Influences on the Attitudes of Pre-service Preschool Teachers in Hong Kong on Environmental Education

by

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Statement of Originality

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Abstract

The mixed methods study detailed in this thesis, which involved 238 Higher Diploma of Early Childhood Education students, investigated the influences on the environmental attitudes of pre-service preschool teachers (hereafter, pre-service teachers) in Hong Kong. The research design adopted both quantitative and qualitative approaches. The quantitative approach was the dominant method of data collection, and it consisted of a web-based self-administrated survey, namely, the Environmental Attitudes of Pre-service Preschool Teachers Scale (EAPPT Scale), which had 52 items that were measured by a Likert-type scale. The qualitative approach aimed to supplement the quantitative findings, and the method involved three face-to-face focus group interviews. The quantitative and qualitative data were analyzed using Rasch modeling and the thematic approach, respectively.

In this study, the Rasch Rating Scale Model (RSM) was utilized to examine the quantitative data of the EAPPT. Person supportiveness and item agreeability were both expressed as probabilistic units (i.e., logits or log-odds) in reference to the same continuum. The Rasch RSM is a probabilistic approach that converts non-linear data (i.e., ordinal data) into linear data (i.e., logits) for the in-depth analysis of psychometric variables.

The Rasch modeling analysis found that the EAPPT Scale and its five subscales, namely, education, alternative experiences, beliefs, social interactions, and action

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potential, fit the Rasch model well, and the respective reliability of the subscales was good. Through the triangulation process, the qualitative results mostly concurred with the quantitative findings. The pre-service teachers' scores in the action potential domain were comparatively lower than those in the other domains. The most influential factors of the environmental attitudes of the pre-service teachers were in the education and alternative experiences domains. The key findings were encouraging in that, overall, the pre-service teachers had a strong sense of environmental awareness. However, self-benefits and decision-making were major barriers to implementing pro-environmental behavior. Future research should focus on ways to break through these barriers.

Keywords: environmental education, environmental attitudes, pre-service preschool teachers, Rasch modeling, EAPPT Scale

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List of Abbreviations and Terms

AE	alternative experiences
AP	action potential
BF	beliefs
EAPPT Scale	Environmental Attitudes of Pre-service Preschool Teachers Scale
EAU Scale	Environmental Attitudes of the University Scale
ECE	early childhood education
EdUHK	The Education University of Hong Kong
EE	environmental education
EN	education
GPC-2006	Guide to the Pre-primary Curriculum 2006
HDECE	Higher Diploma of Early Childhood Education
MNSQ	mean square
PPT	pre-service preschool teachers
RSM	Rasch Rating Scale Model
SI	social interactions

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CHAPTER ONE

INTRODUCTION

The focus of the current study was to examine the influences on the environmental attitudes of Hong Kong pre-service preschool teachers (hereafter, pre-service teachers), beginning with the global concerns of climate change and environmental pollution, which have led to the destruction of nature and the rapid diminution of biodiversity. Scientists, researchers, educators, and policymakers have gathered at the United Nations Economic and Social Council since 1968 to discuss issues related to the environment. In 1972, the theme "Environmental education is essential" was agreed on as one of the 26 principles of the Stockholm Declaration. In 1976, the United Nations Educational, Scientific and Cultural Organization-United Nations Environment Programme laid the foundation for a document on environmental education (EE), an essential factor in achieving a better future for Earth. In the Sustainable Development Goals (SDGs) Report 2020, SDG 4, "Quality Education," is one of the highlights of education for sustainable development (ESD). SDG Target 4.2 states that all young children have the right to access quality early childhood development, and Target 12.8 mentions that people need information on and an awareness of sustainable lifestyles (United Nations Economic and Social Council, 2020). The importance of engaging young children has been recognized as a key element in promoting a potentially life-long disposition toward caring for the environment (Hacking, Barrant, & Scott, 2007, as cited in Ärlemalm-Hagsér, 2013).

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Pre-service preschool teachers (PPT) have a direct influence on young children's learning in terms of formulating their knowledge, attitudes, and skills for a more sustainable future (Türkoğlu, 2019; Folke et al., 2021). In turn, teachers' positive environmental attitudes may foster young children's positive environmental attitudes (Başal et al., 2015; Esteve-Guirao et al., 2019; Türkoğlu, 2019). Measuring the environmental attitudes of PPT is a starting point. Investigating the environmental attitudes of PPT and the content of EE can lead to the development and improvement of pre-service teachers' effective tendencies, attitudes, and behaviors (Başal et al., 2015). To frame this discussion, this study explored the environmental attitudes of PPT and the factors that influenced their attitudes in the Hong Kong context.

Insofar as environmental education is defined, the following definition is widely accepted:

> *Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man [sic], his [sic] culture and his [sic] biophysical surroundings. Environmental education also entails practice in decision-making and self-formulating of a code of behavior about issues concerning environmental quality*. (Martin, 1975, p. 21)

Thamarasseri and Fatima (2018) stated that environmental education is the process in which people develop an awareness and knowledge of the environment and make use

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of their learning to preserve and utilize environmental resources to achieve sustainability for present and future generations. Environmental education also involves cognitive development, which can be enhanced in schools and institutes and in daily life. In addition, EE can influence people's attitudes according to their personal preferences, and their corresponding evaluative judgements subsequently influence their behaviors (Bamberg & Möser, 2007; Eilam & Trop, 2012; Rodríguez-Barreiro et al., 2013).

Başal et al. (2015) reflected that the environment includes all activities that take place in the contexts of biology, society, culture, and the economy. Humanity is a dominant force of change that has affected the Earth's systems. The Anthropocene biosphere has been shaped by human activities (Folke et al., 2021), and individuals' irresponsible environmental attitudes have caused environmental problems (Erol & Gezer, 2006; Basal et al., 2015), suggesting the impact of personal attitudes on environmental issues. Thus, environmental attitudes is seen as a crucial and fervent topic for consideration and research.

Fernández-Manzanal, et al. (2007) claimed that systematic research on environmental attitudes began in the 1970s, and the concept has become clearer today. Many psychologists, sociologists, and researchers define environmental attitudes differently. Schultz (2001), a social psychologist, for example, posited that environmental attitudes are based on a person's concept of self and the degree to which an individual

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perceives himself or herself to be an essential part of the natural environment, which is related to personal beliefs and attitudes.

Attitudes are the result of making evaluative judgments about a wide range of targets and decisions on what courses to take for future behavior (Crawley & Koballa, 1994; Fernández-Manzanal et al., 2007). Ajzen (2001) has suggested that evaluative judgements always focus on attitude objects that are evaluated through cognition, affect, and willingness. Bohner and Dickel (2011) and Albarracin and Shavitt (2018) defined attitudes as orientations toward a person, situation, or socialization that are seen as indicative of personal values or beliefs. In sum, attitudes are a kind of evaluative personal judgement about a particular object or issue, such as the environment. An individual's psychometrical judgement and orientation is based on his or her cognition and behavior, which are constructed by personal knowledge, experiences, and sociocultural influences. Following these lines of thinking, the current study adopted the Environmental Attitudes of the University Scale (EAU Scale), which was developed by Fernández-Manzanal et al. (2007), to develop the Environmental Attitude of Pre-service Preschool Teachers Scale (EAPPT Scale) to examine the role of education, alternative experiences, beliefs, action potential, and social interactions in environmental attitudes.

In Hong Kong, the government, researchers, and educators have attended to environmental issues since 1990, but the development of environmental concern has

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progressed slowly (Lo, 2008). The Hong Kong Government published "Kindergarten Environmental Education: Reference Materials" by the Curriculum Development Institute in 1994 and "Guidelines on Environmental Education in Schools" by the Education Department in 1999. The "Education Bureau Environmental Report (2013–2017)" outlined the maintenance of environmental continuity to sustain environmentally friendly surroundings, which is crucial to the environmental development of future generations. The Education Bureau of Hong Kong (2017) published the "Kindergarten Education Curriculum Guide 2017," which included EE in the Nature and Living learning area. Researchers such as Lee (2001) and Lo (2008) have studied the environmental awareness of preschool teachers, yet there have not been many studies on the environmental attitudes of pre-service preschool teachers. Since PPT affect children's learning and their role in maintaining the health of the world today and in the future, examining the attitudes of this group of teachers is crucial.

1.1 Rationale and significance of the research

The concept of environmental education in the era of climate change, which has led to many disasters and has affected both nature and the existence of all living creatures, has not only drawn attention academically but also globally. Başal et al. (2015) reviewed the environmental sensitivities and attitudes of PPT and suggested the creation of relevant environmental courses. Oncu and Unluer (2015) focused on the

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environmental views and awareness of PPT and found that they needed to be encouraged to participate in activities and courses related to environmental issues. The findings of these studies proposed different perspectives on and implications of the environmental attitudes of PPT.

Hong Kong researchers and educators have conducted various studies on the EE of preschool teachers but seldom have focused on the environmental attitudes of pre-service preschool teachers. Lee and Ma (2006) and Lo (2008) examined the practices and resources of preschool teachers, while Lee (2001) focused on the status of EE in preschools through a questionnaire survey and case studies, the findings of which suggested that enhancing the positive attitudes of preschool teachers is the first and most worthwhile step in improving EE. Other available literature has recommended further studies related to this field.

The significance of this study hence lies in the contribution that it will make in illuminating the environmental attitudes of PPT in contemporary Hong Kong. Given the important role of future preschool teachers on EE, their positive or negative attitudes can affect the young children they teach regarding their environmental orientation. Researching the environmental attitudes of PPT and the influences on them is thus important. This study aims to be a steppingstone for future research on developing EE for preschool teachers.

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The EAPPT Scale, a specific, objective measurement instrument, was developed for the current study. This scale can be utilized in any Chinese cultural contexts to assess pre-service teachers' environmental attitudes. The data from this study and its findings represent a valuable proposition for policymakers and educators to include more elements related to ESD when reforming current teacher education.

1.2 Research questions

The research questions of this study are as follows:

1. What attributes characterize pre-service preschool teachers' environmental attitudes?
2. What factors influence pre-service preschool teachers' environmental attitudes?

1.3 Methodology

This study used the mixed methods approach. The EAPPT Scale was developed based on the EAU Scale to collect quantitative data. Since pre-service preschool teachers are university students, the adoption of the EAU Scale to develop the EAPPT Scale was justified. Follow-up focus group interviews collected descriptive data to support and explain the quantitative findings and to enhance the validity of the study. The research findings suggested some ideas for future studies on improving EE. This approach was suited to the research questions and problems proposed in this study.

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The study recruited 238 students of the Higher Diploma of Early Childhood Education (HDECE; Full-time Year Two) at The Education University of Hong Kong (EdUHK). The whole cohort was invited to fill out the questionnaire online, and nine students were invited to participate in three focus group interviews. Data from the focus group interviews were analyzed qualitatively.

1.4 Outline of the thesis

This introductory chapter, Chapter One, provided the rationale for and context of the study and definitions of key terms that were crucial to the study. It also outlined the main objective, research questions, and research approaches, as well as the significance of the study.

Chapter Two reviewed the literature relevant to this thesis. The literature review focused on the definition of environmental attitudes, the relationship between attitudes and behaviors, and the factors that influenced the pre-service teachers' environmental attitudes.

The development of the study's cognitive frameworks to examine the attitudes of pre-service teachers regarding environmental education was described in Chapter Three. The conceptual framework included the core focus of the current study, which was to assess the environmental attitudes of pre-service teachers. The research's background,

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the literature review, the research questions, and the methodology were also explained in this chapter.

Chapter Four presented the methodology of the study, which adopted a quantitative and qualitative approach to examine the pre-service teachers' attitudes. The chapter also described the development and administration of the survey questionnaire and depicted the results of all the interviews with the participants. The rationale and procedures of the research design were then discussed.

The analysis of the data from the EAPPT Scale was illustrated in Chapter Five. Rasch modeling was applied to confirm the five domains of the EAPPT Scale as the influential factors.

Chapter Six presented the qualitative triangulation analysis of the study. In this final phase of the sequential mixed methods research, the qualitative data from the focus group interviews were integrated with the survey-based quantitative data, and the qualitative results supplemented the quantitative findings for further interpretation. The findings of the triangulation process suggested the following:

1. The environmental attitudes of the pre-service teachers were largely positive, and many respondents agreed that environmental education was important.
2. The pre-service teachers expressed that they had insufficient opportunities for

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teaching environmental issues, suggesting that it was difficult for them to implement environmental education at their schools.

3. The intention of the pre-service teachers to get involved in an environmental organization was very weak. They only participated in green activities occasionally, and none of them were members of any environmental organizations.

Finally, Chapter Seven discussed the findings of the research and presented the implications of the results and the conclusion. Recommendations were also made for future research.

1.5 Conclusion

This introductory chapter has laid the foundation for the thesis and introduced the research questions and research methods, while providing justification for the significance of the research. The methodology was also briefly described, along with an outline of the chapters.

From a macro point of view, the term "environmental education" has recently been identified as an academic concern in research and in education. Particularly, it was also highlighted by the Hong Kong Government's "Education Bureau Environmental Report (2013–2017)," and a topic about EE has also been incorporated into the

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current curriculum guidelines, the "Kindergarten Education Curriculum Guide 2017," by the Education Bureau. Lifetime learning, effective coping, and environmental education have become the overall aim of education in the twenty-first century. Correspondingly, the role of early childhood educators in the promotion of the environmental education of young children is critically significant. Therefore, the development of teachers' positive environmental attitudes is the first step in promoting environmental education in Hong Kong.

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CHAPTER TWO

LITERATURE REVIEW

Environmental problems affect not only the lives of animals and humans but also our future generations. Scientists have discussed employing education as one of the methods for solving problems related to environmental deterioration (United Nations Economic and Social Council, 1987; United Nations Environment Programme, 2015). "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" is one of the Sustainable Development Goals of the United Nations (United Nations Economic and Social Council, 2020). Policymakers overseas have developed and improved policies to promote environmental education in society and schools; however, its implementation relies heavily on research findings and educator support.

Environmental education is important in improving the environmental problems that have been identified by scientists, researchers, policymakers, and educators in the past few decades (United Nations Economic and Social Council, 1987; Lee, 2001; Schultz, 2001; Lo, 2008; Yurt, et al., 2010; Kandir, et al., 2012; Gwekwerere, 2014; Kandemir et al., 2017; Türkoğlu, 2019). The goals of environmental education include improving people's knowledge, attitudes, and behaviors (United Nations Economic and Social Council, 1987). Researchers and educators have agreed that education is the most influential method of changing individuals' consumption habits and lifestyles (Palmer, 1993; Palmer, et al., 1998; Corral-Verdugo & Armendáriz, 2000; Pooley &

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O'Connor, 2000; Christenson, 2004; Henegar, 2005; Engels & Jacobson, 2007; Desjean-Perrotta et al., 2008; Yurt et al., 2010; Türkoğlu, 2019).

Early childhood is a critical developmental period, and preschool teachers are one of the most influential groups for young children. Preschool teachers' positive attitudes toward the environment are a major element in promoting environmental education, particularly during their teacher training stage (Yurt et al., 2010; Kandemir et al., 2017). Having a positive attitude may lead to positive behavior since there is a close relationship between attitudes and behaviors (Ajzen, 2001; Fernández-Manzanal et al., 2007; Yurt et al., 2010; Kandemir et al., 2017). Under this logic, evaluating pre-service teachers' environmental attitudes and their influencing factors can contribute to the development of EE.

Attitudes are based on the judgement and orientation of personal knowledge, experiences, beliefs (Ajzen, 2001; Fernández-Manzanal et al., 2007), and social interactions (Yurt et al., 2010; Kandir et al., 2012). Environmental attitudes are abstract psychological objects that cannot be measured directly and can only be inferred through observation (Henerson et al., 1987). Psychometric scales can serve as instruments to evaluate environmental attitudes. In this research, the EAU Scale was adopted to create the EAPPT Scale, which includes five influential factors: education, alternative experiences, beliefs, social interactions, and action potential.

This chapter discussed the importance of EE in solving environmental problems.

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Environmental education involves an environmental attitude-changing process, and measuring the environmental attitudes of PPT is a particularly important first step in implementing EE (Türkoğlu, 2019). Based on the definitions of environmental attitudes and how they are aligned with global/local research, measuring the level and exploring the influences of the environmental attitudes of PPT is a significant endeavor. The theoretical background of the EAPPT Scale was also covered.

2.1 Development of environmental education

The purpose of developing EE is not only to deliver environmental knowledge; the ultimate goal is to nurture individuals' awareness of and enhance their motivation to participate in and implement pro-environmental activities (Gwekwerere, 2014). Global warming, climate change, pollution, and deforestation have been discussed for several decades regarding the influence of the physical environment on Earth's sustainability. Human activities have caused pollution in different domains, such as the ocean, the atmosphere, and even remote areas of the earth. Başal et al. (2015) have stated that most of the environmental problems are caused by urbanization (i.e., human activities), while also mentioning that when people expand their urban activities into nature, they usually do so without realizing the important link between human biological activities and the natural environment. Erol and Gezer (2006) have suggested that if people appreciate nature and have a responsible attitude toward the environment, then it would benefit the ecological balance. Furthermore, Kandemir et al. (2017) pointed out that the complexity of environmental problems includes the

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excessive use of nature for humans' benefits and a lack of environmental knowledge. Environmental education can increase people's environmental knowledge, raise their awareness, and change their attitudes and behaviors, which in turn will encourage them to search for solutions to environmental problems (Başal et al., 2015; Thamarasseri & Fatima, 2018).

Environmental education includes learning activities that help develop the sustainability of ecosystems and society (Krasny, 2020). Stapp (1969) stated that the purpose of EE is to promote all-around citizenship and to motivate people to search for solutions to problems related to the biosphere by applying their knowledge of EE. The role of EE is to stimulate individuals' awareness of and concerns about the environment; to understand the environment so that individuals can develop positive attitudes and motivation; and to promote the commitment to act on improving the quality of the environment (Thamarasseri & Fatima, 2018). Citizens also need to work with the government to deal with environmental problems. Kopnina (2020) has advocated "Education for sustainability," "Ecological citizenship education," and "Education for ready-state economy" as alternative forms of EE, suggesting that the implication of environmental education is very dependent on individuals' motivation, government policies, and its economic affairs.

Başal et al. (2015) have defined environmental education as an "attitude-changing process." The process of EE, through either indoor and/or outdoor learning, can facilitate people to gradually increase their basic environmental knowledge and alter

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their ignorance and negative attitudes. An evaluation of one's personal environmental attitudes may indicate his or her standards of EE that have been internalized before acted upon. When people know more about the natural environment, they will appreciate and value it (Başal et al., 2015). Subsequently, people who change their beliefs and values toward the environment may become more responsible environmentally.

Early in 1972, the United Nations Educational, Scientific and Cultural Organization and the United Nations Environment Programme proposed declarations and guidelines for EE (Lee, 2001; Lo, 2008). One of the educational targets of the Sustainable Development Goals in 2020 was set out in that "All girls and boys will have access to quality early childhood development" (United Nations Economic and Social Council, 2020). Davis (2009) pinpointed that early childhood EE research is limited, and there is a need for more research on this topic (Green, 2015), as it has been a significant area of pedagogy for the last decade (Cutter-Mackenzie & Edwards, 2013; Edwards et al., 2016). Madden and Liang (2017) found that through the intervention of young children's exploring nature, children at an early stage are capable of learning sustainable EE, with fruitful results. Many researchers, such as Yurt et al. (2010) and Kandemir et al. (2017), have stressed that EE should start in preschool and continue throughout students' schooling as part of life-long learning. The stage of early childhood is a critical moment of learning (Yurt et al., 2010; Green, 2015), since children's positive environmental attitudes can be transferred to later years of development (Wilson, 1996; Chawla, 1999; Buldur & Ömeroğlu, 2018).

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Other educators, such as Tugurian and Carrier (2017), have mentioned that young children are capable of actively constructing their environmental identity.

In the Hong Kong context, the government has released a preschool document on EE titled "Kindergarten Environmental Education: Reference Materials." The document was published by the Curriculum Development Institute in 1994, and yet it was not until the 2010s that preschool EE began to be promoted more vigorously through the Quality Education Fund and Green School scheme. Beginning in 2006, environmental education was included in the "Guide to the Pre-primary Curriculum 2006" (GPC-2006; Curriculum Development Council, 2006). Physical Fitness and Health, Language, Self and Society, Early Mathematics, Science and Technology, and the Arts are the six learning areas in the GPC-2006, but there is no specific learning area for EE, which is embedded in the Science and Technology learning area as part of natural sciences. Only two objectives, namely, "caring for animals and plants and developing children's awareness of environmental protection" and "understanding the relation between humans and nature" (Curriculum Development Council, 2006) relate to EE. Based on the GPC-2006, the "Kindergarten Education Curriculum Guide 2017" was reviewed and EE was incorporated into the Nature and Living learning area. Young children are capable of acquiring knowledge from nature and establishing values and attitudes. Once young children respect and appreciate nature and the environment, they will protect it (Curriculum Development Council, 2017). A breakthrough in the preschool EE curriculum occurred in 2017, when knowledge, values, attitudes, and protection of the environment were recommended.

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Following the global trend concerning environmental problems, the Chief Executive of Hong Kong (2020) stated in "The Chief Executive's 2020 Policy Address" that: (i) Hong Kong would be built to be a more livable city through sustainable conservation; and (ii) within the framework of "Hong Kong's Climate Action Plan 2030+," Hong Kong would attempt to reach carbon neutrality before 2050 (Office of the Chief Executive, 2020). The Hong Kong Government has become more aware of environmental deterioration and environmental conservation, and as a result has been more aggressive in promoting EE to the public. Integrating EE into teacher education would be an advantageous starting point.

Environmental education for PPT is integrated into courses or is offered as an elective course in tertiary programs. In preschool, the implementation of EE varies depending on the policies of individual schools. Some Hong Kong preschools have applied to the Quality Education Fund to implement environmental projects. These preschools frequently organize different kinds of outdoor activities as routine activities, such as visiting country parks, the Hong Kong Wetland Park, etc. Preschool EE is also affected by cases based on Western cultures. The "Forest School" curriculum approach has been adopted as an alternative stream in Hong Kong preschool education. Currently, some preschools have adopted the forest school approach which EE have been embedded in the curriculum. Through free play and child-adult play in school and through outdoor activities, these teaching strategies promote the Forest School mission. Educators and researchers from the United States have contributed to

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publications relating to nature-based education in Forest School kindergartens, which have summarized the pedagogy applied and have emphasized that nature-based education strategies benefit children's cognitive, creative, physical, spiritual, social, and emotional development (Sobel et al., 2016). Forest School kindergartens can provide more learning experiences and opportunities for young children to explore, discover, and learn though inquiry.

Moreover, appropriate teacher training can lead to the successful implementation of environmental education (Pérez-Rodríguez et al., 2017). Transformative learning is an adult learning process that functions to adopt one's meaningful perspectives and converts them to suit personal needs or scenarios (Howie & Bagnall, 2013; Hoggan, 2016; Walshe & Tait, 2019). Gal and Gan (2020) found that transformative sustainability education had a positive impact on pre-service teachers' learning process and behavioral changes. As teacher training emphasizes the construction of knowledge, transformative education is an effective pedagogy in establishing associated changes at both ontological and epistemological levels (Gal & Gan, 2020).

2.2 Research on environmental education

Preschool teachers are among the most influential people who can affect children's environmental attitudes (Buldur & Ömeroğlu, 2018). Teachers' support helps children develop their ability to make logical connections between environmental concepts and solving scientific problems in their daily lives (Şahin, 1998, as cited in Buldur &

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Ömeroğlu, 2018). Therefore, preschool teachers need to be supported in gaining knowledge and building up their environmental awareness and consciousness (Kandir et al., 2012) to promote positive environmental attitudes in teaching.

During the last two decades, many researchers and educators, such as Flogaitis and Agelidou (2003), Flogaitis et al. (2005), Yurt et al. (2010), Kandir et al. (2012), Başal et al. (2015), and Buldur and Ömeroğlu (2018), have conducted studies to assess the environmental attitudes of preschool teachers and pre-service preschool teachers regarding their concepts, awareness, thinking, and practices in environmental education. Some researchers found that the preschool teachers were ambiguous about EE (Flogaitis & Agelidou, 2003; Flogaitis et al., 2005; Kandir et al., 2012), and too much effort was placed on knowledge-based EE (Flogaitis & Agelidou, 2003; Flogaitis et al., 2005). Others, like Başal et al. (2015), however, have claimed that EE should have more than a knowledge-based focus, as it should also support individuals' critical thinking, problem-solving skills, and sense of responsibility about the environment.

Pre-service preschool teachers were found not to have spent much time on nature activities (Meier & Sisk-Hilton, 2017), and they were not concerned about environmental problems. Thus, they were not sensitive to protecting the environment (Erten, 2005, as cited in Kandir et al., 2012). Pre-service and in-service preschool teachers should be educated to sense, respect, protect, and appreciate the natural environment. However, their teacher education mainly focuses on knowledge and

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practical skills, with little attention to affective domains (Kandir et al., 2012). A qualitative study in Turkey that recruited 140 in-service and pre-service preschool teachers applied the phenomenology approach (Türkoğlu, 2019). It was found that the pre-service preschool teachers needed more teaching knowledge than the in-service teachers; on the contrary, the in-service preschool teachers needed more theoretical-based knowledge than the pre-service teachers. Türkoğlu (2019) suggested that different disciplines of the EE curriculum that pinpointed in-service and pre-service teachers, respectively, should be developed. Researchers have concluded that there is a need for preschool teachers to improve their environmental knowledge and enhance their personal experience and cognizance in pedagogy that is aimed to deliver knowledge to preschool children (Birdsall, 2015; Chris & Birdsall, 2019).

Hong Kong researchers and educators have conducted environmental-related research among teachers at different academic levels, but they have seldom targeted pre-service preschool teachers. For example, Lee (2011) used the attitude-intention-behavior model of Ajzen (2002) to investigate how mass media, social exposure, and biosphere value orientation acted on adolescents' pro-environmental behaviors. Cheng and So (2015) studied the environmental literacy of primary school teachers and examined how knowledge, attitudes, and behavior influenced the teachers' implementation of EE. Cheang et al.'s (2020) study included seven Hong Kong primary schools to identify whether a newly introduced Plastic Waste Recycling Bin Program was effective in influencing students' knowledge, attitudes, and behavior. The New Ecological Paradigm Scale (NEP Scale) (Dunlap & Van Liere, 1978; Dunlap

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etal., 2000; Manoli et al., 2007) was utilized to assess the students' pro-environmental attitudes, and face-to-face interviews were conducted to collect more evidence on the students' actions and behaviors toward the environment. In sum, these studies focused on the environmental orientation, literacy, and action competence of primary and secondary school students.

Research on preschool EE in Hong Kong currently includes measuring the environmental attitudes of in-service preschool teachers, the learning and teaching of environmental education, assessing the environmental effectiveness of Green School preschools, etc. Enhancing the positive environmental attitudes of kindergarten teachers is seen as meaningful to improve EE (Lee, 2001). Lee and Ma (2006) and Lo (2008) have studied preschool teachers' implementation of environmental education practices and resources. Other researchers have suggested that teachers' knowledge of environmental education and their positive attitudes are important in carrying out environmental activities (Lee, 2001; Lee & Ma, 2006; Lo, 2008). Ngan and Kwok (2008) and Ngan and Wu (2015) have studied the learning outcomes of PPT through nature visits.

Chung (2017) conducted a qualitative study about how Green School settings influenced preschool children in Hong Kong and found that these settings provided opportunities for preschoolers to connect with nature. These kinds of experiences play a major role in positively affecting individuals' life-long environmental awareness and pro-environmental implementation. Sobko et al. (2018) utilized the Connectedness to

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Nature Index to measure Hong Kong preschoolers' connectedness to nature in urban settings, and the findings suggested that preschoolers' nature connectedness strongly cohered with "Empathy for Nature, Enjoyment of Nature, Awareness of Nature, and Responsibility towards Nature."

Iwan, Rao, and Poon (2018) applied the measurement instruments Environmental Rating Scale for Sustainable Development in Early Childhood and the simplified Leadership in Energy and Environmental Design to compare the characteristics of award-winning Green School preschools in Bali, Hong Kong, and Berkeley, California. They also utilized Bronfenbrenner's (1979) ecological systems theory to study the sociocultural influences on preschools' EE in preschools among different nations. Iwan et al. (2018) concluded that the characteristics of Green Schools can be categorized as holistic, building, and curriculum approaches. It has been suggested that the learning environment needs to cohere with the curriculum to develop an education environment that is more transformative and that will benefit preschoolers in promoting their all-around development of sustainability.

2.3 Definitions of environmental attitudes

The environmental attitudes of PPT can be affected by their personal education background, experiences, beliefs, and social ecological influences (Flogaitis & Agelidou, 2003; Flogaitis et al., 2005; Yurt et al., 2010; Kandir et al., 2012; Buldur & Ömeroğlu, 2018). Shephard et al. (2015) have suggested that if something is non-

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measurable, its improvement cannot proceed. Measuring the self-reported environmental attitudes of PPT is a primary direction in which to investigate their thinking and practices before any EE curriculum reforms can be made.

Attitudes are a psychological judgement of attitudinal objects from positive to negative, such as like-dislike, favor-disfavor, beneficial-harmful, and agree-disagree, toward a related issue (Ajzen & Fishbein, 1980; Fernández-Manzanal et al., 2007). In explaining the theory of attitudes, Ajzen and Fishbein (1980) have suggested using the reasoned action theory (see Figure 2.1) to describe how attitudes predict behavior. The core concept is that people rationalize their decisions before taking any action. Hence, an individual's intention is the immediate determinant of his or her actions based on personal interests and social influence, which forms "attitudes towards the behaviour" (Ajzen & Fishbein, 1980).

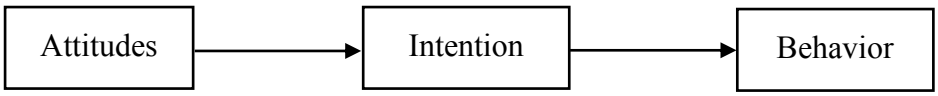

Figure 2.1 Reasoned action theory (Ajzen & Fishbein, 1980; Ajzen, 2002)

Hine et al. (1987) conducted a meta-analysis that included 15 categories of literature, with 315 sets of verified data extraction. Through Schmidt-Hunter meta-analysis, Hines et al. (1987) found that environmental attitudes were a major determinant in pro-environmental behavior. In 2013, Rodríguez-Barreiro et al. (2013) applied the reasoned action theory framework (Ajzen & Fishbein, 1980) to investigate the causal relationship between environmental attitudes and environmental behavior and found

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that environmental attitudes affected individuals' action intention, and in turn they shaped individuals' pro-environmental behaviors. Casaló and Escario (2018) conducted causal model research to depict the association between environmental attitudes and pro-environmental behavior, and their finding that environmental attitudes were a psychological tendency concurred with that of Hine et al.'s (1987) research. Environmental attitudes were thus perceived as a significant determinant in pro-environmental behavior (Casaló & Escario, 2018).

Environmental attitudes are one of the complex psychological attributes of human beings, and different concepts have been applied by social and environmental psychologists since the 1970s (Wiegel & Wiegel, 1978; Kaiser et al. 1999; Fernández-Manzanal et al., 2007; Rodríguez-Barreiro et al., 2013). Gray (1985) stated that environmental attitudes are a human psychological process that is influenced by one's primitive beliefs. Considering the aspect of beliefs, psychologists have focused on the effects of environmental deterioration on individuals, humankind, and the biosphere (Schultz, 2001). Environmental attitudes are a kind of psychological tendency expressed by evaluating the strength of human concerns about the natural environment with either anthropocentric or ecocentric beliefs (Dunlap et al., 2000; Schultz, 2001; Fernández-Manzanal et al., 2007; Hawcroft & Milfont, 2010; Milfont & Duckitt, 2010). The anthropocentric dimension of the environment is the egoistic consideration of personal quality of life versus adverse effects that cause environmental problems (Schultz, 2001; Fernández-Manzanal et al., 2007). Conversely, the ecocentric dimension of the environment stipulates that individuals

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consider the natural environment more important than humans' quality of life (Thompson & Barton, 1994; Schultz, 2001; Fernández-Manzanal et al., 2007).

Environmental attitudes are comprised of cognitive, affective, and conative components (Rosenberg & Hovland, 1960; Fishbein & Ajzen, 1974; Ajzen & Fishbein, 1980; Bogner & Wiseman, 2006; Pérez-Rodríguez, et al., 2017). Cognition is facts, knowledge, and understanding; affect is emotions and feelings; and conation is actions and behavior (Fishbein & Ajzen, 1974; Ajzen & Fishbein, 1980; Bogner & Wiseman, 2006; Kaiser et al., 2018). These attitudinal factors have been further investigated and used as a theoretical background in measuring environmental attitudes. Consequently, evaluating environmental attitudes can reveal valuable insights into how human beliefs, preferences, and rules lead to individuals' pro-environmental actions (Fernández-Manzanal et al., 2007; Pérez-Rodríguez et al., 2017).

2.4 Measuring environmental attitudes

Environmental attitudes are complex and latent variables that can be measured by observation indirectly. Environmental attitudes also denote psychological tendencies, which are expressed by assessing an attitudinal object related to environmental issues with a certain degree of agreement or disagreement, favor or disfavor, etc. (Milfont & Duckitt, 2010; Kaiser et al., 2013). Researchers have developed scales to target different categories of populations and have evaluated their environmental attitudes

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since the 1960s (Larson et al., 2015). The NEP Scale (Dunlap et al., 2000) and the Two Major Environmental Values (2-MEV) Scale (Bogner & Wiseman, 1999) are two of the most prestigious and widely used measurement instruments in recent decades (Liu & Chen, 2020).

