THE EFFECT OF PROJECT-BASED LEARNING ON PRE-SERVICE TEACHERS' ENVIRONMENTAL KNOWLEDGE, ATTITUDE AND BEHAVIOUR

by

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TABLE OF CONTENT

		Page
ACKNOWLEDGMENTS		ii
TABLE OF CONTENTS		iii
LIST OF TABLES		vii
LIST OF FIGURES		vii
LIST OF APPENDICES		vii
LIST OF AWARDS		**ix**
ABSTRACT		**x**
ABSTRAK		**xi**
CHAPTER ONE: INTRODUCTION		
1.0	Introduction	1
1.1	Background of Study	3
1.2	Statement of Problem	6
1.3	Purpose of Study	9
1.4	Research Question	10
1.5	Research Hypotheses	10
1.6	Significance of the Study	10
1.7	Limitation	11
1.8	Definition of Terms	12
1.9	Summary	14

CHAPTER TWO: LITERATURE REVIEW

2.0	Introduction	15
2.1	Environmental Knowledge	15
2.2	Environmental Attitudes	19
2.3	Environmental Behaviour	21
2.4	Knowledge - Attitudes-Behaviour Relationship	23
2.5	Project-based Learning: Applying the Constructivist Approach to Teaching	25
2.5.1	Assessing the Effectiveness of PBL Application in Class	26
2.6	Theoretical Framework	30
2.6.1	Theory of Reasoned Action	30
2.6.2	Model of Ecological Behaviour	33
2.7	Conceptual Framework	35
2.8	Summary	36

CHAPTER THREE: METHODOLOGY

3.0	Introduction	37
3.1	Research Design	37
3.2	Sampling	38
3.3	Research Approach	39
3.3.1	Research Project	39
3.3.2	Web-Quest Activity on Climate Change	39
3.4	Instruments	40
3.4.1	Environmental Knowledge	40

3.4.2 Environmental Attitudes 41

3.4.3 Environmental Behaviour 43

3.5 Pilot Study 43

3.6 Instrument Validity and Reliability 44

3.7 Data Analysis 44

3.8 Summary 45

CHAPTER FOUR: RESULTS AND FINDINGS

4.0 Introduction 46

4.1 Environmental Knowledge 46

4.1.1 Causes of Climate Change 47

4.1.2 Consequences of Climate Change 48

4.1.3 Cures/Solution of Climate Change 49

4.2 Environmental Attitudes 52

4.3 Environmental Behaviour 52

4.4 The Environmental Knowledge-Attitude-Behaviour 57

4.5 Summary 57

CHAPTER FIVE: DISCUSSIONS, IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.0 Introduction 58

5.1 Effect of Project-based Learning on Students' Knowledge 58

5.2 Effect of Project-based Learning on Students' Attitudes 62

5.3 Effect of Project-based Learning on Students' Behaviours 63

5.4 Environmental Knowledge-Attitudes-Behaviour 65

5.5 Implications of the Study 65

5.6 Suggestions for Further Research 67

5.7 Summary 67

LIST OF TABLES

		Page
2.1	Comparison of traditional instruction and project-based learning	27
3.1	Scientific and idiosyncratic statement for causes, consequences and cures/solutions of climate change	41
4.1	Percent of correct response for scientific and idiosyncratic statements of causes of climate change	47
4.2	Percent of correct response for scientific and idiosyncratic statements of consequences of climate change	49
4.3	Percent of correct response for scientific and idiosyncratic statements of cures/solution of climate change	51
4.4	Overall mean, standard deviation and t-values for the pre-test and the post-test for each component of climate change knowledge	51
4.5	Frequency distribution, mean and standard deviation of environmental attitudes	53
4.6	Overall mean, standard deviation and t-value for the pre- and post-test for each subscale of environmental attitudes	54
4.7	Frequency distribution, mean and standard deviation of environmental behaviour	55
4.8	Overall mean, standard deviation and t-value for the pre- and post-test of environmental behaviour	56
4.9	Interrelation between environmental knowledge, attitudes and behaviour	56

LIST OF FIGURES

		Page
2.1	Theory of reasoned action	32
2.2.	Model of ecological behaviour	34
2.3	Conceptual framework of the study	35
3.1	One-Group Pretest-Posttest Design	38

LIST OF APPENDICES

1	Questionnaire on Environmental Knowledge	77
2	Questionnaire on Environmental Attitudes	80
3	Questionnaire on Environmental Behaviour	81

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1 Award given by The Ministry of Higher Education to attend and present paper at East-Asian Science Education Conference 09 (EASE09) organize by National Taipei University of Education and National Science Council, Taipei, Taiwan.

