Pol. J. Environ. Stud. Vol. 34, No. 2 (2025), 1841-1850
DOI: *10.15244/pjoes/188627* ONLINE PUBLICATION DATE: 2024-08-05

Original Research

Research on Types and Driving Mechanism of Participation Behaviors of College Students in Education of Ecological Literacy under the Background of Environment Digital Governance in China

Ruoyu Yang[1*], Yuan Cao[1], Luyao Li[1], Yifan Long[1], Wei Wang[1], Jaffar Aman[2]

[1]School of Economics and Management, Civil Aviation University of China, Tianjin, 300300, China
[2]School of Sociology and Anthropology, Kakakurum International university Gilgit, Pakistan, Gilgit, 151000, Pakistan

Received: 8 October 2023
Accepted:13 May 2024

Abstract

The public ecological literacy and environmental protection behaviors in China still have the intention-behavior gap and exist in the Giddens Paradox. Based on the perspective of public participation in community education, the behaviors related to ecological literacy and environmental protection of college students were classified into three categories: Egoistic, Altruistic, and Ecological. Through investigation, it was found that there are type differences, group differences, and regional differences among them. Based on Norm-Activity-Theory, Theory of Planned Behavior, Value-Belief-Norm Theory, and Attitude-Behavior-Context Theory, an empirical analysis is made on the driving factors of participation behaviors. Based on this, some countermeasures and suggestions are put forward for future development.

Keywords: participation behaviors, ecological literacy, typological research, driving mechanism

Introduction

The concept of environmental literacy was put forward for the first time in 1968, which includes sensitivity to the external environment, the ability to solve environmental problems, sustainability and initiative in paying attention to environmental problems, and the action force for protecting the environment [1]. Afterward, some scholars noticed the internal relationship between the ecological environment and education, creatively put forward the concept of "Ecological Literacy", and thought that Ecological Literacy was an index to measure whether people had a certain understanding of the relevant knowledge and processes of the ecosystem and whether they had the behavior and ability to improve ecological environment problems [2]. Although the concept of ecological literacy originated from environmental literacy, ecological literacy emphasizes the benign interaction

*e-mail: yangruoyu1993abc@163.com;
Tel.: +86-155-1086-6322

and harmonious relationship between humans and the natural environment. Therefore, the concept of "Ecological Literacy" used in this study is not only in line with the development characteristics of the times when humans and nature live in harmony, but also conducive to the sustainable development of humans and society. Citizens' ecological civilization literacy takes ecological knowledge as the cognitive basis, ecological ethics as the value guide, ecological emotion as the emotional link, and ecological behavior as the ultimate embodiment, forming the endogenous power of "unity of knowledge and action" [3]. Previous studies have agreed that the improvement of ecological literacy cannot be separated from ecological environment education. Ecological environment education aims to enable citizens to use natural resources correctly to improve the quality of human life and make them realize that there is an inseparable, equal, and harmonious relationship between people and the ecological environment, so as to enhance citizens' ecological literacy, encourage the public to implement environmental protection behaviors and realize the benign interaction between human and the ecological environment [4].

Generally, academic circles believe that Ecological Literacy includes ecological knowledge, ecological consciousness, emotion, attitude, skills, and ecological behaviors [5-7]. In order to measure public environmental literacy, the Chinese Civic Environmental Behavior Survey 2022, published by the Ministry of Ecology and Environment of China in 2023, investigated the basic situation of public ecological literacy from the aspects of ecological knowledge, attention to the ecological environment, and ecological environmental protection behaviors. According to the survey, the Chinese public generally has a strong willingness to behave in the environment, while there are differences in practical actions in different fields. It has the characteristics of high awareness and low practice, and environmental cognition and environmental behavior are inconsistent. There is a Giddens Paradox in the field of ecological environmental protection. Under the background of digital environment governance, the cultivation of public ecological literacy cannot be separated from the development of community education, and the community is the "last mile" of ecological education. In the future, the community will pay attention to people as its core, pursue modernization of form, and realize high-quality and sustainable development. Therefore, community education must be humanistic, digital, and ecological, and more people need to participate in learning and practicing the concept of ecological civilization education [8]. Community education of ecological literacy is an educational activity that takes the community as the category and all the members of the community as objects, aiming at improving the ecological literacy and environmental quality of the community members as a whole. In China, participants in community education of ecological literacy are very diversified, including government departments, community residents, grass-roots autonomous organizations, social organizations, environmental protection enterprises, and so on. There are various types of public participation behaviors, including garbage sorting, green consumption, participating in environmental protection volunteer activities, reporting pollution behaviors, etc. These participation behaviors go from shallow to deep, from self-interest to altruism, from private domain to public domain, and from governance to prevention, which conform to the characteristics of stepped participation described by Sherry Arnstein [9], forming a "differential pattern" of ecological environment literacy and pro-environmental behavior in the community. In the community of "embedded governance", there is system embedding, technology embedding, knowledge embedding, etc. Environmental digital governance lowers the threshold of public participation. In community environmental governance, various subjects are intertwined, and different groups and different types of participation behaviors have different characteristics, which have different impacts on the ecological environment [10]. Among them, college students are the most important participants. In this context, a large sample of survey data from college students will be used to explore its internal influence mechanism and driving mechanism in this paper.

