A Study on the Teachers' Professional Knowledge and Competence in Environmental Education

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ABSTRACT

The rapid development of technology and economy has largely enhanced the quality of life. Nevertheless, various social and environmental problems have emerged. It would be the key solution to develop environmental education in order to have people present the environmental knowledge and the attitudes and value to concern about the environment and develop the skills and action to solve environmental problems. Environmental education teachers in 25 colleges and universities in central and southern Taiwan are researched in this study. Total 250 copies of questionnaires are distributed, and 224 valid copies are retrieved. The research results conclude the significant positive correlations 1.between professional development and professional knowledge & competence, 2.between teacher belief and professional knowledge & competence, and 3.between teaching efficacy and professional knowledge & competence. According to the research result, suggestions are eventually proposed in this study. It expects to arouse the public cognition of environment to care for the environment through curriculum instruction of environmental education teachers and have people present the environmental knowledge and the attitudes and value to concern about environment.

Keywords: environmental education, professional knowledge and competence, teacher belief, professional development, teaching efficacy

INTRODUCTION

The quality of life is largely enhanced because of the rapid development of technology and economy. Nonetheless, various social and environmental problems have emerged; rubbish battles are everywhere in urban and rural areas, and air pollution, noise pollution as well as cadmium rice caused by polluted water are heard from time to time. Forest estrepement and overbuilding destroy the water and soil so that a lot of human life and families are taken away

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State of the literature

- Various social and environmental problems have emerged; rubbish battles are everywhere in urban and rural areas, and air pollution, noise pollution as well as cadmium rice caused by polluted water are heard from time to time.
- The development of environmental education could have people present the environmental knowledge and the attitudes and value to concern about the environment and develop the skills and action to solve environmental problems.
- It expects to arouse the public cognition of environment to care for the environment through curriculum instruction of environmental education teachers and have people present the environmental knowledge and the attitudes and value to concern about environment.

Contribution of this paper to the literature

- Enhancing the interaction with communities to commonly develop the partnership could acquire required resources as well as help promote environmental education to communities.
- Teachers have to constantly expand the knowledge field to cope with the trend and develop the maximum effect of the environment curriculum teaching.
- Teachers would largely promote the environmental education professional knowledge and competence by actively participating in environmental protection affairs, accumulating practical experiences, and constantly developing oneself with studies.

once there is typhoon attack (Tsai, Tseng, Tzeng, Wu & Day, 2012). Such bloody facts might be the warning to the environment in each major social event. The research and development of various prevention technologies and engineering might provide temporary solutions. The past experiences indicated that the improvement of environmental problems relied on technology and law. People are gradually awakening from constant pollution events, worsening environmental quality, and constant species extinction and discovering that technology and law are just the afterward remedy. More active practice is to prevent in advance, i.e. to arouse the public cognition of environment and concern about the environment. Such goals are achieved through education and promotion that including environmental education into the formal education system is a primary issue. Merely the development of environmental education could have people present the environmental knowledge and the attitudes and value to concern about the environment and develop the skills and action to solve environmental problems. It is considered as the fundamental solution.

The practice of curriculum teaching present major effects on students, and teachers' behaviors and attitudes would be learnt and imitated by students (Cviko, McKenney & Voogt, 2014; Wu & Tai, 2016). For this reason, it would be difficult for teachers, who are lack of academic background or training, properly delivering environment related lessons to students. Besides, the objective, principle, and method of environmental education are different from traditional curricula that inexperienced teachers can hardly practice environmental education. When teachers cannot present positive environment attitudes and

behaviors to correspond to the practice of curriculum teaching, the profound environmental literacy would be questioned. Consequently, environmental education teachers, as the research subjects, are the key to promote environmental education.

LITERATURE REVIEW

Environmental education

Bartos et al. (2014) indicated that environmental education aimed to have the public be aware of environmental problems, understand and concern about the relationship between resources and living environment, and further become the practitioners to maintain ecological equilibrium and environmental quality in order to achieve the sustainable use of resources and have the generation enjoy safe and healthy living environment. Dolnicar (2013) explained it as protecting the public and improving the environment-related ethics, knowledge, attitudes, skills, and value through the education process as well as devoting to natural ecological conservation and reasonable management of environmental resources with humanistic ideas and scientific methods to guarantee the sustainable development of human society. Hill (2013) promoted to cherish resources so that people admired the nature and practice the life style of saving energy, treasuring fortune, appreciating objects, and reducing wastes. Chelonis et al. (2011) also indicated that the development of environmental literacy was the ultimate objective of environmental education in different levels of education, i.e. having each person perceive and appreciate natural environment and artificial environment, present the knowledge of natural systems and ecological concepts, understand current environmental issues, and even make responsible decisions for the environment by survey, critical thinking, writing, and communication abilities, as well as develop the behavior to balance the quality of life and the environmental quality and solve environmental problems. Jurik et al. (2014) argued that teachers were the key characters in people presenting environmental literacy, and the professional knowledge and competence of environmental education would affect the effectiveness of environmental education. In this case, teacher training is regarded as a critical work in the environmental education promotion process.

