UNIVERSITI PUTRA MALAYSIA

EFFECTS OF PROJECT-BASED LEARNING ON ENVIRONMENTAL LITERACY OF PRE-SERVICE TEACHERS AT AN INSTITUTE OF TEACHER EDUCATION IN MALAYSIA

NAZIFAH BINTI SHAIK ISMAIL

FPAS 2013 21

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

September 2013

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DEDICATIONS

I dedicate this thesis to my family :
My mother , Laili Omar
My father, Shaik Ismail Shaik Hussian
My husband, Abd Raof Mat Shaari,
My children, Syaza Batrisyia, Nurina Nabilah, Muhammad Faheem Faliq and Muhammad Imad Ilman.
Your prayers, love, support, understanding and words of encouragement made it possible for me to complete this journey successfully.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

EFFECTS OF PROJECT-BASED LEARNING ON ENVIRONMENTAL LITERACY OF PRE-SERVICE TEACHERS AT AN INSTITUTE OF TEACHER EDUCATION IN MALAYSIA

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September 2013

Chairperson : Professor Turiman Suandi, PhD
Faculty : Environmental Studies

This study was undertaken in response to the need for empirical research concerning the effectiveness of instructional approaches implemented in environmental education programmes. The intent of this quasi-experimental research with pre-test, post-test and delayed post-test non-equivalent control group design is to study the impact of the project based learning instructional approach on the environmental literacy of pre-service teachers. The study involves 131 pre-service teachers (experimental group = 67, control group = 64) from the Institute of Teacher Education. Project-based learning instructional method was applied to the experimental group whereas teaching and learning strategies specified by the curriculum standards was applied to the control group. Environmental literacy survey was used to gather quantitative data whereas student reflective journals were analyzed for the qualitative insights. The validation procedure of the environmental literacy survey involves translation validity, content validity, pilot test, reliability test and construct validity. Content validation indexes for the environmental literacy survey are above 0.90 for all the components whereas the reliability indexes are above 0.75. The construct validity requirements were also satisfied as the CMIN/DF is 2.26; GFI is .92; CFI is .93; TLI is .91; and the RMSEA is .07. The kappa values obtained for qualitative data was above 0.86 indicating that the qualitative analysis was valid. The results gathered based on combined scores of each component of environmental literacy indicated that project based learning instructional method was more effective in enhancing the affective ($t = 3.11$, $p < 0.05$) and cognitive ($t = 3.44$, $p < 0.05$) components of environmental literacy in comparison to the combination of the multiple student centred strategies specified by the curriculum standards. Based on the effect size derived from paired sample t-test, the eta squared value observed for the affective component of the experimental group ($\eta^2 = 0.47$) is

larger than the control group (η^2 = 0.37). Similar results was observed for the cognitive component, where the effect size of the experimental group is 0.77 and the effect size of the control group is 0.60. In the case of behaviour component of environmental literacy, there is no significant difference in the combined mean scores of the experimental and the control group. However, when analysed based on the subscale level, the project-based learning instructional method proved to be significantly more effective in increasing the "Eco-management" subscale of the behaviour component of environmental literacy ($t = 3.28$, $p < 0.05$). Qualitative analysis showed the improvement in values and beliefs towards the environment, sense of obligation towards the environment, individual actions towards improving the environment and environmental knowledge were attributed to discussion and knowledge sharing activities which were triggered by the leading questions embedded in the project. Through these activities, the students gained insightful knowledge that induced the changes in how they feel about the environment and the values that they hold. The knowledge that they have gained had also induced the students to change their lifestyle towards preserving the environment. This study indicated that project-based learning instructional method in environmental education is more effective than a combination of different instructional strategies in improving the environmental literacy of pre-service teachers in Malaysia. The retention analysis on the delayed post-test mean scores showed that environmental literacy did not persist especially for the behaviour component of environmental literacy. However, the mean scores were still significantly higher than the pre-test mean scores. Perhaps, the cultivation of environmental literacy might be more efficient if the programme involves long-term initiatives and many enhancements opportunities. Further investigation needs to be conducted to establish the reasons some subscales increased more or persist more than the others.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN PEMBELAJARAN BERASASKAN PROJEK TERHADAP LITERASI ALAM SEKITAR, GURU-GURU PRAPERKHIDMATAN DI SEBUAH INSTITUT PENDIDIKAN GURU, MALAYSIA