The original NEP Scale measured the salient beliefs (i.e., environmental awareness) of adults about the relationship between human beings and the environment, while the fine-tuned NEP Scale, the NEP for Children, evaluates children's worldview about the environment. The NEP Scale is generally treated as a unidimensional scale. The ecocentric (i.e., balance of nature) aspect and the anthropocentric (i.e., human domination) aspect are the two extremes of its measurement continuum. One limitation of the unidimensional construct of the scale is that it does not fully explain attitudes and behavior (Bogner & Wiseman, 2004; Johnson & Manoli, 2008, 2010). Liu and Chen (2020) claimed that the bi-polarity characteristic of the NEP Scale over-simplified the nature of environmental attitudes. However, Lundmark (2007) stated that although the NEP Scale can measure individuals' anthropocentric beliefs reasonably, ecocentric beliefs are not reflected precisely according to its statements (Liu & Chen, 2020). Moreover, negatively worded statements in the NEP Scale performed less precisely than positively worded ones (Zhu & Lo, 2017).

The 2-MEV Scale is a measurement instrument that assesses adolescents' environmental attitudes (i.e., orientation and values) (Bogner et al., 2015). The

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2-MEV Scale comprised two high-order dimensions—preservation and utilization. Liu and Chen (2020) found that the predictability of the pro-environmental behavior of the 2-MEV Scale was much more powerful than that of the NEP Scale. Manoli et al.'s (2019) study proved that the 2-MEV Scale's preservation dimension correlated with the high score of the NEP Scale (i.e., biocentrism), and the 2-MEV Scale's utilization dimension correlated with the low score of the NEP Scale (i.e., anthropocentrism), hence suggesting that the NEP Scale's biocentric orientation cohered with the 2-MEV Scale's preservation dimension, and the NEP Scale's anthropocentric orientation cohered with the 2-MEV Scale's utilization dimension.

The NEP Scale and the 2-MEV Scale are two popular assessment tools for predicting environmental attitudes and pro-environmental behavior (Liu & Chen, 2020). However, Manoli et al.'s (2019) research found that neither the NEP Scale nor the 2-MEV Scale comprehensively investigated all dimensions of environmental perceptions. Thus, the researcher chose the EAU Scale as the framework to develop a polytomous rating scale for the current study because it is a multifaceted assessment instrument that includes the conservation worldview of the NEP Scale as a conservational belief factor (Fernández-Manzanal et al., 2007). As the objectivity of the EAU Scale was particularly designed to measure university students' environmental attitudes through the dimensions of education, field trips, conservation, and intention (Fernández-Manzanal et al., 2007), the EAU Scale also has more intensive coverage compared with the NEP Scale and the 2-MEV Scale.

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Kaiser et al. (2018) developed a set of scales to measure adults' environmental attitudes based on the Campbell Paradigm and Rasch modeling. The Rasch multidimensional construct concept (i.e., subscales as factors) was applied to validate the specific, objective nature of environmental attitudes (Kaiser et al., 2018). As mentioned, the orientation of environmental attitudes includes personal knowledge, experiences, beliefs, values, socialization, intentions, and behaviors (Bogner & Wiseman, 2006; Fernández-Manzanal et al., 2007; Pérez-Rodríguez et al., 2017). The utilization of environmental attitude scales is a functional method for researchers to evaluate individuals' environmental attitudes. Factor analysis techniques and/or Rasch multidimensional models can analyze and validate individuals' specific, objective environmental attitudes and pro-environmental behaviors effectively (Boger & Wiseman, 2006; Yan & Mok, 2011).

The scale used in the current study (i.e., the EAPPT Scale) was adopted from the EAU Scale, with an incorporation of the social context aspect based on Bronfenbrenner's (1979) ecological systems theory, which is a model that refers to the interaction between individuals and other people in different environmental settings either directly or indirectly. The concept behind this nested social interaction model includes the interaction between different social norms, such as the global environment versus culture, humans' beliefs versus government policies, social contexts versus citizenship, living environment versus closely related people, families

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versus individuals, and so on. As suggested in this model, all influences on humans originate layer to layer in the macrosystem, such as culture and beliefs and interacting with (via a meso-link) the microsystem and the individual, which is the central element of the system.

All influences on environmental attitudes were reframed into five factors: education, alternative experiences, beliefs, social interactions, and action potential (see Figure 2.2). The modified scale was reconfigured as the EAPPT Scale.

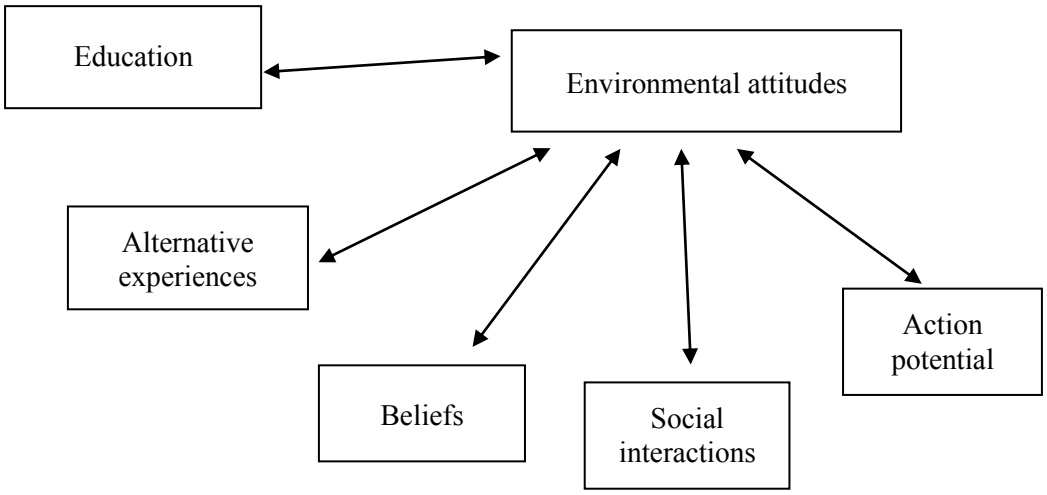

Figure 2.2 Influential factors of environmental attitudes

Figure 2.2 above showed that individual environmental attitudes are influenced by education, alternative experiences, beliefs, social interactions, and action potential. Although environmental attitudes are a psychological latent attribute of humans, they can be assessed and analyzed through an examination of these influential factors.

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2.4.1 Attitudinal factors of the EAPPT Scale

The literature on the core factors of the EAPPT Scale and the assessment instrument used in the current research was reviewed in the following paragraphs.

The first factor, education (EN), is the most crucial influential factor in measuring environmental attitudes (Stern, 2000; Fernández-Manzanal et al., 2007; Yurt et al., 2010; Kandemir et al., 2017), because education constructs environmental attitudes (Armstrong & Impara, 1991; Stern, 2000; Ajzen, 2001; Fernández-Manzanal et al., 2007). Environmental education formulates personal knowledge, which facilitates people to understand environmental problems, build individual awareness, and establish knowledge of pro-environmental behavior (Fernández-Manzanal et al., 2007; Yurt et al., 2010; Kandemir et al., 2017; Thamarasseri & Fatima, 2018). Education is also a consequence of incoming information (Kinsey & Wheatley, 1984) for cognitive development. Cognition is the input knowledge of attitudes (Fishbein & Ajzen, 1974; Bogner & Wiseman, 2006; Pérez-Rodríguez et al., 2017), which can be expressed in verbal or written communication forms (Rosenberg & Hovland, 1960; Ajzen & Fishbein, 1980).

Janmaimool and Khajohnmanee (2019) studied the roles of environmental knowledge in promoting the environmental attitudes and pro-environmental behaviors of university students. The study compared the environmental attitudes of 128 university students who were enrolled in an environmental course with 150 university students who were not enrolled in that course. The findings showed that environmental

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knowledge was highly correlated with environmental attitudes (Janmaimool & Khajohnmanee, 2019). Accordingly, EN is an important input of environmental knowledge that forms the basic aspects of environmental attitudes.

The second factor is alternative experiences (AE), which include all personal experiences that are gained from field trips, nature activities, and related environmental activities. From AE, students and teachers can acquire appropriate contexts and direct experiences that can increase their emotions toward and awareness of environmental problems (Fernández-Manzanal et al., 2007; Kandir et al., 2012; Başal et al., 2015). As first-hand experience can be obtained from participation in the environment, pedagogies have been implemented from preschool to tertiary education. The effectiveness of these pedagogies has been proven (Ngan & Kwok, 2008; Ngan & Wu, 2015; Omidvar et al., 2019).

Researchers such as Fernández-Manzanal et al. (2007), Kandir et al. (2012), Başal et al. (2015), and Cheng and Lee (2015) have demonstrated the effectiveness of field trips, fieldwork, outdoor activities, and nature activities, through which students and teachers can acquire significant achievement in knowledge and develop more positive environmental attitudes (Kinsey & Wheatley, 1984; Orion & Hofstein, 1994; Fernández-Manzanal et al., 2007; Kandir et al., 2012; Başal et al., 2015). In another study, Fernández-Manzanal et al. (2007) interviewed 20 university lecturers and found that the participants had engaged in the natural environment, which was an important influence on both their well-being and quality of life. Sahin and Alici (2019)

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conducted a study to investigate how the nature connectedness of 402 Turkish pre-service preschool teachers from two universities was associated with their pro-environmental behavior and ecological worldview. The study found that the PPT were generally deficient in the sense of environmental relatedness and in their experiences of the natural environment. As such, Sahin and Alici (2019) recommended that nature-related practices would increase the environmental awareness of the PPT and enhance their connectedness to the natural environment.

The third factor, beliefs (BF), is equivalent to the conservation factor in the EAU Scale, which was based on the NEP Scale (Dunlap et al., 2000), that focused on the interruption of ecosystems affected by modern industrialization (Kopnina, 2011). The aim of the NEP Scale is to discover "beliefs about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature" (Dunlap et al., 2000). These three main areas focus on how people regard the aspects of the balance of nature, anthropocentrism, and limits to growth in relation to the environment (Dunlap & Van Liere, 1978). Sociopsychologists have also found that primitive beliefs influence personal attitudes concerning environmental issues to a great extent (Fernández-Manzanal et al., 2007). Ecological beliefs include one's worldview and primitive beliefs toward the environment (Gray, 1985, as cited in Xiao et al., 2019).

Xiao et al. (2019) utilized four sets of cross-country empirical data to study a postulated model that described the ecological worldview as the core component of

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environmental awareness, and over 10,000 sets of valid data were analyzed. The results of the study concluded that ecological beliefs were one of the major components that cohered with environmental awareness (Xiao et al., 2019). In another study that applied the NEP Scale to measure the environmental attitudes of a cohort in Central Greece, it was suggested that a high NEP score correlated with a positive orientation toward the environment, and the score was also significantly associated with the respondents' pro-environmental behaviors (Ntanos, et al., 2019).

The fourth factor is social interactions (SI), which represent an individual's interactions among people in different sociocontextual environments, for example, governmental legislation and regulations, school policies, members of a family, teachers and peers of a school, etc. (Bronfenbrenner, 1979; Bronfenbrenner & Evans, 2000). Rosenberg and Hovland (1960) posited that social interactions are one of the stimuli that influence personal attitudes (Ajzen & Fishbein, 1980). Tikka, et al. (2000) suggested that contextual environments influenced people's thinking, doing, and feeling (Lee, 2011). Tam (2020) investigated the interaction between pro-environmental motivation and political factors through a cross-nation study. The results suggested that individuals' pro-environmental behavior was a function of the political factors in their country; individuals' personal behavior benefitted the environment directly; and governmental policies and legislation regulated citizens in taking more environmental action. Tam (2020) emphasized that the governmental instruments acting as sociocontextual factors mutually interacted with individuals' pro-environmental behaviors.

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Bronfenbrenner's (1979) ecological systems model is a nested concept that explains the interrelation between individuals and different layers of social environments in varying degrees and at different times, from microsystems to macrosystems (Christensen, 2010). As mentioned, each social environment has a particular social context that enables people to participate in the physical environment, which influences individual development. University lecturers, peers, mentors, and principals of preschools act as social agents who directly or indirectly influence the perceptions, affections, and behaviors of PPT. Bronfenbrenner and Evans (2000) proposed the chronosystem, which refers to the changing circumstances in an individual's development over time, such as the past experiences of PPT in primary and secondary school. Lee (2011) applied Bronfenbrenner's ecological systems theory to study the environmental attitudes of 2,160 high school students in Hong Kong and found that social environments and mass media were two key elements that shaped the positive environmental attitudes of adolescents. As late adolescents, PPT engage in mass media and internet activities intensely in their daily lives. An empirical research conducted in China by Zheng et al. (2019) examined the impact of social interactions on pro-environmental behavior. From the large effective sample size of 7,472, the results indicated that social interactions had a positive impact on pro-environmental behavior. This finding highly coincided with the research hypothesis, that social interactions would promote pro-environmental behavior (Zheng et al., 2019). Thus, social interactions are a significant influential factor in constructing environmental attitudes.

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Action potential (AP) is the fifth factor, which is the intention to act in a pro-environmental manner. Fernández-Manzanal et al. (2007) stressed that the willingness to sustain the environment should include measuring environmental attitudes. Ajzen (2002) suggested using the attitude-intention-behavior model, in which attitudes predict behavioral intentions and exhibit behaviors (Fernández-Manzanal et al., 2007; Yurt et al., 2010; Lee, 2011). Researchers have applied Ajzen's (2002) attitude-intention-behavior model to examine the environmental attitudes of adolescents in Hong Kong (Lee, 2011). Prislin and Ouellette (1996) stated that the strength of the connectedness of attitudes toward environmental conservation was associated with individuals' behavioral intentions (Fernández-Manzanal et al., 2007). However, intentions as a predictor of behavior or attitudes is controversial (Wieber et al., 2015). Individuals' action potential may not directly affect whether they will implement actions.

A number of past studies have suggested that action intention plays a mediating role in specific actions or behaviors (Kautish et al., 2019; Liao & Li, 2019; Zhang et al., 2019). Bergman (2015) also suggested that students' behavioral intention was one of the elements that increased their environmental awareness. A mega research on intention acting on actions was conducted by Wieber et al. (2015) in which different measurement instruments and innovative methods were applied to assess the effectiveness of implementing intentions in multiple physiological studies. At the conclusion of the research, although there was no concrete evidence to support the

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hypothesis that implementing intention would affect intentional actions, the participants' action intention correlated with the implementation of specific actions in some ways (Wieber et al., 2015). Based on these studies, action potential has been proven to have a significant influence on attitudes.

2.5 Conclusion

This chapter has provided a detailed account of: (i) the development of environmental education; (ii) research on environmental education; (iii) environmental research in Hong Kong; (iv) the definitions of environmental attitudes; and (v) measurement instruments to examine environmental attitudes. Environmental problems affect all living things, including humans, as well as the economies of countries. Most environmental problems have been caused by human activities, such as the overuse of natural resources, pollution, and severe deforestation. International policymakers and scientists have gathered frequently and have suggested implementing environmental education to solve worldwide environmental problems. The implementation of environmental education was first suggested in 1987 by the United Nations Economic and Social Council as a process to change attitudes. Environmental education stresses the stimulation of mankind's environmental awareness, constructing people's environmental knowledge, influencing their beliefs and attitudes, changing their intention behaviors, and building up their consequent pro-environmental behaviors. Environmental education should be carried out at all levels of the education system, especially early childhood education because experiences from this period have a

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great impact on children's future lives (Wilson, 1996; Buldur & Ömeroğlu, 2018). As teachers are the most crucial people in education, educators have suggested that environmental education should be provided at teacher training institutions (Yurt et al., 2010).

Environmental attitudes have been investigated by many researchers in the past few decades. Sociologists, psychologists, and educators have used different kinds of psychometric instruments to assess the environmental attitudes of both pre-service and in-service preschool teachers and have found that most preschool teachers have ambiguous concepts of environmental education (Flogaitis & Agelidou, 2003; Flogaitis et al., 2005; Kandir et al., 2012). As environmental attitudes are non-observable psychological attributes, they can be assessed with self-reported instruments such as assessment scales. This study adopted the EAU Scale to create the EAPPT Scale to examine five influential factors, namely, education, alternative experiences, beliefs, social interactions, and action potential.

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CHAPTER THREE

CONCEPTUAL FRAMEWORK

The aim of this study was to examine the environmental attitudes of pre-service preschool teachers and the influential factors in the development of their environmental attitudes utilizing the EAPPT Scale. The conceptual framework, which was explained in this chapter, provided guidance in the logical conceptualization of this study.

3.1 The socio-ecological framework of the study

This section depicted the conceptual framework used in the study following the logic of the socio-ecological model (Plano Clark & Ivankava, 2016), as to explain the dynamic and interactive relationships between conceptual components that form different layers, such as macro perspectives of the research background, social contexts, theoretical models, and methodological approaches. A set of research questions formed the core component of the framework. The contextual layers of the conceptual framework for this mixed methods research were depicted in Figure 3.1, and the components of the framework were presented in the following sections.

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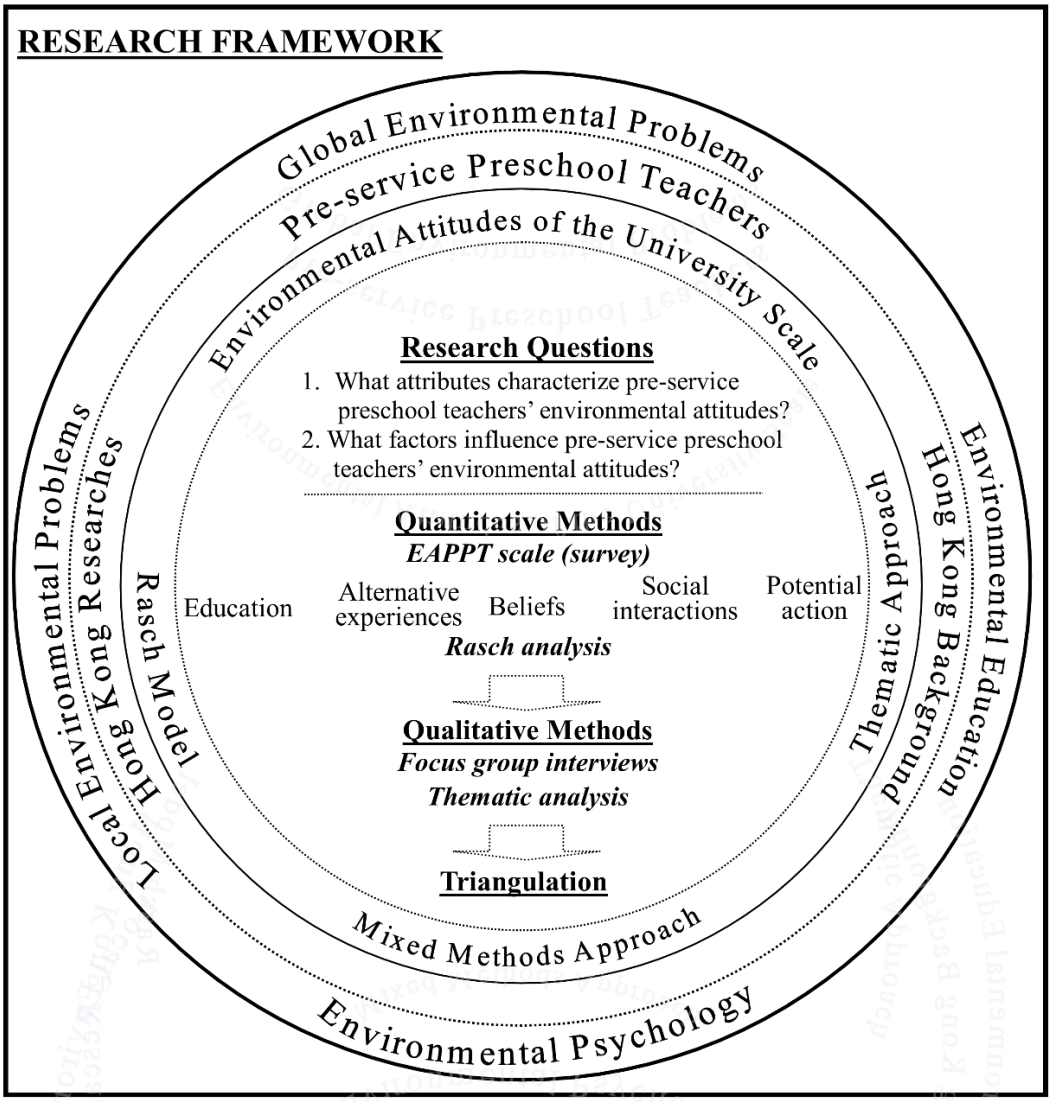

Figure 3.1 The framework of the research

3.1.1 Macro conceptual context and background

The 2030 Agenda for Sustainable Development was first launched in 2015, and the United Nations Sustainable Development Goals (SDGs) were developed to tackle global crises, reduce poverty, and minimize human inequality. Sustainable Development Goal 4, "Quality Education," is the foundation of achieving all the SDGs for all social agencies, such as nations, governments, educational institutions,

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and individuals (i.e., PPT in this study). Ma (2019) stated that "environmental education is a global education obligation, and world main trend and target." Thus, EE became the crucial contextual background of the study.

Environmental problems such as poor air quality, loss of biodiversity, solid waste management, global warming, etc. have been proliferated in Hong Kong in recent decades. The Hong Kong Government has promoted environmental conservation. Some examples of its involvement include the Hong Kong Biodiversity Strategy and Action Plan 2016–2021, which promotes biodiversity awareness through EE (Environment Bureau, 2016); Hong Kong's Climate Action Plan 2030+ (2017) to strengthen the public's responsibility in avoiding global catastrophes (Environment Bureau, 2017); and the Long-term Decarbonisation Strategy (2019) which educates citizens to implement a low-carbon lifestyle (Council for Sustainable Development, 2019). Informal EE programs, campaigns, and publicity activities are also effective modes of raising public environmental awareness and promoting community involvement.

Psychological factors related to environmental issues are one of the major contextual components of the study's framework. "Environmental psychology" is defined as a discipline that studies the inter-connectedness between humans and the natural environment (Steg & de Groot, 2019, p. 2). Environmental attitudes are one of the psychological factors that has been applied to analyze and understand individuals' pro-environmental behaviors for many decades (Fishbein & Ajzen, 1975; Hine et al.,

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1987; Bamberg & Möser, 2007; Casaló & Escario, 2018). Specific attitudinal constructs of environmental attitudes are also capable of depicting different aspects of environmental behaviors (Boger & Wiseman, 2006; Fernández-Manzanal et al., 2007; Yan & Mok, 2011).

3.1.2 Social norms and socio-contextual components

Bronfenbrenner's (1979) ecological model posited that an individual's development was affected by various systemic levels of social contexts; in other words, human development occurs through a reciprocal interplay between individuals and their connected norms. From a micro view, pre-service teachers' demographic background, family, peers, teachers, practicum school members, and other relevant agencies influence their attitudes directly or indirectly. However, the norms of practicum schools, such as school policies, school administrators, headmasters, mentors, and peers, have a unique ascendancy over the determination of PPT to implement EE in the preschool classroom. From a macro view, government policy related to EE plays a major role in setting a sustainable development framework for the whole society. The Hong Kong Education Bureau is the sole agency that formulates the legislation and policies in Hong Kong education.

Although there has not been much research on the current status and effectiveness of the implementation of EE in Hong Kong (Ma, 2019, p. 35), a number of Hong Kong EE studies are still available. Recent examples include Cheng and So's (2011) study on the environmental knowledge, attitudes, and behavioral intention (KAB) model,

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which suggested enhancing teachers' pro-environmental qualities; Tsang and Lee's (2014) cross-nation study, which studied the status of education for sustainable development in Hong Kong and Mainland China; Cheng and Lee's (2015) study, which suggested outdoor nature learning as an effective pedagogy in promoting EE in Hong Kong; and Cheng's (2019) study, which found transdisciplinary education as an effective way to promote EE to university students. A common finding of these studies relating to the incorporation of more EE-related knowledge into every stage of formal education EE in Hong Kong may provide the impetus for a common goal between government and education institutions on promoting EE in the formal school curriculum. In this, EE research can be seen to have bridged the gap between the government and educational institutions by integrating more EE knowledge into the area of formal education in Hong Kong.

3.1.3 The mixed methods research and psychometric theories

A sequential mixed method design (Creswell & Creswell, 2018) was chosen to achieve more in-depth findings in this research. The descriptive data from the quantitative survey generalized the findings from sets of responses in a statistical nature, while the qualitative data from the focus group interviews was applied to elaborate a more in-depth individual perspective. In the explanatory sequential design, qualitative findings served as the supplement, and the comprehensive interpretation of the quantitative findings aimed to draw the ultimate inference of the research (Creswell, 2015).

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Pinpointing the research targets, the EAPPT Scale, which was adopted from the EAU Scale, was used at the quantitative survey stage. The data collected was analyzed using Rasch modeling (Rasch, 1960; Bond et al., 2021) at the dominant quantitative stage. Rasch modeling is a psychometric approach that commonly utilizes variables to assess psychological attributes, such as environmental attitudes and pro-environmental behaviors (Steg & de Groot, 2019). The Rasch unidimensional model (Bond et al., 2021) was applied to test the construct validity and reliability of the EAPPT Scale via the model fit diagnostic tools in Winsteps software (Winsteps Ver. 3.74.0). Within the unidimensional framework, the response measure of each item denoted the strength of supportiveness endorsed by the PPT. Moreover, while the concept of Rasch multidimensionality was adopted, specific objectivity domains, such as Education, Alternative Experiences, Beliefs, Social Interactions, and Action Potential, were confirmed.

In the qualitative interview stage, focus group interviews were conducted and the corresponding data was further interpreted and analyzed using a thematic approach (Savin-Baden & Major, 2013). Qualitative data can be systemically organized by consolidating meanings and developing explanations (Grbich, 2013, as cited in Saldaña, 2016). Both the qualitative and quantitative data were converged to provide more concrete research findings (Jick, 1970, as cited in Creswell & Creswell, 2018).

Further details of the methodology and its workflow (see Figure 4.1) were explained in the methodology chapter of the thesis (i.e., Chapter Four).

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3.1.4 Research questions

To obtain a detailed understanding of the pre-service teachers' tendencies toward the environment, the first research question was "What attributes characterize pre-service preschool teachers?". The five subscales (i.e., factors) in the EAPPT Scale applied in this study measured the specific objectives of the environmental attitudes of the PPT. Accordingly, the second research question was "What factors influenced pre-service preschool teachers?". All of the subscales were verified and generalized to five plausible influential factors of the environmental attitudes of the PPT.

The explanatory sequential mixed methods approach pinpointed these two research questions. The pre-service teachers' perceptions of specific attitudinal issues were deduced from the quantitative findings in Rasch parametric analysis. Through qualitative analysis, the findings interpreted the occurrences in more precise detail. In searching for the outcomes of the research questions, a holistic insight into the importance of teachers' environmental education was highlighted.

3.2 Conclusion

This chapter explained the interplay of different levels of contextual components within the conceptual framework through mixed methods research. In examining the environmental attitudes of PPT, the conceptual framework served to depict the

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rationale for conducting the study and provided valuable insights into its contribution to teachers' environmental education. An explanation of the methodology of the research was presented in the next chapter.

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CHAPTER FOUR

METHODOLOGY

This chapter explained the research methods and report the research design, implementation procedures, validity and reliability, trustworthiness of the qualitative findings, and ethical considerations of this study. A mixed methods design was applied to collect the data in order to answer the following research questions: (i) "What attributes characterize pre-service preschool teachers' environmental attitudes?"; and (ii) "What factors influence pre-service preschool teachers' environmental attitudes?". Quantitative and qualitative data were analyzed using Rasch modeling and the thematic approach, respectively. After explaining the validity and reliability of the study, the ethical and confidentiality aspects of the research was presented.

4.1 Research approach

The conceptual basis of the research approach, its philosophical background, and the study's workflow was outlined in the following sections.

4.1.1 Quantitative research method

Quantitative methods include specific questions or hypotheses, variables to explain answers, the application of statistical analysis, and the interpretation of results (Creswell, 2015). The advantages of using the quantitative research method are the

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ability to generalize the findings to a large sample, analyze data efficiently, find relationships among the data, and control bias. However, this method cannot draw attention to participants' underlying feelings and other contexts (Creswell, 2015). The three major types of quantitative research designs are a survey design, an experimental design, and a longitudinal design (Creswell & Creswell, 2018). A survey design is suitable for attitudes, opinions, and tests that help researchers to answer descriptive questions and predict relationships between variables (Creswell & Creswell, 2018). The benefits of a survey design are economy and efficiency, as the data collection forms are self-administrated, and the data-collecting modes include paper-and-pen questionnaires, mail, internet surveys, personal interviews, telephone interviews, etc. The different kinds of survey data-collecting methods were explained in Appendix I.

4.1.2 Qualitative research method

The qualitative research method proposes specific questions and collects data in various formats (e.g., text, video, and audio recordings) through open-ended questions. The collected data is analyzed and followed up by thematic analysis. Lastly, the findings are presented in written form. Thus, the advantages of the qualitative method are the collection of more specific responses from a few respondents; the examination of participants' comprehensive perspectives; the exploration of participants' experiences as well as their respective backgrounds; and the collection of participants' personal views (Creswell, 2015). The disadvantages are limited generalization, the subjectivity of the responses, and the inability to work with

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a large sample for in-depth investigation (Creswell, 2015).

In conducting face-to-face focus group interviews, researchers can obtain more information beyond simple observation, as well as study the general trends or opinions of the sample for analysis. In focus group discussions, participants may alter each other's viewpoints in a more positive direction (Savin-Baden & Major, 2013; Bryman, 2016). Focus group interviews are less expensive and less time-consuming than individual interviews. The different types of interview designs were explained in Appendix II.

4.1.3 Mixed methods approach

The mixed methods approach collects both quantitative data and qualitative data for analysis. Some researchers have claimed that the mixed methods approach is a better methodology compared with that of applying either the quantitative method or the qualitative method alone, as the mixed methods approach can generate more accurate and precise results to explain social phenomena (Biesta, 2017). Creswell and Creswell (2018) have shown that quantitative data can be obtained from close-ended questions in questionnaires, and qualitative data obtained from open-ended statements do not assume or restrict responses set beforehand. Thus, the mixed methods approach enables researchers to gain two different perspectives (i.e., through close-ended and open-ended data) for a more comprehensive view (Creswell, 2015). Through mixed methods research, the details of the qualitative information such as setting, place, and personal experiences can supplement the quantitative data (Creswell, 2015).

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The three types of mixed methods designs are convergent mixed methods, explanatory sequential mixed methods, and exploratory sequential mixed methods (Creswell and Creswell, 2018). The convergent mixed methods design is a one-phase method in which the quantitative method and the qualitative method are conducted nearly at the same time, and the results are merged for comprehensive analysis to interpret the research problems. The explanatory sequential mixed methods design is a two-phase method that begins with the quantitative method and then proceeds to the qualitative method. The qualitative results are then applied to explain and interpret the quantitative results in more detail. The explanatory sequential mixed methods design is more relevant to investigating cultural issues (Creswell & Creswell, 2018). Similar to the explanatory sequential mixed methods design, the exploratory sequential mixed methods design is also a two-phase research method. However, the exploratory sequential mixed methods design starts with the qualitative method, followed by quantitative method. The exploratory sequential mixed methods design focuses on exploring the concepts of the participants, and then applies the qualitative results and analysis for the further development of tests, instruments, or experiments.

4.1.4 Advantages of implementing the mixed methods approach

The explanatory sequential mixed methods design matched the aims of this study, which were to measure the psychometric traits of the pre-service preschool teachers (i.e., the first research question) and explore the influential factors in their perceptions (i.e., the second research question). This study started with the quantitative strand, and

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then the qualitative strand was conducted to explain and support the quantitative results (Tashakkori & Teddie, 2010; Creswell, 2015). The explanatory sequential mixed methods design is useful in modifying a test to measure a sample of a population (Creswell & Creswell, 2018). In this study, the quantitative analyses and results provided the statistical significance of the environmental attitudes of the PPT, and the qualitative strand provided more details to explain and triangulate the quantitative data.

The explanatory sequential design is relatively economic and highly effective regarding the consumption of time. In this study, the responses from the target group were generated as numerical data for quantitative analysis. Then, the focus group interview discussions were transformed to descriptive data for qualitative analysis. Triangulation of the data from the quantitative and qualitative methods were converged to elaborate the research findings of both methods (Jick, 1979, as cited in Creswell & Creswell, 2018). In triangulating the mixed methods approach, the convergence of the findings obtained from the different types of research methods strengthens the validity and reliability of the research results (Biesta, 2017, as cited in Coe et al., 2017).

4.1.5 Rasch modeling

Rasch modeling is a suitable technique for analyzing human sciences (Bond & Fox, 2015). Andrich (1988), Fisher (1994), and others have shown that Rasch modeling utilizes psychometric measurements (i.e., knowledge, abilities, attitudes, and

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personality traits) in social science studies, which typically involves rating scales. However, researchers have claimed that the raw data of a rating scale may lead to inaccurate results in parametric analysis. Boone (2016) showed that Rasch analysis is a psychometric technique that was developed to improve the accuracy of constructing instruments, monitoring the quality of the instruments, and computing respondents' performances.