Professional knowledge and competence

Burns & Bell (2011) also mentioned that a competent environmental education teacher could apply the knowledge, behaviors, and skills required for practicing environmental education and effectively practice and assist students in reaching the objective of environmental education. In "Environmental education teacher training strategies" made by Wilke, Peyton & Hungerford (1987) for International Environmental Education Program of United Nations, environmental education teachers should present the following competence.

(1) Core competence

Clarke et al. (2014) explained it as being able to apply educational philosophy knowledge, theory of moral reasoning, knowledge/attitudes/behavior relationship theory, learning theory, and learning transfer theory to select, develop, practice, and evaluate

curricula and teaching methods & materials in order to effectively achieve the objective of environmental education.

(2) Content competence

Level 1: Fundamentals of ecology. Being able to apply the knowledge of ecology to analyze environmental problems, predict the result of the environmental problem solutions, and present ecological literacy to investigate, discover, and evaluate problem solutions, as well as apply the main ideas of ecology to teaching curricula (Glomo-Narzoles, 2013). Level 2: Concept cognition. Being able to select, develop, and practice curricula so that students realize the effects of cultural activity and personal behaviors on the environment, different levels of environmental problems, solutions, and value clarification for environment decision-making and responsible civil action practice (Hossain & Tarmizi, 2013). Level 3: Survey research and evaluation. Being able to study environmental problems and evaluate alternative solutions and to develop, select, and practice teaching materials and methods so that students develop the same competence. Level 4: Environmental action skills. Environmental education teachers should take active attitudes to achieve or maintain the dynamic balance between the quality of life and the environmental quality as well as develop, select, or practice teaching methods and materials so that students could present the same competence to take personal and group action at proper time (Kose et al., 2011).

Teacher belief

Kotler (2012) considered that belief was individual statement about some people, affairs, and objects being true, which was constructed through the experiences, regardless whether the person perceived the belief. Belief was the reference with which people explained the real world and could reveal personal action tendency. Butler & Walton (2013) analyzed belief from the viewpoints of philosophy, psychology, and socioculture. From the aspect of philosophy, belief was a mental state and individual feeling or inference about affairs, in which believing in something being true and presenting the attitudes of agreement were hidden. From the aspect of psychology, belief was regarded as a psychological thinking model and the system of representation which an individual used for explaining external phenomena and taking actions. From sociocultural points of view, belief was the persistent attitudes, value, and ideology of an individual under the effect of sociocultural environment. Gurland & Glowacky (2011) pointed out teaching belief as the psychological tendency of teachers considering the belief about themselves, students, teaching interaction, and teaching materials being true. Akalin & Sucuoglu (2015) defined teacher belief as teachers' viewpoint of believing the teaching work, teacher role, curricula, students, and learning in the teaching situation and history being true, and the content would be affected by the connection between teachers' practical teaching experiences and life experiences to further guide the teachers' thinking and behaviors. "Education belief" studied by Lee & Shen (2013) actually focused on teachers' "teaching belief"; therefore, "education belief" and "teaching belief" could be regarded as the same. Debra & Michael (2012) argued that "teacher belief" should contain "education" and

"instruction"; "education belief" was a macro idea, including education, student, educational activity, curricula, and school role, while "teaching belief" was a relatively micro idea, referring to teachers' inner thoughts about subjects, teaching materials, instruction, learning, students, and themselves in the teaching process.

Collie, Shapka, Perry & Martin (2016) pointed out cognition content, affection content, and behavior content as the dimensions of teacher belief. Cognition content referred to belief as the result of person cognition, standing for different degrees of an individual believing or ensuring distinct affairs; affection content referred to the subjective, intuitive, and irrational characteristics of belief; and, behavior content referred to belief being transferred into specific behavior in proper situations. Such dimensions are applied to this study.