Oleh

NAZIFAH SHAIK ISMAIL

September 2013

Pengerusi : Profesor Turiman Suandi, PhD
Fakulti : Pengajian Alam Sekitar

Keperluan penilaian secara empirikal terhadap keberkesanan pendekatan pengajaran dalam Program Pendidikan Alam Sekitar telah mendorong kajian ini dijalankan. Kajian berbentuk eksperimental-kuasi ini bertujuan menentukan kesan pembelajaran berasaskan projek terhadap literasi alam sekitar, guru-guru praperkhidmatan dari Institut Pendidikan Guru (IPG). Reka bentuk kajian ini menggunakan kumpulan ekperimen dan kumpulan kawalan tidak setara, yang telah ditadbirkan ujian pra, ujian pasca pertama dan akhirnya ujian pasca kedua. Sampel kajian terdiri daripada 131 orang guru praperkhidmatan IPG (67 orang ditempatkan dalam kumpulan eksperimen dan 64 orang dalam kumpulan kawalan). Strategi pembelajaran berasaskan projek telah dilaksanakan terhadap kumpulan eksperimen, manakala strategi-strategi berpusatkan pelajar yang terdapat dalam huraian sukatan sedia ada, dijalankan kepada kumpulan kawalan. Data kuantitatif dikumpulkan melalui soal selidik literasi alam Sekitar, manakala, data kualitatif diperoleh daripada jurnal reflektif pelajar. Prosedur pengesahan soal selidik literasi alam sekitar yang dijalankan melibatkan proses-proses berikut; kesahan alih bahasa, kesahan kandungan, kesahan konstruk, ujian rintis dan akhirnya ujian kebolehpercayaan. Indeks kesahan konstruk yang diperoleh bagi kesemua komponen literasi alam sekitar adalah melebihi 0.90, manakala indeks-

indeks kebolehpercayaan turut melebihi 0.75. Keperluan kesahan konstruk juga telah dipenuhi, dengan perolehan nilai *CMIN/DF*, 2.26; *GFI,0*.92; *CFI, 0*.93; *TLI, 0*.91; dan *RMSEA* sebanyak 0.07. Seterusnya, nilai Kappa bagi data kualitatif yang melebihi 0.86, memberikan indikasi bahawa analisis data kualitatif adalah sah. Skor yang diperoleh bagi setiap komponen literasi alam sekitar menunjukkan bahawa, intervensi pembelajaran berasaskan projek adalah lebih berkesan dalam meningkatkan komponen afektif ($t = 3.11$, $p < 0.05$) dan kognitif ($t = 3,44$, $p < 0.05$) literasi alam sekitar, berbanding dengan strategi berpusatkan pelajar, yang dicadangkan oleh sukatan pelajaran sedia ada. Nilai eta (nilai saiz kesan yang diperoleh melalui Ujian-t Bersandar) bagi komponen afektif kumpulan eksperimen ($\eta^2 = 0.47$) adalah lebih besar dari kumpulan Kawalan ($\eta^2 = 0.37$). Keputusan yang sama juga ditunjukkan oleh komponen kognitif, iaitu nilai eta yang lebih besar diperoleh kumpulan eksperimen ($\eta^2 = 0.77$), dan kumpulan kawalan ($\eta^2 = 0.60$). Komponen tingkahlaku pula tidak menunjukkan perbezaan yang signifikan, dari segi perbandingan skor min antara kumpulan eksperimen dengan kumpulan kawalan. Walau bagaimanapun, analisis peringkat subskala bagi komponen tingkahlaku literasi alam sekitar ($t = 3.28$, $p < 0.05$) telah membuktikan bahawa kaedah pengajaran pembelajaran berasaskan projek adalah lebih berkesan dalam meningkatkan subskala "Pengurusan Alam Sekitar". Dapatan kualitatif pula menunjukkan peningkatan dalam nilai dan kepercayaan terhadap alam sekitar, rasa tanggungjawab terhadap alam sekitar, tindakan individu ke arah memelihara alam sekitar dan pengetahuan alam sekitar. Hal ini adalah disebabkan oleh aktiviti perbincangan dan perkongsian pengetahuan yang telah dapat dicetuskan melalui pemberian soalan berpandu dalam intervensi ini. Melalui aktiviti-aktiviti di atas, pelajar memperoleh pengetahuan mendalam, sehingga mendorong perubahan dari segi perasaan dan nilai-nilai yang dipegang terhadap alam sekitar. Pengetahuan yang diperoleh juga menggalakkan pelajar mengubah gaya hidup mereka menjurus ke arah pemeliharaan alam sekitar. Kajian ini mendapati bahawa, kaedah pengajaran pembelajaran berasaskan projek dalam pendidikan alam sekitar adalah lebih berkesan daripada kombinasi pelbagai strategi pengajaran dari segi meningkatkan literasi alam sekitar bagi guru-guru praperkhidmatan IPG. Namun demikian, analisis skor min ujian pasca kedua untuk membuktikan pengekalan intervensi menunjukkan bahawa literasi alam sekitar tidak kekal, terutama bagi komponen tingkahlaku. Walau bagaimanapun, skor min diperoleh dalam ujian pasca kedua adalah jauh lebih tinggi daripada skor min ujian pra. Hal ini mendedahkan kemungkinan penerapan literasi alam sekitar ini akan lebih berkesan sekiranya ia melibatkan inisiatif jangka panjang dan membuka banyak peluang penambahbaikan. Kajian lanjutan juga perlu dijalankan untuk membuktikan mengapa beberapa subskala menunjukkan peningkatan yang lebih tinggi, atau kekal sama, berbanding dengan subskala lain.

