DEVELOPMENT AND VALIDATION OF THE TAIWAN CHILDREN'S ENVIRONMENTAL ACTION INDEX

Chiung-FenYen
Department of Ecological Humanities,
Providence University, Taichung, Taiwan
Chia-Ling Chiang
Department of Curriculum Design and Human Potentials Development,
National Dong Hwa University, Hualien, Taiwan
Li-Hua Hou
Tsung-Wei Yao
Chiu-Ju Su
Department of Ecological Humanities,
Providence University, Taichung, Taiwan
Joel J. Mintzes
Department of Science Education, California State University, Chico USA

Abstract

In this study, we use Smith-Sebasto & Fortner's (1994) *Environmental Action Internal Control Index (EAICI)* as a framework to develop, and validate a useful instrument for assessing environmental attitudes and behavior among elementary and middle school children within the Taiwanese context. We dub the new instrument the *Taiwan Children's Environmental Action Index (TCEAI).* Our findings suggest that the *TCEAI* displays substantial internal consistency (Cronbach's alpha=.92), moderately positive correlations with self-report measures of environmentally responsible behavior ($R = .35$ to $.46$, $p < .01$), and few threats to validity by age or gender. The results suggest that the *TCEAI* may be used to elicit important dimensions of environmental attitudes and to predict environmentally responsible behavior for elementary and middle school children in Taiwan. Practical implications are discussed.

Keywords: Environmental Education, Environmental Action, Internal Locus of Control, Environmentally Responsible Behavior

Introduction

One of the principal objectives of environmental education (EE) is to encourage and support environmentally responsible behavior (ERB) (Sia, Hungerford & Tomera, 1985). In keeping with this broad-based goal, our research group has focused its efforts on creating, validating and assessing instructional materials for use at the elementary and middle school levels that address significant environmental issues in the Taiwanese context. Given the strong relationship between ERB and locus of control (LoC) (Hwang, Kim & Jeng, 2000), we have worked concurrently on the development of a suitable assessment instrument that addresses environmental locus of control for use among Taiwanese children in grades five to nine.

Our assessment efforts are modeled after the work of Smith-Sebasto & Fortner (1994) whose *Environmental Action Internal Control Index (EAICI)* was developed and validated for use with university students in the United States. As with other such instruments, the range of items and construct validity of the *EAICI* are culturally-embedded, and its appropriateness for use in the Taiwanese context is open to question. Accordingly we focused on adapting the instrument for use in our own context and for students in the compulsory elementary through middle school age range.

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Subjects of the current study were students attending elementary school, grades five [n=65] and seven [n=80], and middle school, grade nine [n=71] in Taichung (including Taichung City, Taichung County and Chang-Hua County), central Taiwan, ROC, and third year students [n=165] enrolled in a general ecology course at Providence University in Taichung. A summary of the development and validation process is given in Figure 1.