Professional development

Canrinus et al. (2012) explained that teachers actively participated in various formal or informal learning activities in the teaching career to promote the professional knowledge, skills, attitudes, and self-reflection abilities, enhance personal self-actualization, improve the education quality of schools, and achieve the professional history of teachers. Hair et al. (2011) stated the major purpose of teacher professional development as perceiving the needs to enhance the professional abilities of knowledge, affection, and skills, actively enhancing personal progress on "new education knowledge and belief", "teaching skills and attitudes", "interpersonal relationship and communication", and "administrative knowledge and competence" by participating in formal or informal learning activities to achieve the final goal of professional development. Aloe et al. (2014) indicated it as to effectively enhance the professional knowledge, skills, attitudes, and self-reflection abilities, promote the teaching skills and quality, actively and continuously participate in various activities to enhance the professional ability in the teaching career as well as achieve the teacher development in the interactive situation and the professional history of self-actualization. Del Guercio (2011) regarded teacher as professional work that teachers could present adequate general knowledge, professional knowledge & competence and professionalism by continuously and actively involving in activities and actions to enhance the development in the teaching career and to achieve personal professional development and positive development of the organization through constant learning and exploration to further serve the society. Jo & Bednarz (2014) discussed teacher professional development from four dimensions.

(1) Development objective: Teacher professional development could enhance teachers' teaching knowledge and competence to further promote the teaching quality and students' learning outcome as well as achieve teachers' personal self-development and self-actualization.

(2) Development method: Teacher professional development contained formal and informal learning activity covering any activities to promote the professional knowledge & competence and enhance teachers' professional ability.

(3) Development content: Teacher professional development included professional knowledge, professional skills, professional attitudes, and professionalism, such as teaching skills, new education knowledge, interpersonal communication, administrative knowledge and competence, curriculum design, classroom management, and student counseling, that the explicit behavior and the implicit affection could be changed and developed.

(4) Development history: Teacher professional development was a constant history and a dynamic process. Teachers, in the teaching career, actively and continuously enhanced the ability and applied to the teaching activity to promote the teaching quality (Lewicka, 2011).

Teaching efficacy

DeWaters & Powers (2013) indicated that teachers should have high teaching efficacy, master in cultivating the teacher-student relationship as a teacher and a friend, but did not go beyond the education ethics, encourage peers for cooperative learning, encourage students active learning, provide students with constructive feedback, give students high evaluation, and stress on individual difference of students. Aziz & Zainol (2011) considered that teachers' teaching performance would create a brand-new mastery experience, which would provide teachers with new information and feedback and influence the future teaching efficacy. Lee (2011) concluded that teachers' teaching performance would have them perceive the emotion, instruction, or participation in teacher professional workshop. After the cognition process and self-evaluation and analysis, teachers, when perceiving good teaching efficacy, would constantly make efforts and insistence on better teaching performance. On the contrary, they might be gradually disappointed about teaching and even gave up the efforts and insistence on teaching to result in worsening teaching performance. Chang (2011) pointed out three dimensions included in teachers' teaching efficacy. 1. Personal efficacy referred to a teacher perceiving himself/herself being able to become an efficient teacher. 2. Teaching efficacy referred to a teacher's instruction would affect students' learning belief. 3. Personal teaching efficacy, as the integration of above two, referred to a teacher regarding the effective teaching being able to promote students' learning (Hamre et al., 2012).

Professional development and professional knowledge & competence

Under contemporary education reform policies, teachers face various system situations and diverse role expectations (Radovan, 2011). It is essential for teachers constantly learning, accepting new knowledge, improving the teaching, and enhancing education professional knowledge & competence (Glomo-Narzoles, 2013). It is important to promote teachers' literacy and further enhance the professional knowledge and competence through "teacher professional development activity" (Kose et al., 2011). Smith et al. (2013) proposed the importance of teacher professional development, including enhancing teachers' constant learning and development, having teachers cope with changes, assisting teachers in solving teaching dilemma, promoting teacher professional knowledge & competence and the status,

and developing the diversity of teacher roles. Canrinus et al. (2012) mentioned the reasons for teacher professional development that (1) teachers had to proceed professional development to conform to the lifelong learning trend, (2) teachers had to promote the professional knowledge and competence through professional development to clarify the fuzzy professional image, and (3) teachers, because of the diverse and multiple teacher roles, had to face changeable environment and challenge through professional development. The following hypothesis is therefore proposed in this study.

H1: Professional development shows significantly positive correlations with professional knowledge and competence.