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I feel fortunate to have all of the support, guidance, and expertise this extraordinary team of people has given me. May you all be well, in good health and always be blessed by Allah.

I certify that a Thesis Examination Committee has met on 24th September 2013 to conduct the final examination of Nazifah binti Shaik Ismail on her thesis entitled " Effects of Project-based Learning on Environmental Literacy of Pre-service Teachers at an Institute of Teacher Education in Malaysia " in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor Of Philosophy. The members of the Supervisory Committee were as follows :

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Date:

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I hereby confirm that:

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INTRODUCTION

1.0 Preface

This chapter begins with a discussion on the background of the study and the statement of the problem. This is followed by the research questions, research objectives, research hypothesis, significance of the study, limitations of the study and lastly operational definition of terms.

1.1 Background of the Study

The earth's ecological balance has been drastically changed by human activities. The environmental crisis that we face has emerged from our exploitation of the earth's natural resources and advances in science and technology (Chawla, 1998; Kilinc, 2010). Evidence of disruptions to the earth, such as global warming, ozone depletion, loss of biodiversity, acid rain, soil loss, biosphere toxification and destruction of natural habitats continue to escalate. Biologists see these threats as a warning that we are reaching the limits of the Earth to sustain our population and that crossing these limits will surely impact the present and future human population (Cairns, 2002; Chawla, 1998; Green, 1997).

Concern and awareness of the deteriorating earth's ecosystem resulted in the United Nations World Conference on the Human Environment in Stockholm in 1972. The conference became the foundation for global environmental governance and conservation. It led to the commencement of the United Nations Environmental Programme (UNEP) in 1973, the blueprints called the Belgrade Charter (1975), the discussion on environmental education in The Tbilisi Declaration (1997), the report of the Bruntland Commission entitled "Our Common Future" which then provided the base line for the blueprint called "Agenda 21". The blueprint provides comprehensive guidelines for governments in taking action for economically, socially and environmentally sustainable development in the twenty-first century (Palmer, 1998).

Repeatedly, throughout the history of global environmental governance, it is predominantly agreed that education should take the lead in increasing and developing environmental citizenry. Environmental education was identified as being the essential means to attend to the environmental problems that we continually face today. Through education we hope to develop a well-informed and environmental literate citizenry that can take individual action and make collective well informed public policy decisions. This is important as we increasingly face choices that affect our lives, families, communities and the rest of the world (Simmons, 2005; Weiser, 2001).

Literacy in environmental education goes beyond cognitive competency. Researchers have attempted to ascertain the concept and definition of environmental literacy over the past few decades. Many of the variances in the definitions of environmental literacy are subject to different components of environmental literacy (Weiser, 2001). The review of the literature shows that almost all the definitions of environmental literacy include knowledge concerning ecological concepts and processes, awareness and attitude towards the environment and solving environmental issues and the motivation to demonstrates commitment towards the sustainability of the environment through environmentally responsible behaviour (Erdogan, Kostova, & Marcinkowski, 2009; McBeth, Hungerford, Marcinkowsi, Volk, & Meyers, 2008; McBeth & Volk, 2010; Negev, Sagy, Garb, Salzberg, & Tal, 2008). Being environmentally literate also includes having the necessary skills regarding the action strategies needed to make informed decisions and solve problems that are environmentally related (Stevenson, Peterson, Bondell, Mertig, & Moore, 2013). Even though there are differences in the way environmental literacy was defined or described by the environmental educators, they bear many similar characteristics or components. Most experts agree that cognitive or knowledge, attitude or values, skills and behaviour are all important components in developing and achieving the ultimate goal of environmental education, that is, developing an environmentally literate citizenry (Hollweg, et al., 2011; Stevenson, et al., 2013). Many studies were conducted to distinctively describe the components of environmental literacy and characteristics that portray each of the components.

The cognitive or knowledge component of environmental literacy not only refers to basic fundamental knowledge of environmental concepts and processes but also the interdependence and interaction between the natural and social systems (Hill, 2012; Hollweg, et al., 2011; Roth, 1992, 2002). It also includes knowledge regarding environmental issues and action strategies. On the other hand, the affective component of environmental literacy includes values, awareness, attitudes and sensitivity towards the environment. This component refers to general feelings and moral reasoning towards the environment, concern towards specific environmental issues and feelings towards taking action to rectify environmental problems (Hollweg, et al., 2011; McBeth, et al., 2008; Pe'er, Goldman, & Yavetz, 2007; Simmons, 1995). Behaviour, however, takes account of personal investment, responsibility and active involvement. It involves a lifestyle in which individuals engage themselves and portray leadership in activities that works towards resolving environmental problems and issues (Hollweg, et al., 2011; McBeth, et al., 2008; Roth, 1992), The skills component of environmental literacy encompasses the ability of an individual to act accordingly by using the knowledge and attitude that they possess. The skills of an environmentally literate individual include psychomotor abilities (sorting material for recycling processes), communication skills to work collectively with others and higher order thinking skills to analyse and synthesize information in the process of thoroughly understanding various environmental issues (Hollweg, et al., 2011; Hungerford, Peyton, & Wilke, 1980; McBeth, et al., 2008; Roth, 1992, 2002).