Rasch analysis makes measurements meaningful through linearity (Boone, 2016), which measures the linear differences in participants' abilities and attitudes across items. A Likert-type scale is commonly used in Rasch modeling, which is an ordinal and non-linear instrument with different levels of agreement, from "strongly disagree" to "strongly agree," for example. A brief discussion of Likert scales was presented in the following subsection. In general, participants are given a potentially unequal range for each item in each category (Boone, 2016) that can result in mathematical errors when added to compute the total score.

The core concept of Rasch modeling, which pinpoints the ordinal nature of a survey's raw data, can be applied to convert non-interval data into even-interval data. Linear and hierarchical data is more appropriate in conducting rating scale statistical analysis. A unique measurement unit, the logit (i.e., log-odds unit), is used in Rasch modeling to express both person and item measures. As a probabilistic model, Rasch modeling is capable of computing and predicting the probability of an individual's responses to certain items (Boone et al., 2014; Bond & Fox, 2015). Hence, the

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interaction of item agreeability and respondents' supportiveness was used in this study to investigate the influential factors of the environmental attitudes of the PPT. Winsteps Rasch software is easily accessible commercial software that can conduct Rasch modeling analysis. Graphic and tablet presentations of Winsteps, such as Wright Maps and Winsteps outputs, can help researchers to assess the quality of a rating scale and optimize it (Boone et al., 2014).

4.1.6 Likert-type scales

A Likert-type scale is a commonly used rating measurement and a dominant method of measuring attitudes (Riconscente & Romeo, 2010; Scholderer, 2011, as cited in Johnson & Morgan, 2016). Participants judge statements (i.e., items) based on response options that indicate levels of agreement, such as "strongly disagree," "disagree," "neither agree nor disagree," "agree," and "strongly agree." However, DeVellis (2017) has suggested that the "neutral" response option needs to be handled with great care.

4.1.7 Coding and thematic analysis

Coding is a method of analyzing qualitative data that consists of open-ended questionnaire responses, interview transcripts, artifacts, etc. (Saldaña, 2016). Coding is a critical link between data collection and the explanation of their meanings (Charmaz, 2001, as cited in Saldaña, 2016). During the coding process, a code is utilized to summarize, distill, and condense qualitative data for analysis. A code is an assigned symbol in the form of a word or short phrase that is a summative, salient,

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essence-capturing, and evocative attribute of text, audio, or visual data (Guest et al., 2012; Saldaña, 2016). Coding allows researchers to acquire data more easily, conduct data comparisons, and identify patterns to determine whether they would be beneficial to in-depth analysis (Savin-Baden & Major, 2013). Several codes can be systemically organized by consolidating meanings and developing explanations (Grbich, 2013, as cited in Saldaña, 2016) to create categories, which typically consist of clusters of themes that are the products of coding, categorization, and analytical reflection (Saldaña, 2016).

Thematic analysis belongs to the branch of qualitative data analytical methods, which aims at the identification, analysis, and presentation of patterns (i.e., themes) in qualitative research (Braun & Clarke, 2006, as cited in Savin-Baden & Major, 2013). Guest et al. (2012) and Saldaña (2016) have suggested that thematic analysis is the summary and analysis of expanded phrases and/or sentences within a set of qualitative data in contrast with shortened codes. Hence, thematic analysis is a popular, useful, and flexible instrument for qualitative data analysis within and beyond psychology (Boyatzis, 1998; Roulston, 2001, as cited in Braun & Clarke, 2006). Although thematic analysis is not a well-defined analytical method, it is still commonly used (Braun & Clarke, 2006).

4.1.8 Procedures of the study

The current study consisted of three stages: preparation and the pilot study, the quantitative stage, and the qualitative stage, as summarized in the workflow diagram in Figure 4.1.

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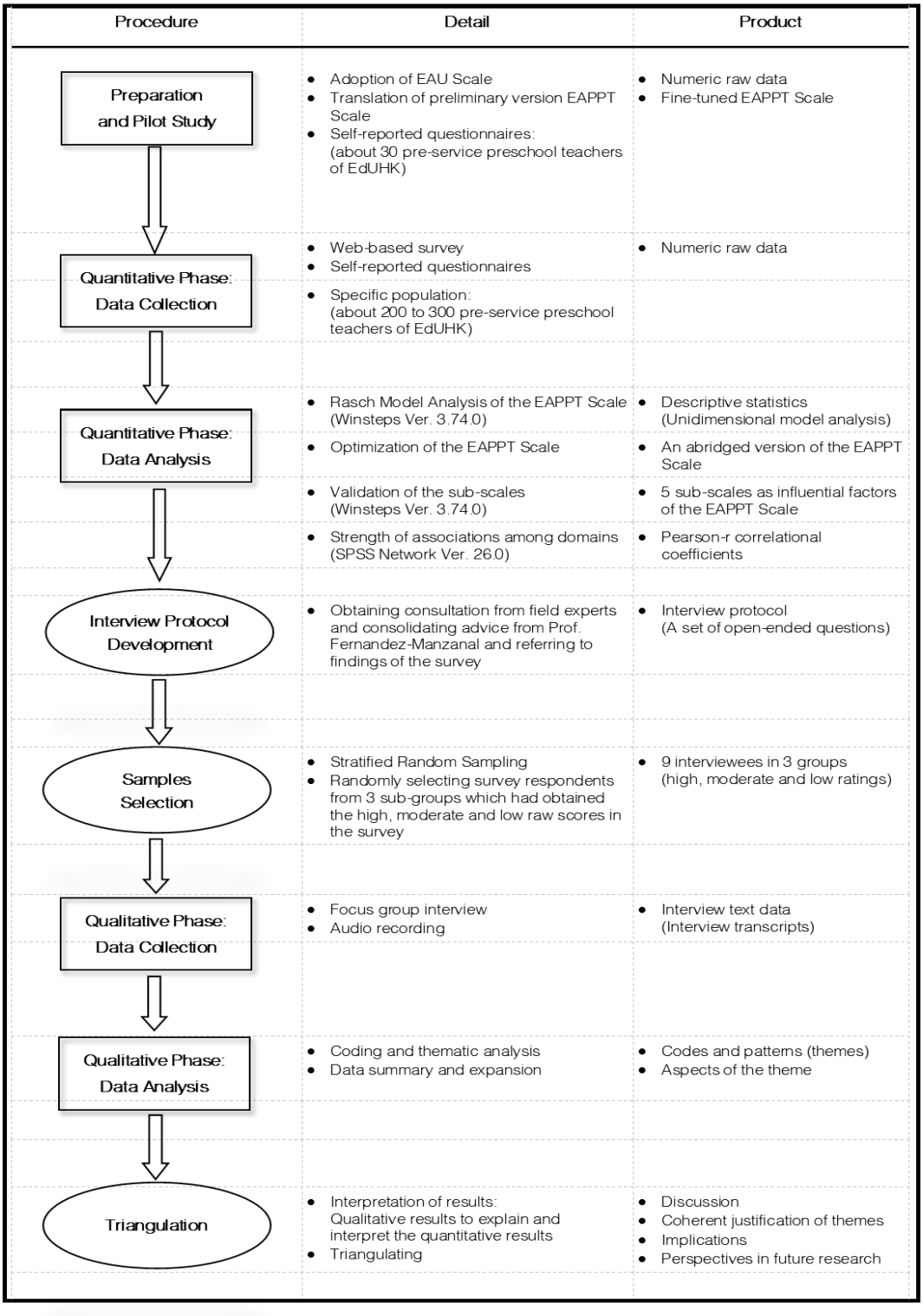

Figure 4.1 Workflow of the research

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4.2 Implementation of research methods

This study applied the mixed methods approach to achieve the research aims. An adopted attitudinal rating scale was modified to suit the samples as well as the Hong Kong context. Rasch modeling was utilized to analyze the collected quantitative data. Focus group interviews were conducted to collect qualitative data. Finally, qualitative triangulation of the quantitative data was implemented to draw the ultimate conclusion of the study. A brief explanation of the implementation of the research methods was described in the following subsections.

4.2.1 Research design

Development of the EAPPT Scale: The EAU Scale was adopted and modified to create the EAPPT Scale. Both scales have similar conceptualizations of variable interests to predict participants' environmental attitudes, and the EAU Scale has been validated in numerous studies. The EAU Scale's reliability and validity have been proven by several studies in the past few decades, such as those measuring initial professional development (Fernández-Manzanal et al., 2015) and evaluating students' attitudes in Early Childhood Education and Primary Education (Pérez-Rodríguez et al., 2017). Recently, the EAU Scale was used in a study on pre-service preschool teachers in Spain, who were comparable to the target groups in this study (Pérez-Rodríguez et al., 2017).

The English version of the EAU Scale was modified for adoption in the current study

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for the Hong Kong cohort and culture. A pilot study was conducted to clarify the wording and content of the EAPPT Scale. After the initial phase of modification, the EAPPT Scale was sent to Fernández-Manzanal, who created the EAU Scale, for advice, and the EAPPT Scale was validated. The EAPPT Scale is comprised of five factors, namely, education, alternative experiences, beliefs, social interactions, and action potential. In addition, the EAPPT Scale uses a 5-point Likert scale to assess the responses, with "strongly disagree," "disagree," "neutral," "agree," and "strongly agree" as the levels of agreement toward the environment. The 52-item EAPPT Scale was shown in Appendix III.

Interview questions and focus group interviews: The interview questions were designed to align with the EAPPT Scale, and they covered the concepts of environmental education; pre-service preschool teachers' alternative experiences and perceptions of outdoor learning; their awareness of environmental problems; their interaction between individuals, agencies, and members of society; and their pro-environmental actions. The interview questions were pre-drafted before the distribution of the survey questionnaires and were refined after the surveys were completed. Changes were made to the interview statements according to the preliminary findings of the main survey. The final set of interview questions was more focused on the highlighted questions from the survey. The full set of interview questions was presented in Appendix IV.

As all the participants were identified based on the data from the survey, the raw

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scores were arranged from the lowest to the highest, accordingly. Stratified random sampling reduced the normal sampling variation in the probability sampling process (Fowler, 2014). In this study, the potential interviewees were divided into three subgroups, namely, the low stratum group, the moderate stratum group, and the high stratum group. The data collected from the raw scores were arranged from low to high in ascending order. Then, the data were divided into three groups of 79, 80, and 79 raw scores, respectively. Based on the categorization of the quantitative data, the raw scores ranged from 147 (the lowest score) to 184 (the low stratum group), 185 to 194 (the moderate stratum group), and 195 to 237 (the highest score; the high stratum group). For the focus group interviews, three samples were randomly selected from each stratum, for a total of nine samples. It has been suggested that proportional representative groups can obtain more precise outcomes than simple random sampling (Fink, 2017). Thus, stratified random sampling is a scientific and efficient way of explaining the research questions and the triangulation of the quantitative results.

4.2.2 Data collection

The pilot study: The pilot study was conducted in February 2018, and 31 students in the Higher Diploma of Early Childhood Education (HDECE) (Full-time, Year One) Programme at EdUHK were invited to participate in the preliminary version of the survey questionnaire based on the EAPPT Scale. After the pilot study, the EAPPT Scale was fine-tuned according to the findings of the pilot study. The modified statements were sent to Fernández-Manzanal again for further validation. The final EAPPT Scale was developed to suit the Hong Kong cultural context and Hong Kong

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pre-service preschool teachers.

The main study: Since the researcher worked at EdUHK, the population was an accessible group. The target population of the survey was HDECE (Full-time, Year Two) students, and a total of 514 students were recruited for the study. The survey invitations were conducted in June 2018 via WhatsApp and emails. In order to gain a higher response rate, follow-up invitations were carried out, and the whole process of conducting and collecting the survey questionnaires ended in August 2018. Of the 514 students recruited, 238 responded to the survey, resulting in a satisfactory rate of about 46%. Three sessions of focus group interviews were conducted in September 2018. The duration of each interview was about one and a half hours. The interview contents were audio-recorded with the consent of the interviewees. The recordings were transformed to transcripts, which were analyzed using a coding procedure, followed by analysis via the thematic approach. The survey and interview findings were articulated for data triangulation.

4.2.3 Data analysis

This study applied Rasch modeling to analyze and interpret the descriptive variables data, evaluate the reliability of the EAPPT Scale, and validate the scale's construct. Rasch analysis also aimed to validate the dimensionality of the EAPPT Scale (Yan & Mok, 2011; Mok et al., 2015). The procedures and their applied criteria were presented as follows.

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Rasch modeling: The source of the empirical data for the quantitative part of the study was obtained from the responses of the 238 participants (i.e., PPT) who completed the survey questionnaire. Rasch measures were applied to the parametric analysis of the collected quantitative data. Descriptive statistics were applied to study the perceptions of the PPT through item analysis. An item-person map (i.e., Wright Map), a graphic presentation of the results, was generated to examine how the item measures of the EAPPT Scale targeted the person measures along a common logit continuum. Based on Rasch analytical procedures, odd or irrational responses were removed as missing data to obtain an optimized version of the EAPPT Scale (Boone et al., 2014). Rasch modeling is capable of processing missing data for analysis (Linacre, 2019).

The optimized version of the EAPPT Scale did not lose its assessment ability, and its reliability and effectiveness were slightly improved. Then, the five subscales representing the influential domains of the EAPPT Scale were validated (Yan & Mok, 2011; Yao, 2015). In sum, according to the confirmatory nature of Rasch modeling, the evidence suggested that the five subscales in the EAPPT Scale measured the specific environmental attitude domains effectively. The analytical procedures of Rasch modeling in this study was first described briefly, followed by the criteria and the conceptual interpretation of the analytical procedures.

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Rasch analytical procedures: Analytical methods were utilized in this study to (i) investigate the descriptive data from the EAPPT Scale and their interpretations; (ii) optimize the EAPPT Scale; (iii) assess the construct validity and the reliability (i.e., internal consistency) of the optimized scale through the diagnostic processes of Rasch modeling; and (iv) analyze and validate the subscales (i.e., the influential factors). The workflow of these procedures was illustrated in Figure 4.2.

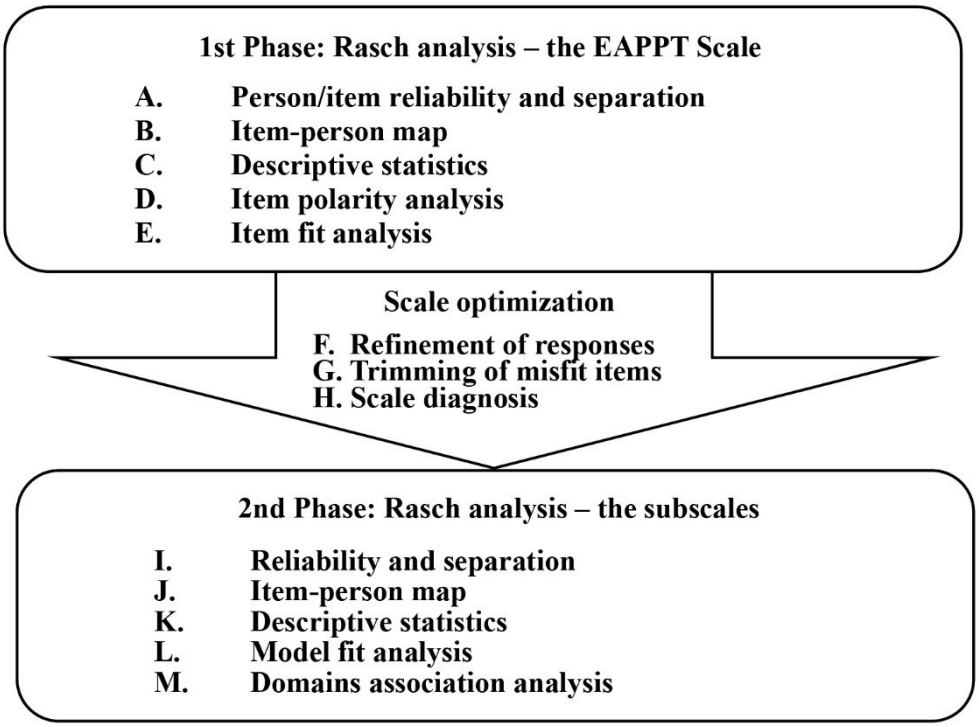

Figure 4.2 List of procedures

The analytical procedures of the quantitative analysis were carried out in two phases. The first phase of the Rasch analysis focused on the item level of the EAPPT Scale to obtain data for analysis. Rasch analysis was constrained to conduct unidimensionality, meaning that all the variables of the EAPPT Scale were measured according to a

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single psychological trait in one direction at the same time. Moreover, a number of statistical methods were applied, including the following:

(A) Person reliability, item reliability, and separation: The REAL person reliability coefficient, the REAL person separation index, and Cronbach's alpha were utilized to assess the internal consistency of the EAPPT Scale using Rasch modeling.

(B) Item-person map: The Wright Map in the Rasch modeling produced a graphic presentation that functioned to provide conceptual information on the overall quality of the EAPPT Scale to show how the person measure (i.e., respondents' supportiveness) was related to the item measure (i.e., item agreeability), and to depict the measures of the PPT regarding the items and whether they were different from the supportiveness of the PPT.

(C) Descriptive statistics: Logit measures and raw score central tendency measures were utilized in the item statistics, and the percentile frequency values for each item provided additional information to supplement the results in a more specific manner.

(D) Item polarity analysis: It has been suggested that investigating the point-measure (PT-measure) correlation (i.e., item polarity) is an important procedure to detect the validity of a scale's construct (Linacre, 2012; Bond & Fox, 2015). Item polarity

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provided insight into how the items of the EAPPT Scale assessed the latent variables in the environmental attitudes of the PPT. PT-measure correlation is similar to that of traditional point-biserial correlation, except the correlations utilize logit measures instead of raw scores.

(E) Item fit analysis: This analysis investigated whether the collected data was close to the expectations of the specific Rasch model. The outfit mean-square (OUTFIT MNSQ) values indicated the accuracy of the item measures (i.e., model fit). A generally acceptable OUTFIT MNSQ range between 0.70 and 1.30 was utilized to indicate that the items of the EAPPT Scale contributed to a single construct's unidimensionality (Linacre, 1996; Yan & Mok, 2011; Boone et al., 2014; Mofreh, 2019). Additionally, the Z-standardized (Z-std) value was also applied to serve as one of the item fit indicators (Boone et al., 2014; Bond & Fox, 2015).

(F) The researcher attempted to optimize the EAPPT Scale into an abridged construct that was still capable of representing the overall dimension coverage of the original instrument. The goal was to modify the EAPPT Scale to an optimized version in which the reliability coefficient reached an acceptable value and all items fulfilled the fit criteria of Rasch modeling. In the scale's optimization, any unpredictable responses of the PPT were deleted according to the indicators of the Z-residual values (Boone et al., 2014; Linacre, 2019).

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(G) Refined data was used to run Rasch analysis. Following the model fit guidelines, a small number of items were trimmed.

(H) An optimized version of the EAPPT Scale was developed. In order to validate the construct of the optimized scale and to assess its reliability, Rasch Winsteps diagnostic analysis was applied.

In the second phase, the analyses and validation were aimed at the subscales level (i.e., influential factors). The empirical responses of the PPT to the EAPPT Scale were the fundamental data. The influential factors were conceptually interpreted as individual subscales to assess different aspects of the EAPPT Scale. The subscales of the EAPPT Scale were analyzed using a method similar to that for item analysis. The different analytical methods that were used were briefly explained below.

(I) Reliability and separation: All individual subscales' REAL person reliability and their respective separation, the REAL item reliability and their respective separation, and Cronbach's alpha reliability coefficients were utilized to assess the construct validity of the EAPPT Scale using Rasch modeling.

(J) Item-person maps: The Wright Maps for the individual subscales showed the distribution of the respondents' supportiveness and item agreeability, along with the

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corresponding vertical logit-scaled continuum in the plot. The Wright Maps provided sketches of how the item measures interacted with the person measures and depicted how the subscales targeted their corresponding variables.

(K) Descriptive statistics: This step aimed to understand the complexity of the individual subscales' constructs. The individual subscales' person means, the dispersion of the respondents' supportiveness (i.e., minimum and maximum logits), and Rasch standard deviation and standard errors were used to assess the functional ability of each subscale.

(L) Model fit analysis: Rasch modeling is confirmatory in nature. Model fit represents a set of data that fulfills the expected model and performs the functional assessment of latent variables (i.e., the specific environmental attitudes of the PPT in this study) (Bond et al., 2021). The model fit of each subscale was investigated in many aspects. The mean square indices and PT-measure correlation coefficients were utilized to diagnose the model fit of each subscale.

(M) Association analysis of the domains: Rasch-derived scores from the subscales of the EAPPT Scale were exported to SPSS Network Version 26.0 (IBM SPSS Statistics, IBM Corporation, NY, U.S.A.). The Pearson's correlation coefficients of the five subscales were calculated to evaluate their intercorrelation in order to understand the strength of the associations of the different domains in the EAPPT Scale.

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Rasch statistical indices and their interpretations: Table 4.1 presented how the Rasch analysis was interpreted and the criteria applied throughout the study. The analytical software Winsteps analyzed the EAPPT Scale construct as a whole (hence, unidimensionality). To validate a scale construct, usually the reliability coefficient and separation index need to be investigated first. The model fit statistics revealed whether the item and person measures met the model expectations for model fit. Lastly, different diagnostic tools aimed to assess the scale's construct validity.

Table 4.1 Rasch analysis and interpretations

Concept	Statistical Notation	Criteria and Interpretation
Logit scale (log-odd unit)	Logits Item difficulty and person ability measures (in this study, item agreeability and respondents' supportiveness)	A logit scale, generally ranging from -5 to +5 logits. The item mean of a scale is usually 0.00 by default. As a probabilistic model, a logit scale is difficult to understand, and sometimes the data will be rescaled to 1-100, etc.
Reliability	Cronbach's alpha (same as REAL person reliability) Person separation index (REAL person separation index)	Below 0.60, unacceptable; between 0.65 and 0.70, minimally acceptable; between 0.70 and 0.80, respectable; between 0.80 and 0.90, very good; and if Cronbach's alpha is much above 0.90, the researcher should consider shortening the scale (DeVilles, 2017). Above 2.00 is the minimal requirement; the person separation value represents the difference between item and person among groups; and a high person separation value indicates that the repetitive performance of an instrument (i.e., a scale) is high. **This study aimed to obtain a Cronbach's alpha/REAL person reliability greater than 0.70 and REAL person separation higher than 2.00.**
Item data fit to model (item fit)	INFIT Mean Square (MNSQ) - sensitive to inliers; and OUTFIT Mean Square (MNSQ) - sensitive to outliers.	MNSQ range: 0.50 to 1.50 is the ideal range; 0.70 to 1.30 is the strict range; < 0.50 may be useful, but the item may be a redundancy or a repetition; 1.30 to 2.00 may be useful, but the items may be a misfit; and ≥ 2.00 is not recommend for those items.

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	Z-standardized (Z-std infit, Z-std outfit)	Z-std range: -2.00 < Z-std < +2.00 is considered acceptable. Items may be problematic outside the ranges above. **The item fit analysis of this study utilized the OUTFIT MNSQ ranging from 0.70 to 1.30 and the Z-std ranging from -2.00 to +2.00. However, a Z-std value smaller than -2.00 may indicate that the item is too agreeable. However, no action needs to be taken.**
Polarity (orientation of an instrument)	PTMA or PT-measure (the point-measure correlation is similar to the point-biserial correlation in SPSS)	A negative PTMA indicates that the direction of the item is contrary to the latent trait, suggesting that the item is a reverse-scored statement. A PTMA value that is too small suggests that the item may be problematic, and the context of the statement needs improvement. PTMA > + 0.40 indicates that the item has a consistent polarity in the scale; and PTMA < + 0.20 indicates that the item has little correlation with the scale. **For each item, this study aimed at having a positive PTMA value greater than 0.20, which is the minimal requirement.**
Targeting	Item-person map or Wright Map	A graphic presentation that shows how well the items target the respondents and how well the respondents can be assessed by the items (i.e., in this study: items' agreeability versus respondents' supportiveness). **In this study, Wright Maps offered an accessible way to examine how well the items assessed the respondents' supportiveness toward the environment.**

Note: All the criteria and interpretations in Table 4.1 were adapted from Boone et al. (2014), Bond and Fox (2015), and Bond et al. (2021).

4.2.4 Reliability and validity

Reliability refers to the repetitive measuring ability of a measurement instrument, and validity refers to verifying the accuracy or truth of a study. A brief summary of the pilot study, followed by the investigation of the reliability and validity of the EAPPT

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Scale and its subscales, will be presented in the following.

Pilot study: In order to validate the preliminary 52-item EAPPT Scale, a pilot study was conducted in which items were chosen, and then their wordings were fine-tuned to suit the targeted population—pre-service preschool teachers. The English version of the original Spanish EAU Scale was further modified for the Hong Kong context. For example, the statement "No matter how convenient public transportation is, I will choose to drive" was modified to "No matter how convenient public transportation is, I will choose to drive if I have a car." These changes in wordings were sent to Fernández-Manzanal for validation.

Thirty-one Year One HDECE students at EdUHK were chosen to participate in the pilot study anonymously. The SSPS computer program was used to analyze the collected data. The study findings showed that (i) the Cronbach's alpha was 0.74, which indicated a high level of internal consistency for the preliminary scale with this specific sample; and (ii) the item mean of the scale was 3.27, which suggested that an above average number of respondents in this sample had a positive orientation toward the environment. These findings of the pilot study served as a reference for the next stage of the study. Upon completing the modification of the EAPPT Scale, the final version of the EAPPT Scale was ready to use.

Content validity: All items of the EAPPT Scale received comments and validation from Fernández-Manzanal, and both positively and negatively worded items were

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included in the EAPPT Scale, which facilitated the detection of irrational responses. The intention of this application was to investigate whether there was a consistent pattern of responses from the perspective of the respondents. The results suggested that the effects of acquiescence bias and affirmative effects in responding to the survey were avoided (DeVellis, 2017).

Reliability of the EAPPT Scale and its subscales: Reliability coefficients were applied to assess the consistency of the repetitiveness in the EAPPT Scale and its subscales. REAL person reliability and REAL separation indices, REAL item reliability and REAL separation indices, and Cronbach's alpha coefficients were applied as assessment indicators, and the separation index was a unique type of indicator in the Rasch modeling (Boone et al., 2014). The person separation index was applied to distinguish high and low person ability (i.e., in this study, respondents' supportiveness). If the person separation rating is too low, it is suggested that more items be created. The item separation index was applied to confirm the item difficulty (i.e., item agreeability) hierarchy, hence, construct validity. An item separation rating that is too low should add more samples to verify the hierarchical construct of a rating scale (Boone et. al., 2014).

Validation of the EAPPT Scale and its subscales: Apart from the optimization of the EAPPT Scale, Rasch (Winsteps) diagnostic processes were applied to validate the EAPPT Scale and its subscales. The diagnostic procedures verified that all items were

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pinpointed to measure their corresponding traits, and each subscale was underpinned by a specific scale construct (Yan & Mok, 2011; Mok et al., 2015). Recent studies have reported that individuals' environmental attitudes are associated with a number of influential factors, including education, alternative experiences, beliefs, social interactions, and action potential. As Rasch modeling is confirmatory in nature (Rasch, 1960; Bond et al., 2021), these five subscales were confirmed as the influential factors (i.e., domains) in the EAPPT Scale.

4.3 Trustworthiness of the qualitative findings

Quantitative research examines the validity and reliability of its findings, but qualitative research applies different strategies to verify its trustworthiness. Bloomberg and Volpe (2016, p. 162) mentioned that creditability, dependability, and transferability are effective strategies to ensure the quality of qualitative research. Following Savin-Baden and Major (2013) and Bloomberg and Volpe (2016), the researcher adopted some of these strategies in this study. A pilot study was conducted to search for evidence supporting the creditability of the interview questions. The set of interview questions was refined to match the research themes.

As the researcher was not the current tutorial lecturer of the participants, conflict of interest and potential bias did not need to be considered. During the focus group interviews, note-taking was applied, and to capture the interviewees' verbal

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expressions and non-verbal expressions, such as head nodding and facial expressions, the interviews were also recorded. After each session of the interviews, “peer debriefing” took place, which involved asking assistants to comment on the researcher’s fieldnotes. This process helped to examine the researcher’s assumptions, which enhanced the interpretation of the interview transcripts.

In order to collect every interviewee’s viewpoints and perceptions in a consistency manner, repetitive procedures took place in every interview. To ensure the quality of the interview transcripts, drafts were sent to the corresponding interviewees for their comments. Moreover, the triangulation reports required further comments from the researcher’s supervisor. This cross-examination process complemented the final findings more realistically and reflected the accuracy of the generalized consequences. Lastly, as the researcher has presented a detailed research background and methodology in this thesis, other researchers can easily transfer these concepts and methods in future studies.

4.4 Ethical approval and confidentiality

Before the implementation of the research, ethical approval for the study was obtained from the Human Research Ethics Committee of The Education University of Hong Kong (see Appendix IX). Since the researcher was also the lecturer of the participants, the implementation of the study could not be conducted until after her teaching

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semester. The pilot study and the main research were conducted in February 2018, and between June and September 2018, respectively. The researcher had completed all of the students' performance assessments before conducting the main research; therefore, conflict of interest between the researcher and the participants was avoided.

In the pilot study, the participants did not need to disclose any personal particulars and were thus guaranteed confidentiality. The data of this study were collected from web-based survey questionnaires and through focus group interviews. In the web-based survey, a consent form was included on the cover page of the internet version of the questionnaire. If any participants did not agree with the consent form, the survey would not proceed automatically. Although the participants were requested to include their student numbers, they could withdraw from the survey at any time, even after their consent forms had already been signed.

The consent, confidentiality, and consequences of the interviews were considered ethical issues (Kavale, 1996, as cited in Cohen et al., 2011). Before the formal interviews were conducted, the research details were explained to the interviewees. They were then asked to sign the consent form, which included the research title and aims of the study. The interview questions were also presented to the interviewees beforehand. A verbal commitment was required by all interviewees to document the interviews via audio-video recording. The interviewees could withdraw at any time during the interviews. Pseudonyms were utilized in both the recordings and the

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transcriptions. Finally, individual transcripts were sent back to the corresponding interviewees for verification.

4.5 Conclusion

In this chapter, an overview of the methodology used in this thesis was discussed. The mixed methods design, data analysis, reliability and validity, and ethical considerations were also presented. With reference to the application of Rasch modeling and the implementation of the EAPPT Scale, a conceptual framework was designed to serve as guidance in the study. In the quantitative design, Rasch modeling was the core analytical method applied to examine the empirical data and to investigate the psychometric properties of the individual subscales in the EAPPT Scale. Hence, the influential factors of the pre-service teachers' environmental attitudes were revealed. In the qualitative design, the sample, interview procedures, interpretation of findings, and triangulation were also presented. Finally, ethical concerns and confidentiality regarding participation in the study were addressed. Based on the presentation of the methodology of the research in this chapter, the results of the quantitative analysis will be elaborated in the next chapter.

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CHAPTER FIVE

QUANTITATIVE ANALYSIS FINDINGS

This chapter presented the mixed methods analysis of the environmental attitudes of the PPT and the quantitative results. Rasch modeling was applied and the resulting Rasch logit scores facilitated the interpretation of the EAPPT Scale. Rasch modeling was also used to analyze the qualitative empirical data of the EAPPT Scale, which depicted the respondents' attitudes and tendencies toward the environment (i.e., their environmental orientation). The item hierarchy of the instrument was utilized to predict the intended measures. In this study, data from the respondents defined item difficulty (i.e., item agreeability) and data from the items defined person ability (i.e., respondents' supportiveness) in terms of the target attribute.

As a probabilistic model, Rasch modeling is capable of computing and predicting the probability of how individuals will respond to certain items. In the quantitative analysis, graphic and table presentations, such as Wright Maps and outputs, facilitated in: (i) assessing the quality of the item responses; (ii) investigating the EAPPT Scale as a single-parameter model, and hence the attitudes of the PPT; (iii) validating and analyzing the five subscales of the EAPPT Scale as the influential factors of the attitudes of the PPT toward the environment; and (iv) investigating associations among various domains of the EAPPT Scale. A summary of the findings from the analysis of item responses and validation of the education, alterative experiences, beliefs, social interactions, and action potential subscales as factors was presented in the following sections.

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5.1 Rasch analysis of the variables of the environmental attitudes of the pre-service preschool teachers

A Rasch model is a parameter-based model. Conceptually, Rasch analysis is applied to evaluate the empirical data of respondents in a unidimensional manner; as such, all the items in the EAPPT Scale aimed to measure a single psychometric attribute (i.e., the environmental attitudes of the PPT). The item response analysis of the reliability and validity of the EAPPT Scale and the parametric statistical findings was outlined in the following subsections.

5.1.1 Reliability and validity of the EAPPT Scale (sample = 238, items = 52)

Reliability refers to the repetitive measuring ability of a measurement instrument (i.e., a scale). The internal consistency of the EAPPT Scale was calculated using Cronbach's alpha and the person reliability coefficient of the Rasch model, which obtained a consistent value of around 0.87~0.88 in this study. These results indicated that the internal consistency of the EAPPT Scale was functional for evaluating the environmental attitudes of the PPT. Moreover, the respondents were separated into three distinguishable groups according to their responses, with a person separation coefficient of 2.54. The items were separated into approximately nine to 10 measurable groups, with an item separation coefficient of 9.41. This indicated that a sufficient number of PPT responded to the items and confirmed the item difficulty hierarchy (Linacre, 2019). Overall, the Rasch person reliability and item reliability of the EAPPT Scale were reasonably high in assessing the different levels of the focal population.