Teacher belief and professional knowledge and competence

DeWaters & Powers (2013) pointed out the factors in teacher belief, containing past learning experiences, professional background, personality traits, teaching environment, teaching seniority, social background, school administration, family factors, teacher role, and peers. Ramkissoon et al. (2013) also indicated that teachers' teaching belief were affected by teachers' personality traits, schooling experiences, professional knowledge and competence, personal belief, educational philosophy, teaching experiences, students' learning outcome, parent characteristics, pressure of curriculum schedule, school administration, campus culture, credentialism, and educational policies. Collie et al. (2016) discovered that teacher belief would influence teachers' thinking, judgment, and decision as well as the teaching philosophy, experience interpretation, and personal teaching professional knowledge & competence. To further understand teachers' professional knowledge and competence, various possible factors in teacher belief could be discussed. Wynveen et al. (2012) argued that most teachers had personal interpretation of teacher role before making the decision to become teachers. In other words, teachers' teaching belief was formed before entering teaching training institutions (Hossain & Tarmizi, 2013). The following hypothesis is therefore proposed in this study.

H2: Teacher belief reveals remarkably positive correlations with professional knowledge and competence.

Teaching efficacy and professional knowledge and competence

Teachers' teaching experiences, competence, professional teacher curriculum training, lifelong learning, perception of self-development, and the diverse background of learners would stimulate teachers' teaching and professional development. Lee & Shen (2013) considered that a good teacher had to present good professional knowledge and competence, be able to deal with and explain learners' problems beyond class learning, provide relevant data conforming to students for further learning, reinforce teaching on more difficult learning, and timely offer students with positive feedback so as to effectively improve and enhance personal teaching efficacy. Moreover, professional knowledge and competence was related to teachers' teaching efficacy. Schmitt (2011) revealed that teachers paid attention not only to the

study on professional subjects, but most importantly, to personal lifelong learning. For example, the acquisition of other relevant knowledge, learning from senior teachers, and the promotion of educational professional knowledge & competence were the keys to enhance personal professional development and teaching efficacy. From the summary of above research, presenting teaching professional knowledge and competence is a key to promote teaching efficacy. The following hypothesis is further proposed in this study.

H3: Teaching efficacy presents notably positive correlations with professional knowledge and competence.

SAMPLE AND MEASURE

Research sample and subject

In this study, environmental education teachers in 25 colleges and universities in central and southern Taiwan are selected as the research subjects. Total 500 copies of questionnaire are distributed, and 224 valid copies are retrieved. Most research subjects (169) are male, about 75.4%; the average age is 35.7; the average teaching seniority is 14.5 years; and, the average hours teaching environmental education per week is 7.2 per person.

Reliability and validity test

The questions in the questionnaire are referred to domestic and international researchers and have been proceeded the pretest and validity test before distributing the formal copy that the questionnaire presents certain content validity. Furthermore, the causal relationship amount professional knowledge & competence, teacher belief, professional development, and teaching efficacy is analyzed with Linear Structural Relations Model, where the data input is based on the correlation coefficient matrix of observed variables. The Linear Structural Relations Model analysis results reveal the overall model fit reaching the rational range that it shows favorable convergent validity and predictive validity.

Item-to-total correlation coefficients are utilized in this study for testing the construct validity, i.e. Reliability Analysis. The calculated item-to-total correlation coefficients are used for judging the questionnaire content. The item-to-total correlation coefficients in this study are higher than 0.4, revealing certain construct validity of the questionnaire. To further understand the reliability and validity of the questionnaire, the Cronbach's α of the formal questionnaire appears in 0.75-0.88, conforming to the reliability range.

ANALYSIS OF EMPRICAL RESULT

LISREL (linear structural relation) model combines Factor Analysis in traditional statistics and Path Analysis and includes simultaneous equations in econometrics that it could calculate multi-factor, multi-casual path. The evaluation of model fit should be done from preliminary fit criteria, overall model fit, and fit of internal structure of model. The data are organized in **Table 1**, and the explanations are summarized as below.

Table 1. Analysis of the entire linear structural relation model

Evaluation item	Parameter/evaluation criteria		Result	t
Preliminary fit	Professional knowledge and competence	Core competence	0.751	8.63**
		Content competence	0.764	7.56**
	Professional development	Development objective	0.698	7.42**
		Development method	0.677	8.91**
		Development content	0.683	9.58**
		Development history	0.694	7.83**
	Teacher belief	Cognition content	0.801	10.16**
		Affection content	0.822	10.67**
		Behavior content	0.817	10.34**
	Teaching efficacy	Personal efficacy	0.833	12.74**
		Teaching efficacy	0.845	13.28**
		Personal teaching efficacy	0.829	11.96**
Internal fit	professional development→professional knowledge and competence		0.863	22.45**
	teacher belief→professional knowledge and competence		0.882	23.46**
	professional knowledge and competence→teaching efficacy		0.906	25.71**
Overall fit	X2/Df		1.633	
	GFI		0.957	
	AGFI		0.916	
	RMR		0.003	