In Malaysia, an environmental education programme was introduced in the Teacher Education Institutes in 2001 and was fully implemented in 2003. Also known as the *Dinamika Guru Pendidikan Alam Sekitar* (DG-PAS), this environmental education programme is a non-examination but a compulsory course for pre-service teachers enrolled under the post-graduate programme called *Kursus Perguruan Lepas Ijazah (KPLI).* This environmental education programme aims to develop environmental citizens who will adopt sustainable lifestyles (M.O.E, 2003). Among the outcomes outlined in the objectives of the environmental education programme are to develop teachers who apply ecological concepts and knowledge to analyse and solve environmental problems, have a positive attitude and values towards the environment, are able to take actions and participate in environmental conservation and sustainability, and, ultimately, become a good environmental citizen. These objectives run parallel with the attributes of an environmentally literate citizen.

Part of the integral components of the learning process in environmental education is incorporating knowledge, understanding, awareness and sensitivity towards the environment and its challenges; motivation in improving and maintaining environmental quality; the skills necessary to identify environmental challenges and help resolve them and lastly, the importance of participation in resolving the environmental challenges (UNESCO, 1977). Environmental education should also foster appreciation of the interrelationship between humans and their biophysical surroundings. Ideally, environmental education should be instilling and enhancing critical thinking skills, and exercising problem solving skills. These traits are crucial in developing an environmentally literate citizenry, which is the ultimate aim of environmental education. Through environmental education, environmental literacy should be nurtured from preschool level and continued as a lifelong process. However, since educators have immensed influence on students (Amirshokoohi, 2010; Disinger, 2005; Jannah, Halim, Meerah, & Fairuz; Kilinc, 2010; Norizan, 2010; Tuncer, et al., 2009) they themselves have to be environmentally literate (Corina, Esmie Obrin, Tamoi, & Nero, 2013) and competent enough to teach environmental education effectively (Ballantyne & Pecker, 1996; Simmons, 2005; Tuncer, et al., 2009). Environmental educators should have the ability to encourage learners to become informed and responsible decision-makers (Habibah & Punitha, 2008; Hungerford & Peyton, 1986; Orr, 1996). They are also professionally obligated to present an in depth analysis of all sides of environmental issues (Disinger, 2005).

In Malaysia, an environmental education programme was introduced in the Institutes of Teacher Education in 2001 and was fully implemented by 2003. Also known as the *Dinamika Guru Pendidikan Alam Sekitar* (DG-PAS), this environmental education programme is a non-examination but compulsory course for pre-service teachers enrolled under the post-graduate programme called *Kursus Perguruan Lepas Ijazah (KPLI).* This environmental education programme aims to develop environmental citizens who will adopt sustainable lifestyles (M.O.E, 2003). Among the outcomes outlined in the objectives of the environmental education programme are to develop teachers who apply ecological concepts and knowledge to analyse and solve

environmental problems, have a positive attitude and values towards the environment, are able to take actions and participate in environmental conservation and sustainability, and, ultimately, become a good environmental citizen. These objectives run parallel with the attributes of an environmentally literate citizen.

1.2 Statement of Problem

Previous researches have shown that the training for pre-service teachers are not effective enough in developing highly literate educators (Knapp, 2000). Disinger (2005) claims that the pre-service and in-service training of teachers on the scientific and technical aspects of environmental issues have not been particularly successful. This scenario also reflects the present situation in Malaysia. The Environmental Education Programme in the Teacher Education Institutes has only proven to be effective in developing environmental knowledge but not for attitudes, action and decision making (Ho, 2007). Teachers awareness towards environmental issues has been found to be at a moderate level (Lim, 2005). Malaysian teachers have high level of environmental concern, are fair in environmental knowledge but have poor understanding of the underlying causes of environmental problems and lack environmentally responsible behaviour (Aini Mat, Fakhru'l-Razi, Laily, & Jariah, 2003). Situation analysis on the implementation of environmental education in Malaysia has identified lack of proper training for teachers as one of the prevailing problems in producing environmentally literate teachers who can execute environmental education effectively (Daniel, Nadeson, & Ghani, 2006). Immediate remedial measures are needed for the lack of empirical evidence that focuses on learned outcomes of environmental education instructional strategies (Bright & Tarrant, 2002; Hungerford & Volk, 2003; Kilinc, 2010; Zimmerman, 1996). Few are designed to provide a rigorous, objective and balanced examination of all sides of environmental issues (Disinger, 2005). Intervention in the teacher training is essential to develop future generations who are environmentally literate (Kilinc, 2010; Tiwi, 2011; Tuncer, et al., 2009). Thus, research on environmental education instructional strategies, especially for pre-service teachers needs to be given the upmost attention.

