalists, politicians, and citizens that are highly concerned about environmental quality. Further, the term sustainable development is a abstract concept to the teachers. It has been criticized as being too vague and fuzzy and used in many ways or situations [25]. This brings confusion among the teachers and does not allow teachers to confidently use in their teaching.

W.G. Rosen adopted the word biodiversity in 1985 during his planning of the National Forum on Biological Diversity organized by the National Research Council (NRC) in 1986, and first appeared in a publication by entomologist E. O. Wilson in 1988 [26]. The concept of biodiversity is also available in the 1998 (Malaysian) Teachers' Handbook of Environmental Education Across Curriculum in Secondary Schools. Deforestation concept was discussed in The United Nations Conference on Environment and Development (UNCED) in 1992. Agenda 21 suggests on the conservation and management of natural resources, which form the basis of life, including preventing deforestation. These concepts were considered new to teachers.

This study found that experienced teachers were more aware of certain concepts, while teachers with less experience (new teachers) lack knowledge about certain concepts. Working experience, according to the teachers can overcome the lack of knowledge of environmental concepts. Experience usually comes with learning through training and professional development programs, will expose teachers to new and current ideas and development of knowledge in environmental education. Statement by the teacher that he knew the concept after attending the courses on the environment shows that teachers latest knowledge rely heavily on training courses.

The authors suggest that in-service training and workshops must be provided to teachers to enhance their knowledge of issues and up-to-date concepts of environment, as well as the knowledge and skills on teaching methods to implement the environmental education that not only about the teaching *about* environment, but focuses on education *for* and *through* the environment. The study by Lane et al. [27] found that the total time used by teachers to teach environmental education increase by the number of in-service courses attended by teachers. This gives the impression that in order to increase of time and content of environmental education conveyed by the Geography teachers, in-service courses for teachers should be held as well as courses to improve environmental education in teacher training levels. Teachers themselves need to be proactive in informally updating their knowledge related specifically to the environment to enhance their teaching in the classroom. With today's information and communication technology (ICT), teachers can use the internet to get information about concepts, methods and other matters related to environmental education.

7. Conclusion

The study found that teachers' knowledge of environmental concepts were mostly high, but there were variations in their knowledge. Teachers were less knowledgeable about the concepts that are new, abstract and technical or scientific, but were more knowledgeable about the concepts that are widely used and concrete.

Based on the arrangement by the Rasch Model, examples of the least known concepts i.e. biodiversity, deforestation and sustainable development were more technically or scientifically sound. These concepts are not specifically included in the Geography syllabus and textbooks, and are new to the teachers. While the most known concepts like environmental pollution, natural resources and over population were often appeared and discussed in mass media, textbook and syllabus. The findings from the interviews give similar picture portrayed by the quantitative findings. When there are still teachers who never heard the concept of biodiversity and deforestation, as a way out of this problem, teachers need to be re-tooled in-service courses related to environmental education.

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