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ABSTRACT

The rising interest in environmental literacy and education for sustainability has created expectations that timely, accurate content should be taught to the primary, secondary as well as teacher education curriculum. The learning context should provide opportunities for students to develop critical thinking skill, problem solving and values. Project-based learning approaches that emphasize student learning may be a key to the successful development of good citizenship. The purpose of this study is to investigate the effect of a project-based learning on students' environmental knowledge, attitudes and behaviour. As part of the course requirements students were asked to develop a web-quest on climate change and to identify suitable topics in the curriculum for the integration of climate change. The topic on climate change was chosen since global climate change is a challenging topic to teach and learn and the teaching is flawed through omission, simplification and misrepresentation. A one group pre-test post-test design was employed for the study. Data were collected from the 173 students enrolled in the chemistry teaching methods course through questionnaires containing true-false items to measure factual knowledge about climate change and Likert-type items (Environmental Concern Scale and Pro-Environmental Behaviours) designed to assess the degree of environmental concern and readiness in pro-environmental behaviours. Analysis of the data showed that the students performed significantly better in the post-tests than pre-tests for all the three variables investigated. The results support the notion that adopting the project-based learning in the chemistry methods course could enhance students' knowledge, attitudes and behavior towards environment

ABSTRAK

Tumpuan bidang literasi alam sekitar dan pendidikan lestari memberi harapan yang wajar pada masanya, agar kandungan yang tepat, harus dilaksanakan di sekolah rendah, sekolah menengah dan juga dalam kurikulum pendidikan guru. Konteks pembelajaran haruslah menyediakan peluang kepada pelajar membina kemahiran berfikir secara kritikal, penyelesaian masalah dan nilai-nilai murni. Pendekatan pembelajaran berasaskan projek yang menitikberatkan pembelajaran berpusatkan pelajar barangkali kunci kepada pembinaan rakyat yang sejahtera. Tujuan kajian adalah untuk menentukan kesan pembelajaran berasaskan projek terhadap pengetahuan, sikap dan tingkahlaku pelajar terhadap alam sekitar. Sebagai sebahagian daripada keperluan kursus, pelajar ditugaskan untuk membina satu *web-quest* dalam topik perubahan iklim dan mengenalpasti topik-topik yang sesuai dalam kandungan kurikulum untuk pelaksanaan topik perubahan iklim. Topik perubahan iklim dipilih kerana mempunyai cabaran untuk mengajar dan belajar mengenainya. Pengajaran dalam topik ini juga seringkali diringkaskan, salah konsep malah tidak diajar langsung. Kajian berbentuk *one-group pre-test post-test* digunakan dalam kajian ini. Data diperoleh dari 173 pelajar yang mengambil kursus kaedah pengajaran kimia melalui soal selidik betul-salah untuk mengukur pengetahuan mengenai perubahan iklim, dan soal selidik dengan yang menggunakan skala Likert *{Environmental Concern Scale* dan *Pro-Environmental Behaviours)* bagi menilai sikap dan tingkahlaku terhadap alam sekitar. Analisis data menunjukkan keputusan pelajar adalah lebih baik dalam ujian pos berbanding ujian pra bagi ketiga-ketiga pembolehubah. Keputusan ini menyokong pandangan bahawa pembelajaran berasaskan projek dalam kursus kaedah pengajaran kimia meningkatkan pengetahuan, sikap dan tingkahlaku alam sekitar pelajar.

CHAPTER 1
INTRODUCTION

1.0 Introduction

Global climate change, one of the many world-wide dimensions of the environmental problems has received national and international concern. Recent scientific evidence shows that humans are strong contributors to a changing climate. A recent report by the Intergovernmental Panel on Climate Change (IPCC) stated that concentrations of certain greenhouse gases (namely carbon dioxide, methane, and nitrous oxide) "have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values" (IPCC, 2007, p. 2). Hence, combating global climate change is one of the most challenging and important problems that this generation faces. For this reason, there has been a great interest in educating pupils, the future citizens, so as to enable them to successfully cope with these pressing problems. Each and every one of us will be responsible for making decisions that will shape the health of the environment.