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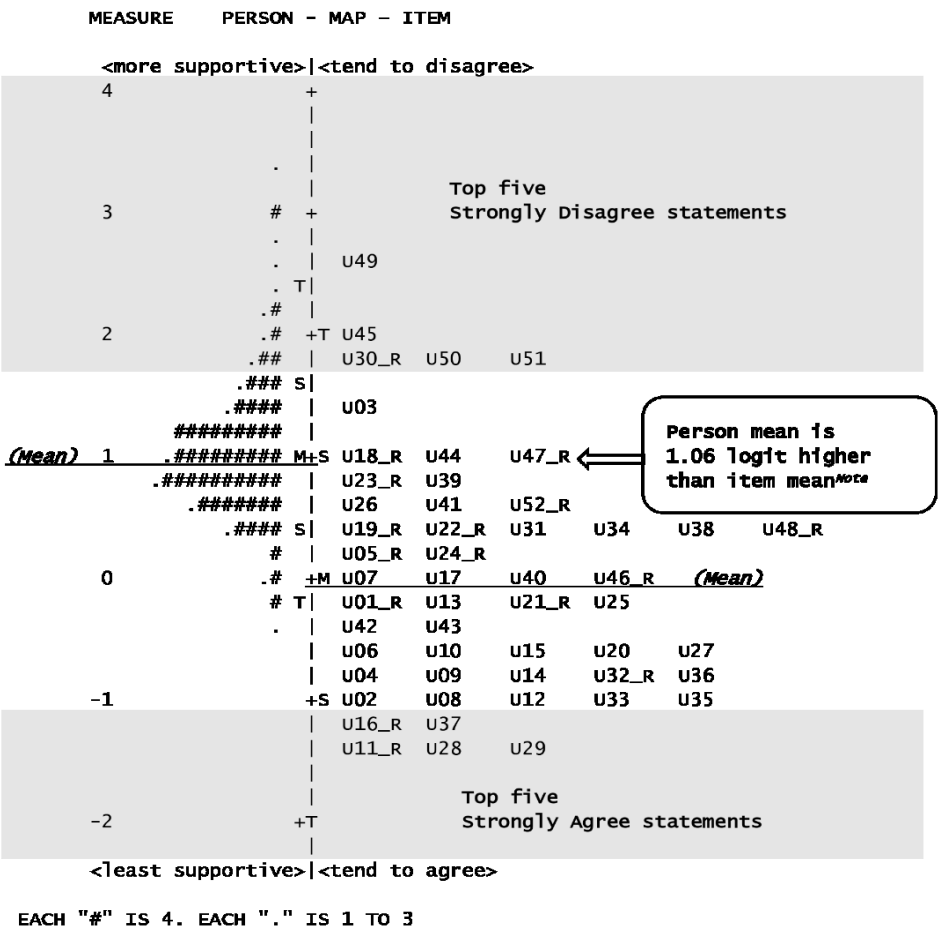
REAL: Person Reliability = 0.87; Person Separation = 2.54

REAL: Item Reliability = 0.99; Item Separation = 9.41

Cronbach's Alpha (KR-20) Person Raw Score "Test" Reliability = 0.88

5.1.2 Graphic presentation of the item-person map (Wright Map)

A Wright Map is a powerful and accessible tool for Rasch modeling that provides a quick view of how item measures interact with person measures within an instrument. Before any in-depth item response analysis, the graphic presentation functions as the blueprint of a measurement instrument, as shown in Figure 5.1.



Note: $e^{1.06} = 2.88 \Rightarrow 2.88/3.88 = 0.74 = 74\%$; 1.06 logit => 74% (probabilistic value).

Figure 5.1 Item-person map

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In the item-person map, the person and item measures showed an even distribution, despite the few outliers of the person measure. Items clustered around the mean value hierarchically (i.e., at uniform intervals), with only a few extreme items, and most items were located near the base portion of the graph. This suggested that the construct of the EAPPT Scale was well-targeted to the measures.

The item measure mean was constrained at zero logits. In contrast, the mean value of the person measure (i.e., respondents' supportiveness) was about one logit higher than the mean value of the item difficulty measure (i.e., item agreeability). The distribution of the respondents was located above the distribution of the items, which suggested that the respondents tended to agree with most of the items in the EAPPT Scale used in this study, implying that the majority of the PPT tended to have positive attitudes toward the environment.

The hierarchy of the items along the continuum of the scale and the total coverage of the respondents were ideal. Except for item U49, all the items in the EAPPT Scale were tightly clustered within a range of -2.00 logits to +2.00 logits. The even distributional pattern of the items provided an effective way of pinpointing the measures of the targeted attributes.

In the Wright Map (see Figure 5.1), item U49 ("I will participate in and be a member

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of an environmental organization") was positioned in the upper-most portion of the map (i.e., Strongly Disagree), and items U11R ("Teaching environmental education to preschool students is a waste of time"), U28 ("Humans are severely abusing the environment"), and U29 ("The earth is like a spaceship, with very limited land space and resources") were positioned in the lowest portion of the map (i.e., Strongly Agree). Items U07 ("Environmental education should focus on the development of skills, such as critical thinking, reflective decision-making, and participation"), U17 ("I really like going on trips to the countryside, for example, country parks or outermost islands"), U40 ("I have received sufficient support from my peers in the teaching or promoting of environmental education"), and U46R ("Even though the development of housing and road building will cause threats to endangered plants and species, I support the captioned idea") had an item mean of 0.00 logits, which was the default. The item agreeability mean was located below the respondents' supportiveness mean, which suggested that most of the PPT had supportive attitudes toward the environment.

Roughly more than 60% of the items were located at the base portion of the graph. These items' overlapping strength measured the same portion of traits that were redundant items. Some of the items were removed so that an optimized structure of the EAPPT Scale could be constructed without the loss of its original measuring precision. Further discussion on the analysis of the item responses was presented in the following subsection.

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5.1.3 Rasch parametric analysis of the items in the EAPPT Scale

The Rasch logit measurement was applied throughout the whole analysis to examine items concerning the pre-service teachers' responses to the EAPPT Scale. The full set of parametric data is shown in Appendix V, and the data presented in this subsection was shown in Table 5.1.

Table 5.1 Selected item response analysis

Item	Statement	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %	Mode	Logit	Actual PTMA	Expected PTMA	Outfit MNSQ	Zstd	Model S.E.
U29	The earth is like a spaceship, with very limited land space and resources.	0	1.27	2.95	60.93	34.88	4	-1.47	0.44	0.32	0.84	-1.9	0.11
U11R	Teaching environmental education to the pre-school students is a waste of time.	45.38	45.80	2.53	4.63	1.69	4	-1.45	0.43	0.32	1.83	7.3	0.11
U28	Humans are severely abusing the environment.	0	0.43	4.63	63.03	31.94	4	-1.38	0.48	0.32	0.73	-3.1	0.11
U37	To minimize the impact of the usage of fossil fuel on the environment, the government needs to adopt policy encouraging the implementation of renewable or alternative energy, such as solar power, energy from waste and wind power.	0	1.27	5.47	65.97	27.32	4	-1.17	0.43	0.33	0.79	-2.3	0.11
U16R	Nature-outdoor activities are a waste of time. The most important thing is classwork.	32.36	58.41	5.47	3.37	0.43	4	-1.16	0.46	0.33	1.18	1.8	0.11
U34*	Governmental policies and related facilities encourage us to reduce and recycle waste.	1.27	11.35	25.22	59.25	2.95	4	0.41	0.08	0.39	1.39	3.7	0.09
U52R*	Although my currently used products are not environmentally friendly in nature, I still prefer to buy them.	4.21	38.24	47.90	7.99	1.69	3	0.69	0.16	0.41	1.08	0.9	0.08
U23R*	Nowadays, the laws and government regulations and control lead to very little pollution.	6.73	38.66	28.58	25.64	0.43	4	0.84	0.09	0.41	1.66	6.5	0.08
U47R*	I will tolerate the noise caused by transportation.	12.19	22.27	38.24	22.27	5.05	3	1.02	0.20	0.42	1.79	7.8	0.08
U51	I will discuss with others about environmental issues publicly.	4.21	37.40	47.48	10.09	0.85	3	1.74	0.49	0.44	0.65	-4.9	0.08
U50	I will participate in environmental activities actively.	3.37	38.66	48.74	8.41	0.85	3	1.76	0.44	0.44	0.67	-4.6	0.08
U30R*	The earth has plenty of natural resources if we just learn how to develop them.	2.53	21.01	19.75	47.90	8.83	2	1.83	0.06	0.45	1.78	7.7	0.08
U45*	When I buy a product, I consider the type of packaging and choose one that is recyclable.	11.77	34.88	42.02	10.93	0.43	3	1.93	0.22	0.45	1.18	2.1	0.08
U49	I will participate in and be a member of an environmental organization.	22.27	50.85	23.95	2.11	0.85	2	2.67	0.40	0.44	0.93	-0.8	0.09

Note: U34, U52R, U23R, U47R, U30R and U45 had too small PT-measure values (PTMA $\leq$ 0.02) respectively, and did not match the model expected. These items are suggested to problematic statements that further investigation may be needed.

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Analysis of item polarity: Finding the point-measure (PT-measure) correlation (i.e., item polarity) is the initial procedure in detecting the validity of a scale's construct (Linacre, 2012; Bond & Fox, 2015). PT-measure correlation values must be positive and cannot be too near zero. If the values of the PT-measure correlation are positive and near zero ($0.00 \leq$ PT-measure $\leq +0.20$), the corresponding items may be extreme or questionable (Bond & Fox, 2015). If the values are negatively oriented or questionable items (PT-measure ≤ -0.20), they need to be examined further (Bond & Fox, 2015; Bond et al., 2021).

As shown in Table 5.1, no items in the EAPPT Scale had a negative PT-measure correlation value in this analysis. Items U30R, U34, U23R, U52R, and U47R had PT-measure correlation values of 0.06, 0.08, 0.09, 0.16, and 0.20, respectively, and these five values also performed far from the Rasch model's expected values. The assessment functions of items U30R ("The earth has plenty of natural resources if we just learn how to develop them"), U34 ("Government policies and related facilities encourage us to reduce and recycle waste"), U23R ("Nowadays, the laws and government regulations and control lead to very limited pollution"), U52R ("Although my currently used products are not environmentally friendly in nature, I will still buy them"), and U47R ("I will tolerate the noise caused by transportation") all underperformed, which suggested that these items did not perform the assessing function well. This also suggested that the respondents did not understand these items fully, or that the items were controversial and the PPT had difficulty responding to them. Except for item U34, items U30R, U23R, U52R, and U47R were negatively written items that may need to be modified or rewritten in a more comprehensive style

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in the future. The PT-measure correlation values for items U30R, U52R, and U47R suggested that the respondents were hesitant about taking action on environmental protection, while the values for items U34 and 23R suggested that the respondents did not acknowledge government policies or regulations, or were not sure whether the government had put enough effort toward promoting environmental preservation to the public.

Analysis of the parametric item responses: Parametric analysis in this study utilized logit measures based on Rasch modeling for the analysis of the item responses and the percentile frequency values to determine whether each item provided additional information to supplement the results in a more specific manner. The item agreeability mean was constrained at 0.00 for model identification purposes, and the measurement of the respondents' supportiveness was evaluated with the same logit measurement as that of item agreeability. In the EAPPT Scale, positive logit values indicated that the response was closer to Disagree, while negative logit values indicated that the response was closer to Agree on the continuum of the scale. As Rasch modeling produces a probabilistic model, the strength of the respondents' agreement was always compared with item difficulty (i.e., the items' agreeability in this study).

The EAPPT Scale utilized a 5-point Likert scale in this study. For positively written statements (i.e., items), the response options were coded as Strongly Disagree (SD) – 1, Disagree (D) – 2, Neutral (N) – 3, Agree (A) – 4, and Strongly Agree (SA) – 5, respectively. For negatively written statements, the response options were reverse-coded as Strongly Disagree (SD) – 5, Disagree (D) – 4, Neutral (N) – 3, Agree (A) –

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2, and Strongly Agree (SA) – 1, respectively. Reverse scoring was used to rationalize the negatively written statements, which were items that negatively correlated with other items within the rating scale (DeVellis, 2017; Bond et al., 2021). In sum, response options as verbal descriptors (i.e., Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree) in the EAPPT Scale were always presented in the same order for all items, but response options as numerical figures (i.e., 1, 2, 3, 4, and 5) were presented in either ascending or descending order, depending on the nature of the statement being positively or negatively written. For example, in the EAPPT Scale, item U11R ("Teaching environmental education to preschool students is a waste of time") could be interpreted as follows:

Positively written statement:

("No matter how time-consuming it is to teach environmental education to preschool students, it is worth doing so")

Positive scoring:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5*

Negatively written statement:

("Teaching environmental education to preschool students is a waste of time")

Reverse scoring:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5*	4	3	2	1

* *The higher the score, the more positive the attitudes of the PPT toward the environment.*

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Regarding individual item modes, out of the 52 items, 40 resulted in the Agree response option, which was the most frequently chosen option by the PPT. This indicated that the PPT had positive attitudes toward the environment. For conceptual review purposes, the Strongly Agree and Agree response options were merged into the Agreement aspect, and the Strongly Disagree and Disagree response options were merged into the Disagreement aspect. According to the response option frequency obtained for items U29 ("The earth is like a spaceship, with very limited land space and resources") and U28 ("Humans are severely abusing the environment"), which were related to scenarios concerning the limitations of land and natural resources of the earth, their corresponding percentages in the Agreement aspect were over 95%, respectively. This indicated that the PPT had a strong belief that the natural resources of the earth were limited, and humans overused and misused these resources.

Moreover, according to the response option frequency obtained for U11R ("Teaching environmental education to preschool students is a waste of time"), a negatively written item that was related to the necessity of EE for preschoolers, the percentage in the Disagreement aspect was over 90% (reverse scoring was applied to negatively written items in this study), which indicated that the PPT strongly acknowledged that EE was beneficial to preschoolers. Conversely, according to the response option frequency obtained for item U49 ("I will participate in and be a member of an environmental organization"), which was related to participation in an environmental organization, the percentage in the Disagreement aspect was about 73%, which

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indicated that the majority of the PPT had no intention of joining an environmental organization.

As for the central tendency measures, items U30R ("The earth has plenty of natural resources if we just learn how to develop them") and U49 ("I will participate in and be a member of an environmental organization") obtained the Disagree response option for their respective modes. The results of item U30R, a negatively written item, suggested that the majority of the PPT believed that the depletion of natural resources was a serious problem, while the results of item U49, which was related to participation in pro-environmental activities, indicated that the motivation of the PPT to participate in pro-environmental activities was minimal.

In Rasch analysis, item logit measures indicate the strength of the items (i.e., item agreeability) along the scale's continuum. In this study, the logit measures of the items ranged from -1.47 to 2.67, with the average item mean value constrained at 0.00. The respondents' logit mean was 1.06 above the item mean, with no missing data, which suggested that for the average supportive respondent, the probability of a positive endorsement of acting on items was about 74% (1.06 logits = 0.74). Referring to the item logit mean, items U18R ("I find it more interesting in a shopping mall than out in a country park"), U44 ("I am willing to consume less and go without some comforts if it helps to protect the environment"), and U47R ("I will tolerate the noise caused by transportation") were close to the respondents' logit mean, which showed that the

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average supportive respondent had a 50% chance of agreeing with the corresponding items. Hence, the results of U44 and U47R showed that about 50% of the PPT were either not sure of or neither agreed nor disagreed with the importance of environmental conservation, while the results of U18R also indicated that about 50% of the PPT neither had an interest in nor felt compelled to encounter the natural environment. Justifications for these items require further exploration.

Furthermore, the minimum logit of item U29 ("The earth is like a spaceship, with very limited land space and resources") was -1.47, which was the most agreed item. This suggested that the PPT had a strong sense of concern for and awareness of natural resources. The maximum logit of item U49 ("I will participate in and be a member of an environmental organization") was 2.67, which was the most disagreed item. This showed that the PPT had no intention of participating in an environmental organization. This issue is worthy of further investigation to find the causes behind this tendency.

Besides the maximum and minimum logit values, in the Agreement aspect, U11R ("Teaching environmental education to preschool students is a waste of time"), U28 ("Humans are severely abusing the environment"), U37 ("To minimize the impact of the usage of fossil fuels on the environment, the government needs to adopt policies encouraging the implementation of renewable or alternative energy, such as solar power, energy from waste, and wind power"), and U16R ("Nature-outdoor activities

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are a waste of time. The most important thing is classwork") had logit values of -1.45, -1.38, -1.17, and -1.16, respectively. These low logit values showed that most of the participants tended to strongly agree with these particular statements (U11R and U16R were negatively written items). The responses for items U11R and U16R indicated that the PPT believed that EE and ecological activities were important for preschoolers, and the responses for items U28 and U37 suggested that human activities caused negative impacts on the environment and solutions needed to be found.

Conversely, in the Disagreement aspect, items U45 ("When I buy a product, I consider the type of packaging and choose one that is recyclable"), U30R ("The earth has plenty of natural resources if we just learn how to develop them"), U50 ("I will participate in environmental activities actively"), and U51 ("I will discuss with others about environmental issues publicly") had logit values of 1.93, 1.83, 1.76, and 1.74, respectively. These high logit values indicated that most of the participants tended to strongly disagree with these particular statements (U30R was a negatively written item), which showed that the PPT did not intend to take action to preserve natural resources (U45 and U30R) and had no intention of participating in pro-environmental activities (U50 and U51). These issues also need further investigation.

Analysis of model fit: For construct validation, the analysis of model fit investigates whether the collected data are close to the expectations of the Rasch model. Mean-

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square (Infit MNSQ and Outfit MNSQ) values indicate the accuracy of the measures (i.e., model fit). MNSQ values range from zero to positive infinity. The closer the MNSQ value of Infit or Outfit is to 1.00, the better. As a rule of thumb, Outfit MNSQ is utilized to detect item fit within a model (Boone et al., 2014). The range $0.70 \leq$ Outfit MNSQ ≤ 1.30 is interpreted as a reasonable fit of the data in a model if the calculation of their MNSQ average approaches 1.00, which is the best fit (Linacre, 2019). The range of the Outfit MNSQ (i.e., 0.70 to 1.30) was applied in this study.

In addition, the Z-standardized (Z-std) value also functions as one of the indicators of model fit. The Z-std value is a t-statistical-based analysis that reports the probability of how the MNSQ values fit in an acceptable range within a model. If the absolute Z-std values of person measures and item measures are more than 3.00 ($|\text{Z-std}| \geq 3.00$), then they are most likely misfits, and this criterion was utilized throughout this study (Boone et al., 2014). Beside these indicators, PT-measure correlation values are also important indicators in assessing item model fit (Boone et al., 2014; Bond & Fox, 2015; Bond et al., 2021).

Referring to Table 5.2, items U48R, U11R, U47R, U30R, U26R, U21R, U23R, U05R, U34, U46R, U41, U36, U35, U08, U06, U14, U15, U51, U50, and U33 did not fall within the acceptable range of the Outfit MNSQ ($0.70 \leq$ Outfit MNSQ ≤ 1.30 and Outfit Z-std ≥ 3.00), which showed that the respective data did not fit the expectations of the Rasch model. However, items U36, U35, U08, U06, U14, U15, U51, U50, and

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U33 were overfit items that met the expectations of the model too well. Under most circumstances, these items would be classified as functional and good items (Bond & Fox, 2015).

Table 5.2 Misfit and overfit items

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT Z-std	OUTFIT MNSQ	OUTFIT Z-std	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM	
48	837	238	.40	.09	1.97	8.4	2.07	8.9	A .23	.39	35.7	49.3	U48_R	Misfit items
11	1020	238	-1.45	.11	1.90	7.6	1.83	7.3	B .43	.32	52.1	60.7	U11_R	
47	748	238	1.02	.08	1.67	6.9	1.79	7.8	C .20	.42	39.1	42.6	U47_R	
30	620	238	1.83	.08	1.66	6.8	1.78	7.7	D .06	.45	37.4	43.7	U30_R	
26	808	238	.62	.08	1.60	5.9	1.76	7.0	E .29	.40	33.2	44.9	U26_R	
21	918	238	-.29	.10	1.71	5.6	1.72	5.7	F .34	.36	59.7	61.5	U21_R	
23	775	238	.84	.08	1.48	5.0	1.66	6.5	G .09	.41	34.0	43.8	U23_R	
5	857	238	.25	.09	1.51	4.7	1.58	5.1	H .31	.38	53.8	52.3	U05_R	
34	836	238	.41	.09	1.23	2.4	1.39	3.7	I .08	.39	44.1	48.5	U34	
46	876	238	.09	.09	1.32	3.0	1.34	3.1	J .33	.38	43.7	55.3	U46_R	
41	811	238	.60	.08	1.13	1.5	1.30	3.1	K .27	.40	47.5	45.7	U41	
16	997	238	-1.16	.11	1.21	2.0	1.18	1.8	L .46	.33	61.3	62.6	U16_R	
1	908	238	-.20	.10	1.17	1.6	1.20	1.8	M .32	.36	67.2	60.3	U01_R	
45	603	238	1.93	.08	1.13	1.5	1.18	2.1	N .22	.45	46.6	44.7	U45	
17	889	238	-.02	.09	1.17	1.7	1.16	1.6	O .51	.37	52.1	57.3	U17	
24	866	238	.17	.09	1.13	1.3	1.16	1.6	P .40	.38	55.9	54.2	U24_R	
25	907	238	-.19	.10	1.07	.7	1.11	1.0	Q .43	.36	61.8	60.2	U25	
52	798	238	.69	.08	1.00	.1	1.08	.9	R .16	.41	50.0	44.5	U52_R	
38	845	238	.34	.09	1.05	.5	1.07	.8	S .46	.39	51.3	50.0	U38	
22	842	238	.36	.09	1.05	.6	1.06	.6	T .48	.39	49.2	49.9	U22_R	
18	757	238	.96	.08	1.04	.6	1.05	.6	U .51	.42	36.1	42.5	U18_R	
19	832	238	.44	.09	1.00	.0	1.00	.0	V .53	.39	52.1	48.4	U19_R	
32	968	238	-.82	.11	.98	-.1	.98	-.2	W .53	.34	61.3	63.6	U32_R	
10	944	238	-.55	.10	.95	-.5	.97	-.2	X .50	.35	62.6	63.2	U10	
42	930	238	-.41	.10	.94	-.5	.95	-.4	Y .39	.36	64.3	62.3	U42	
31	828	238	.47	.09	.93	-.8	.95	-.6	Z .38	.39	47.9	48.1	U31	
49	496	238	2.67	.09	.94	-.7	.93	-.8	z .40	.44	54.2	50.3	U49	
39	786	238	.77	.08	.79	-2.6	.87	-1.5	y .35	.41	52.5	44.1	U39	
7	880	238	.06	.09	.81	-2.0	.87	-1.3	x .29	.38	52.5	55.9	U07	
29	1022	238	-1.47	.11	.86	-1.5	.84	-1.9	w .44	.32	71.4	60.5	U29	
20	956	238	-.68	.10	.82	-1.7	.83	-1.6	v .55	.35	69.7	63.6	U20	
40	894	238	-.07	.09	.79	-2.2	.82	-1.8	u .44	.37	60.5	58.2	U40	
37	998	238	-1.17	.11	.81	-2.0	.79	-2.3	t .43	.33	70.2	62.6	U37	
13	913	238	-.24	.10	.78	-2.2	.81	-1.9	s .55	.36	65.1	60.8	U13	
2	987	238	-1.04	.11	.78	-2.2	.79	-2.2	r .39	.33	75.6	63.3	U02	
9	970	238	-.84	.11	.79	-2.1	.77	-2.3	q .58	.34	71.4	63.5	U09	
43	936	238	-.47	.10	.76	-2.4	.79	-2.1	p .25	.35	76.1	62.7	U43	
4	962	238	-.75	.11	.77	-2.3	.78	-2.2	o .45	.34	75.2	63.6	U04	
12	980	238	-.95	.11	.77	-2.4	.78	-2.3	n .43	.34	71.4	63.4	U12	
3	692	238	1.38	.08	.70	-4.1	.77	-3.1	m .27	.43	56.3	41.6	U03	
27	957	238	-.69	.10	.77	-2.4	.76	-2.4	l .58	.35	69.3	63.6	U27	
44	762	238	.93	.08	.73	-3.6	.75	-3.2	k .28	.42	52.1	42.9	U44	
28	1015	238	-1.38	.11	.74	-2.9	.73	-3.1	j .48	.32	71.8	61.2	U28	
33	988	238	-1.05	.11	.67	-3.6	.64	-4.1	i .51	.33	76.1	63.2	U33	Overfit items
50	630	238	1.76	.08	.64	-5.1	.67	-4.6	h .44	.44	54.2	43.3	U50	
51	633	238	1.74	.08	.64	-5.1	.65	-4.9	g .49	.44	53.8	43.0	U51	
15	947	238	-.59	.10	.64	-3.9	.62	-4.1	f .51	.35	79.8	63.3	U15	
14	971	238	-.85	.11	.60	-4.4	.61	-4.4	e .47	.34	80.7	63.6	U14	
6	943	238	-.54	.10	.59	-4.5	.58	-4.7	d .58	.35	75.2	63.2	U06	
8	986	238	-1.03	.11	.57	-4.9	.57	-5.0	c .59	.33	74.8	63.2	U08	
35	979	238	-.94	.11	.53	-5.5	.52	-5.7	b .53	.34	77.3	63.5	U35	
36	975	238	-.90	.11	.48	-6.1	.49	-6.1	a .55	.34	77.3	63.6	U36	
MEAN	870.7	238.0	0.00	0.10	1.00	-0.3	1.03	0.0			58.9	55.2		
S.D.	120.5	0.0	0.97	0.01	0.36	3.6	0.38	3.8			13.2	8.2		

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Concurrently, nine (U48R, U11R, U47R, U30R, U26R, U21R, U23R, U05R, and U46R) out of 11 misfit items were negatively written statements, which suggested that negatively written statements were sometimes problematic for the PPT, or they did not comprehend them accurately or seriously during the survey, based on their contradictory and inconsistent responses. The contents and interpretations of the results of these nine negatively written items were discussed below.

Items U05R ("Environmental education activities are useful only for children") and U11R ("Teaching environmental education to preschool students is a waste of time") were related to the education domain, and about 70% and 90% of the respondents rated these items as Disagree, respectively. According to the outcomes of item U05R, a large portion of the respondents disagreed that EE only benefited preschoolers, indicating that it also benefited everyone. Referring to the results of item U11R, nearly all of the respondents were convinced that spending time teaching preschoolers EE was a priority in preschool education. Referring to the results of items U05R and U11R, although most of the respondents agreed that teaching environmental education was a priority for everyone, especially preschoolers, EE was not the biggest concern for the PPT. This was a controversial issue.

Items U21R ("I believe that environmental problems are exaggerated, as nature balances out over time") and U26R ("The so-called 'ecological crisis' facing humankind has been greatly exaggerated") were related to the beliefs domain, and

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about 80% and 55% of the respondents rated these items as Disagree, respectively, which suggested that a global ecological crisis was the respondents' biggest concern, but a few respondents believed that its impact was not as severe as people supposed. Referring to item U30R ("The earth has plenty of natural resources if we know how to develop them"), it was a controversial misfit item that was related to the beliefs domain, and over 55% of the respondents rated this item as Agree, which indicated that a large portion of the respondents believed that humans were able to master the natural environment and its resources to a great extent. This suggested that although most of the respondents agreed that the deficiency of natural resources was a global problem, they also believed that humans could alter nature to offset this deficiency of natural resources. Human domination over nature was an enduring concept in the respondents' minds, and as such, this issue is worthy of further study, as it was outside the scope of the current study.

In the beliefs domain, item U23R ("Nowadays, laws and government regulations and control lead to very limited pollution") represented a tri-model item, as about 40%, 30%, and 25% of the respondents rated this item as Disagree, Neutral, and Agree, respectively. This indicated that item U23R did not function well in assessing the tendency of the respondents' beliefs. It also suggested that most of the respondents either did not agree with the functionality of government policies or did not recognize the policies. This issue was concurrently reflected in the interview-based qualitative results.

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Finally, items U46R ("Even though the development of housing and road building will threaten endangered plants and species, I support the captioned idea"), U47R ("I will tolerate the noise caused by transportation"), and U48R ("No matter how convenient public transportation is, I will choose to drive if I have a car") were related to the action potential domain and were model misfits. More than 30% of the respondents rated these three items as Neutral, and more than 20% of the respondents rated them as Disagree, which indicated that in a real scenario, the respondents would not sacrifice their individual benefits to implement pro-environmental action or to conserve other species. This issue concurred with the results of items U21R and U26R, which suggested that there were either some external psychological attributes or influential norms acting on the respondents' pro-environmental behaviors. More discussion on this topic was conducted in Chapter Seven.

Section 5.2 to follow presented the results of the applied Rasch analytical procedure to detect possible misfit data (i.e., odd or irrational responses), which were deleted and then coded as missing data to optimize the scale's construction (Boone et al., 2014). Rasch analytical software includes Winsteps, which is capable of handling missing data in Rasch analysis (Bond & Fox, 2015; Bond et al., 2021).

5.2 Scale optimization

After the analysis of the parametric item responses, the EAPPT Scale was optimized to a more comprehensive construct to represent the overall dimensional coverage of

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the original instrument. The optimized version of the EAPPT Scale was an intermediary product in which the subscales of the EAPPT were validated in the final phase of this study. As Rasch modeling is confirmatory in nature, the five subscales were verified as five plausible influential factors (i.e., specific environmental attitude scales) of the environmental attitudes of the PPT (Yan & Mok, 2011; Mok et al., 2015; Bond et al., 2021).

5.2.1 Optimization of the EAPPT Scale

Referring to the first phase of the model fit analysis, 11 items were identified as misfits in the EAPPT Scale, and thus they were not capable of measuring latent variables. Misfit items can be caused by unpredictable responses. In Rasch modeling, Z-residuals are major indicators in finding possible odd responses. The common cut-off value of Z-residuals is the absolute value of 2.00 or higher ($|\text{Z-residual}| \geq 2.00$) (Boone et al., 2014). Tables of poorly fit items in Winsteps can guide researchers in sorting out odd responses from poorly fit items (Linacre, 2019). Corresponding responses with Z-residual absolute values of 2.00 or higher are recoded as "x," which represents missing values. The optimized data sets from the 238 respondents in this study were applied to a control file to re-run Winsteps. As one of the main features of Rasch modeling, the capability of handling missing data represents statistical competence (Boone et al., 2014; Bond & Fox, 2015; Bond et al., 2021).

The goal of the study was to modify the EAPPT Scale to an optimized version in which the person reliability coefficient was at least 0.80, and all items that fulfilled

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the fit criteria for Rasch modeling met Outfit MNSQ values ranging from 0.70 to 1.30 and Z-std values less than 3.00 (Boone et al., 2014). For items that did not fulfill the model fit criteria, their contents were investigated. After content investigation, 12 redundant (i.e., overfit) or questionable (i.e., misfit) items (i.e., U01R, U06, U08, U14, U17, U24R, U26R, U35, U36, U45, U48R, and U52R) were removed from the EAPPT Scale. Following the detection of misfit responses and the removal of misfit items, the optimized 40-item EAPPT Scale version was ready for use, and the functionality of the five subscales' constructs as determined by various Winsteps diagnostic procedures was confirmed. The optimized version of the EAPPT Scale was presented in Appendix VI. A brief summary of the comparison of characteristics between the original version of the EAPPT Scale and the optimized version was shown in Table 5.3.

Table 5.3 Comparison of the original version and the optimized version of the EAPPT Scale

	The EAPPT Scale	
	Original Version	Optimized Version
No. of Items	52	40
Cronbach's Alpha	0.88	0.89
Real Person Reliability	0.87	0.89
Real Person Separation	2.45	2.87
Real Item Reliability	0.99	0.99
Real Item Separation	9.41	11.41
Range of Outfit MNSQ	0.49 to 2.07	0.70 to 1.33
Range of PT-measure Correlation	0.06 to 0.59	0.27 to 0.61

In sum, both versions of the EAPPT Scale had a reasonably good ability to measure the latent variables' unidimensionality. However, the optimized version of the EAPPT Scale well fulfilled the goal of the model fit criteria of this study, including the Outfit

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MNSQ indices and the PT-measure correlation coefficients. Details of the analysis of the EAPPT Scale's subscales were outlined in Section 5.3.

5.3 Rasch analysis of the subscales of the optimized EAPPT Scale

Based on the optimized version of the EAPPT Scale, the five subscales were analyzed using different diagnostic tools in Winsteps to verify that the items within each subscale were measured as a single variable (i.e., a specific attitudinal factor), hence achieving unidimensionality. Various reliability coefficients were used to assess the consistency of the measuring ability of the subscales. Graphic presentations were utilized to find out how the item estimates targeted the person measures within their corresponding logit continuums, and parametric statistics were conducted to confirm the overall construct validity of each subscale. The subscales of the EAPPT Scale conceptually acted as influential factors that evaluated the pre-service teachers' attitudes toward different attitudinal objects or issues. The validation of the five attitudinal factors of the EAPPT Scale was explained in the following subsections.

5.3.1 Reliability and separation coefficients of the subscales

Table 5.4 showed that the Cronbach's alpha reliability coefficients of all the subscales ranged from 0.72 to 0.81, and the Rasch REAL person reliability coefficients ranged from 0.63 to 0.77, which exhibited good results (DeVellis, 2017). The Rasch REAL item reliability coefficients ranged from 0.98 to 0.99, and the item separation coefficients ranged from 7.33 to 13.68, which also exhibited reasonably good ranges. However, the person separation coefficients ranged from 1.29 to 1.85, which did not meet the targeted criteria of this study (i.e., ≤ 2.00), indicating that the hierarchical

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structure of the items was not well constructed to discriminate item difficulty (i.e., agreement levels of endorsement toward items). Hence, the number of effective items was not very sufficient in validating the individual subscales' constructs.