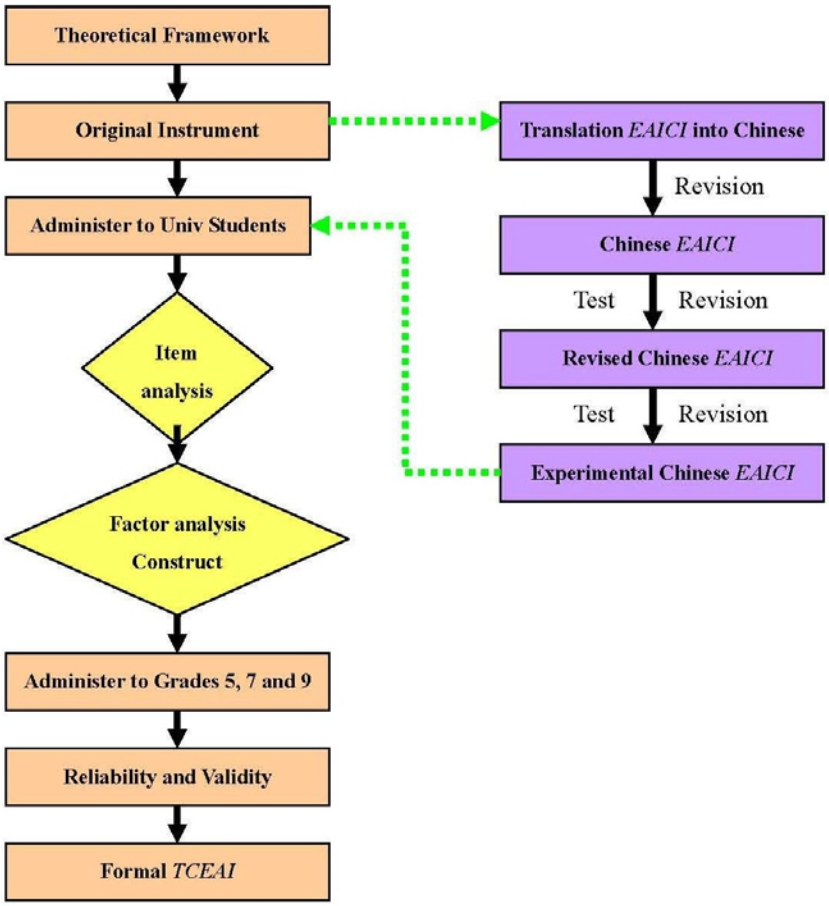

Figure 1. Development of the *TCEAI*

Smith-Sebasto & Fortner's (1994) instrument (the *Environmental Action Internal Control Index*) was translated directly into Mandarin Chinese (*Chinese EAICI*). Initially, several minor modifications in wording were made to accommodate differences found in Chinese language and Taiwanese culture. The modified instrument was field tested for comprehension and readability among a small group of university students (*Revised Chinese EAICI*). Subsequently, the revised instrument was further modified for use among a wider range of subjects including elementary and middle school children (*Experimental Chinese EAICI*). The modifications involved extensive discussions and field tests involving elementary and middle school teachers, graduate students, instructors, and an external visiting scholar in environmental education. An attempt was made to insure that the modified instrument conformed to the reading level of children in grades five to seven, and that all items addressed relevant and significant environmental issues in

the Taiwanese context. The *Experimental Chinese EAICI* was then administered to third year students (n=165) enrolled in a general ecology course for non-majors at Providence University.

Responses to the experimental instrument were factor analyzed (SPSS 12.0) generating a principal component solution with Varimax rotation and Kaiser normalization. Only those factors possessing an eigenvalue of two or greater were retained, and those having factor loadings >.50 were interpreted. The remaining twenty items were randomized and nine items comprising a translated version of Smith-Sebasto and Fortner's *ERBI* were addended in order to assay self-reported frequencies of environmentally responsible behavior. This instrument (*TCEAI*) and its addendum were administered to a convenience sample of students in grades five, seven and nine.

In this section we report the results of studies that explore the following characteristics of the *TCEAI*: (1) construct validity by factor analysis; (2) internal consistency by Cronbach's alpha; (3) predictive validity by correlation with *ERBI* scores, and (4) threats to validity by age and gender.

Construct Validity

Results of the factor analysis are given in Table 1. Following the deletion of items with low factor loadings (ie. <.50), 20 items were retained in the formal instrument. The items loaded on four factors which were named *Conservation* (6 items), *Enforcement* (6 items), *Persuasion* (4 items), and *Recycling* (4 items). Normalized means and standard deviations for the four factors are given in Table 2.

Table 1. Rotated Factor Matrix (*TCEAI*)

Items	Factors			
	Ⅰ	Ⅱ	Ⅲ	Ⅳ
Ⅰ: Conservation				
1. Buy conservation products, such as reprocessed paper	**.635**	**.190**	**0.081**	**0.332**
	.611	**.228**	**0.074**	**0.180**
5. Persuade someone to conserve water by not running the water while brushing their teeth and fit up low-flow stools.	**.573**	**.233**	**0.248**	**0.115**
9. Persuade parents to set their household appliances to energy-saver levels, such as refrigerators, washing machines and air conditioners.	**.569**	**.145**	**0.045**	**0.069**
13. Open windows for ventilation rather than using a fan or air conditioner.	**.553**	**0.287**	**0.162**	**0.103**
17. Persuade parents to choose environmental label products, such as low-flow commode.	**.551**	**0.208**	**0.461**	**0.067**
19. Persuade someone to set consumer electrics to energy-saver levels, such as refrigerators, washing machines and air conditioners.				
Ⅱ: Enforcement				