Despite the scientific consensus on global warming, the issue is still controversial and confusing for the general public. With only superficial knowledge and unfounded ideas about climate change, citizens are not in a position to take the steps necessary to stem its progression. Inadequate information about global warming either from the news media and the curriculum has precluded an accurate assessment of the situation and what should be done about it. Education is recognized as one of the most important tools to

develop present and future citizens to live life in a sustainable manner. Through formal education, apart form acquisition of knowledge and dexterities, attitudes, perceptions, ways of thinking and behavior of the students are cultivated (Skanavis et a1, 2004). Education can illuminate incentives, showing people both how they could personally benefit from changing their behavior, and how they would suffer from a lack of change. Meaningful lifestyle changes will require a certain amount of direct financial and lifestyle sacrifice from individuals. The long term effects of increasing environmental education and awareness will lead to a more informed citizenry that is well equipped to solve future challenges and positive attitudes towards the environment, both social and natural. Research on environmental education has shown that positive environmental voting, consumption, and behavior patterns are largely determined by how much a person knows about a topic (Patchen, 2006). Therefore, personal understanding about how climate change will affect individuals and communities is essential for positive environmental policy implementation.

Changes in attitudes come from early education that builds awareness and empowerment. People are more likely to self-identify as environmentalists if they are exposed to these ideas at an early age (Falk & Dierking, 2002; O'Connor, 1999). Environmental education is an instrument to enable the participation and learning of various age groups based on a two-way communication, both formal and non-formal. Project-based learning (PBL) is a well-known method for imparting thinking competencies and creating flexible learning environments. Students have a chance to learn by doing, enhancing their critical skills and shaping the learning process by being

active participants. Students in a project-based learning environment deal with real-life problems, which may result in permanent knowledge. In PBL, projects are focused on questions or problems that "drive" student to encounter (and struggle with) the central concept and discipline and maybe build around thematic units (Blumenfeld, et al., 1991).

1.1 Background of study

Environmental Education (EE) is considered as an essential component of the education for future citizens in order for them to be able to confront and deal with the upcoming environmental issues. EE was first defined in Tbilisi Declaration which affirmed the international commitment to international environmental education and came out with the ultimate goal to sensitize the public towards environmental problems and lay the foundations for the citizens' active participation in the protection of the environment and appropriate use of natural resources (Flogaiti, 2006). This commitment to create awareness about environment in the general population and changes in the human behavior must be made in order for individual and social groups to be actively involved, at all levels in working towards resolution of environmental problems (UNESCO-UNEP, 1978). Through the process of EE, individuals obtain an understanding of the concepts of and knowledge about the environment. They also acquire experience, shape values, skills, understanding and the knowledge necessary to form judgments to participate in decision-making, and to take appropriate action in addressing environmental issues and problems.

EE is one of the tools that could be used to achieve sustainable development. EE was re-oriented and renewed to the direction of sustainable development in 1992 at the Earth Summit in Rio de Janeiro and is manifested in Chapter 36 of Agenda 21. Chapter 36 of Agenda 21 stresses on the following: Education, including formal education, public awareness and training, should be recognized as a process by which human beings and societies can reach their fullest potential. Education is critical for achieving environmental and ethical awareness, values and attitudes, skills and behavior consistent with sustainable development and for effective public participation in decision-making. Publication of the Agenda 21 Report strengthened the effort and is regarded as the blue print for countries to pursue sustainable development. It is a plan to achieve a sustainable society in this environmentally and economically inequitable world. With rapid population increase and economic growth in many countries, the environment is becoming more vulnerable and natural resources are depleted faster to meet the basic needs.

Malaysia, as most countries in the region, has reacted to implement EE. It starts with the decision by the Education Planning Committee of Ministry of Education to integrate and infuse EE throughout the New Primary School Curriculum (NPSC) and Integrated Curriculum for Secondary Schools (ICSS) in 1991 (Naderson and Norshidawati, 2005). The goals of environmental education in the Malaysian school curriculum are to educate children in order to create an environmentally aware and caring society whose members can act individually and collectively to overcome environmental problems; enable children to love and care for the environment so that they will think and

act wisely to preserve it; and make children aware of the importance of sustainable development.

In line with the recommendations of Agenda 21, Malaysia's National Policy has outlined Green Strategies which emphasize on Education and Awareness (Ministry of Science, Technology and the Environment (MOSTE, 2002). EE in Malaysia is geared towards addressing environmental challenges such as littering, water pollution, air pollution and the degradation of biodiversity (Pudin et aL, 2005). The school curriculum focuses on educating the society to be more sensitive and concerned about environmental issues, to be knowledgeable, skilled and committed to act individually or collectively to address environmental issues has been instituted. This program cuts across the primary and secondary school curriculum (Naderson and Nor Shidawati, 2005). Teachers are required to integrate the concepts and components of EE across the curriculum at all levels, particularly in subjects like Science, Geography, History, Local Studies, Mathematics and languages. To facilitate the tasks for teachers, EE Curriculum Guidelines that include the specific objectives, components and implementation strategies of EE at pre-school, primary, and secondary levels was provided. At the tertiary level, various environmental science and environment-related courses are offered at degree level. After years of research, several local universities have built up their expertise in the environment-related fields (Arba'at et aL, 2009).