The majority of research on instructional method used in environmental education have revolved around experiential learning through nature study and outdoor education (Andrejewski, 2011; Brademan, 2003; Ferderbar, 2013; Kartini, 2007; Miller, 2001; Ogelman, 2012; Ozsoy, Ertepinar, & Saglam, 2012; Yusof, 1999). These methods have been demonstrated to be able to significantly increase the cognitive (Brademan, 2003; Ferderbar, 2013; Kartini, 2007; Ogelman, 2012; Ozsoy, et al., 2012; Yusof, 1999), affective (Andrejewski, 2011; Brademan, 2003; Ferderbar, 2013; Kartini, 2007; Miller, 2001; Ozsoy, et al., 2012; Yusof, 1999) and behavior(Andrejewski, 2011; Brademan, 2003; Ferderbar, 2013; Ozsoy, et al., 2012) component of environmental literacy of the participants involved. Community based pedagogies have also been proven to create similar impacts on the cognitive (Conaway, 2006; Cornell, 2007; Ratanapojnard, 2001; Silcox, 1993), affective (Berger & Kanetkar, 1995; Conaway, 2006; Cornell, 2007;

Ratanapojnard, 2001) and behavior (Cornell, 2007; M. P. Quinn, 2011; Ratanapojnard, 2001; Silcox, 1993) component of environmental literacy. The instructional elements in these methods, however, are not feasible for all educational contexts due to constraints, such as community commitment, financial support, logistics, course structure and time. This is true for the environmental education programmes in the Malaysian Institute of Teacher Education as time, curriculum and financial standings do not allow the environmental education programmes to be implemented either by experiential nature study, nor by community-based strategies. Thus, the effectiveness of more feasible strategies such as laboratory (Mageswary, Zurida, & Norita, 2012), spiritually (Crowe, 2011; Tiwi, 2011) and information technology-based pedagogies (Aslan Efe, Yucel, Baran, & Oner Sunkur, 2012; Plankis, 2009; Renuka, Sharifah, & Norhaidah, 2008; Skaza, 2010), trade books program (Lewis, 2003), scientific terminologies activities (Nicklason, 2006) and thinking activities (Eason, 2000) has been considered. However, none of the latter instructionals methods were able to effectively target the cognitive, affective and behaviour component of environmentally simultaneously.

Nevertheless, the successful elements incorporated within these strategies can provide the foundations for other environmental education instructional initiatives. Thus, as an environmental educator the researcher aims to combine the successful elements of various environmental education instructional methods and develop an instructional module that will effectively correspond to the current environmental education programme in the Institute of Teacher Education Malaysia. Wright (2006) emphasized that environmental education instructional strategy should help students to use what they have learnt, personal knowledge and experience to support their beliefs, opinion and action. Students should be provided with a learning environment that makes them feel that they can initiate change by making individual and collective choices that support the sustainability of the environment. Environmental education should also foster higher order thinking skills (Simmons, 2005) , information accessing and processing skills, analytical and evaluation skills, critical thinking skills and problem solving skills to enable students to make well informed, reasoned and sensible decisions and actions (Disinger & Monroe, 1994; Goldman, Assaraf, & Shaharabani, 2013). These attributes could be achieved through learner centred pedagogy that stimulates students to explore concepts and skills based on meaningful investigation. Volk and McBeth (1997) concluded that thoughtfully, meaningfully and logically sequenced instruction, which is sustained over time, is able to promote and enhance various components of environmental literacy.

To integrate the elements mentioned above, the researcher will adapt a constructivism based instructional method known as project-based learning. The project-based learning instructional method has the capacity to inculcate similar instructional elements that support environmental education and allows the researcher to integrate different instructional strategies under the same approach (Lehmann, Christensen, Du, & Thrane, 2008; Lipson, Epstein, Bras, & Hodges, 2007; Martinich, Solarz, & Lyons, 2006; Savage, Chen, & Vanasupa, 2007). The potential of applying project-based learning in environmental education has been explored by recent researches (Aslan Efe, et al., 2012;

Benzer & Sahin, 2013; Kilinc, 2010). The assessement of the effectiveness however were not measured for all the components of environmental literacy and only research by Kilinc (2010) were implemented on pre-service teachers. In this study, the researcher intends to explore the effect of the project-based learning instructional method on the cogntive, affective and behavior component of environmental literacy of pre-service teachers. The project-based learning instructional method in this study will integrate elements of problem solving and issue based activities within a technology mediated environment. The retention of environmental literacy will also be investigated.