2. Report someone who violates our natural resources, such as illegal fishing, hunting.	**0.261**	**.778**	**0.155**	**0.127**
6. Report someone who has air polluting behaviors to the newspaper, such as burning trash.	**0.214**	**.720**	**0.254**	**0.188**
10. Persuade someone to report someone who violates our natural resources, such as illegal fishing, tree cutting.	**0.278**	**.641**	**0.367**	**0.159**
18. Report someone who has noise polluting behaviors to the local environmental organization, such as the noise of funeral affairs and Karaoke	**0.221**	**.615**	**0.132**	**0.027**
14. Report someone who tampers with the anti-pollution devices on a car to the proper authorities.	**0.054**	**.613**	**0.298**	**0.174**
20. Report someone who steals sandstone to the police.	**0.133**	**.588**	**0.264**	**0.294**
Ⅲ: Persuasion				
3. Persuade someone to sign a petition regarding an environmental issue.	**0.096**	**0.254**	**.717**	**0.046**
11. Persuade someone to care about politicians implementing their environmental polices.	**0.028**	**0.199**	**.643**	**0.283**
15. Get involved in activities of stop building nuclear power stations, such marching and signing.	**0.124**	**0.194**	**.563**	**-0.005**
7. Persuade someone to reuse envelops.	**0.372**	**0.177**	**.548**	**0.196**
Ⅳ: Recycling				
4. Recycle my bicycle's old tires.	**0.086**	**0.111**	**0.149**	**.749**
8. Recycle the kitchen waste.	**0.176**	**0.206**	**0.099**	**.668**
12. Persuade someone to recycle old tires.	**0.117**	**0.029**	**0.432**	**.615**
16. Reduce the amount of my household trash by reusing and recycling items to the fullest extent possible.	**0.489**	**0.297**	**-0.054**	**.524**

Items comprising the *Conservation* subscale appear to cluster around issues of reducing the amount of waste products, water, and energy used in daily living. These include buying products made of reprocessed paper; persuading individuals to be careful in the use of running water, and setting appliances and consumer electronic devices to energy-saving levels. The *Enforcement* subscale is comprised of items that describe reporting violations of statutes designed to protect the environment. In the *Persuasion* subscale are questions that ask about encouraging political engagement or activist causes, and the *Recycling* subscale queries subjects on reusing tires, kitchen wastes and household trash.

Table 2. Scores on *TCEAI* (Means, Standard Deviations, and Ranges)

item	n	mean	Standard deviation	Idea score range
Ⅰ: Conservation	206	82.51	15.13	20~100
Ⅱ: Enforcement	206	78.38	15.87	20~100
Ⅲ: Persuasion	206	67.35	15.03	20~100
Ⅳ: Recycling	206	79.32	15.70	20~100
Total *TCEAI*	206	307.56	53.24	80~400

Internal Consistency

A summary of Cronbach's alpha coefficients for the total instrument and for each of the subscales and is given in Table 3. The estimates are: .92 (total); .81 (Conservation); .79 (Enforcement); .65 (Persuasion), and .75 (Recycling).

Table 3. Estimates of Cronbach's Alpha

Item	Reliability
Ⅰ: Conservation	0.813
Ⅱ: Enforcement	0.793
Ⅲ: Persuasion	0.653
Ⅳ: Recycling	0.758
Total	0.921

Predictive Validity

In order to estimate the extent to which factor scores on the *TCEAI* predict environmentally responsible behavior, a series of correlations with scores on the *ERBI* were performed (Table 4). Of 36 Pearson product moment correlations, 27 (or 75%) were significant ($p<.05$). Multiple correlations ® ranged from .35 to .46 ($p<.01$) and the first root of the overall canonical correlation (R_{can}) was .50 ($p<.01$).