In order for students to have sound knowledge and good values towards environment, the knowledge base of the teachers themselves is of great importance as

good subject knowledge is essential for best teaching (Summers, 1994). Specifically, Skanavis et al., (2004) asserts implementation of EE definitely depends initially on the attitudes or the receptivity of teachers to this innovation. Teachers should be familiarized with the strategies of teaching that may help in the achievement of the cognitive, sentimental and behavioural objectives of EE. The environmental attitudes, values, behaviour, participation and action skills of teachers themselves are important for the configuration of students" opinions, perceptions and behaviors, while at the same time educators serve as role models for the consolidation of the desirable student behavior (Banks, 1993). As environmental science rapidly advanced, it is essential for educators to have up-to-date, relevant teaching material that present basic concept in ways that stimulate student interest.

1.2 Statement of Problem

Undoubtedly, EE research has tended to conclude that the problems associated with the implementation of environmental education are due to a perceived lack of adequate pre-service and in-service environmental education training. Gabriel (1996) found that teachers are not well-prepared to integrate EE into their classrooms and that inadequate teacher training is the predominant reason teachers are not teaching EE. Thus, the provision of further or restructured teacher education has been identified as the 'priority of priorities' for environmental education (Ballantyne, 1995).

According to Naderson and Nor Shidawati (2005), though environmental education is infused into the school curriculum, it is unfortunate that its importance is not

stressed and so students do not really see the need to practice an environment-friendly lifestyle. It is treated as just one more academic topic for students to study, with no real connection to their lives beyond the classroom. This was supported by Lim (2005) who claimed that Malaysia students have a long way to go before they can be at par with other developed countries in environmental awareness. Lim (2005) reported that students' understanding of environmental issues and recognition of environmental problems was only at the surface level and that awareness and sensitivity towards environmental issues were low.

A study by Sharifah et al., (2005) revealed that participation in environmental activities had a positive influence on knowledge. The study also found that knowledge correlated positively with environmental attitudes, behaviors and participation. Julia (1999) reported that there is a gap between what students view as positive actions toward the environment and the activities in which they are personally involved. When it came to action, the respondents preferred conservation practices, which required little effort such as switching off fans, but did not commit to action like taking along their own shopping bags (Lim, 2005). After years of effort to integrate environmental education, studies keep revealing that Malaysians in general and students specifically have not reached a certain desired level of commitment towards our environment. Education should be able to change the behavior and motivate students toward taking care of the environment.

There are varied and diverse teaching and learning strategies in order to increase environmental awareness and internalize values relevant to the preservation and

conservation of the environment and one of the promising is project-based learning. Project-based learning (PBL) is a well-known method for imparting thinking competencies and creating flexible learning environments. Project-based learning (Barak & Dori, 2004; Krajcik et a1, 1999) is an approach that makes extensive use of student-directed scientific inquiry supports by technology and collaboration in teams. Students have a chance to learning by doing, enhancing their critical skills and shaping the learning process by being active participants. Students in a project-based learning environment deal with real-life problems, which may result in permanent knowledge (Barak & Dori, 2004). In PBL, projects are focused on questions or problems that "drive" student to encounter (and struggle with) the central concept and discipline and maybe build around thematic units (Blumenfeld, et al., 1991).

An environmental topic which has been debated in various arenas, including among scientists themselves are global warming and climate change. Climate change as a result of global warming is one of the most serious global environmental problems and has implication in food and water supplies, energy production and use, ecosystem and species survival, human health, and social and political stability (Paterson, 1996). This topic is a challenging topic to teach and to learn and the complexity of the topic offers an opportunity to engage students in higher order thinking skills in addition to making learning relevant.

The use of information technology in education is also on the rise and and has become a common tool in the classroom. Research by Leidner and Jarvenpaa (1993)

illustrated that the use of new media to communicate ideas in an academic environment can affect learning. Technology can play an important role in ensuring that learning is the result of dialogue and production of new knowledge in new media for audiences beyond the classroom, making both course content and student work more relevant. Technology can also supplement whole class instruction and give students the tools to reach more in depth understandings. Students can use technology to produce new knowledge in new forms including web sites, video clips and PowerPoint presentations. Integrating information technology in collaborative, project-based learning prepares learners by conceiving, developing, and implementing projects relevant to the learners' needs. This active learning process teaches critical thinking, problem solving, teamwork, negotiation skills, reaching consensus, using technology, and taking responsibility for one's own learning.