1.3 Objectives of the Study

The general objective for this present study is to determine the effect of the project-based learning on the environmental literacy of pre-service teachers at the Institute of Teacher Education Malaysia.

The specific objectives of this present study are as follows:

1. To develop project-based learning instructional module for environmental education for pre-service teachers from Institute of Teacher Education.
2. To determine the effect of the project-based learning instructional method on the cognitive, affective and behaviour component of the environmental literacy of pre-service teachers.
3. To determine the effect of the project-based learning instructional method on the retention of the cognitive, affective and behavior component of the environmental literacy of pre-service teachers.

1.4 Research Hypotheses

This study utilizes the design of the non-equivalent pre-test, post-test and delayed post-test control group design with one independent variable of project-based learning instructional method and three dependent variables of the affective, behaviour and cognitive components of environmental literacy. Based on the research questions and the design of this study, these hypotheses were constructed:

H_1 There is a significant increase in the post-test mean scores for the cognitive component of the environmental literacy of the experimental group and the control group.

H_2 The post-test mean score for the cognitive component of the environmental literacy of the experimental group is significantly higher than the control group.

H_3 There is a significant increase in the post-test mean scores for the affective component of the environmental literacy of the experimental group and the control group.

H_4 The post-test mean score for the affective component of the environmental literacy of the experimental group is significantly higher than the control group.

H_5 There is a significant increase in the post-test mean scores for the behaviour component of the environmental literacy of the experimental group and the control group.

H_6 The post-test mean score for the behaviour component of the environmental literacy of the experimental group is significantly higher than the control group.

H_7 There is no significant difference between the post-test mean scores and the delayed post-test mean scores for the cognitive component of the environmental literacy of the experimental and the control group.

H_8 The delayed post-test mean score of the cognitive component of the environmental literacy of the experimental group is significantly higher than that of the control group.

H_9 There is no significant difference between the post-test mean scores and the delayed post-test mean scores for the affective component of the environmental literacy of the experimental and the control group

H_{10} The delayed post-test mean score of the affective component of the environmental literacy of the experimental group is significantly higher than that of the control group.

H_{11} There is no significant difference between the post-test mean scores and the delayed post-test mean scores in the behaviour component of the environmental literacy of the experimental and the control group.

H_{12} The delayed post-test mean score of the behaviour component of the environmental literacy of the experimental group is significantly higher than that of the control group.

In the statistical analysis, the hypotheses were further broken down into the subscale level of each component of environmental literacy to provide more in depth evidence concerning the effect of the project-based learning instructional approach on the environmental literacy of the pre-service teachers.

1.5 Scope and Limitations of the Study

A quantitative quasi-experimental non-equivalent control group with embedded qualitative design is employed in this research. This study has a few limitations that are beyond the control of the researcher and have to be digested prior to examining the results and conclusion. The study population are pre-service teachers from the post-graduate level teacher preparation programme for university graduates with a bachelor

degree or higher. Based on the parameters of statistical predictions namely, the power, the alpha (α) and the effect size, , the minimum sample size for each group is 64. The research participants must also be selected from institutes with the same course structure. To satisfy these requirement, six groups of pre-service teachers from two Institutes of Teacher Education Malaysia were taken as an intact group to take part in this study. Due to overlapping teaching schedules between the selected groups, the researcher was not able to conduct classes for both experimental and control group. To avoid lecturers that are not skilled enough or familiar with the project-based learning instructional method, the intervention was conducted by the researcher. Thus, the instructional activities for the experimental group are conducted by the researcher using the project-based learning instructional method while the instructional activities for the control group are conducted by three lecturers appointed by the respective Institute of Teacher Education Institutes using the standard strategies specified by the environmental education standards.

The generalizability of the results is limited to the pre-service teachers enrolled in the 27 Malaysian Teacher Training Institutes under the governance of the Ministry of Education, Malaysia. This population does not include other teacher training institutions as the curriculum standards varies from one institution to the other. This research does not consider the effect of project-based learning instructional method with variables, such as gender, race or educational background as this is a quasi-experimental research where the pre-service teachers are grouped according to their selected majors which is specified by the administrative division of the institute. The researcher has no control of the students' placement, either groups or subject major.

In this study, the main data is obtained from the quantitative measurements through the administration of the environmental literacy survey, while qualitative data is obtained through reflective journals written during the course by the pre-service teachers in the experimental group. The sections in the instrument used in this study to measure the affective and behavioural components are based on self-reported perceptions rather than direct measures of the variables. Thus, there is potential for biased responses.