Overall, the internal consistency of all five subscales was reasonably acceptable, and the number of respondents in this study was sufficient for a reliable and valid measurement. Chen et al. (2013) suggested that in order to maintain a stable performance of a polytomous rating scale in Rasch modeling, the minimum requirement for a sample size is 250. Müller (2020) also suggested that a sample size of about 200 is appropriate for a study that utilizes mean-square values ranging from 0.70 to 1.30. The sample size in this study was 238, which was compatible with the numbers recommended for Rasch modeling. However, in future studies, creating more effective items within the subscales is recommended.

Table 5.4 Reliability of the subscales: Rasch reliability and separation coefficients and Cronbach's alpha (n = 238)

	Rasch Model					
Subscale	No. of Items	Item Reliability	Item Separation	Person Reliability	Person Separation	Cronbach's Alpha
Education	9	0.99	13.68	0.63	1.31	0.75
Alternative Experiences	7	0.99	9.33	0.77	1.85	0.81
Beliefs	9	0.99	10.78	0.75	1.75	0.80
Social Interactions	11	0.98	7.33	0.72	1.62	0.74
Action Potential	8	0.99	11.09	0.63	1.29	0.72

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5.3.2 Graphic presentations of the subscales in Wright Maps (item targeting)

Referring to Appendix VII, the item measures of the action potential subscale closely targeted the person measures, and the item measures of the alternative experiences, beliefs, and social interactions subscales moderately targeted the corresponding person measures. The item-person maps for the education and alternative experiences subscales showed that the distributions of the person measures were highly skewed toward the upper portion of the graphs. This suggested that most of the items within the education and alternative experiences subscales were not difficult to endorse with agreement, and the majority of the respondents were supportive of the education and alternative experiences factors. Conversely, the items in the action potential subscale were relatively difficult to endorse with agreement. This suggested that most of the respondents lacked action potential to implement pro-environmental actions.

5.3.3 The five subscales as individual latent variables

The EAPPT Scale consists of five subscales—education, alternative experiences, beliefs, social interactions, and action potential—which were the factors that pinpointed the pre-service teachers' specific psychological domains of environmental attitudes. A concise confirmation of these influential factors was described below.

Descriptive statistics of the Rasch person measures: Table 5.5 showed that the average person mean of the action potential subscale was identical to the average item mean (generally, the item mean was constrained to zero). This suggested that the action potential subscale was a well-targeted scale to measure latent variables. The

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average person means of the education, alternative experiences, beliefs, and social interactions subscales ranged from 1.57 logits (social interactions subscale) to 2.16 logits (alternative experiences subscale), which were well above the average item means. This suggested that the average supportiveness of the respondents (i.e., person ability) was higher than item agreeability (i.e., item difficulty) in these four subscales.

The standard error estimates of all the subscales were significantly small. This indicated that the subscales performed with reasonable precision in their corresponding measurement estimates. The distribution of the respondents' supportiveness (i.e., person measures) ranged from 6.75 logits (social interactions subscale) to 10.23 logits (alternative experiences subscale). This wide dispersion of person agreeability measures indicated that the coverage of item difficulty within all the subscales was large, which suggested that the subscales' items well distinguished the respondents' supportiveness (i.e., in Rasch modeling, "person ability" is usually denoted).

Table 5.5 Descriptive statistics of the Rasch person measures (in logits, n = 238)

Subscale	No. of Items	Minimum	Maximum	Range	Mean	Standard Deviation	Standard Error
Education	9	-1.21	6.60	7.81	2.12	1.15	0.07
Alternative Experiences	7	-1.69	8.54	10.23	2.16	1.81	0.12
Beliefs	9	-0.76	8.43	9.19	2.00	1.44	0.09
Social Interactions	11	-1.13	5.62	6.75	1.57	1.16	0.08
Action Potential	8	-3.60	3.52	7.12	0.00	1.02	0.07

Note: All values are presented in logits; the person measure estimate means of all the subscales are labeled "Mean"; minimum and maximum values of the person measure estimates are labeled "Minimum" and "Maximum," respectively.

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Analysis of model fit: Table 5.6 showed the results of the Outfit MNSQs of all the subscales, which ranged from 0.70 to 1.35. Although the MNSQ indices of the social interactions and action potential subscales slightly exceeded the targeted upper limit of this study (social interactions: 0.70 to 1.35; action potential: 0.76 to 1.31), all of the subscales were model fit because the MNSQ values ranged from 0.70 to 1.30, which is generally considered to be a strict range of model fit. The PT-measure correlation coefficients of all the subscales ranged from +0.42 to +0.72 (PT-measure ≥ +0.40), which indicated that all the subscales were able to measure their corresponding variables (Bond at el., 2021). These findings suggested that all the data from the subscales had a good model fit and functioned to measure their targeted variables' unidimensionality within the individual subscales.

Table 5.6 Model fit of Rasch modeling (n = 238)

Subscale	No. of Items	Range of Infit MNSQ	Range of Outfit MNSQ	Range of PT-measure
Education	9	0.90 - 1.31	0.85 - 1.30	0.43 - 0.66
Alternative Experiences	7	0.75 - 1.08	0.74 - 1.27	0.51 - 0.72
Beliefs	9	0.74 - 1.29	0.70 - 1.26	0.50 - 0.68
Social Interactions	11	0.77 - 1.35	0.70 - 1.35	0.42 - 0.64
Action Potential	8	0.76 - 1.31	0.76 - 1.31	0.44 - 0.68

5.3.4 Associations among the different domains of the EAPPT Scale

Rasch-derived scores from the subscales of the EAPPT Scale were calculated to evaluate their intercorrelation in order to understand the strength of the associations among the different domains of the EAPPT Scale, which used Pearson-r correlational coefficients. The results were presented in Table 5.7.

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Table 5.7 Pearson's correlation among the five domains (n = 238)

	EN	AE	BF	SI
AE	0.645**			
BF	0.542**	0.628**		
SI	0.700**	0.537**	0.510**	
AP	0.662**	0.519**	0.563**	0.558**

***p < 0.01*

Evidence of significant correlations ($p < 0.01$) was found among the five subscales. A significantly high correlation (r = 0.700, n = 238, $p < 0.01$) was found between the education and social interactions subscales. Moderate significant correlations occurred between the education and alternative experiences subscales (r = 0.645, n = 238, $p < 0.01$), the education and action potential subscales (r = 0.662, n = 238, $p < 0.01$), and the alternative experiences and beliefs subscales (r = 0.628, n = 238, $p < 0.01$). In sum, the five specific, objective-based measures of environmental attitudes were moderately to strongly correlated (0.510 ≥ Pearson's r ≥ 0.700) with each other.

5.4 Conclusion

Environmental attitudes are complex and abstract, meaning that they cannot be observed or measured directly by any means. The EAPPT Scale was developed and validated to assess the attitudes of the PPT toward the environment. The participants (n = 238) validated the 52-item scale, and its internal consistency was good, so it was a functional measurement instrument (Rasch model: Real Person Reliability = 0.87; Real Person Separation = 2.54; and Cronbach's alpha = 0.88).

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The variables of the environmental attitudes of the PPT were not only restricted to the measurement of the items in the EAPPT Scale; their environmental attitudes were also manifested in different aspects of the EAPPT Scale's constructs (hence, the subscales). In this study, five subscales were developed to assess the influential aspects of environmental attitudes. As Rasch modeling is confirmatory in nature (Bond et al., 2021), Rasch analysis was carried out to verify each construct of the subscales individually.

The Cronbach's alpha reliability coefficients of all the subscales ranged from 0.71 to 0.81, suggesting that the reliability of all the subscales was respectable (DeVellis, 2017). The Rasch PT-measure correlation coefficients of all the items within the subscales ranged from 0.42 to 0.72 (PT-measure $\geq +0.40$), which indicated that all the items within the subscales were highly positively correlated with their corresponding measurement variables and that all the subscales were unidimensional (Bond et al., 2021). Lastly, the Rasch Outfit MNSQ values of all the subscales ranged from 0.70 to 1.35, which indicated that all the subscales were reasonably model fit. Thus, the five subscales—education, alternative experiences, beliefs, social interactions, and action potential—were a valid set of influential factors that explained the environmental attitudes of the PPT.

In examining the associations among the various domains of the EAPPT Scale, the analysis revealed that there was a positive and strong correlation between the education and social interactions domains. The significant interconnectedness

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suggested that social norms helped in the provision of implementing EE. Conversely, the education aspect also influenced the development of the pre-service teachers' environmental attitudes in society. Further studies on the interplay between education and social interactions factors and their influence on environmental attitudes are needed.

Referring to the parametric analysis, the response option "Agree" was the most frequently applied option for the items, and the average mean of person ability was 1.06 logits, which was above the average mean of item difficulty. These findings showed that most of the PPT had positive attitudes toward the environment, especially regarding the impact of the education, alternative experiences, beliefs, and social interactions factors. The PPT were also convinced that education and nature experience were crucial influential factors of their environmental attitudes, and they strongly believed that environmental education benefited preschoolers.

However, the PPT were less supportive of the action potential factor, suggesting that they lacked motivation to participate in pro-environmental activities. From this viewpoint, professional training in the field may be one way to help enhance their environmental awareness and to strengthen their intention to perform environmental conservation actions. Although the PPT possessed a strong sense of environmental awareness and ecological concern, they had no intention of sacrificing their daily conveniences for the sake of environmental preservation. Another influential factor in the environmental attitudes of the PPT was social norms at different levels of Hong

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Kong society. Indeed, the PPT questioned whether either the Hong Kong Government or social agents had provided enough facility and policy support to the public in promoting EE. On the other hand, the PPT had the least drive to participate in environmental activities or be a member of an environmental organization.

As another product of this study, an optimized version of the EAPPT Scale was developed, which included only 40 items while maintaining its assessment ability compared with the original version. The optimized version of the EAPPT Scale fulfilled the criteria of model fit, with PT-measure correlation coefficients of all the items positively oriented and ranging from +0.27 to +0.61; the values of the Outfit MNSQ indices of the items ranged from 0.70 to 1.33; and the internal consistency (Rasch model: Real Person Reliability = 0.89; Real Person Separation = 3.22; and Cronbach's alpha = 0.89) was as good as that in the original version. The optimized version of the EAPPT Scale is a more comprehensive instrument that can be applied in future research. Based on the findings presented in this chapter, the qualitative data was triangulated with the quantitative data. Further analysis and discussion were presented in the next chapter.

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CHAPTER SIX

TRIANGULATION

This chapter reported the triangulation of the study results, which utilized an explanatory sequential mixed methods design that included both quantitative and qualitative research methods. It was found that the qualitative research method complemented the dominant quantitative method. Through triangulation, both the quantitative and qualitative results were integrated, and the qualitative results further interpreted the quantitative results.

6.1 Triangulation

The triangulation process was based on the dispersion of items in a Wright Map (see Figure 5.1) using Rasch modeling; the estimates of each item measure; the frequency percentages of the item response options in the EAPPT Scale; and the qualitative interview transcriptions, which articulated the quantitative findings. The rationale for using triangulation, the categorization of the focus group interviewees (hereafter, interviewees) into strata, and the coded notation system for the interviewees' quotes were explained in the following subsections.

6.1.1 Conceptual view of qualitative triangulation

The conceptual view of the qualitative triangulation method used in this study provided a perspective to investigate the various influential factors that underpinned

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the variables of the environmental attitudes of the PPT. The five factors, including their themes and subthemes, adopted in the qualitative phase were consistent with those in the quantitative phase. These factors indicated the interaction between the PPT and specific attitudinal items about environmental issues. The focus group interviews (hereafter, interviews) focused on the five domains of the environmental attitudes of the PPT, namely, education, alternative experiences, beliefs, social interactions, and action potential, to generate empirical qualitative data. Major issues from the quantitative findings of the study were highlighted and pursued in the qualitative phase, the results of which served as a supplementary interpretation of the quantitative findings.

6.1.2 Categorization of the interviewees and the coded notation system

The qualitative part of the study involved nine graduates (i.e., PPT) from the HDECE Programme at EdUHK, and three focus group interview sessions (refer to subsection 4.2.1) were conducted on three separate days. To achieve the stratified random sampling approach, the interviewees were randomly selected from the three strata that categorized the PPT based on their scores on the main survey, and their consent to participate in the interviews was obtained. The nine interviewees were Annie, Vincent, Yeung, Mandy, Ka Ka, Margaret, Cynthia, Maybelle, and Carman, which were pseudonyms to maintain confidentiality. Table 6.1 showed the abbreviations, scores, and strata of these nine representative interviewees.

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Table 6.1 Abbreviations, scores, and strata of the representative interviewees

Names	Abbreviations	Scores	Strata
Annie	HAN	230	High-performing
Vincent	HVI	219	High-performing
Yeung	HYE	210	High-performing
Mandy	MMY	190	Moderate-performing
Ka Ka	MKA	188	Moderate-performing
Cynthia	MCY	184	Moderate-performing
Margaret	LMT	174	Low-performing
Maybelle	LME	164	Low-performing
Carman	LCA	150	Low-performing

In Table 6.1, the upper-case letters "H," "M," and "L" in the abbreviations denoted the High-performing stratum, the Moderate-performing stratum, and the Low-performing stratum, respectively, while the upper-case letters "AN," "VI," "YE," "MY," "KA," "CY," "MT," "ME," and "CA" denote Annie, Vincent, Yeung, Mandy, Ka Ka, Cynthia, Margaret, Maybelle, and Carman, respectively. The three strata represented different ranges of total scores (see subsection 4.2.1, which described the research design), with higher scores indicating higher levels of pro-environmental attitudes. Hence, the interviewees in the High-performing stratum had higher levels of pro-environmental attitudes than those in the Moderate-performing stratum, while the interviewees in the Low-performing stratum had relatively lower levels of pro-environmental attitudes.

The combination of a stratum abbreviation and the abbreviation of a participant's name comprised the first part of the coded notations, and the second part consisted of

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the number of the interview question and the subthemes of the interview question (if any), which were denoted by lower-case letters and in some cases were followed by roman numerals in parentheses (see Appendix IV). For example, “HAN, 2a” represented a quote from Annie (i.e., “AN”), who was in the High-performing stratum (i.e., “H”), in response to the first subtheme question (i.e. “a”) of the second open-ended or semi-open-ended theme question (i.e., “2”).

6.2 Findings of the qualitative triangulation

The qualitative findings complemented and explained the quantitative results. Irrational or questionable responses from the quantitative study were investigated to explain the statements most in agreement and those least in agreement. In addition, the interactions between the influential factors were also explored. The following subsections presented the results of the qualitative triangulation.

6.2.1 Education as the most important factor in the environmental attitudes of the pre-service preschool teachers

Referring to the Wright Map (see Figure 5.1), most of the item measures in the education domain were highly skewed toward the bottom portion of the graph, and the item means were significantly located below most of the person means, indicating that most of the respondents agreed that environmental education affected their environmental attitudes to a great extent. The quantitative findings of items U11R, U02, and U08 concurrently supported education as a crucial domain that affected the

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environmental orientation of the PPT in that it positively altered their beliefs and behaviors accordingly. Discussions from the interviews on these issues were elaborated as follows.

Preschool education as a starting point of environmental education: According to the results of the negatively worded item U11R ("Teaching environmental education to preschool students is a waste of time"), its item measure was -1.45 logits, and more than 90% of the respondents rated it either Disagree or Strongly Disagree. This indicated that most of the PPT were convinced that even though they needed to spend time on environmental education for preschoolers, it was worthwhile to do so. Concurrently with the quantitative findings, all of the interviewees stressed that there was a need to include EE in preschool education, which suggested that children should start to learn EE at the early childhood stage so that their pro-environmental behaviors would gradually develop into life-long habits. Since young children represented the future generation, this would benefit society. Thus, embedding EE into preschool education was seen as a priority, as shown in the following excerpts from the interviews:

[MKA, 2]: *I believe that environmental education has to start in kindergarten because we learn everything from kindergarten* (the remarks of [MKA, 1a(i)] were similar)*…they are the future owners of the earth….*

[HAN, 1a(i)]: *…it would be more effective if any environmental education started with young children…it can be their habit.*

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The benefits of including environmental education in tertiary education:

Regarding item U09 ("I believe that including environmental education at tertiary institutions can help to change the environmental behavior of the whole community"), nearly 90% of the respondents rated it either Agree or Strongly Agree, indicating that that the respondents strongly supported the inclusion of EE at the tertiary level of education. As suggested by the interviewees, EE could change people's beliefs and, subsequently, their behaviors. As young adults in society are well equipped with environmental knowledge, this knowledge can positively alter their behaviors accordingly, resulting in society becoming more environmentally friendly, as shown in the following excerpt:

[HVI, 7c(i)]: *...If the teacher teaches environmental education, he/she needs to be educated in environmental education and act as a pro-environmental person….*

The significance of including environmental education in teachers' education:

Referring to item U10 ("I think it is important that all teachers receive environmental training"), over 78% of the respondents rated this item either Agree or Strongly Agree, indicating that the majority of the interviewees supported this statement. The interviewees believed that since children were the future generation of all living things, it was important to teach preschoolers appropriate EE and its sustainable value to develop a more livable world in the future. Hence, there is a need to improve teachers' environmental knowledge, teaching skills, sustainable worldview, and

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positive attitudes toward the environment. Evidence supporting these views were shown in the following excerpts:

[MKA, 2]: *I believe that environmental education has to start in kindergarten because we learn everything from kindergarten…they are the future owners of the earth….*

[MCY, 3b(ii)]: *...lecturers have taught me a topic about 'Well Being'…the lecturer discussed with us how to promote environmental education in preschool….*

[LME, 7b]: *...the teacher training program…does not include any environmental courses about how to integrate it [environmental information] in the teaching theme….*

[HVI, 7c(iii)]: *Actually, my [environmental] concepts were from the lecturer [practicum supervisor] of the university….*

Implementation of environmental education at all levels of education: For item U08 ("For environmental education to be as effective as possible, there should be a commitment from the entire education community"), its item measure was -1.03 logits, and over 90% of the respondents rated this item either Agree or Strongly Agree, indicating strong support from the majority of the respondents regarding this statement. Accordingly, the qualitative results concurred with the quantitative findings in that the interviewees suggested that EE should be implemented at all educational stages, including preschool, primary and secondary school, university, and the community. The interviewees also suggested that government policies needed to work hand in hand with education so that people could be well informed about the policies. It was further suggested that EE should be integrated at all levels of education to educate students to protect the environment, as shown in the following excerpts:

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[MME, 11]: *...government policy needs to work hand in hand with education. If people have not been well informed about environmental knowledge, they cannot understand the government's policies….*

[MCA, 11]: *I think environmental education needs to be included in secondary school, primary school, and preschool. Students can explore the concepts of how to make good use of resources, and how to protect the environment….*

[HVI, 7c(ii)]: *...he/she needs to be educated in environmental education and act as a pro-environmental person…thus, environmental education is important at preschool, primary, secondary, and university levels.*

Referring to the results of item U02 ("I believe that information is increasingly necessary to make people aware of the effects our actions have on the environment"), this item was the second-highest-rated item in the education domain, with an item measure of -1.04 logits. About 95% of the respondents rated this item either Agree or Strongly Agree, indicating that the majority of the PPT highly supported the idea that education could enhance people's beliefs and behaviors. Furthermore, once people knew more about the environment, they would value and protect it. Both the quantitative and qualitative results of this item were similar, as shown in the following excerpts:

[MMY, 12(i)]: *...education can change people's beliefs and enhance their behaviors.*

[MKA, 7]: *...when people know more about nature, they will develop a good relationship…they will value and protect the environment.*

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Deficiency of environmental knowledge and non-engagement in environmental education: Referring to item U03 ("I try to choose courses that deal with matters related to the environment because I feel that I do not know enough"), its item measure was +1.38 logits, which was a relatively high positive value. About 60% of the respondents rated this item Neutral and over 20% rated it Disagree, suggesting that although the PPT recognized that their environmental knowledge was insufficient, there was no motivation for them to enroll in environmental courses. The qualitative results of this item were consistent with the quantitative findings in that all of the interviewees had acquired only minimal environmental knowledge from the two courses offered at their university. However, four out of the nine interviewees still tried to integrate EE into their teaching even if their practicum schools did not require them to do so, as shown in the following excerpts:

[MMY, 12a]: *Pre-service preschool teachers lack environmental knowledge….*

[HYE, 1a(i)]: *…there is little environmental information in primary and secondary schools.*

[MMY, 1a(i)]: *…I had not learned any environmental knowledge in my primary school, but a Community Recycling Promotion Vehicle visited once….*

[HVI, 3]: *…There was only a three-hour lecture in the 'Promoting Children's Emotional & Social Well-being' course of the HDECE, including some environmental knowledge, which was not sufficient…. I am not able to explain sophisticated theories in a simpler way to children…*

[MKA, 7a]: *…I integrated ideas about the conservation of endangered animals in the 'animal' project….*

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[MMY, 12(ii)]: *...the government needs to provide more resources to promote pre-service preschool teachers' knowledge concerning environmental preservation....*

The qualitative results concurred with the quantitative findings. In general, all of the interviewees believed that education could change people's beliefs and behaviors. Though most of the interviewees had acquired minimal environmental knowledge in their higher education, they were aware of and concerned about the environment and attempted to implement EE into their teaching. They were of the view that EE could benefit preschoolers. Conversely, insufficient relevant knowledge and a lack of government and school support for the PPT hindered their promotion of EE in preschool. The interviewees also recommended that EE should be incorporated at all stages of education.

6.2.2 Alternative experiences as an effective pedagogy in environmental education

Referring to the Wright Map (see Figure 5.1), most of the item measures, except item U18R, in the alternative experiences domain were skewed toward the bottom portion of the graph, indicating that on average, most of the items tended to be endorsed by the Agreement aspect. The item measure of U18R was located close to the person mean, which needs further investigation. Moreover, items U14 and U16R were two of the most supported items. In addition to the education domain, the alternative experiences domain was another crucial domain that positively influenced the environmental attitudes of the PPT. The qualitative findings from the alternative experiences domain foregrounded the relationship between the effects of nature-outdoor experiences and the environmental attitudes of the PPT.

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The vital influence of the pre-service preschool teachers' environmental knowledge: For item U14 ("Nature-outdoor activities help me to be more in touch with nature"), more than 90% of the respondents rated it either Agree or Strongly Agree, suggesting that nature-outdoor activities could enhance people's positive orientation toward the environment. The interviewees expressed that they had experienced learning by their interactions with nature. The interviewees participated in a variety of nature settings to learn about biodiversity and the coexistence of living things and nature, as well as the mutual interactions between humans and the earth. One of the interviewees also stated that her childhood nature experiences not only affected her knowledge acquirement but also greatly influenced her attitudes concerning environmental awareness, as she implemented pro-environmental behaviors throughout her lifetime. Examples of the interviewees' views on item U14 were shown in the following excerpts:

[MCY, 4]: *I went to Lung Mei Shore…to investigate how its biodiversity was affected by the changing environment….*

[LMT, 3a(i)]: *…I joined the 'mountain craft' course…the content of the course included how people interact with nature….*

[HAN, 3a(i)]: *I grew up in the countryside, so I have 'complex' enthusiastic feelings about the environment. I am always aware of my surroundings and information about environmental education.*

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Field trips (nature-outdoor activities) as an effective pedagogy in environmental education: Referring to the results of the negatively worded item U16R ("Nature-outdoor activities are a waste of time. The most important is classwork"), over 90% of the respondents rated this item either Disagree or Strongly Disagree, suggesting that engagement in nature-outdoor activities was viewed as an effective way for individuals to understand and learn from nature. From the qualitative results, most of the interviewees believed that everything originated from nature and that individuals could acquire knowledge through hands-on experience by interacting with nature and implementing environmental conservation. Moreover, utilizing one's experiences was viewed as a more adequate pedagogy in environmental education than employing different kinds of teaching tools in the classroom, such as books or electronic media. In the interviews, four out of the nine interviewees mentioned that they were inspired by the natural environment and used natural materials to create hands-on artworks. Through those experiences, they intended to implement this pedagogy in their future teaching, as shown in the following excerpts:

[MMY, 1(i)]: *...I believe that everything originates from nature, and young children can acquire environmental knowledge through their experiences of interacting with nature* ([HAN, 7a] and [HVI, 1b] had similar viewpoints).

[MCA, 7]: *Visiting nature is good because children can be in touch with the elements of nature…and then protect the earth….*

[MCY, 2]: *...facilitating children's experiences is a comparatively effective pedagogy than just utilizing books, videos, or mass media as teaching materials for environmental education* ([LME, 2] had the same viewpoint).

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[HAN, 3b]: *In the VA [Visual Arts Education in ECE] course…the lecturer arranged for the student teachers to visit the Fung Yuen Butterfly Reserve, and we worked on some 'Installation Art' artworks…a good experience about how to learn from nature and interact with nature…how to implement this nature experience in my teaching.*

No preference for engagement in either outdoor activities or indoor activities: According to the results of the negatively worded item U18R ("I find it more interesting in a shopping mall than out in a country park"), its item measure was 0.96 logits, which was very close to the person mean. The respondents rated this item in a trimodal manner with similar frequencies: Disagree (24%), Neutral (33%), and Agree (24%). No agreement of preference was rated by most of the respondents. On the other hand, the qualitative findings indicated that the interviewees engaged in a variety of activities in their leisure time, which occurred both indoors and outdoors. Although some of the interviewees enjoyed encountering the natural environment, they did not object to participating in indoor activities, such as going to a shopping mall, playing electronic games, relaxing at home, reading books, etc. This suggested that outdoor activities were not their most preferred activities, but they agreed that outdoor nature activities were a pleasurable experience, as shown in the following excerpts:

[LME, 5b]: *I love to go shopping and play board games in my leisure time.*

[LCA, 5]: *I like reading…. I do not have any preferred outdoor activity.*

[MMY, 5b]: *I love to play mobile games in my leisure time.*

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[MKA, 5b]: *...I am lazy to go out. I like to stay at home in my leisure time. I go hiking once per few months.*

[MCY, 5a]: *I have an outing every week or twice a week depending on the weather.*

[HVI, 5]: *...going to the beach…jogging….*

[HYE, 5]: *I will go hiking and play football.*

[LMT, 3a(i) and 5]: *...'mountain craft' activities….*

The qualitative results aligned well with the quantitative findings, indicating that outdoor nature experiences enhanced the pre-service teachers' environmental knowledge. Through first-hand nature experiences, they learned about the biodiversity of nature, the coexistence between living things and nature, and how human beings interacted with nature and in what ways they interacted. They believed that nature experiences could affect their behaviors throughout their lifetime. Although the PPT had no preference for engaging in nature activities, they suggested that outdoor nature activities could promote their environmental awareness and enhance their ecological and environmental knowledge through different kinds of sensory experiences. In sum, alternative experiences was viewed as an effective pedagogy in teaching environmental education.

6.2.3 Salient beliefs that humans have disturbed the balance of the natural environment

In Figure 5.1, overall, the item measures in the beliefs domain were widely dispersed across the graph. This indicated that these items were well targeted in assessing the

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support of the respondents (the respondents' supportiveness is represented as person ability in Rasch modeling). Items U29, U28, and U27 were located at the bottom-most part of the graph, indicating that the respondents strongly believed that the earth's resources were limited and that humans were severely abusing the environment. However, item U30R was located in the top-most part of the graph, which indicated uncertainty in the belief of this item. All of the above-mentioned items were discussed further in the subsequent sections. Similarly, the qualitative findings concurred with the quantitative results in many aspects. All interviewees believed that humans were part of nature, that protecting the environment and preserving the earth was the responsibility of humans, and that, in the end, both human beings and living organisms would experience adverse consequences. One of the interviewees believed that technology could solve environmental problems.

Humans need to coexist with nature: Referring to item U29 ("The earth is like a spaceship, with very limited land space and resources"), its item measure was -1.47 logits, which was the lowest logit value in the EAPPT Scale, and hence the most supported item. About 60% of the respondents rated this item Agree and about 35% rated it Strongly Agree, meaning that nearly all of the respondents agreed with this statement. The qualitive results showed that all of the interviewees held a similar view that humans and nature should coexist harmoniously together because the earth was a unique habitat for human beings and creatures. The strong agreement with this statement was unquestionable, as shown in the following excerpts:

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[HAN, 1]: *...nature and humans have a close relation with one another and cannot be separated....*

[HAN, 1a(ii)]: *We [human beings] live in the same 'Global Village.' We need harmonious coexistence between nature and humans….*

[MCY, 1]: *...some resources cannot be produced by humans. Resources belong to nature. If we use up all the resources, then we will lose them forever.*

The deterioration of the earth is the result of human selfishness: Referring to item U28 ("Humans are severely abusing the environment"), its item measure was -1.38 logits, which was a relatively high negative logit value. About 95% of the respondents rated it either Agree or Strongly Agree, suggesting that this item was supported by nearly all of the respondents. These qualitative results matched the quantitative findings. All nine interviewees were convinced that the serious destruction of the natural environment was most likely rooted in human selfishness, for example, misusing the land, overconsuming natural resources, etc., as shown in the following excerpts:

[MAN, 1]: *I think the natural environment is abused by humans. We need to find ways to stop deteriorating ecology.*

[MCY, 1a]: *Many people are selfish, are not concerned about the environment….*

[LCA, 2]: *...when people do not use resources properly…it will cause environmental pollution…the habitat of all living things will be quickly deteriorated.*

[HYE, 8]: *...ecological catastrophes are a severe global problem, which includes animal extinction…as shown in the news. It is because humans have overconsumed the forest and*

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abused the environment (similar viewpoints were shared by [HAN, 8], [HVI, 8(i)], [MMY, 8], [MCY, 8], [MKA, 8], [LMT, 8], [LME, 8], and [LCA, 8]).

Concerns about environmental and ecological disasters: For item U27 ("If things continue on their present course, we will soon experience a major ecological disaster"), about 85% of the respondents rated this item either Agree or Strongly Agree, suggesting that most of the respondents were highly aware of environmental crises. The qualitative results showed the same trend as the quantitative results. The responses from the interviewees indicated that they were concerned about the occurrence of environmental and ecological disasters. Moreover, the interviewees believed that humans needed to reflect on their behaviors and search for solutions to slow down the deterioration of the environment. The interviewees also suggested that EE played a major role in solving environmental problems, as shown in the following excerpts:

[MMY, 8]: *I think it [the global crisis] may be exaggerated, but it is not far…because we can see the effects of global warming nowadays, glaciers melt gradually…penguins lose their habitat….*

[MMY, 1(ii)]: *…we need to stop the global crisis by searching for solutions…to slow down the deterioration….*

[LME, 1]: *Environmental education can be divided into two processes. First, we need to understand the conditions of the environment…find out the problems…second, then solve them.*

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Technology as a solution to environmental problems: Referring to item U30R ("The earth has plenty of natural resources if we know how to develop them properly"), slightly more than 55% of the respondents rated this item either Agree or Strongly Agree. As shown in the Wright Map (see Figure 5.1), its item measure was located in the top portion of the graph and tended to endorse the Disagreement aspect, which did not follow the overall trend of the items in the beliefs domain. This suggested that an above-average number of respondents believed that humans had no ability to alter the current status of nature, even those people with enough knowledge to do so. According to the qualitative results, only one interviewee believed that technology could help people fully utilize natural resources, and he expressed the controversial view that natural resource deficits and species extinction were not related to human activities as those occurrences were a natural phenomenon. His views might be explained by people's enduring concept of anthropocentricity, as shown in the following excerpt:

[HVI, 8(ii)]: *I have two viewpoints concerning these issues. First, humans can apply technology to solve natural resource problems, such as the utilization of solar, hydraulic, or wind power for generating electricity…. Second, resource depletion and species extinction are both natural ecological phenomena that may not be caused by human activities.*

In sum, an above-average number of the PPT had a strong sense of environmental awareness. The limitations of the earth's resources, human abuse of the environment, and, consequently, the occurrence of ecological crises were their greatest concerns.

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The PPT were convinced that human selfishness and misbehavior toward the environment were critical causes of natural disasters, and human needed to take responsibility and learn how to coexist with nature and other living things. However, it was also pointed out that some people controversially believed that technology could help to create a better society that would solve globally adverse effects such as climate extremes, ecological disasters, resource deficits, species extinction, etc. The PPT believed that henceforth, humans should play a major role in preserving the environment through EE to promote people's environmental awareness and, in turn, reduce environmental degradation.

6.2.4 Action potential did not align with the pre-service preschool teachers' attitudes toward the environment

In the Wright Map (see Figure 5.1), the item measures in the action potential domain tended to be highly skewed in the top portion of the graph, and all item measures were located above the item mean. This suggested that the items were not supported by most of the respondents. Moreover, most of the item measures were well-targeted person measures, except item U49 ("I will participate in and be a member of an environmental organization"), which was located in the top-most part of the graph at more than two standard deviations above the item mean. Overall, these indicated that most of the respondents had a low intention of engaging in any pro-environmental activities. The qualitative findings were consistent with the quantitative findings, with a few controversial issues. The pre-service teachers' behaviors and their environmental perspectives on different aspects, including consumption behaviors,

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implementation of pro-environmental behaviors, engagement in pro-environmental activities, and participation in environmental organizations, were examined in the following sections.