1.3 Purpose of study

The purpose of the present study is to investigate the effect of project-based learning on students' environmental knowledge, attitudes and behaviour. The specific objectives of the study are as follows:

1. To investigate the effect of project-based learning on students" environmental knowledge, attitudes and behaviour.
2. To determine if there is any significant relationship between environmental knowledge, attitudes and behaviour.

1.4 Research Question

The following research questions were addressed:

1. What are the effects of project-based learning on students" environmental knowledge, attitudes and behaviour?
2. Is there any significant relationship between environmental knowledge, attitudes and behaviour?

1.5 Research Hypotheses

Hoi: There is no significant difference in students' environmental knowledge, attitudes and behaviour before and after experiencing project-based learning.

Ho2: There is no significant relationship between students" environmental knowledge, attitudes and behaviour.

1.6 Significance of the Study

There are various studies assessing students' environmental knowledge, attitudes and behaviour but only few studies have been published relating to the method to increase pre-service teachers' environmental knowledge, attitudes and behaviour. By highlighting misconceptions that occur among pre-service teachers, it is hoped that it will prevent the pre-service teachers passing these on to the children they might teach. Such a rational is vital in teaching of issues related to EE (Dove, 1996). So this study establishes

how a student-centered class activity, specifically project-based learning in teacher education, affect their knowledge, attitudes and behaviour towards environment. This kinds of research will provide a good insights not only to academic researcher in the fields of EE, but also for those involved in the design of educational policy for the promotion of EE in pre-service teachers' training courses. Through this knowledge, a better understanding of the educational reality of EE could be obtain and helps to improve teacher professional training and developments. Thus, this knowledge would be able to assist teachers themselves in critically reflecting on their conceptual and theoretical underpinnings of their teaching practices. From broader perspectives, this study will enrich the theoretical knowledge and research tradition for EE. Moreover, it contributes towards a better understanding of educational practice in EE, provides research data for a substantial, more realistic and democratic assessments of EE (Flogaitis et al, 2006).

1.7 Limitation

The study has the following limitations:

1. The result can only be generalized to the population under discussion - the preservice teachers (undergraduate science education students) at the Universiti Sains Malaysia
2. The research does not determine if significant life experience of individual students affect the outcome of the study.

1.8 Definition of Terms

Environmental Knowledge

Environmental knowledge which considered as cognitive strand in the present research refers to the knowledge and understanding of facts, concepts and generalizations related to the 'environmental concerns' (Chin Ivy et al, 1998). It defined as information that enables someone to study and reach conclusions about the physical, social and cultural conditions that affect the development of an organism. In the current research operationally, the environmental knowledge tested for causes (16 items), consequences (19 items) and cures/solutions (18 items) of climate change developed by Boyes and Stanisstreet(1993).

Environmental Attitudes

Environmental attitudes which considered as affective strand in the present research, dealt with evaluating whether the students agree or disagree, are favorable or unfavorable, with regard to aspects of the environment. It is defined as the predispositions that affect how someone perceives and interprets the physical, social, and cultural conditions that affect the development of an organism (DeChano, 2006). In the current research operationally, the environmental attitudes was measure through Environmental Concern Scale first developed by Weigel and Weigel (1978).

Environmental Behaviour

Environmental behaviour refers to the overt and observable actions taken by a student in response to the environment. Hence, programs created to enhance environmental awareness should be designed to engage the target audience in not only increasing their environmental knowledge but their environmental skills, attitudes and behaviour as well (Grodzinska-Jurczak et a1, 2003). Enviommental behaviour was measured using 11 pro-environmental behaviour statements. Students were required to indicate their willingness to participate in pro-environmental behaviour. The statements were taken from two different sources: Chan (1996) and Volk and McBeth (1997).

Project-Based Learning

Project-based learning is a teaching and learning model that uses projects to engage students and focus their learning. Projects are complex tasks that involve students in design, problem-solving, decision-making, and investigative activities. Students work autonomously over extended periods of time, and prepare realistic products or presentations (Diehl et al., 1999). In the present research, the central concept is climate change. Students working in groups were given 8 weeks to design a Web-Quest lesson on global climate change.