1.6 Assumptions of the Study

Several assumptions were made to comply with the design of the research:

1. Environmental literacy is a measurable attribute.
2. Then respondents to the research will follow the written instruction provided.
3. The participants in the study will respond to the surveys and reflective dialogue journal honestly and conscientiously.
4. The researcher is competent enough to facilitate in the project-based learning instructional method. It is also assumed that the instructor of the present teaching unit would be equally efficient.
5. All pre-service teachers would participate in the collaborative work that is specified in the treatment.

6. The instrument does not have regional bias even though the instrument was designed for students in the State of Wisconsin in the United States of America. To support this assumption, the instruments were reviewed and adapted, and a pilot study was conducted to confirm that the instrument is appropriate for the chosen population.

1.7 Significance of the Study

The significance of this research is as follows:

Research significance. The results of this study will contribute empirical insight for further research regarding the environmental literacy and project-based learning instructional method. This research will give evidence whether project-based learning instructional method would produce positive impact in environmental education similar to the results from previous researches in other areas The instrument of this study could be used to assess and further investigate the environmental literacy of Malaysians elsewhere.

Educational significance. This study offers empirical evidence, which could be used as a guide for the improvement of environmental education in the Teacher Education Institutes in Malaysia both for pre-service and in-service teachers. The evidence provided could help the institutions to re-examine the present curriculum and instructional practice. This instructional practice research with demonstrated evidence will assist the educational community of the Ministry of Education in developing an effective formal or non-formal programme that supports environmental sustainability. Furthermore, raising the level of the environmental literacy of pre-service teachers through a hands on and minds on experience with project-based learning instructional method will increase their effectiveness in weaving environmental instruction and activities appropriately for their students in the future. Even though generalizability is limited, it is hoped that this study provides useful data for other teaching institutions to consider planning and improving environmental programmes or courses. Moreover, if the project-based learning instructional method is proven to improve the environmental literacy of pre-service teachers, then the educational community may be encouraged to adopt this approach in other curricula to inculcate values or ethics in other disciplines.

Social significance of the study. This study could also have direct applicability for policy makers and programme developers from governmental and non-governmental organizations that aim to develop a structured training programme to enhance environmental literacy. This will indirectly contribute to the development of citizens that are environmentally literate and will support the sustainability of our ecosystem.

1.8 Operational Definition of Terms

The meanings of the following terms and phrases used throughout this thesis are based on the definitions given below:

Institute of Teacher Education of Malaysia (*Institut Pendidikan Guru)* refers to the 27 teacher training colleges under the Ministry of Education located in Peninsular Malaysia, Sabah and Sarawak.

Environmental education refers to a process of developing a citizenry that understands the complexity that exists within the natural and built environments induced by various biological, social, physical, economic, and cultural aspects. Besides environmental knowledge, environmental education also involves education efforts to inculcate the values, attitudes, and skills needed to effectively manage the environment and solve environmental problems (M.O.E, 2003; UNESCO, 1977).

Environmental Education Programme refers to a compulsory course offered in the Institutes of Teachers Education of Malaysia known as *Dinamika Guru Pendidikan Alam Sekitar (DG-PAS).*

Pre-service teachers/ Teacher trainees/ student teachers refer to the teacher trainees enrolled in the Institutes of Teacher Education of Malaysia prior to their appointment as school teachers. These terms are used interchangeably.

Environmental Literacy refers to an individual's knowledge of the ecosystem and its processes, concerns towards environmental issues, capability in using appropriate skills to take appropriate active actions for the maintenance, restoration and improvement of the environment in order to achieve equilibrium between the quality of life and the quality of the environment (Barrett & Peles, 1997; Morrone, Manci, & Carr, 2001; Moseley, 2000; Orr, 1990; Roth, 1992, 2002; Wilke, 1995).

Cognitive component of environmental literacy includes knowledge of environmental concepts and skills that can be used in resolving environmental issues (I. Iozzi & Marcinkowsi, 1990). This component is measured through knowledge of ecological principles, environmental problems and issues, and environmental issue investigation and action strategies.

- **Knowledge of Ecological Principles** refers to an individual's knowledge regarding ecological concepts in relation to:
  - Individuals, Populations and Communities
  - Change and Limiting Factors
  - Energy Flow
  - Biogeochemical Cycling
  - Ecosystem and Biodiversity (Champeau, et al., 1997).

- **Knowledge of Environmental Problems and Issues** refers to an individuals' knowledge concerning local, national, and global environmental problems and issues in relation to:
  - Air Quality
  - Water Quality and Quantity
  - Soil Quality and Quantity
  - Wildlife and Habitat
  - Energy
  - Human Population and Health
  - Waste (Champeau, et al., 1997)

- **Knowledge of Environmental Issues and Investigation and Action Strategies** refers to knowledge regarding the various environmental action strategies (i.e. Ecomanagement, persuasion, economic action, political action and legal action) that are available to prevent and resolve environmental problems and issues and knowledge regarding strategies available to investigate environmental problems and issues (Simmons, 1995).