The controversial issue of consumption habits: Referring to item U45 ("When I buy a product, I consider the type of packaging and choose one that is recyclable"), its item measure was +1.93 logits, which was a relatively high positive logit value in the EAPPT Scale. More than 40% of the respondents rated this item Neutral and about 35% rated it Disagree, suggesting that they did not consider the environment much in their consumption habits. In the qualitative findings, there was a contradiction between the pre-service teachers' beliefs and their consumption habits. Despite most of the interviewees having positive attitudes about consumption habits, they had not taken any corresponding actions. Overconsumption was another concern that needed to be tackled. The PPT, however, did not care much about whether the products they consumed were environmentally friendly or not, as shown in the following excerpts:

[LCA, 9]: *[The most serious environmental problem in Hong Kong is the] overconsumption of useless stuff…. People always buy too many things, such as clothes, which they may not need, and then waste is caused*.

[HVI, 1a(i)]: *I bring a bag, bottle, and do not overconsume….*

[HVI, 8(i)]: *I think human beings need to rethink our overconsumption habits….*

[LME, 12]: *…when I buy the product, I am not concerned about whether the packaging is recyclable*.

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Similar findings were found for item U52R ("Although my currently used products are not environmentally friendly in nature, I still prefer to buy them"). Given that the content of statements U45 and U52R were very similar, the qualitative results concurred with the quantitative findings.

Minimal engagement in pro-environmental activities: For item U50 ("I will participate in environmental activities actively"), its item measure was +1.76 logits, a relatively high positive logit value. About 50% of the respondents rated this item Neutral and about 40% rated it Disagree, suggesting that there was no significant motivation for the PPT to engage in pro-environmental activities. The qualitative results were consistent with the quantitative results, as the majority of the interviewees seldom engaged in any environmental activities. Though most of the interviewees were concerned about environmental preservation, they had a low intention of joining pro-environmental activities. Unenthusiastic perspectives, time constraints, and information deficiencies were the major obstacles accounting for the low engagement of the interviewees in either environmental or ecological activities, as shown in the following excerpts:

[HAN, 4(i)]: *If time is available, I will engage in ecological nature activities because I think this is the place [Earth] where we live. We all have a responsibility to protect the environment.*

[LCA, 6b]: *...I am usually not aware of 'environmental preservation'...thus, I do not attend any related activities.*

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[MKA, 4]: *I know that there was some information about environmental activities at EdUHK…but I did not pay any attention to it.*

[MKA, 6b]: *…I have no determination to do [an environmental activity] because my environmental attitude is weak. It seems that it is none of my business.*

[HVI, 4(i)]: *…I am not keen to participate in any ecological activities, but I initiate collecting rubbish in the natural environment sometimes. I invite my best friends to work together collecting Styrofoam at the beach….*

Low intention of becoming a member of an environmental organization:

Referring to item U49 ("I will participate in and be a member of an environmental organization"), its item measure was +2.67 logits, which was the highest positive logit value in the EAPPT Scale, and more than 70% of the respondents rated this item either Disagree or Strongly Disagree, suggesting that the majority of the respondents would not join an environmental organization as a member. The qualitative results concurred with the quantitative results in this aspect. Almost all of the interviewees had a very low intention of joining an environmental organization as a member. The obstacles were similar to those of their non-engagement in pro-environmental activities. Additionally, the interviewees did not know how environmental organizations operated and were also confused about the societal role of non-governmental organizations (NGOs) and environmental organizations. However, the benefits of being a member of an environmental organization were considered, as shown in the following excerpts:

[HVI, 4(ii)]: *…I know [about environmental organizations]…but I do not contact them.*

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[HVI, 6b]: *...I am not interested in participating in any community activities….*

[HAN, 4(i)]: *If time is available, I will engage in ecological nature activities because I think this is the place [Earth] where we live. We all have a responsibility to protect the environment.*

[HAN, 6b]: *...I am concerned about the time spent…because I need to take care of my family…maybe…when my child gets older.*

[LCA, 6b]: *...I am usually not aware of 'environmental preservation'…thus, I do not attend any related activities.*

[MCY, 6b]: *...the school does not provide any information about ecological activities and environmental organizations…. I don't know how to find the information.*

[LMT, 6a]: *Is 'Breakthrough' an environmental organization* (it is not an environmental organization)*?*

[LMT, 6b(i)]: *...I am interested in voluntary work regarding 'refugees.'*

In this study, although a large number of participants had positive environmental attitudes, their intention of implementing pro-environmental actions was limited and their overall pro-environmental behaviors were relatively minimal, such as consumption behaviors and engagement in environmental activities. Based on the interviews, overconsumption and misuse behaviors were major concerns of the PPT. The primary obstacle to implementation was mostly likely due to the powerlessness felt by the interviewees regarding the lack of support from society and the consideration of personal gains in taking pro-environmental action, which indicated that there was a gap between their positive pro-environmental attitudes and their actions. The next chapter discussed this gap further.

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6.2.5 Social interaction between the pre-service preschool teachers and the agencies of society

Referring to Figure 5.1 (i.e., the Wright Map), overall, the item measures in the social interactions domain were densely clustered below the person mean and skewed toward the bottom portion of the graph. This indicated that most of the items in this domain overlapped in assessing the supportive tendencies of the respondents, and most of the PPT agreed that social norms affected their environmental attitudes. However, any deduction concerning social influences was difficult to draw because the social context is comprised of diverse attributes (e.g., personality, personal background, relevant experiences, social resources, government policies, etc.). Conceptually, social interaction is the mutual influence between individuals and social components (Shelton, 2019), and social interactions at different levels of the community are complex. The interviewees' views on their practicum schools, government policies, and mass media were further examined in the following subsections.

Teachers' environmental attitudes as one of the most important elements in environmental education: Referring to item U33 ("Teachers' attitudes are a very important factor in environmental education"), its item measure was -1.05 logits, which was a relatively low logit value, and about 95% of the respondents rated this item either Agree or Strongly Agree, suggesting that almost all of the respondents

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agreed that teachers should play a role in EE. Both the quantitative and qualitative results concurred. All the PPT believed that teachers should have positive environmental attitudes and be well equipped with environmental knowledge, which are fundamental requirements in teaching subjects concerning EE, as shown in the following excerpt:

[HVI, 7c(iii)]: *Actually, my environmental concept was from the practicum supervisor of the university. Some concepts come from daily experiences. To be honest…sometimes I am not a pro-environmental person. If children ask me environmental questions, I don't know how to answer them. Thus, if we care about the effectiveness of implementing environmental education, every teacher must be a pro-environmental person and be well educated in environmental knowledge. Therefore, I think environmental education is very important in preschool, primary school, secondary school, and university.*

Major influential people during the pre-service preschool teachers' practicums:

Referring to item U39 ("School principal(s) have supported me in activities concerning environmental issues"), more than 55% of the respondents rated this item Neutral and about 30% rated it Agree, suggesting that the majority of the respondents believed that their school principals had supported them in teaching subjects related to the environment, but the support was minimal. The qualitative findings concurred with the quantitative results. As the school policymaker, the principal's orientation of environmental attributes strongly influenced the whole school, such as the curriculum, the learning environment, etc., as shown in the following excerpt:

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[HAN, 7c(i)]: *The principal is the person in charge of the school…. She has to plan and implement school policy…. My practicum school had 'Environmental Week.' The young children learned a lot of environmental knowledge through the activities…. If the principal is concerned about this [environmental education], she will plan a series of activities….*

Also referring to item U38 ("School mentor(s) have supported me in teaching or promoting environmental education"), about 30% of the respondents rated this item Neutral and about 50% rated it Agree, suggesting that the respondents usually obtained support from their mentor(s) in their teaching related to EE. The quantitative and qualitative results were consistent. During the pre-service teachers' practicums, their mentors usually supported them by discussing their teaching plan, assisting in the implementation of EE, and providing advice for improvement, as shown in the following excerpts:

[MCY, 7b]: *...I taught 'Water – Natural Resource of the Earth.' I played a 'water rationing' game with the young children. The mentor assisted me in helping the children fill water in their own bottles. The children needed to make use of their bottled water to wash their hands after they used the toilet…. The activity was suggested by my mentor.*

[LCA, 7c]: *Before teaching the 'planting activity,' my mentor explained how to use the planting tools. During my teaching practice, she stood beside me….*

[HYE, 7c]: *My mentors facilitated me and advised me in my teaching practice* ([HAN, 7c], [MCY, 7c], [LMT, 7c], and [LCA, 7c] had similar experiences).

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The government as an information provider and education agency in promoting environmental education: For item U34 ("Government policies and related facilities encourage us to reduce and recycle waste"), about 25% of the respondents rated this item Neutral and about 60% rated it Agree, suggesting that most of the respondents agreed that the government had attempted to promote pro-environmental habits to the public through different policies and facilities. However, some of the respondents believed that the government did not put enough effort into EE. The qualitative results concurred with the quantitative findings, indicating that the government played a critical role in promoting environmental policies through the integration of EE into the curricula across all educational stages. However, some interviewees claimed that they knew little about government policies concerning environmental issues, as shown in the following excerpts:

[LME, 11]: *I think education is more important than government policies. Policies need to work hand in hand with education. If people do not have solid environmental knowledge, they cannot understand the government's policies, such as the 'Waste Charging Scheme.' Most people are just concerned about the money spent caused by this scheme. Thus, the effect of education may be more important than the government's policies.*

[HVI, 11]: *Many people are against the 'Waste Charging Scheme.'... The government needs to stress environmental education....*

[LMT, 1a]: *...even though Hong Kong has 'Three-colored Separation Bins,' actually, all rubbish will go to the landfill....*

[HAN, 1a(iii)]: *I do waste separation at home, but I discovered that all the sorted wastage had been transported to the landfill later.... I do not believe in the government because the government will put all rubbish into the landfill.*

[HAN, 11]: *I know nothing about the government's policies...only solar power....*

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Mass media as a source of information about environmental issues: For item U43 ("Mass media, such as the internet, television, and newspapers, is the main source of my environmental knowledge"), more than 85% of the respondents rated this item either Agree or Strongly Agree, suggesting that the majority of the respondents acquired their environmental knowledge mainly from mass media. Item U42 ("Mass media, such as internet, television, and newspapers, affects my environmental attitudes to a great extent") had similar findings as those for item U43. The qualitative results also concurred with the quantitative findings. As mass media was the main source of access to environmental information, such as television programs, social media, etc., it was suggested that the government should make use of mass media propaganda to promote environmental policies to the community, as shown in the following excerpts:

[LMT, 8]: *...deforestation of the Amazon Forest…from Facebook…someone shared the information….*

[HAN, 4(ii)]: *I watch television for information about the environment….*

[MMY, 11]: *...the government should arouse public awareness of environmental policies via mass media propaganda….*

The qualitative results aligned well with the quantitative findings in this domain, revealing that all the PPT strongly believed that teachers should have positive environmental attitudes and be well equipped with environmental knowledge, which are fundamental requirements in teaching subjects concerning EE. During the pre-

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service teachers' practicums, school members and mentors usually supported them in teaching topics related to the theme of environmental protection. However, as the school's policymaker, the school principal determined school policies on whether the integration of EE into teaching should be practiced or not. In addition, the PPT believed that the government played a critical role in promoting environmental policies and in implementing the integration of EE into the curricula across all educational stages. Two out of the nine interviewees had some misconceptions about the government's environmental policies, and one interviewee claimed that she knew nothing about the government's policies on environmental issues. The interviewees also reflected that mass media was their main source of environmental information, and that the government therefore needed to utilize different kinds of media to promote environmental policies to educate the public to become more environmentally friendly.

6.3 Conclusion

In this chapter, the influences on the environmental attitudes of the respondents and interviewees were described. Focusing on the analysis of the five specific domains that influenced the interviewees' environmental attitudes, namely, education, alternative experiences, beliefs, social interactions, and action potential, the qualitative findings complemented the quantitative findings. This connoted that the majority of the interviewees had positive attitudes toward the education and

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alternative experiences domains, and the education domain was undoubtedly the most crucial domain that influenced their environmental attitudes.

Contrarily, the interviewees had relatively negative tendencies in the action potential domain. Analyses of both the quantitative and qualitative data convincingly showed consistency in many aspects. It was also found that the interviewees' positive beliefs regarding conservation contradicted their behaviors to a certain extent. Different sociocultural agencies played complicated roles in the pre-service teachers' potential to implement pro-environmental actions, and some common misconceptions about the government's environmental policies were firmly established among some of the PPT.

Furthermore, knowledge and awareness deficiencies were found to be the main barriers to teaching EE, implying a need to improve teachers' environmental education, say, by including environmental education in tertiary education. The government, educational institutions, and practicum schools are crucial agencies in the promotion of EE to support pre-service teachers' all-around development. These findings are worthy of further discussion. In the final chapter, a discussion and conclusion was presented, along with the possible implications of environmental education in Hong Kong.

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CHAPTER SEVEN

DISCUSSION AND CONCLUSION

This chapter discussed the discrepancy between the environmental attitudes and pro-environmental behaviors of the pre-service preschool teachers and the factors that influenced their attitudes and behaviors. A brief review of environmental education in teacher education was also conducted. The chapter concluded with an outline of the limitations of the study and suggestions for future research.

7.1 Discussion

The findings of this research revealed that the PPT had positive environmental attitudes but had little intention of engaging in environmental activities.

7.1.1 Attitudinal patterns of and discrepancy between environmental attitudes and pro-environmental behaviors

For decades, researchers have suggested that attitudes are a strong predictor of environmental behaviors (Bamberg & Möser, 2007; Pavalache-Ilie & Cazan, 2017; Bhattacharyya et al., 2020). However, Taylor et al. (2008), Sadik (2013), Koc and Kuvac (2016), Sarıkaya and Saraç (2018), and Janmaimool and Khajohnmanee (2019) obtained contrary findings that suggested that environmental attitudes are not a

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significant determinant in predicting pro-environmental behaviors in some circumstances. A discussion about this controversial issue was conducted as follows.

Patterns of environmental attitudes: The PPT showed a relatively high degree of agreement in the domains of education and alternative experiences, with Rasch person means of +2.12 and +2.16 logits, respectively, but a relatively lower degree of agreement in the action potential domain, with a Rasch person mean of 0.00 logits and item mean of 0.00 logits (the default measures), in this study (see Table 5.5). This implied that the PPT had little intention of executing pro-environmental activities, resulting in a gap between their attitudes and behaviors.

Contrast between attitudes and behaviors: The findings of this study concurred with those in previous studies by scholars and educators, such as Taylor et al. (2008), Sadik (2013), Koc and Kuvac (2016), and Sarıkaya and Saraç (2018), whose research involved pre-service teachers in different fields of education and showed an inconsistency between their attitudes and behaviors.

Based on the findings of this study, the interviewees in the High-performing stratum were more willing to take part in pro-environmental activities, such as separating waste, sharing environmental information, and cleaning shorelines. The Moderate- and Low-performing strata interviewees had relatively passive tendencies. The

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interviewees from the Low-performing stratum had comparatively less concern about their daily consumption habits and environmental conservation, which suggested that their environmental attitudes were a predictor of their pro-environmental behaviors.

Referring to the Wright Map for the action potential subscale (see Appendix VII and Figure 5.1), most of the survey respondents had little intention of engaging in particular pro-environmental activities when there were perceived constraints to implementing environmentally friendly actions or a lack of immediate advantages to do so. For example, most of the respondents did not participate in environmental organizations and did not engage in environmental activities. The interviewees also had similar negative attitudes when there were perceived constraints to actively engaging in pro-environmental activities, and their biggest concerns were time limitations, interest in the activity, and benefits received. On the other hand, the survey respondents had a relatively positive (or less negative) orientation toward daily pro-environmental and conservation behaviors (see Appendix VII and Figure 5.1). This suggested that the respondents believed that daily pro-environmental behaviors would benefit them, and immediate effects could easily be generated from their daily actions.

Some researchers have proposed that the implementation of pro-environmental behavior most likely depended on people's "goal-directed behavior" (Ajzen &

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Madden, 1986; Aarts & Dijksterhuis, 2000; Han et al., 2018). The findings from the interviews concurred with the results of the survey (see Appendix VIII, specifically, codes LMT, 4, 6b(i); LME, 6b; MMY, 6b; HAN, 4(i), 6b; HVI, 4(i), 4(ii), 6b; and HYE, 6b), implying that besides action intention, perceived behavioral control may also have played a major role in the pre-service teachers' implementation of pro-environmental behaviors (Ajzen & Madden, 1986; Ajzen, 2002; Defloor & Bleys, 2017; Fang & Zhan, 2018; Guo et al., 2018). Ajzen (2002) stated that perceived behavioral control could affect how an individual performed certain behaviors, either with ease or difficultly. In sum, individuals' behavioral control is seen as largely a result of their personality, cognitive ability, time availability, monetary affordability, etc. (Kurisu, 2016). Recent research has found that perceived behavioral control has a positive correlation with pro-environmental behavior (Hansmann et al., 2020).

The influence of guilt on pro-environmental behavior: It has been suggested that psychological factors can influence environmental attitudes. According to Barr and Gilg's (2007) model, situational variables, behavioral intention, and psychological variables are all determinants of environmental behavior. Environmental attitudes are directly and indirectly linked to individuals' perceptions of the environment and their action intention (Barr & Gilg, 2007), while altruistic values are important aspects to consider in studying environmental awareness and pro-environmental behavior (Hopper, 1991; Nguyen, et al., 2017).

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As a psychological variable, some studies have found that an individual's "environmental guilt" is strongly associated with the implementation of pro-environmental behavior (Elgaaied, 2012; Tam, 2019). Environmental guilt is the result of an individual's self-conscious feeling of regret for contributing to environmental problems (Mallett et al., 2014). The findings from the interviewees (see Appendix VIII, specifically, codes MMY, 1, 1(ii); MCY, 1, 1a; HAN, 4(i); and HVI, 4(i)) that depicted a feeling of guilt for global catastrophes suggested that the interviewees believed that they should be more responsible for conserving the environment by adopting a more sustainable lifestyle. The findings also revealed that, based on the interviewees' views of altruistic values, the PPT showed feelings of guilt about environmental problems causing harm to other people and all living things, such as the impact of the construction of artificial beaches on biodiversity (see Appendix VIII, code MCY, 4) and pollution ruining the habitats of all creatures (including humans) (see Appendix VIII, code LCA, 2).

Furthermore, according to anthropomorphism (Tam et al., 2013; Tam, 2014, 2019), it has been suggested that individuals who treat the natural environment as if the environment had human qualities (i.e., human attributes) were more likely to experience more environmental guilt and enhance their connectedness to nature. This evidence implies that individuals' environmental guilt is capable of motivating efforts

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to engage in pro-environmental behavior (Mallett, 2012; Tam, 2019). This concurred with the findings of the current study, in that the interviewees were convinced that human needed to harmoniously coexist with nature (see Appendix VIII, codes HAN 1, 1a(ii) and MKA, 7) .

Barriers to and accelerators of acting pro-environmentally: Despite the feelings of guilt which should have led to more pro-environmental behavior, there is less inclination to implement this behavior due to a number of barriers. This study found that the barriers that prevented the PPT from acting environmentally included a deficiency of environmental knowledge and some adverse effects from psychological factors. Blake's (1999) study suggested that individuality, individual and social-contextual responsibilities, and social and institutional practicalities were three major barriers to the environmental attitudes and pro-environmental behaviors of people (Kurisu, 2016).

For example, one of the interviewees stated that she preferred relaxing at home rather than encountering nature during her leisure time; another interviewee believed that EE would not benefit her; and one interviewee preferred participating in voluntary works rather than joining a membership of an environmental organization. These remarks suggested that the PPT perceived personal benefits and their interests as their main considerations in implementing pro-environmental behaviors. Those statements,

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which were similar to the survey findings, exhibited a low degree of agreement (see Appendix V, where positive-valued logits denote a negative tendency of agreement.)

Referring to the social-contextual responsibility barriers of the PPT, one interviewee claimed that her environmental attitudes were very minimal and she had no intention of engaging in pro-environmental activities, while three other interviewees did not trust the government to implement environmental policies (see Appendix VIII, in particular, codes LMT, 1a; MKA, 1a(ii); and HAN, 1a(iii)). The participants of this study had a general lack of confidence in the government's capability of protecting the environment (see Appendix V). Three participants identified themselves as non-environmentalists and did not believe that they had an obligation to behave pro-environmentally (see Appendix VIII, codes LCA, 6b; LME, 6b; and MKA, 6b).

Lastly, referring to social and institutional practicality barriers, time constraints were the biggest concern of two interviewees because they needed to focus on their private lives as well as their studies in their ECE courses, and nearly all of the interviewees stated that their university had provided minimal coverage of environmental knowledge in their study programs (see Appendix VIII, particularly codes LME, 3; LCA, 3a; MCY, 3b(i); MKA, 3b(i); MMY, 3; HYE, 1a(ii); HVI, 3; and HAN, 3a(ii)).

Ajaps and McLellan (2015), Hwang and Seo (2017), Wi and Chang (2019), and

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Collado et al. (2020) have advocated that EE fosters pro-environmental behavior. Nearly all of the survey participants agreed that environmental knowledge could enhance people's awareness of the environment; EE could benefit the whole community in becoming more environmentally friendly; and more environmental-related knowledge should be integrated into different subjects in education programs for PPT (see Appendix V, where negative-valued logits denote a positive tendency of agreement.). One interviewee stressed that the government should provide more resources to support the EE of PPT (see Appendix VIII, code MMY, 12(ii)).

In the interviews, the participants shared their academic learning experiences, which revealed that they had not learned any topics about the environment in primary school, only a small amount of environmental knowledge was embedded in the subjects of geography and liberal studies in secondary school, and only a few topics related to EE were included in their tertiary education (see Appendix VIII, in particular, codes LCA, 1a; MCY, 1b, 3a; MMY, 1a(i); and HVI, 1a(ii), 3a). Most of the participants stated that they lacked environmental awareness and their environmental knowledge was not sufficient enough to implement it into their future teaching (see Appendix VIII, particularly codes MMY, 1a(ii); LME, 7b; MMY, 1a(ii); and HVI, 7c(iii)). The findings of this study showed that the participants had acquired minimal environmental knowledge at all levels of their education. Therefore, the government needs to take more initiative in adjusting the curriculum at all stages of

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education to include more environmental elements, especially at the elementary and tertiary education stages. EE could be seen as an accelerator in promoting pro-environmental behaviors.

Based on the results of this study, it can be concluded that the pro-environmental behaviors of the PPT were affected by their attitudes, but numerous contextual and personal influences also played important roles. These factors resulted in either barriers to or accelerators of participation in environmental activities and the promotion of pro-environmental behaviors. Other plausible accelerators that enhanced the environmental attitudes and behaviors of the PPT and a substantiated discussion of the findings were presented in the following sections.

7.1.2 Influences on environmental attitudes

Education and alternative experiences were found to be significant influential factors of the environmental attitudes of the PPT. As mentioned, education includes the domains of cognition and knowledge, which are important elements that affect individuals' environmental attitudes. Alternative experiences is also seen as a knowledge input in developing cognition, which is an effective pedagogy for EE. In the social interactions domain, teachers, lecturers, mentors, peers, and practicum schools were the specific social agents that acted on the environmental attitudes of the PPT, especially during their practicums.

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Environmental education: In this study, the domains of education and alternative experiences were perceived positively by the participants in terms of their development of environmental attitudes. They believed that education could change people's beliefs and enhance their pro-environmental behaviors (Başal et al., 2015; Sarıkaya & Saraç, 2018; Thamarasseri & Fatima, 2018).

Piaget (n.d.) suggested that education is the development of cognition and the construction of knowledge (Glasersfeld, 1989). In general, knowledge is the foundation for teachers in planning what to teach and how and why to teach it. Thus, in teaching subjects related to the environment, teachers need to have basic environmental knowledge so that they are capable of choosing relevant contents and designing appropriate pedagogy for implementation in their teaching.

Most of the survey respondents believed that teachers could acquire environmental knowledge, enhance positive attitudes, and conduct pro-environmental behaviors through EE (see Appendix V, in particular, agreed items: U02 = -1.04 logits; U09 = -0.84 logits; U04 = -0.75 logits; and U10 = -0.55 logits). Their environmental experiences, perceptions, and attitudes in turn could directly influence the environmental attitudes and pro-environmental achievement of their students (Sarıkaya & Saraç, 2018). The results of this study concurred with the views of

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Sarıkaya and Saraç (2018), in that EE affects how environmental lessons are taught and increases teachers' awareness in presenting environmental problems and solutions.

In the High- and Moderate-performing strata, the interviewees attempted to integrate topics related to the environment into their teaching themes. On the contrary, the Low-performing stratum interviewees had less concern for the environment and did not consider including environmental content in their teaching. Their deficiency of environmental knowledge may have been attributed to their lack of EE in their previous stages of schooling and their current university education being undertaken.

Critical thinking: About two thirds of the survey respondents agreed that EE focused on the skills of critical thinking, reflective decision-making, and participation, but some confused critical thinking with the development of thinking techniques (see Appendix V, item U07 = 0.06 logits, where the item mean is 0.00 logits by default). Three out of the nine interviewees mentioned that they utilized recycled materials to create artworks, but they seldom discussed with their students why certain recycled materials were chosen for use (see Appendix VIII, particularly codes LCA, 1, 1b; MMY, 1a(ii); and HAN, 7c(ii)). Only two interviewees in the High-performing stratum implemented environmental contents in their activities to stimulate children's critical thinking. Most of the interviewees only mentioned the preliminary functions of environmental protection and facilities, such as three-colored rubbish bins. This

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indicated that the PPT did not teach preschoolers EE in an in-depth and more appropriate way.

Yurt et al. (2010) and Başal et al. (2015) stated that preschool teachers emphasized environmental knowledge and ignored the critical thinking elements in their teaching, yet EE was not only about the process of environmental knowledge acquisition, as critical thinking, problem-solving skills, and environmental sensibility also needed to be developed so that people could build a connection with the natural environment (Sahin & Alici, 2019).

Alternative experiences in connection with nature and the environment:

Alternative experiences included field trips and outdoor learning in nature settings or in the community. Most of the survey participants and all of the interviewees were convinced that referring to and undertaking alternative experiences was an effective pedagogy in implementing EE (see Appendix V, specifically, agreed items: U16R = -1.16 logits; U12 = -0.95 logits; and U15 = -0.59 logits; and Appendix VIII, particularly, codes HAN, 3b; MCY, 4, 7; and MKA, 7). The findings of Cheng and Lee's (2015) study concurred with those of the current study, suggesting that outdoor learning experiences are an effective pedagogy that facilitates the cognitive skills (including knowledge understanding and academic outcomes) and fosters the personal and social development (encompassing communication and leadership skills) of young children.

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All participants of the study had graduated from the HDECE Programme, in which they had learned fundamental concepts about the early childhood learning theories of pioneering educators, included Rousseau, Frobel, and Montessori. The core ideas in these theories focused on how children can learn from nature through different sensory explorations. All interviewees also stressed that young children should explore nature through hands-on sensory and play experiences to connect with nature and the environment. For environmental learners, outdoor experiences are a more effective pedagogy for enhancing learners' cognitive development and independent learning compared with learning in the classroom (Hoalst-Pullen & Garell, 2011, as cited in Cheng & Lee, 2015).

When people connect with nature, their self-conceived "environmental identity" can be established (Clayton & Opotow, 2003; Clayton, 2012) and, subsequently, health benefits such as feelings of pleasure can be gained (Krasny, 2020). Zelenski and Nisbet (2014) further explained that people with a strong sense of connecting with nature intentionally protected the environment. For example, one of the High-performing stratum interviewees who grew up in the countryside expressed her appreciation of the beauty of nature and explicated her pro-environmental behavior, which suggested that her positive behavior was most likely facilitated by having more opportunities to encounter nature (see Appendix VIII, in particular, codes HAN, 3a(i), 3b).

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The influence of lecturers and practicum school members: Based on Bronfenbrenner's (1979) ecological systems model, social interactions was adopted as one of the influential factors in the EAPPT Scale. University lecturers, peers, mentors, and principals of preschools were found to be specific social agents that influenced the attitudes of the PPT during their practicums. It was also found that lecturers and practicum school members had prominent effects on the PPT (La Paro et al., 2020).

More than 90% of the survey participants agreed that teachers' positive environmental attitudes were very important in teaching EE (see Appendix V, in particular, agreed items U11R = -1.45 logits; and U12 = -0.95 logits). Most of the interviewees opined that their instructors and lecturers were facilitators and resource providers in that they instructed them in related teaching techniques and offered them a variety of reference cases for the implementation of environmental activities. These activities included the use of recycled materials for creating artwork, discussions about environmental issues, etc. (see Appendix VIII, particularly codes LCA, 3a; LMT, 3a(ii), 3b; MKA, 3b(ii); MCY, 3b(ii); and HAN, 3b). Recent studies have also found that the interprofessional relationship between pre-service teachers and supervising lecturers is a central element in the development of becoming teachers (Zeichner, 2010, cited in La Paro et al., 2020; Foong et al., 2018; La Paro et al., 2018). This was evidence that lecturers had a significant influence on the PPT regarding the development of their environmental attitudes.

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During the practicums of the PPT, school principals, peers, and mentors were the primary influential agents in determining their teaching contents. On the other hand, as the principal was the curriculum developer and the policymaker of the school, the utilization of environmental elements integrated in teaching was highly dependent on the principals' environmental attitudes and the prevailing school policies (Borg & Vinterek, 2020). During their practicums, most of the interviewees said that they had obtained support from their principals to promote EE through thematic teaching and eco-material applications (see Appendix VIII, in particular, codes MCY, 7b; HAN, 7c(i); HVI, 7c(iv); and HYE, 4). Lecturers as university supervisors should work hand in hand with school mentors to deepen pre-service teachers' reflective thinking and to explore solutions to problems during their practicum (Foong et al., 2018). University lecturers need to communicate to respective school members that the PPT should have more opportunities to teach topics on environmental issues during their practicums.

As a constraint, the PPT had to apply the same theme for all subjects within a fixed period of time during their practicums. In many circumstances, their teaching content precisely prescribed which topics were taught, and their deficiency in environmental knowledge was one of the major barriers to promoting EE (see Appendix VIII, in particular, codes LME, 7b; MMY, 3, 12a; MKA, 3b(i); and HVI, 3, 7c(iii)). This suggested that besides essential ECE teaching knowledge and techniques, equipping the PPT with different specific fields of knowledge was essential. In teaching EE, the PPT need to learn more about the environment and the ecosystem and master skills

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such as guiding young children to sense, explore, participate in, and appreciate nature. The framework for environmental literacy encompasses environmental knowledge in global contexts (OECD, 2015). As one of the components of environmental literacy, environmental knowledge can help enhance teachers' environmental literacy and prepare them to become competent environmental educators (Dada et al., 2017; Clark et al., 2020).

7.1.3 Environmental education for pre-service preschool teachers

Nearly 85% of the survey respondents agreed that the existing global environment has severely deteriorated. They believed that it was a priority to integrate EE into teacher education (see Appendix V, in particular, agreed items: U09 = -0.84 logits; and U10 = -0.55 logits) to slow down this trend. Some of the interviewees suggested that the existing ECE curriculum did not cover enough topics on EE. They also suggested that lecturing hours needed to be extended and that the university should offer more elective environmental courses in the ECE curriculum (see Appendix VIII, specifically, codes LMT, 11 and MCY, 3b(i)).

Sarıkaya and Saraç's (2018) study found that pre-service teachers who had participated in courses on environmental-related subjects displayed a more positive environmental attitude than those who had not. The findings suggested that whenever environmental-related topics were included in any courses, individuals' environmental attitudes were enhanced. This implies that more environmental-related elements need

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to be integrated into different courses, and that elective environmental-related courses and core environmental courses should be developed to meet the need of promoting EE.

As a teacher of early childhood education, the researcher is convinced that EE needs to integrate environmental knowledge, critical thinking, and alternative experiences into teaching practices. The PPT can also develop competence in designing appropriate activities and apply their knowledge in teaching and stimulating children to reflect on their learning processes. Correspondingly, pedagogical content knowledge is a combination of environmental knowledge, designing pedagogy, and implementing skills that can equip the PPT with better teaching competence (Lee & Luft, 2008, as cited in Birdsall, 2015). Eames and Birdsall (2019) stated that in order to be competent environmental educators, teachers need to know what content to teach (knowledge) and how to deliver it effectively (pedagogy). As a conceptual tool to enhance the teaching profession, mastery of pedagogical content knowledge in EE is important in fostering the environmental knowledge of PPT to prepare them for their future teaching.

The "Kindergarten Education Curriculum Guide" (2017) by the Curriculum Development Council is the latest guideline for preschools in Hong Kong. "Child-centeredness" has been adopted as the core value, and all-around development is stressed in kindergarten education. "Nature and Living" is one of the five

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developmental objectives that is related to EE, and it is closely related to children's daily lives. The PPT therefore need to know how to cater to children's curiosity and inspire them to explore nature (Cutter-Mackenzie & Edwards, 2014).

In the interviews in the current study, most of the interviewees agreed that in promoting EE, teachers had a role in facilitating how children explore and investigate environment-related issues on their own (see Appendix VIII, in particular, codes LME, 1; MKA, 1; MMY, 1(i); MCY, 2, 7, 7b; HVI, 1b; HAN, 3b, 7c(ii); and HYE, 4). Some of the interviewees also believed that effective child-centered play activities can enhance the environmental knowledge acquisition of young children (see Appendix VIII, specifically, codes MCY, 2, 7b; LME, 2; and HAN, 3b, 7c(ii)). Inquiry-based learning is one of the educational strategies that is currently applied in teaching science subjects (Pedaste et al., 2015), and Cutter-Mackenzie and Edwards (2013) have suggested that the play-based learning approach is an effective pedagogy in connecting environmental knowledge with early childhood EE. Both approaches are child-centered and emphasize the active participation of learners. Through exploration and investigation, young children can construct their own knowledge instead of merely acquiring their knowledge through teachers' didactic teaching. Suitable and diverse teaching themes in EE for young children is a priority. The daily experiences of young children, teachers, and families are effective learning contents for young children, and preschool teachers are encouraged to guide young children in exploring the environment (Cutter-Mackenzie & Edwards, 2014).