Table 4. Relationships Between TCEAI Factors and Self-Reports of ERB（n=196）

Behaviors	Factors			
	Ⅰ	Ⅱ	Ⅲ	Ⅳ
1. uy products packaged in containers that either can be reused or recycled.	.24	.19	.16	.19
	.07	.03	.12	.03
2. onate money or paid membership dues to a conservation organization.	.08	.05	.19	.01
	33	.25*	.21	.32*
3. write to the newspapers expressing your opinions on environmental issues.	.33*	.26*		*
	.40*	.29	.17*	.32*
4. ry to learn what you can do to help solve environmental problems.	.25*		.15	*
	*	.26*	.18*	.34*
5. o recycling.	.19*	*	*	*
	*	.17*	.30*	.14
6. onserve energy, such as turn off the water and light immediately.	.19*	.14*	*	.10
	*	.38*	.17*	.17*
7. oin in community cleanup efforts.	.46*	*	.35*	.42*
	*		*	*
8. nroll in camp for the purpose of environmental issues.	.50*			
	*			
9. ead publications that focus on environmental issues.	.37*			
	*			
Multiple R				
Rcan Root 1				
Root 2				

*p＜.05 **p＜.01

r≧.14（p＜.05）

Threats to Validity

Our intention to develop a widely applicable, valid and reliable instrument for assessing environmental locus of control among Taiwanese adolescents and young adults could be undermined by several factors, including differences among individuals by age or sex. To test these possibilities, a series of separate, one-way univariate ANOVAs were performed. The results revealed no differences ($p>.05$) among any of the four factor scores as a product of age or gender.

Conclusion

Based on previous work by Smith-Sebasto & Fortner (1994), this study focused on the development and validation of a useful instrument (ie., the *TCEAI*) for assessing environmental locus of control attitudes among elementary and middle school children in Taiwan. The instrument we have constructed is intended to be a helpful device for documenting and understanding internal control convictions in the Taiwanese context. Our primary goal in this effort has been to construct a readily useable tool for elementary and middle school teachers who are implementing environmental education programs and wish to assess the extent to which the programs affect important learning outcomes.

In comparison to the original instrument developed by Smith-Sebasto & Fortner (1994), the *TCEAI* was found to possess acceptably high levels of internal consistency (Cronbach's alpha, .92), and correlations with environmentally responsible behavior were also strong and significant (R range= .35 to .46). No differences were found among students by gender or age. These findings suggest that the new instrument has substantially favorable psychometric characteristics and may be a valuable tool for use in elementary and middle school classrooms in Taiwan.

Our work in environmental education has both a practical and a theoretical thrust. At the practical level, we have been heavily influenced by Boerschig & DeYoung (1993) who suggested that environmentally responsible behavior may be substantially promoted by enhancing students' internal control convictions. Accordingly, we are using the *TCEAI* as a vehicle to drive efforts in curriculum and instruction.

Currently we are developing teaching modules that address each of the four factors identified in the rotated factor matrix. The module on Conservation, for example, introduces students to the importance of buying products that use recycled paper; using household appliances that have energy-saving devices, and opening windows rather than using air conditioning. The module on Persuasion teaches topics on political intervention such as signing petitions, contacting political leaders, and demonstrating against polluting industries. Our intention is to implement the

TCEAI in pre- and posttesting conditions as a way of documenting and assessing the effectiveness of the curricular materials.

On a more theoretical level, we are also interested in clarifying and understanding the underlying factors that influence environmentally responsible behaviors among diverse groups of learners in Taiwan. In previous work we found that middle school students in Taiwan often demonstrate minimal commitment to environmentally responsible behavior and that this situation is strongly linked to a feeling of helplessness in the face of powerful external forces. We think that these feelings are widespread in Taiwan's culture and need to be documented and studied in greater depth.

The instrument needs further testing and refinement among geographically isolated populations and among relatively urban and rural, wealthy and poor, and linguistically distinct subgroups. Furthermore, in validating the instrument we did not consider Taiwan's half million aboriginal people, who are intimately connected with the environment. Instead, we took only a small sample of Taiwan's majority group (Han Chinese) as our subjects. In future work, we plan to develop revised versions of the instrument to accommodate aboriginal and tribal students in order to broaden its scope and applicability.

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