Regarding preliminary fit, the explanation of professional knowledge and competence (core competence and content competence) achieves the significance (t > 1.96, p < 0.05), professional development (development objective, development method, development content, and development history) shows significant explanations (t > 1.96, p < 0.05); teacher belief (cognition content, affection content, and behavior content) presents remarkable explanations (t > 1.96, p < 0.05); and, teaching efficacy (personal efficacy, teaching efficacy, and personal teaching efficacy) reveals notable explanations (t > 1.96, p < 0.05). Apparently, the entire model presents favorable preliminary fit criteria. In regard to overall model fit, the overall model fit standards appear χ2/Df 1.633 and RMR 0.003, revealing that χ2/DF and RMR are proper. Moreover, the overall model fit standards show GFI 0.957 and AGFI 0.916 that the model present better fit criteria.

In terms of internal fit, professional development reveals positive and remarkable correlations with professional knowledge and competence (β= .382, P< .001), teacher belief appears positive and notable correlations with professional knowledge and competence (β=
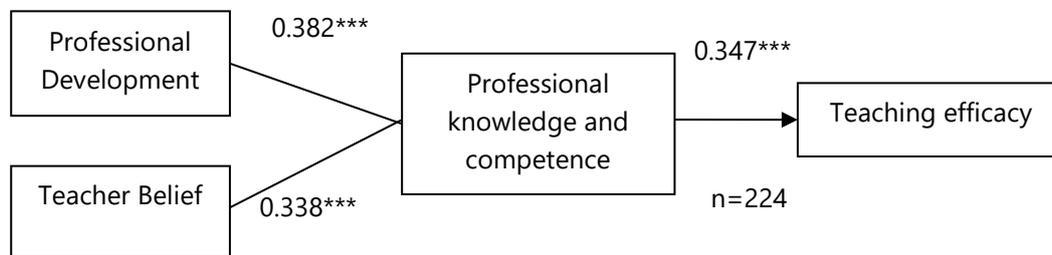
Figure 1. Path Analysis

.338, P< .001), and professional knowledge and competence shows positive and signification correlations with teaching efficacy (β= .347, P< .001) that H1, 2, and 3 are supported, **Figure 1**.

CONCLUSION

The research results reveal the positive and remarkable effects of professional knowledge and competence on professional development and teacher belief. Apparently, the professional knowledge and competence of environmental education teachers could be enhanced by promoting the environment related experiences, offering opportunities for actual perception, participation, and performance, and providing opportunities for further study. The most powerful teaching support is the primary route for teachers presenting successful environmental education teaching. Besides, constantly increasing the experiences in environmental protection practice and study would directly or indirectly, through the promotion of environmental literacy, enhance the curriculum teaching effectiveness and cultivate the environmental literacy. The environmental protection practice could be enhanced through network, which is not restricted to time and space. The convenience of network allows environmental education teachers proceeding professional development that it is a time and energy saving good method. Moreover, online learning or distant teaching for relevant studies allows environmental education teachers learning with the spare time. What is more, newsletters could regularly provide environmental education teachers with relevant professional skills and knowledge and introduce environmental education related regulations with case studies to promote environmental education teachers' interests and intention to understand more.

RECOMMENDATION

From the research results and findings, practical suggestions are further proposed in this study.

I.   Enhance interaction with communities to establish partnership and acquire required resources

Teaching situation is a major factor in environmental education teachers' curriculum teaching in colleges, and the interaction with communities in the environmental education

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teaching situation is important. For this reason, enhancing the interaction with communities to commonly develop the partnership could acquire required resources as well as help promote environmental education to communities.

II.   Expand teachers' knowledge field

Environmental education is a technology integrated subject. The emergence of Sustainable Development has expanded the levels of environmental education. In this case, teachers have to constantly expand the knowledge field to cope with the trend and develop the maximum effect of the environment curriculum teaching.

III.   Enhance practical experiences in environmental protection and professional development

Environmental protection related experiences and environmental education learning experiences are the primary factors in environmental education teachers' environmental literacy and curriculum teaching. As a result, teachers would largely promote the environmental education professional knowledge and competence by actively participating in environmental protection affairs, accumulating practical experiences, and constantly developing oneself with studies.

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