Affective component of environmental literacy refers to the environmental sensitivity and the development of a set of positive attitudes towards the environment (I. Iozzi & Marcinkowsi, 1990). This component is measured through environmental sensitivity/awareness, attitudes and values for prevention and remediation of environmental problems and issues and perspective on environmentally responsible behaviour subscales.

- **Environmental sensitivity/awareness** refers to an individuals' empathetic view, such as appreciation, respect or concern towards the environment and matters relating to environmental issues and problems (Hungerford & Volk, 1990; William B. Stapp, 1974).

- **Attitudes and Values for prevention and remediation of environmental problems and issues** refers to an individual's general feelings based on moral reasoning, beliefs and ethics towards the environmental issues and actions needed to solve environmental problems (Pe'er, et al., 2007).

- **Perspective on environmentally responsible behaviour.**
  This subscale is measured by the locus of control and assumption of personal responsibility:

  - **Locus of Control** refers to an individual's perception towards his/her capability to influence or bring about change to a specific situation through personal action or pro-environmental behaviour. In this study the situation refers to environmental issues and problems (Pe'er, et al., 2007; Peyton & Miller, 1980; Simmons, 1995).

- **Assumption of personal responsibility** refers to an individual's general feelings regarding personal duty, obligation or responsibility towards the protection of the environment and resolving environmental issues (Hines, Hungerford, & Tomera, 1987; Pe'er, et al., 2007; Simmons, 1995).

Behavioural component of environmental literacy refers to an individual's active participation in the form of actions that aim to solve environmental problems and environmental issues (I. Iozzi & Marcinkowsi, 1990). This component is measured through various actions, such as ecomanagement, economic action, persuasion, political action, legal actions and others.

- **Ecomanagement** refers to the physical actions taken to maintain and improve the existing ecosystem (Hungerford & Peyton, 1976) and conserve the earth's resources (Simmons, 1995).

- **Economic Action** refers to taking action relating to the consumption of goods or services that present economic threats or financial pressure to induce behavioural modification in business, such as boycotting and purchasing recycled materials (Hungerford & Peyton, 1976; Simmons, 1995).

- **Persuasion** refers to verbal efforts such as debating, encouraging, arguing, speech making or letter writing to motivate other individuals to modify their values or encourage others to adopt environmentally sound practices (Hungerford & Peyton, 1976; Simmons, 1995).

- **Political Action** refers to persuasive actions involving policies and legislative initiatives that aim to influence voters, legislators or government agencies to conform to sound environmental values. This action includes lobbying, voting, supporting candidates (Hungerford & Peyton, 1976; Simmons, 1995).

- **Legal Action** refers to judiciary action taken to assist in the enforcement of environmental law or the legal restraint of undesirable environmental behaviour, such as imposing law suits and injunctions (Hungerford & Peyton, 1976; Simmons, 1995).

Project-based learning refers to a systematic teaching method, which is usually powered by challenging questions or problems that directs learners to become involved in investigative or problem solving activities and ends with carefully designed products. (Markham, Larmer, & Ravitz, 2003; Thomas, Mergendoller, & Michealson, 1999). The elements included in the environmental education project-based learning instructional method used in this research are authentic (driving) questions, authentic assessment through the use of rubrics and content checklist, cooperative and collaboration learning

in small groups, inculcation of higher order thinking skills through problem solving activities, research and investigation activities, communication and reflective skills through product presentation and technology based product.

1.9 Thesis Organisation

Rigorous actions have to be taken locally and globally to resolve the impacts of development on the environment. Each individual has to be encouraged to initiate conservation and remediation efforts to protect the environment and to prevent further degradation. The best means of doing this is through education. As the prime mover of education, teachers are expected to be environmentally literate in order to successfully deliver the task of developing an environmentally literate generation. Therefore, it is critical that a strong and solid foundation is laid during teacher training. In accordance with this aim, this instructional practice research will study the impact of project-based learning instructional method, which is implemented through the environmental education programme, on the environmental literacy of the pre-service teachers. It is hoped that this research will provide insights for the improvement of the environmental education instructional strategy. The organization of the other chapters in this study is as follows:

Chapter 2 of this study provides an in depth view of scholarly literature relevant to environmental literacy and project-based learning instructional method research. This chapter revolves around the analysis of literature concerning field practice, instructional theory and models, and the findings from prior research.

Chapter 3 describes the research methodology of this concurrent embedded experimental mixed methods study. This chapter outlines and discusses the methodological approach, research participants and sample, assessment tools, data collection and data analysis procedure. The reliability and validity process is also provided.

Chapter 4 discusses the results of the study. The results of the research include the scores from the pre-test, post-test and delayed post-test. Excerpts from the students' reflective journals are also presented to further support the quantitative results.

Chapter 5 summarizes the research through interpretation and discussion of the findings, conclusion and recommendations for practice and future research.

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