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Furthermore, the researcher is convinced that the PPT need to be well-equipped with pedagogical content knowledge in order to design and conduct appropriate activities that are suited to the interest level of preschoolers. This viewpoint concurs with the government guidelines on kindergarten education. Preschool teachers need to develop curricula related to real-world contexts, choose appropriate entities, and target the learning of young children (Curriculum Development Council, 2017). In a mega research project (2009–2014) by the World Organisation of Early Childhood Education (OMEP), education for sustainability (EfS) was found to be the key driver of quality early childhood education (Engdahl, 2015; Warwick et al., 2018; Türkoğlu, 2019). It was also argued that the establishment of individuals' pro-environmental behaviors was required to change environmental awareness, values, and habits (Engdahl, 2015). Warwick et al. (2018) suggested that the content of sustainable development goals can be reframed as an appreciation-based active learning process for young children, such as "appreciative care for people and planet"; "appreciative care for the local and global"; and "appreciative care for the present and future." Cultivating children's positive attitudes toward the environment and helping them to raise environmental awareness are fundamental to their acting more pro-environmentally throughout their lifetime (Türkoğlu, 2019).

To be a competent environmental ECE educator, the PPT need to be equipped with basic teaching competences and acquire knowledge related to the environment and

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ecological matters. A Hong Kong environmental education proposal for the government (2019) suggested that understanding the value of the natural environment, mastering the technique of conducting outdoor EE, and implementing ecological knowledge to develop a student-centered experiential curriculum should be specific focuses in teacher training (Ma, 2019, pp. 33–34). Hence, environmental and ecological knowledge are suggested to be integrated into courses offered in teacher training programs. The PPT also need to learn corresponding teaching skills for teaching in outdoor environment contexts (Cheng & Lee, 2015).

Designing nature-based early childhood curricula is costly, laborious, and time-consuming. However, outdoor learning in nature settings would benefit preschoolers (Sobel et al., 2016; Sobel, 2020). Nature-based childhood learning is increasingly popular in Western countries (Lerstrup & Refshauge, 2016; Larimore, 2018). A nature-based early childhood curriculum should include high-quality EE practices, and as such, nature-based preschool teachers should be well-trained and capable of fostering young children's exploration in nature settings (Sobel et. al., 2016). Before the publication of this thesis, not many registered "Forest School" kindergarten had been founded in Hong Kong. The Forest School approach emphasizes facilitating children's outdoor learning experiences in nature and free-play learning in the environment. For environment-enthusiastic PPT, becoming a nature-based preschool teacher may be an appealing career choice.

Besides formal EE, the PPT can gain hands-on experience through internships

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working in non-governmental environmental organizations, preschools, and elementary schools. Scholz et al.'s (2004) study concluded that offering internships in environmental studies is a valuable approach to enhancing students' professional career, communication skills, and field knowledge. Moreover, current research has found that the majority of pre-service teachers neither had taken any environment-related courses nor participated in any pro-environmental activities. Pre-service preschool teachers' participation in environmental NGOs as an internship may offer the chance to learn about environmental issues and then utilize this knowledge to educate young children (Doğan & Simsar, 2019). The direct involvement in environmental protection, EE promotion, and conservation projects can expose PPT to environmental endeavors in society before they start their professional career in the workplace (Scholz et al., 2004; Mosseray, 2015; Clark et al., 2020).

An interpretive case study by Walshe and Tait (2019) found that the conference approach can provide effective experiences that inspire pre-service teachers to develop the practice of environmental and sustainability education and empower them to become competent teachers. Environmental education workshops and ecological activities were also suggested to deepen pre-service teachers' environment-related knowledge and experiences and to well prepare them to implement environmental learning in their future classrooms (Scott & Sulsberger, 2019). More environmental activities in tertiary teacher education, such as green workshops, conferences, and ecological activities, would therefore be useful to provide the PPT with more opportunities to enrich their environmental knowledge.

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In the current study's interviews, though nearly all of the interviewees were not keen to engage in any pro-environmental activities, they showed concern about the rapid deterioration of the environment globally (see Appendix VIII, in particular, codes LCA, 2, 6b, 8; LME, 5b, 6b, 8; MKA, 3b(i), 4, 6b, 8; MMY, 1(ii), 3, 5b, 6b, 8; HAN, 6b, 8; HVI, 4(i)(ii), 6b; and HYE, 6b, 8). Thus, there is a need for PPT to participate more actively in pro-environmental activities and build up their pro-environmental behaviors in order to act as a role model to young children.

The findings from the survey and focus group interviews showed that the university of the PPT did not offer any elective EE courses. Furthermore, the participants believed that educational institutions need to offer more EE courses to the PPT. Based on the outcomes of this study, the main goals of EE for the PPT were: (i) to master teaching techniques for preschoolers; (ii) to acquire environmental and ecological knowledge for the future teaching of EE; (iii) to foster preschoolers' natural exploration skills; (iv) to develop positive attitudes toward the environment; (v) to build up preschoolers' environmental identities through role models; and (iv) to work closely with the community (i.e., preschools, non-governmental environmental organizations, the government, etc.). In sum, the content of EE in teachers' training should include child-centered teaching strategies in its pedagogy, conservation implementation to address psychological attitudes, ecological science as a specific subject, and outdoor learning to fulfill experiential fieldworks (Brandt et al., 2019; Ma, 2019).

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7.2 Recommendations for enhancing environmental education for teachers

Most Hong Kong teachers lack confidence in including environment-related knowledge in their teaching (Ma, 2016). This study revealed that the pre-service teachers were deficient in environmental knowledge and teaching techniques. Environmental education for pre-service teachers needs to improve (Brandt et al., 2019) so that every participant has an essential understanding of environmental issues, such as the human factors of environmental protection, sustainable conservation, appreciation of the environment, ECE green curriculum and teaching aids design, etc. Outdoor nature education is an effective pedagogy in implementing EE, and as such, ecological fieldworks and nature visits would allow pre-service teachers to obtain first-hand experience in the natural environment. These practical experiences can raise their confidence in future teaching (Ma, 2019).

The complexity of EE has been emphasized in subject areas such as sustainability, ecology, and citizen responsibility (Walker et al., 2017). The content of environmental education no longer covers a single subject area. In order to deliver a holistic understanding of EE, environmental-related concepts and knowledge can be embedded in different fields of knowledge. Riley and White (2019) suggested that interdisciplinary environmental education should shift to transdisciplinary environmental education as we are currently in the Anthropocene. A transdisciplinary environmental education should include pedagogy that integrates different branches

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of subjects, such as philosophy, science, and the arts, to connect environment-related knowledge and apply it in teaching and learning practices (Riley & White, 2019). Transdisciplinary education is suggested as an effective practice of formal environmental education (Walker et al., 2017; Riley & White, 2019). Through the integration and transformation of knowledge, teachers can apply their learned theories to practices in a real-world context.

Because pre-service teachers usually do not have an in-depth understanding of environmental sustainability pedagogy (Evans et al., 2017), EE workshops can offer opportunities to apply pedagogy to practice. In addition to EE training workshops, participating in conferences can enrich pre-service teachers' environmental knowledge so that they can better understand the value of environmental sustainability (Walshe & Tait, 2019).

According to Kincheloe and Steinberg (1993), future EE training for pre-service teachers will focus more on post-formal thinking and transformative learning which is a type of high-level thinking that considers the relationship between objects or issues from different perspectives in an in-depth manner. In the EE aspect, post-formal thinking facilitates individuals' discovery of different levels of connectedness between the psyche and the ecosystem. As an example of transformative environmental education, in a conservation activity about Taiwan, while a group of children acquired some knowledge of environmental protection, community volunteers were inspired by the children's participation in the conservation activity (Chao, 2017). The adult

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volunteers were motivated to accept some new ideas related to environmental awareness that may affect their habit of environmental preservation.

In sum, in order to foster pre-service teachers' fundamental environmental knowledge, teaching skills, values, and confidence, different strategies or pedagogies should be applied (Ma, 2016; Brandt et al., 2019; Ma, 2019). Apart from formal environmental education for pre-service teachers, engaging in nature settings for outdoor nature education is one of the effective pedagogies in implementing EE. In the current Anthropocene, teacher training in environmental and sustainability education can be embedded in different branches of academic subjects. In the teaching and learning process, high-level pedagogical approaches are recommended to deepen teachers' sense of environmental sustainability. Post-formal thinking and transformative learning strategies can facilitate pre-service teachers' environmental knowledge and experiences, which can contribute to the practice of teaching EE to young children.

7.3 Limitations of the study and suggestions for future research

In the research process, both the web-based questionnaire survey and the focus group interviews were met with limitations in many aspects. In utilizing a web-based self-administrated survey to collect data, a high response rate could not be guaranteed. On the other hand, stratified random sampling was utilized to select candidates for the focus group interviews, and the respondents needed to fill in their student numbers for identification purposes. This non-anonymity aspect might have influenced the

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response rate. Another problem was that the follow-up invitations via WhatsApp were time-consuming and lacked effectiveness. There was also the difficulty of inviting candidates to participate in the interviews, especially candidates in the Low-performing stratum who had relatively less interest in EE and thus did not want to participate in a study on it. As the interviews were conducted during the beginning of a new semester of their part-time bachelor studies, the PPT needed to adapt their university lives, as well as the new starting point of their careers as preschool teachers. Therefore, the interviews had to be postponed for about two months after the main survey to wait for better timing.

Additionally, as the collected data was mainly based on the self-administrated questionnaire, the respondents participated on a voluntary basis, and there might have been bias in that the respondents with more positive attitudes about the environment would more willingly participate in the survey. Therefore, the survey results might have underrepresented the target population who participated in the survey (Cohen et al., 2011). In the qualitative phase of the study, although the focus group interviews suggested some generalization of the insights of the interviewees, misconceptions and biased findings were also drawn (Krueger & Casey, 2013). The interviewees had a tendency to be thoughtful and reflective, and they tried to guess an answer for every issue even though they were not familiar with them. In addition, the discussions among the interviewees was easily dominated by the active participants, and as a result, the collected data were more homogeneous in content (Krueger & Casey, 2013; Savin-Baden & Major, 2013). Thus, the researcher had to actively moderate the

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discussions to curb this behavior throughout the interviewing process.

To avoid bias in the interviews, the researcher worked to justify the collected data before consolidating them as results. Great care was applied in the interpretation of the quantitative findings and the qualitative results to enhance the validity and reliability of the study.

The study revealed a discrepancy between the environmental attitudes and pro-environmental behaviors of the PPT. This is worthy of more in-depth investigation to study this gap. Moreover, an ancillary outcome of this research was related to the use of a fully validated scale (i.e., the EAPPT Scale). Prior to any further validation of the EAPPT Scale, large-scale research should be conducted with both in-service and pre-service preschool teachers. Education is more focused on sustainable development; thus, the EAPPT Scale may be further modified in line with global trends to study how early childhood EE can contribute to sustainability in an innovative way.

The influential factors in the environmental attitudes and behaviors of the PPT were also examined in this research. It was found that the PPT had positive attitudes about the environment, but their behaviors did not reflect this. The five domains of EE, namely, education, alternative experiences, beliefs, social interactions, and action potential, in the EAPPT Scale explained the attitudes of the PPT in varying degrees. Through the triangulation process, the qualitative results mostly concurred with the quantitative findings that were validated by Rasch modeling. The findings were

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encouraging in that, overall, the PPT had a strong sense of environmental awareness. However, self-benefits and decision-making were major barriers to implementing pro-environmental behavior. Future research should focus on ways to break through these barriers.

Finally, it is suggested that Rasch modeling should substantially be implemented by both education and psychology researchers. Rasch modeling is both quantitative and qualitative in nature (Boone et al., 2014). Pinpointing the weakness of the theoretical-driven techniques of quantitative statistics, Rasch qualitative calculations rationalize the responses of the participants in a study. Human traits as psychometric variables can be measured via Rasch measurements. Statements in a measurement instrument (i.e., items) are used to assess individuals' ability, and, conversely, individuals' ability is applied to measure the assessing strength of the items. Under the same principles, empirical data from the respondents can be utilized to create a psychometric instrument (i.e., a rating scale), and, conversely, the instrument can be used to assess the empirical data descriptively and parametrically. In addition, Rasch modeling can be employed to summarize complicated statistical research data in simple graphic presentations. Hence, Rasch modeling can be used in further research in line with this study.

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APPENDICES

APPENDIX I: Survey-design Method for Quantitative Data Collection Types, Advantages, and Disadvantages and Limitations

"A **survey design** provides a quantitative description of trends, attitudes, and opinions of a population, or tests for associations among variables of a population, by studying a sample of population" (Creswell & Creswell, 2018, p. 147, bold added).

Data Collection Types	Options/Media	Advantages	Disadvantages and Limitations
Interview-administrated	- Personal interviews - Group administration - Telephone interviews - Internet "real-time" interviews	- More personal background data can be obtained. - Researcher can adjust the questions to pinpoint the participants' responses. - Unexpected information can be acquired. - Some respondents prefer face-to-face contact with interviewer. ***Via electronic modes*** - Researcher can approach different kinds of respondents easily. - Researcher can obtain data in a more flexible way with ease.	- Researcher must expend much effort to convert narrative data to numerical data. - Meetings may need to be convened at a specific time and designated place. - Interviewers need to be well-trained. - Researcher's participation and participants may lead to biased responses. - Human resource administration fee is high. ***Via electronic modes*** - Ethics issues in obtaining permission to use one's contact particulars. - License fees for commercial software and online service charges. - Quality of collected data is physically affected by the functionality of devices and technologies. - More commitment and motivation is needed due to the remoteness of respondents.

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Self-administrated: Questionnaires	- On-site physical document distribution - Physical mail (i.e., letters) - Email or communication software (e.g., WhatsApp, WeChat, etc.) - Online web sites (e.g., social media, bulletin boards, etc.)	- Existing validated and reliable evaluation tool can be adopted and applied. - Consistent questioning method for participants. - Numerical data can be obtained directly. ***Via on-site physical document:*** - Researcher can clarify the question wording so that respondents can respond precisely. ***Via physical mail (i.e., letters):*** - People from different geographic areas can be reached. ***Via electronic media:*** - Accessible population through the internet is huge. - In a web-based survey, the data is "real-time." Researcher can access the data bank at any time, and data accumulates over time. - Retrieved data comes in the form of a table, which is easily applied for analysis and nearly error-free. - Administration cost may be less than that of traditional paper-and-pen method. - Multimedia elements such as audio, video, images, and photographs can be utilized as evaluation tools.	- Participants must have the ability to understand the instructions and the survey statements. - Researcher needs to consider the motivation of participants responding to the survey. - License fee for the survey instrument is needed. - Follow-up invitations may be necessary based on response rate. ***Via physical documents:*** - Manual input of hand-written data is a time-consuming process. - Manual input may result in data errors. - Printing material fee and document handling fee are needed. ***Via electronic media:*** - Ethics issues in obtaining permission to use one's email address. - Researcher does not know exact personal background of participants. Hence, participants may lack representation (of the specified population). - License fees for commercial software and online service charges may be needed in implementing a web-based survey.

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APPENDIX II: Interview-design Method for Qualitative Data Collection Types, Advantages, and Disadvantages and Limitations

"In **qualitative interviews**, the researcher conducts face-to-face interviews with participants, telephone interviews, or engages in focus group interviews with six or eight interviewees in each group. These interviews involve unstructured and generally open-ended questions that are few in number and intended to elicit views and opinions from participants" (Creswell & Creswell, 2018, p. 187, bold added).

Data Collection Types	Options	Advantages	Disadvantages and Limitations
Human contact	***Individual interviews:*** - One-on-one	***Individual interviews:*** - Researcher can obtain information beyond observations. - Researcher can obtain one's psychological attributes through questions (e.g., attitudes, beliefs, perceptions, etc.). - Researcher can obtain more personal background information of participants. - Researcher dominates the method of conducting interviews (i.e., structured, semi-structured, or unstructured interviews).	***Individual interviews:*** - Data collection needs to be transcribed before data analysis. - Interviewer needs to be well trained. - Analysis and interpretation of results are strongly dependent on researcher's subjective point of view. - Researcher's participation and other participants may lead to biased responses. - Human resource administration fee is large.
	Focus group interviews: - Certain number of interviewees in each group	***Focus group interviews:*** - Stratified or randomly chosen participants to focus on exploring a certain issue or topic. - Interaction and discussion offer opportunities for researcher to study general trends or opinions of a population on a specified topic. - In group discussions,	***Focus group interviews:*** - Participants' opinions may lack depth and breadth compared with individual interviews. - Outcome of discussion may depend on the communication dynamics of the group. - Obtained data may be more difficult to interpret than data from individual interviews.

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		participants may alter each other's viewpoints to a more positive extent. - May be less expensive and less time-consuming than individual interviews.	
Media	***Via face-to-face***	***Via face-to-face:*** - Flexible questioning techniques can be applied. - Face-to-face contact may capture some unexpected information. - Some respondents feel comfortable with face-to-face contact.	***Via face-to-face:*** - Informational data needs to be collected in a designated place and at a specified time. - Researcher's participation and other participants may interfere with interviewee's responses or discussion.
	Via electronic devices: - Telephone (such as FaceTime) - Internet "real-time" (such as Skype, FaceTime, etc.)	***Via electronic devices:*** - People from different geographic areas can be reached at any time. - Some respondents feel more comfortable versus in-person contact. - Cost and time saving compared with in-person interviews.	***Via electronic devices:*** - Quality of collected data is physically affected by the functionality of devices and technologies. - More commitment and motivation is needed due to the remoteness of respondents.

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APPENDIX III: Statements in the EAPPT Scale

Items	Statements
U01R	Environmental education cannot help resolve environmental problems, only technology can do this.
U02	I believe that information is increasingly necessary to make people aware of the effects our actions have on the environment.
U03	I try to choose courses that deal with matters related to the environment because I feel that I do not know enough.
U04	In my opinion, the more people know about the natural environment, the greater they will have the attitude to protect the environment.
U05R	Environmental education activities are useful only for children.
U06	Facing current environmental problems, it is a priority to integrate environmental education in education institutions.
U07	Environmental education focuses on the development of skills, such as critical thinking, reflective decision-making, and participation.
U08	For environmental education to be as effective as possible, there should be a commitment from the entire education community.
U09	I believe that including environmental education in education institutions can help change the environmental behavior of the whole community.
U10	I think it is important that all teachers receive environmental training.
U11R	Teaching environmental education to preschool students is a waste of time.
U12	Education institutions should schedule more nature-outdoor activities because they help students understand the natural environment better.
U13	I like to participate in nature-outdoor activities because it is a good way for me to understand the environment in which I live.
U14	Nature-outdoor activities help me to be more in touch with nature.
U15	Nature-outdoor activities help increase people's awareness of environmental issues.
U16R	Nature-outdoor activities are a waste of time. The most important thing is classwork.
U17	I really like going on trips to the countryside, for example country parks or outermost islands.
U18R	I find it more interesting in a shopping mall than out in a country park.
U19R	I would rather spend my weekend in the city than in the countryside.
U20	I enjoy spending time in natural settings just for the sake of being out in nature.
U21R	I believe that environmental problems are exaggerated and that nature balances out over time.
U22R	The progress of a region should not be held up with the excuse of protecting some birds/animals.
U23R	Nowadays, the laws and government regulations and control result in very little contamination.
U24R	The benefits brought by consumer products are more important than the contamination caused by their production and use.
U25	We should try to conserve the earth's plants and animals, even though it is expensive to protect them.
U26R	The so-called "ecological crisis" facing humankind has been greatly exaggerated.
U27	If things continue on their present course, we will soon experience a major ecological disaster.
U28	Humans are severely abusing the environment.

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U29	The earth is like a spaceship, with very limited land space and resources.
U30R	The earth has plenty of natural resources if we know how to develop them.
U31	I often try to persuade others that protecting the environment is important.
U32R	I will never try to persuade others that environmental protection is important.
U33	Teachers' attitudes are a very important factor in environmental education.
U34	Government policies and related facilities encourage us to reduce and recycle waste.
U35	The government needs to conduct more environmental awareness programs to educate the public to live in a more environmentally sustainable way.
U36	The government has a responsibly to support schools in promoting environmental education to tackle climate change and to achieve a sustainable lifestyle.
U37	To minimize the impact of the usage of fossil fuels on the environment, the government needs to adopt policies that encourage the implementation of renewable or alternative energy, such as solar power, energy from waste, and wind energy.
U38	School mentor(s) have supported me in teaching or promoting environmental education.
U39	School principal(s) have supported me in activities concerning environmental issues.
U40	I have received sufficient support from my peers in the teaching or promoting of environmental education.
U41	Inspiration from my parents and family encourage my awareness of the quality of ecology and the environment.
U42	Mass media, such as the internet, television, and newspapers, affects my environmental attitude to a great extent.
U43	Mass media, such as the internet, television, and newspapers, is the main source of my environmental knowledge.
U44	I am willing to consume less and go without some comforts if it helps to protect the environment.
U45	When I buy a product, I consider the type of packaging and choose one that is recyclable.
U46R	Even though the development of housing and road building threatens endangered plants and species, I support the captioned idea.
U47R	I will tolerate the noise caused by transportation.
U48R	No matter how convenient public transportation is, I will choose to drive if I have a car.
U49	I will participate in and be a member of an environmental organization.
U50	I will participate in environmental activities actively.
U51	I will discuss environmental issues with others publicly.
U52R	Although my currently used products are not environmentally friendly in nature, I still prefer to buy them.

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APPENDIX IV: Qualitative Interview Questions

1. How do you define "environmental education"?
   1a. Please describe your overall comments regarding the implementation and priority of environmental education in Hong Kong?
   1b. Why is there/why is there not a need to integrate environmental education in the preschool curriculum?

2. What do you think constitutes an environmental education program or ecological activity?

3. Have you taken any course(s) related to environmental education before?
   3a. If so, please specify.
   3b. What have you learned from it/them?

4. What are some of the environmental or ecological activities that you have participated in this year?

5. What major outdoor activities have you taken part in?
   5a. How frequently do you conduct these types of activities?
   5b. What is your most preferred activity for entertainment?

6. Have you joined an environmental organization as a member?
   6a. If you have, please provide details.
   6b. If you have not, please explain why you have not in detail.

7. Why do/don't you think that natural field experience is one of the learning processes in environmental education?
   7a. How do outdoor (nature) activities benefit young children?
   7b. What difficulties have you experienced when integrating outdoor (nature) activities into the curriculum?
   7c. If anyone, who has supported you in teaching or promoting environmental education?

8. Do you think that the global ecological crises (such as climate change, natural resource depletion, species extinction, etc.) facing humankind have been overexaggerated?

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9. What is the biggest environmental problem facing Hong Kong?

10. Have you thought about how to protect the environment (i.e., environment awareness, such as waste reduction, low-carbon living, respect for living things and nature, etc.)?

11. What are your suggestions regarding how the Hong Kong Government can provide support or facilities to promote environmental awareness to the public (such as waste reduction and recycling and alternative energy utilization)?

12. Is there any further information that you would like to share that we have not covered?

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APPENDIX V: Parametric Analysis of the Items in the EAPPT Scale

Items	"1" %	"2" %	"3" %	"4" %	"5" %	Mode	Logit	Actual PTMA	Expected PTMA	Outfit MNSQ	Z-std	Model S.E.
U29	0.00	1.27	2.95	60.93	34.88	4	-1.47	0.44	0.32	0.84	-1.90	0.11
U11R	1.69	4.63	2.53	45.80	45.38	4	-1.45	0.43	0.32	1.83	7.30	0.11
U28	0.00	0.43	4.63	63.03	31.94	4	-1.38	0.48	0.32	0.73	-3.10	0.11
U37	0.00	1.27	5.47	65.97	27.32	4	-1.17	0.43	0.33	0.79	-2.30	0.11
U16R	0.43	3.37	5.47	58.41	32.36	4	-1.16	0.46	0.33	1.18	1.80	0.11
U33	0.43	0.85	4.21	72.27	22.27	4	-1.05	0.51	0.33	0.64	-4.10	0.11
U02	0.85	0.00	5.05	71.85	22.27	4	-1.04	0.39	0.33	0.79	-2.20	0.11
U08	0.00	0.85	5.89	71.43	21.85	4	-1.03	0.59	0.33	0.57	-5.00	0.11
U12	0.43	0.00	9.25	68.07	22.27	4	-0.95	0.43	0.34	0.78	-2.30	0.11
U35	0.00	0.43	6.73	73.95	18.91	4	-0.94	0.53	0.34	0.52	-5.70	0.11
U36	0.00	0.00	7.99	74.37	17.65	4	-0.90	0.55	0.34	0.49	-6.10	0.11
U14	0.00	1.69	5.47	76.06	16.81	4	-0.85	0.47	0.34	0.61	-4.40	0.11
U09	0.43	1.69	9.25	67.23	21.43	4	-0.84	0.58	0.34	0.77	-2.30	0.11
U32R	0.00	2.11	14.71	57.57	25.64	4	-0.82	0.53	0.34	0.98	-0.20	0.11
U04	0.00	2.95	7.57	71.85	17.65	4	-0.75	0.45	0.34	0.78	-2.20	0.11
U27	0.00	2.11	13.45	64.71	19.75	4	-0.69	0.58	0.35	0.76	-2.40	0.10
U20	0.43	1.69	13.03	65.55	19.33	4	-0.68	0.55	0.35	0.83	-1.60	0.10
U15	0.00	2.95	8.83	75.64	12.61	4	-0.59	0.51	0.35	0.62	-4.10	0.10
U10	0.43	1.69	18.91	58.83	20.17	4	-0.55	0.50	0.35	0.97	-0.20	0.10
U06	0.00	1.69	13.87	71.01	13.45	4	-0.54	0.58	0.35	0.58	-4.70	0.10
U43	0.00	2.95	10.93	76.06	10.09	4	-0.47	0.25	0.35	0.79	-2.10	0.10
U42	0.00	3.37	18.07	63.03	15.55	4	-0.41	0.39	0.36	00.95	-0.40	0.10
U21R	1.69	10.93	6.73	61.35	19.33	4	-0.29	0.34	0.36	1.72	5.70	0.10
U13	0.43	2.95	21.85	62.19	12.61	4	-0.24	0.55	0.36	.81	-1.90	0.10
U01R	0.00	10.51	8.83	69.33	11.35	4	-0.20	0.32	0.36	1.20	1.80	0.10
U25	0.00	6.73	20.17	58.41	14.71	4	-0.19	0.43	0.36	1.11	1.00	0.10
U40	0.85	1.69	27.74	60.51	9.25	4	-0.07	0.44	0.37	0.82	-1.80	0.09

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U17	0.43	9.25	22.27	52.53	15.55	4	-0.02	0.51	0.37	1.16	1.60	0.09
U07	0.00	1.69	35.30	54.63	8.41	4	0.06	0.29	0.38	0.87	-1.30	0.09
U46R	0.43	5.89	37.40	37.82	18.49	4	0.09	0.33	0.38	1.34	3.10	0.09
U24R	0.43	11.35	22.27	55.89	10.09	4	0.17	0.40	0.38	1.16	1.60	0.09
U05R	3.37	12.19	15.13	59.67	9.67	4	0.25	0.31	0.38	1.58	5.10	0.09
U38	2.11	8.41	30.26	50.85	8.41	4	0.34	0.46	0.39	1.07	0.80	0.09
U22R	1.27	12.19	26.48	51.69	8.41	4	0.36	0.48	0.39	1.06	0.60	0.09
U48R	3.79	13.03	31.94	30.26	21.01	3	0.40	0.23	0.39	2.07	8.90	0.09
U34	1.27	11.35	25.22	59.25	2.95	4	0.41	0.08	0.39	1.39	3.70	0.09
U19R	1.69	12.19	29.00	49.16	7.99	4	0.44	0.53	0.39	1.00	0.00	0.09
U31	0.43	10.51	35.72	47.48	5.89	4	0.47	0.38	0.39	0.95	-0.60	0.09
U41	1.27	11.35	40.34	39.50	7.57	3	0.60	0.27	0.40	1.30	3.10	0.08
U26R	2.95	19.75	22.69	44.12	10.51	4	0.62	0.29	0.40	1.76	7.00	0.08
U52R	1.69	7.99	47.90	38.24	4.21	3	0.69	0.16	0.41	1.08	0.90	0.08
U39	1.69	6.31	57.57	29.00	5.47	3	0.77	0.35	0.41	0.87	-1.50	0.08
U23R	0.43	25.64	28.58	38.66	6.73	4	0.84	0.09	0.41	1.66	6.50	0.08
U44	0.85	10.93	57.57	28.58	2.11	3	0.93	0.28	0.42	0.75	-3.20	0.08
U18R	2.11	24.37	33.20	34.04	6.31	4	0.96	0.51	0.42	1.05	0.60	0.08
U47R	5.05	22.27	38.24	22.27	12.19	3	1.02	0.20	0.42	1.79	7.80	0.08
U03	1.69	22.27	60.51	14.71	0.85	3	1.38	0.27	0.43	0.77	-3.10	0.08
U51	4.21	37.40	47.48	10.09	0.85	3	1.74	0.49	0.44	0.65	-4.90	0.08
U50	3.37	38.66	48.74	8.41	0.85	3	1.76	0.44	0.44	0.67	-4.60	0.08
U30R	8.83	47.90	19.75	21.01	2.53	2	1.83	0.06	0.45	1.78	7.70	0.08
U45	11.77	34.88	42.02	10.93	0.43	3	1.93	0.22	0.45	1.18	2.10	0.08
U49	22.27	50.85	23.95	2.11	0.85	2	2.67	0.40	0.44	0.93	-0.80	0.09

Note: The rating scale response options are denoted as follows:

Positively written statements:

SD = 1 – Strongly Disagree; D = 2 – Disagree; N = 3 – Neutral; A = 4 – Agree; and SA = 5 – Strongly Agree.

Negatively written statements, reverse coding:

SD = 5 – Strongly Disagree; D = 4 – Disagree; N = 3 – Neutral; A = 2 – Agree; and SA = 5 – Strongly Agree.

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APPENDIX VI: Optimized Version of the EAPPT Scale

Items	Statements
Education	
U02	I believe that information is increasingly necessary to make people aware of the effects our actions have on the environment.
U03	I try to choose courses that deal with matters related to the environment because I feel that I do not know enough.
U04	In my opinion, the more people know about the natural environment, the greater they will have the attitude to protect the environment.
U05R	Environmental education activities are useful only for children.
U07	Environmental education focuses on the development of skills, such as critical thinking, reflective decision-making, and participation.
U09	I believe that including environmental education in education institutions can help change the environmental behavior of the whole community.
U10	I think it is important that all teachers receive environmental training.
U11R	Teaching environmental education to preschool students is a waste of time.
Alternative Experiences	
U12	Education institutions should schedule more nature-outdoor activities because they help students understand the natural environment better.
U13	I like to participate in nature-outdoor activities because it is a good way for me to understand the environment in which I live.
U15	Nature-outdoor activities help to increase people's awareness of environmental issues.
U16R	Nature-outdoor activities are a waste of time. The most important thing is classwork.
U18R	I find it more interesting in a shopping mall than out in a country park.
U19R	I would rather spend my weekend in the city than in the countryside.
U20	I enjoy spending time in natural settings just for the sake of being out in nature.

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Beliefs	
U21R	I believe that environmental problems are exaggerated and that nature balances out over time.
U22R	The progress of a region should not be held up with the excuse of protecting some birds/animals.
U23R	Nowadays, the laws and government regulations and control result in very little contamination.
U25	We should try to conserve the earth's plants and animals, even though it is expensive to protect them.
U27	If things continue on their present course, we will soon experience a major ecological disaster.
U28	Humans are severely abusing the environment.
U29	The earth is like a spaceship, with very limited land space and resources.
U30R	The earth has plenty of natural resources if we know how to develop them.
Social Interaction	
U31	I often try to persuade others that protecting the environment is important.
U32R	I will never try to persuade others that environmental protection is important.
U33	Teachers' attitudes are a very important factor in environmental education.
U34	Government policies and related facilities encourage us to reduce and recycle waste.
U37	To minimize the impact of the usage of fossil fuels on the environment, the government needs to adopt policies encouraging the implementation of renewable or alternative energy, such as solar power, energy from waste, and wind energy.
U38	School mentor(s) have supported me in teaching or promoting environmental education.
U39	School principal(s) have supported me in activities concerning environmental issues.

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U40	I have received sufficient support from my peers in the teaching or promoting of environmental education.
U41	Inspiration from my parents and family encourage my awareness of the quality of ecology and the environment.
U42	Mass media, such as the internet, television, and newspapers, affects my environmental attitudes to a great extent.
U43	Mass media, such as the internet, television, and newspapers, is the main source of my environmental knowledge.
Action Potential	
U44	I am willing to consume less and go without some comforts if it helps to protect the environment.
U46R	Even though the development of housing and road building threatens endangered plants and species, I support the captioned idea.
U47R	I will tolerate the noise caused by transportation.
U49	I will participate in and be a member of an environmental organization.
U50	I will participate in environmental activities actively.
U51	I will discuss environmental issues with others publicly.

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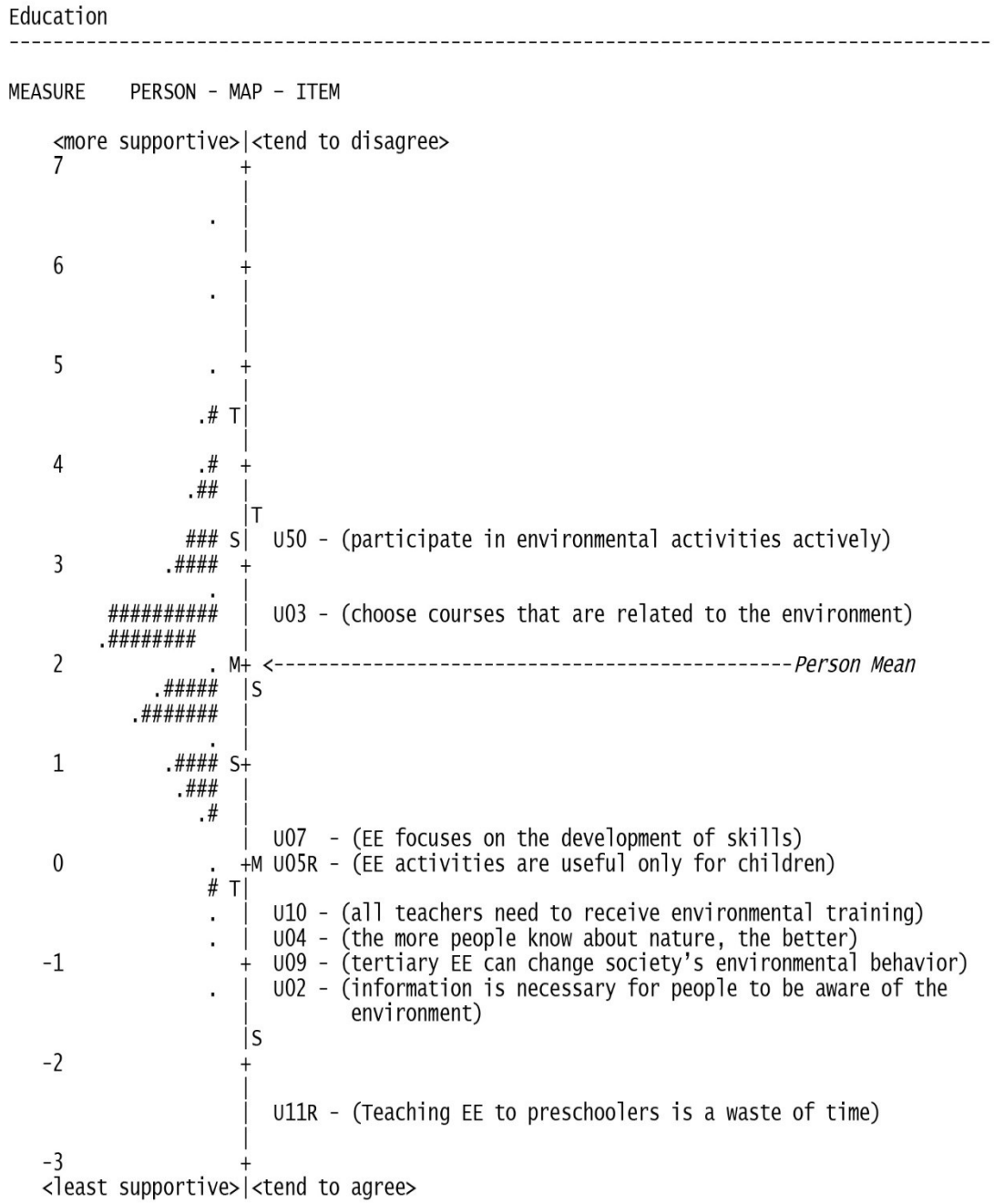
APPENDIX VII: Wright Maps of the Subscales of the EAPPT Scale



Note: For illustration purposes only; all of the statements were shortened. For the original statements, please refer to Appendix III.

Figure 5.2 Wright Map of the education subscale

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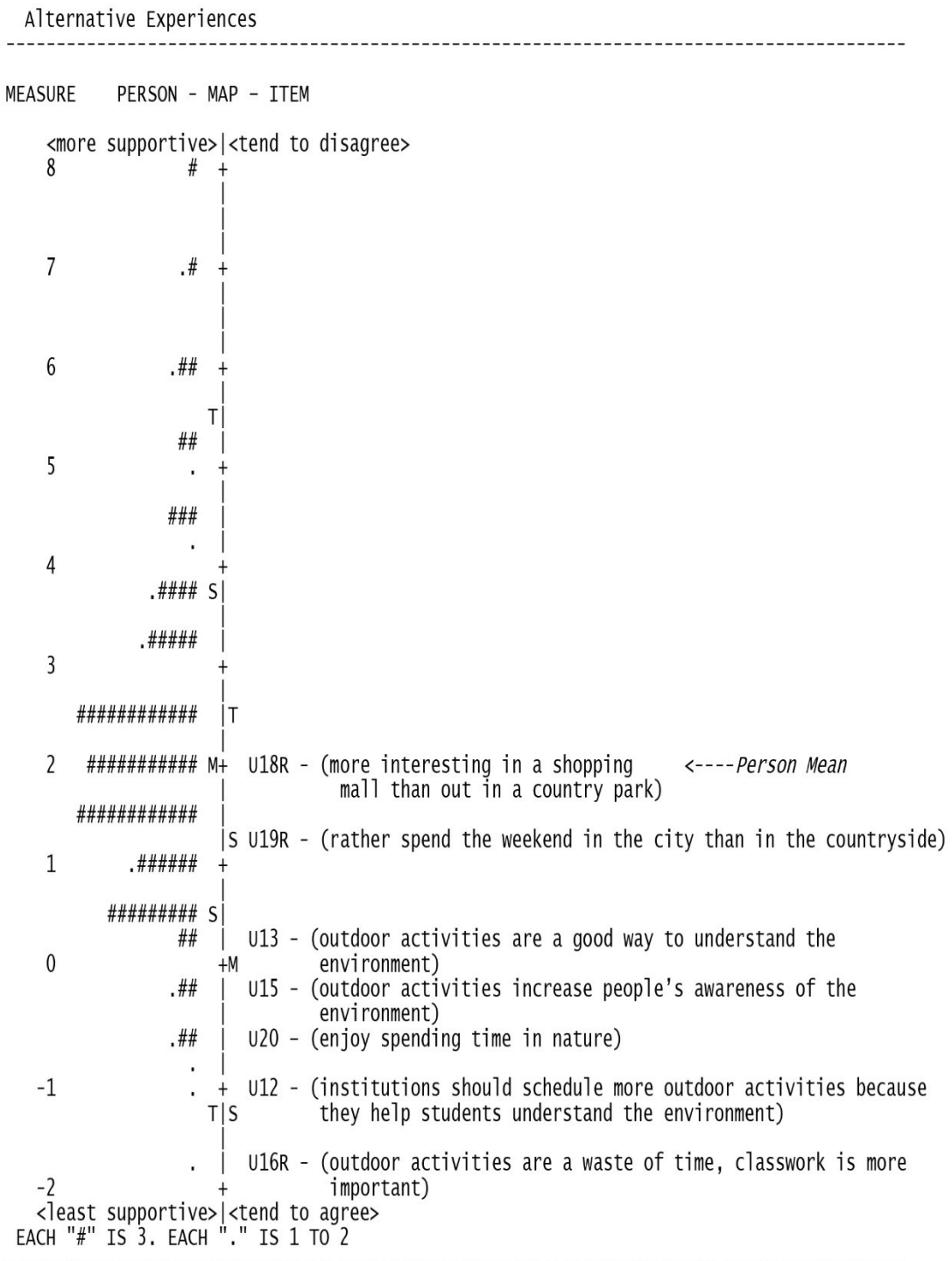

Note: For illustration purposes only; all of the statements were shortened. For the original statements, please refer to Appendix III.

Figure 5.3 Wright Map of the alternative experiences subscale

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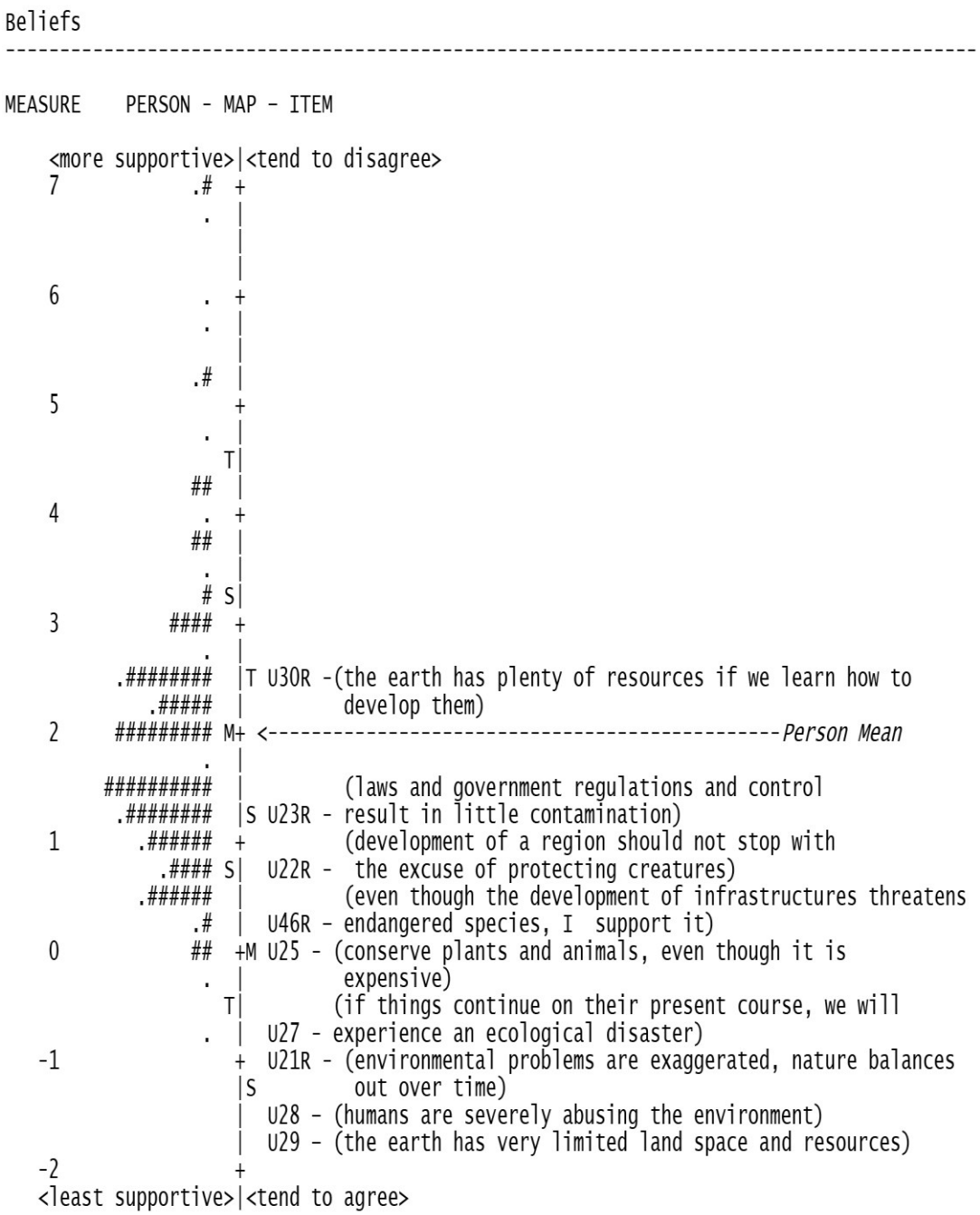

Note: For illustration purposes only; all of the statements were shortened. For the original statements, please refer to Appendix III.

Figure 5.4 Wright Map of the beliefs subscale

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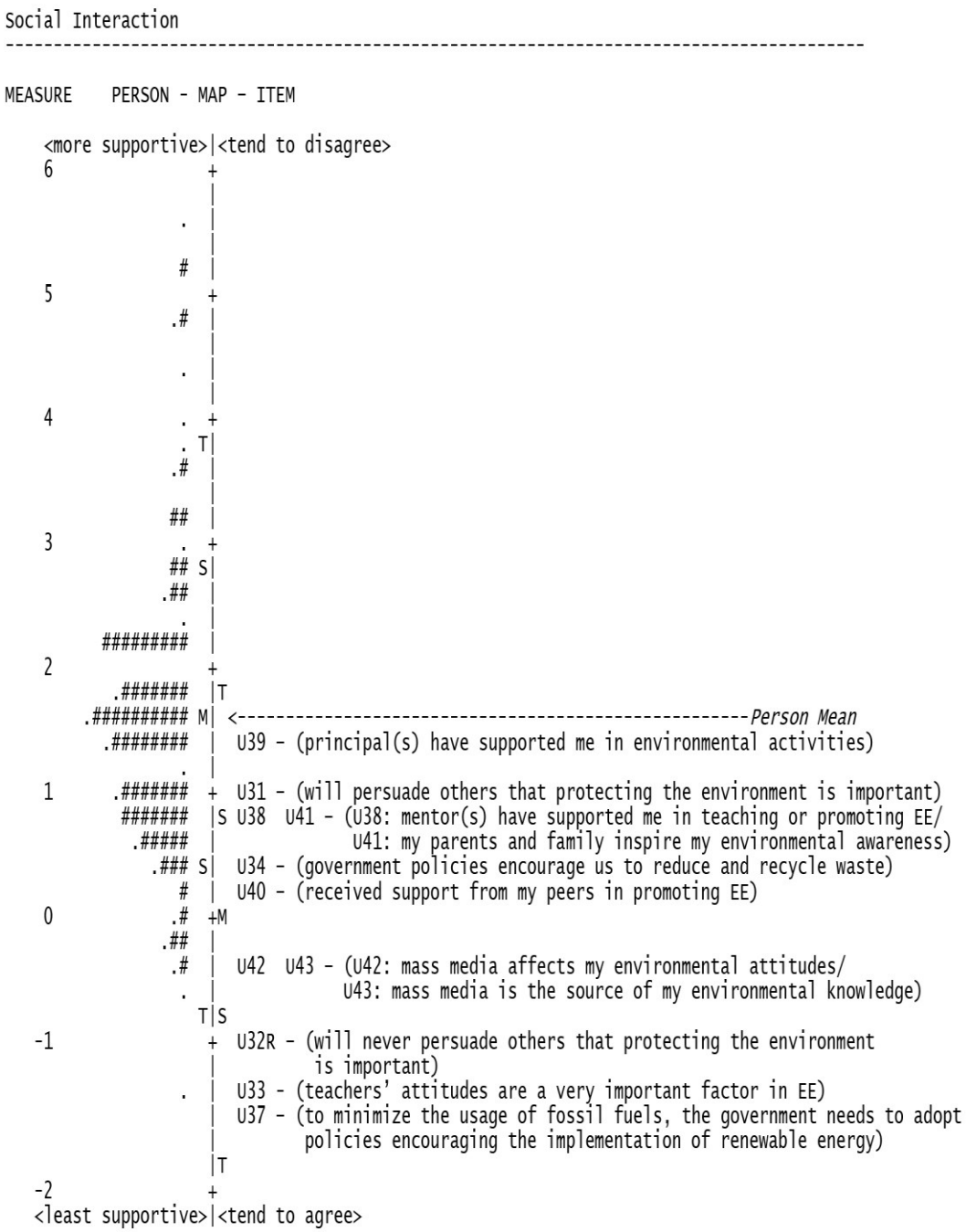

Note: For illustration purposes only; all of the statements were shortened. For the original statements, please refer to Appendix III.

Figure 5.5 Wright Map of the social interactions subscale

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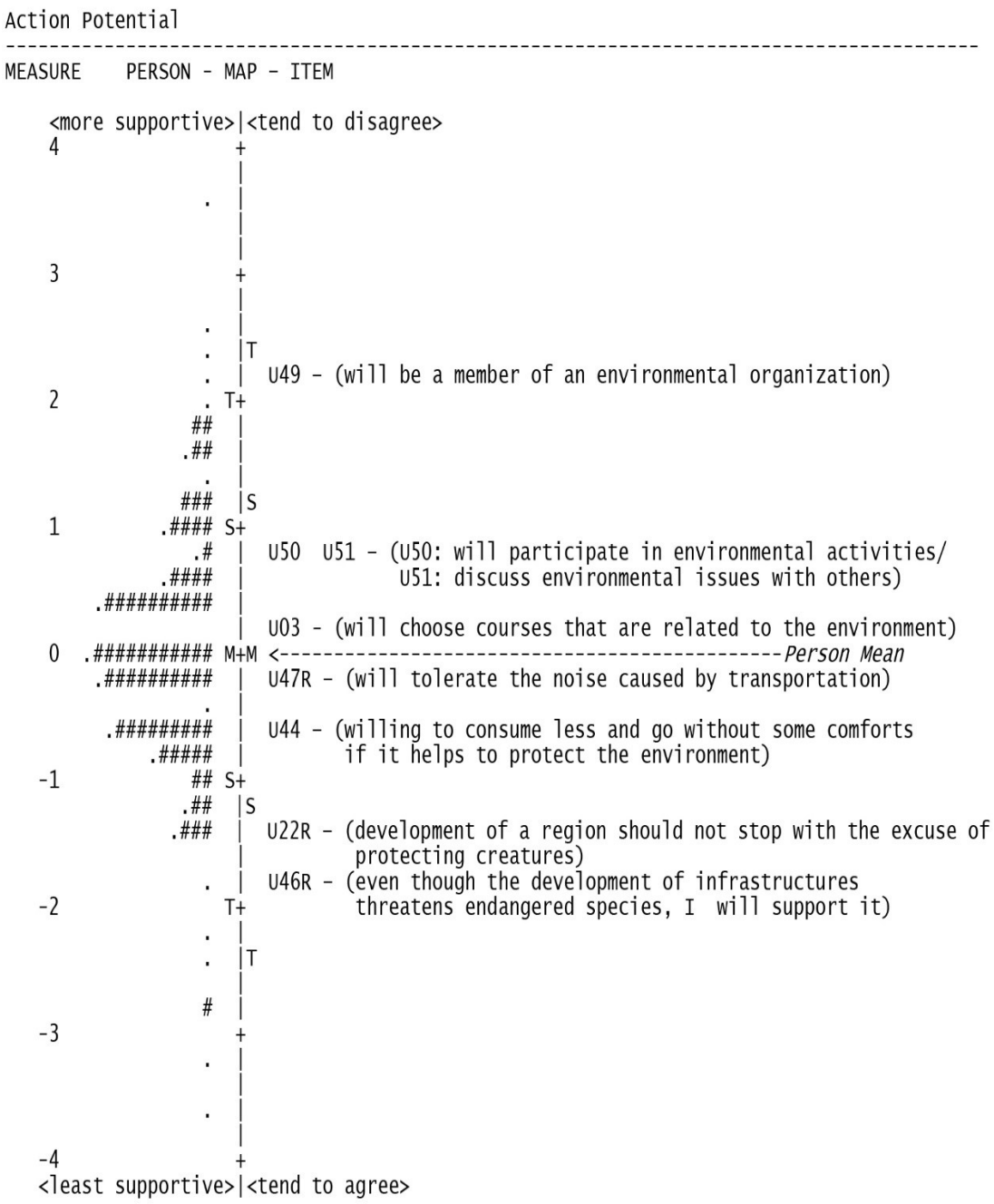

Note: For illustration purposes only; all of the statements were shortened. For the original statements, please refer to Appendix III.

Figure 5.6 Wright Map of the action potential subscale

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APPENDIX VIII: Empirical Data and Evidence of the Focus Group

Code	Empirical Data/Evidence
LCA,1	*Environmental education is about how to use the limited resources of the earth. Children learn the relation of nature and humans…or use recycled materials in art to reduce resources….*
LME, 1	*Environmental education can be divided into two processes. First, we need to understand the conditions of the environment…find out the problems…second, then solve them.*
MKA, 1	*I think the natural environment is abused by humans. We need to find ways to stop deteriorating ecology.*
MCY, 1	*...some resources cannot be produced by humans. Resources belong to nature. If we use up all the resources, then we will lose them forever.*
MMY, 1(i)	*...I believe that everything originates from nature, and young children can acquire environmental knowledge through their experiences of interacting with nature.*
MMY, 1(ii)	*...we need to stop the global crisis by searching for solutions…to slow down the deterioration….*
HAN, 1	*...nature and humans have a close relation with one another and cannot be separated....*
LCA, 1a	*... the education system is not concerned about it [environmental education]…[it] was in the liberal study subject in my secondary school….*
LMT, 1a	*...even though Hong Kong has 'Three-colored Separation Bins,' actually, all rubbish will go to the landfill….*
MCY, 1a	*Many people are selfish, are not concerned about the environment….*
MKA, 1a(i)	[Similar viewpoint as MKA, 2]
MKA, 1a(ii)	*I agree that the government is not doing [environmental education] properly…. The government usually conducts a 'using less plastic' activity, but it produces more wastage….*
MMY, 1a(i)	*...I had not learned any environmental knowledge in my primary school, but a Community Recycling Promotion Vehicle visited once….*
MMY, 1a(ii)	*...I utilized recycled materials to make gifts for my students…but I forgot to explain the reason for using the recycled materials to the young children.*
HAN, 1a(i)	*...it would be more effective if any environmental education started with young children…it can be their habit.*
HAN, 1a(ii)	*We [human beings] live in the same 'Global Village.' We need harmonious coexistence between nature and humans….*

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HAN, 1a(iii)	*I do waste separation at home, but I discovered that all the sorted wastage had been transported to the landfill later…. I do not believe in the government because the government will put all rubbish into the landfill.*
HVI, 1a(i)	*I bring a bag, bottle, and do not overconsume….*
HVI, 1a(ii)	*Geography in secondary school included pollution, global warming.*
HYE, 1a(i)	*…there is little environmental information in primary and secondary schools.*
HYE, 1a(ii)	*In the HD [High Diploma]…environmental education may be in science and maths [Scientific and Mathematical Explorations for Young Children].*
LCA, 1b	*…environmental education can be a topic in preschool…for example, using recycled materials for artwork….*
MCY, 1b	*…there are only a few EE contents in the liberal study [subject].*
HVI, 1b	[Similar viewpoint as MMY, 1(i)]
LCA, 2	*…when people do not use resources properly…it will cause environmental pollution…the habitat of all living things will be quickly deteriorated.*
LME, 2	[Similar viewpoint as MCY, 2]
MCY, 2	*…facilitating children's experiences is a comparatively effective pedagogy than just utilizing books, videos, or mass media as teaching materials for environmental education.*
MKA, 2	*I believe that environmental education has to start in kindergarten because we learn everything from kindergarten …they are the future owners of the earth….*
LME, 3	*I had not taken any environmental courses…. I took the High Diploma…in science [Scientific and Mathematical Explorations for Young Children], there was a topic about animals and plants, which is natural science…that relates with environmental education….*
MMY, 3	*I have not taken any environmental courses….*
HVI, 3	*…There was only a three-hour lecture in the 'Promoting Children's Emotional & Social Well-being' course of the HDECE, including some environmental knowledge, which was not sufficient…. I am not able to explain sophisticated theories in a simpler way to children….*
LCA, 3a	*'Management and sustainability'…the lecture provided some suggestions, such as environmental preservation concepts that can be implemented in preschool…use recycled materials to make artwork.*
MCY, 3a	*The liberal study [subject] in secondary school had only a topic about pollution, world resources, and global warming….*
LMT, 3a(i)	*…I joined the 'mountain craft' course…the content of the course included how people interact with nature….*

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LMT, 3a(ii)	*...in the lecture [Visual Arts], I discovered materials in the natural environment and created artwork, which was a new experience.*
HAN, 3a(i)	*I grew up in the countryside, so I have 'complex' enthusiastic feelings about the environment. I am always aware of my surroundings and information about environmental education.*
HAN, 3a(ii)	*'Management and sustainability' has little information about environmental education.*
HVI, 3a	[Similar viewpoint as HVI, 1a(ii)]
LMT, 3b	*...my tutor in mountain crafts was a pro-environmental person.*
MCY, 3b(i)	*'Promoting well-being'...needs to have two lectures [6 hours].*
MCY, 3b(ii)	*....lecturers have taught me a topic about 'Well Being'...the lecturer had discussed with us how to promote environmental education in preschool.....*
MKA, 3b(i)	*I haven't taken any environmental courses.*
MKA, 3b(ii)	*During my art lessons, we were taught to apply recycled plastic materials and useless paper to create some installation artwork. That was a new concept for me because I had not tried it before.*
HAN, 3b	*In the VA [Visual Arts Education in ECE] course...the lecturer arranged for the student teachers to visit the Fung Yuen Butterfly Reserve, and we worked on some 'Installation Art' artworks...a good experience about how to learn from nature and interact with nature...how to implement this nature experience in my teaching.*
LMT, 4	*Do mountain craft [courses] include [environmental education]?*
MCY, 4	*I went to Lung Mei Shore...to investigate how its biodiversity was affected by the changing environment....*
MKA, 4	*I know that there was some information [about environmental activities] at EdUHK...but I did not pay any attention to it.*
HAN, 4(i)	*If time is available, I will engage in ecological nature activities because I think this is the place [Earth] where we live. We all have a responsibility to protect the environment.*
HAN, 4(ii)	*I watch television for information about the environment....*
HVI, 4(i)	*...I am not keen to participate in any ecological activities, but I initiate collecting rubbish in the natural environment sometimes. I invite my best friends to work together collecting Styrofoam at the beach....*
HVI, 4(ii)	*...I know [about environmental organizations]...but I do not contact them.*
HYE, 4	*...Last year in the practicum period, I went [had permission to go] with young children to the Jockey Club Museum of Climate.*

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LCA, 5	*I like reading…I do not have any preferred outdoor activity.*
LMT, 5	*… 'mountain craft' activities….*
HVI, 5	*…[going] to the beach…jogging….*
HYE, 5	*I will go hiking and play football.*
MCY, 5a	*I have an outing every week or twice a week depending on the weather.*
LME, 5b	*I love to go shopping and play board games in my leisure time.*
MKA, 5b	*…I am lazy to go out. I like to stay at home in my leisure time. I go hiking once per few months.*
MMY, 5b	*I love to play mobile games in my leisure time.*
LMT, 6a	*Is 'Breakthrough' an environmental organization [it is not an environmental organization]?*
LCA, 6b	*…I am usually not aware of 'environmental preservation'…thus, I do not attend any related activities… and, I have no intention to join any environmental organization,*
LME, 6b	*…I do not understand the work of the organization…Because…I am usually not aware of 'environmental preservation'…. Thus, I have no intention to join any environmental organization.*
LMT, 6b(i)	*…I am interested in voluntary work regarding 'refugees.'*
MCY, 6b	*…the school does not provide any information about ecological activities and environmental organizations.…I don't know how to find the information.*
MKA, 6b	*…I have no determination to do [an environmental activity] because my environmental attitude is weak. It seems that it is none of my business.*
MMY, 6b	*I do not understand the organization so I am not interested….*
HAN, 6b	*…I am concerned about the time [spent]…because I need to take care of my family…maybe…when my child gets older.*
HVI, 6b	*…I am not interested in participating in any community activities….*
HYE, 6b	*I do not understand…'I haven't heard the name'….*
MCY, 7	*Visiting nature is good because children can be in touch with the elements of nature…and then protect the earth….*
MKA, 7	*…when people know more about nature, they will develop a good relationship…they will value and protect the environment.*
MKA, 7a	*…I integrated ideas about the conservation of endangered animals in the 'animal' project….*

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HAN, 7a	[Similar viewpoint as MMY, 1(i)]
LME, 7b	*... the teacher training program…does not include any environmental courses about how to integrate it [environmental information] in the teaching theme…the themes were not exactly related with environmental education, such as 'transportation,' 'fruits'…. Now I think…I can integrate some elements [of environmental knowledge] in the themes, for example, do not waste food [in the 'fruit' theme]…. At that moment, I didn't think of that [integrating environmental knowledge].*
MCY, 7b	*...I taught 'Water – Natural Resource of the Earth.' I played a 'water rationing' game with the young children. The mentor assisted me in helping the children fill water in their own bottles. The children needed to make use of their bottled water to wash their hands after they used the toilet…. The activity was suggested by my mentor.*
LCA, 7c	*Before teaching the 'planting activity,' she [my mentor] explained how to use the planting tools. During my teaching practice, she stood beside me….*
HAN, 7c(i)	*The principal is the person in charge of the school…. She has to plan and implement school policy…. My practicum school had 'Environmental Week.' The young children learned a lot of environmental knowledge through the activities…. If the principal is concerned about this [environmental education], she will plan a series of activities….*
HAN, 7c(ii)	*I used toilet paper tubes as teaching material for children to create their only artwork… I had just explained them applying recycled materials briefly.*
HVI, 7c(i)	*...If the teacher teaches environmental education, he/she needs to be educated in environmental education and act as a pro-environmental person….*
HVI, 7c(ii)	*...he/she needs to be educated in environmental education and act as a pro-environmental person…thus, environmental education is important at preschool, primary, secondary, and university levels.*
HVI, 7c(iii)	*Actually, my [environmental] concepts were from the lecturer [practicum supervisor] of the university. Some concepts came from daily experiences. To be honest…sometimes I am not [a pro-environmental person]. If children ask me [environmental] questions, I don't know how to answer them. Thus, if we care about the effectiveness of implementing environmental education, every teacher must be a pro-environmental person and be well educated in environmental knowledge. Therefore, I think environmental education is very important in preschool, primary school, secondary school, and university.*
HVI, 7c(iv)	*During my practicum, tertiary lecturers, the principal, and mentors supported me and gave me much concrete advice on teaching topics related to environmental issues. I think that no matter university students or preschoolers, knowing how to implement environmental protection is very important.*
LCA, 7c	[Similar experiences as HYE, 7c]
LMT, 7c	[Similar experiences as HYE, 7c]
MCY, 7c	[Similar experiences as HYE, 7c]

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HAN, 7c	[Similar experiences as HYE, 7c]
HYE, 7c	*My mentors facilitated me and advised me in my teaching practice.*
LCA, 8	[Similar viewpoint as HYE, 8]
LME, 8	[Similar viewpoint as HYE, 8]
LMT, 8	*…deforestation of the Amazon Forest…from Facebook…someone shared the information….*
MCY, 8	[Similar viewpoint as HYE, 8]
MKA, 8	[Similar viewpoint as HYE, 8]
MMY, 8	*I think it [the global crisis] may be exaggerated, but it is not far…because we can see the effects of global warming nowadays, glaciers melt gradually…penguins lose their habitat….*
HAN, 8	[Similar viewpoint as HYE, 8]
HVI, 8 (i)	*I think human beings need to rethink our overconsumption habits….*
HVI, 8 (ii)	*I have two viewpoints concerning these issues. First, humans can apply technology to solve natural resource problems, such as the utilization of solar, hydraulic, or wind power for generating electricity…. Second, resource depletion and species extinction are both natural ecological phenomena that may not be caused by human activities.*
HYE, 8	*…ecological catastrophes are a severe global problem, which includes animal extinction…as shown in the news. It is because humans have overconsumed the forest and abused the environment.*
LCA, 9	*[The most serious environmental problem in Hong Kong is the] overconsumption of useless stuff…. People always buy too many things, such as clothes, which they may not need, and then waste is caused.*
LME, 11	*I think education is more important than government policies. Policies need to work hand in hand with education. If people do not have solid environmental knowledge, they cannot understand the government's policies, such as the 'Waste Charging Scheme.' Most people are just concerned about the money spent caused by this scheme. Thus, the effect of education may be more important than the government's policies.*
LMT, 11	*… Actually, there should be an elective course [on environmental education]….*
MKA, 11	*I think environmental education needs to be included in secondary school, primary school, and preschool. Students can explore the concepts of how to make good use of resources and how to protect the environment….*
MCY, 11	*…government policies need to work hand in hand with education. If people have not been well informed about environmental knowledge, they cannot understand the government's policies….*

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MMY, 11	*…the government should arouse public awareness of environmental policies via mass media propaganda….*
HAN, 11	*I know nothing about the government's policies…only solar power….*
HVI, 11	*Many people are against the 'Waste Charging Scheme.'… The government needs to stress environmental education….*
LME, 12	*…when I buy a product, I am not concerned about whether the packaging is recyclable.*
MMY, 12(i)	*…education can change people's beliefs and enhance their behaviors*
MMY, 12(ii)	*…the government needs to provide more resources to promote pre-service preschool teachers' knowledge concerning environmental preservation….*
MMY, 12a	*Pre-service preschool teachers lack environmental knowledge….*

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APPENDIX IX: Ethics approval for the study

香港教育大學
The Education University of Hong Kong

13 June 2018

Ms NGAN So Fong
Doctor of Education Programme
Graduate School

Dear Ms Ngan,

Application for Ethical Review <Ref. no. 2017-2018-0400>

I am pleased to inform you that approval has been given by the Human Research Ethics Committee (HREC) for your research project:

Project title: The Environmental Attitude of Pre-service Preschool Teachers in Hong Kong

Ethical approval is granted for the project period from 1 July 2018 to 31 December 2019. If a project extension is applied for lasting more than 3 months, HREC should be contacted with information regarding the nature of and the reason for the extension. If any substantial changes have been made to the project, a new HREC application will be required.

Please note that you are responsible for informing the HREC in advance of any proposed substantive changes to the research proposal or procedures which may affect the validity of this ethical approval. You will receive separate notification should a fresh approval be required.

Thank you for your kind attention and we wish you well with your research.

Yours sincerely,

Patsy Chung (Ms)
Secretary
Human Research Ethics Committee

c.c. Prof CHOU Kee Lee, Chairperson, Human Research Ethics Committee

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