Literature Review and Research Hypothesis

The most direct purpose, the most important content, and the most effective function of environmental education and ecological literacy in the community is to improve people's cognitive level of the ecological environment and advocate for people to carry out green environmental protection actions. Theory of Reasoned Action (TRA), Social Cognitive Theory, and Theory of Planned Behavior (TPB) all believe that ecological recognition and environmental awareness, emotions and attitudes, subjective norms, and perceived behavior control have a significant positive impact on local residents' willingness to participate and environmental responsibility behaviors [11-17]. Subjective norms include social norms and individual norms. Norm-Activity-Theory (NAT) holds that awareness of conflict, responsibility attribution, and subjective norms will all have an impact on environmental behaviors [18]. Some scholars have built an integrated framework of TPB and NAT, adding variables such as behavior attitude, subjective norms, and perceived behavior control (PBC) on the basis of environmental cognition in order to better interpret people's intentions or behaviors toward ecological environment protection. The results showed that variables such as ecological value, emotions and attributes, subjective norms, and PBC will affect the public's ecological literacy and environmental behavior [19].

Therefore, this paper proposes the following research hypotheses:

H1: Cognition and awareness have a positive effect on emotions and attitudes.

H2: Cognition and awareness have a positive effect on subjective norms.

H3: Cognition and awareness have a positive effect on perceived behavioral control.

H4: Cognition and awareness have a positive effect on behavioral intentions.

H5: Emotions and attitudes have a positive effect on behavioral intentions.

H6: Subjective norms have a positive effect on behavioral intentions.

H7: Perceived behavioral control has a positive effect on behavioral intentions.

Dunlap and Van Liere put forward the concept of the "New Ecological Paradigm" in 1978, which revealed the cognition of humans on the relationship between themselves and the environment and reflected the universal concern of humans on the impact of their own development on the ecological environment. In the past, scholars believed that different environmental cognition and values would lead to different ecological paradigms and then affect environmental behaviors [20]. Value-Belief-Norm Theory pointed out that environmental behaviors are caused by internal factors and external situational factors, and ecological values can be divided into three types (Egoistic, Altruistic, and Ecological), with different influencing factors and results. This theory integrates price view, personal belief, and viewpoint in NAT, and comprehensively explores the influence of various subjective and objective factors on public ecological literacy and environmental protection behaviors [21]. Meanwhile, some scholars' studies show that cognition and awareness will also affect public emotions and attitudes, subjective norms, and ecological environment perception [22]. Therefore, this paper considers that cognition and awareness have a positive impact on emotions and attitudes, subjective norms, perceived behavior control, and behavior intention, while emotions and attitudes, subjective norms, and perceived behavior control all have a positive impact on behavior intention. Between cognition and awareness and behavior intention, emotions and attitudes, subjective norms, and perceived behavior control play an intermediary role. In addition, cognition and awareness, emotions and attitudes, subjective norms, perceived behavioral control, and behavior intention will also affect participation behaviors, either directly or indirectly. Based on previous theoretical and empirical research results, this study considers that behavioral intention plays a mediating role among emotions and attitudes, subjective norms, perceived behavioral control, and participation behaviors.

Therefore, this paper proposes the research hypotheses below:

H8: Behavioral intentions have a positive effect on participation behavior.

H9: Emotions and attitudes have a positive effect on participation behavior.

H10: Subjective norms have a positive effect on participation behavior.

H11: Perceived behavioral control has a positive effect on participation behavior.

H12: Cognition and awareness have a positive effect on participation behavior.

H13: The positive impact of cognition and awareness on behavioral intentions is mediated by emotions and attitudes, subjective norms, and perceived behavioral control.

H14: The positive impact of emotions and attitudes, subjective norms, and perceived behavioral control on participation behavior is mediated by behavioral intentions.

Attitude-Behavior-Context (ABC theory): behavior (B) is the result of the interaction between attitude (A) and context (C). The change in public environmental behavior is mainly caused by internal and external stimuli, including environmental concentration analysis, environmental knowledge, awareness of conflict, self-effectiveness, ascription of response, altruistic values, place attachment, nature-relatedness, the anticipatory feeling of priority, as well as guides and other factors [23-29]. In practice, the cultivation of public ecological literacy and the implementation of environmental behavior are the result of the comprehensive action of internal cognition and external conditions. The education of ecological literacy and environmental protection action in the community is a collective action with strong spillover and positive externality [30]. Therefore, social trust plays an important role in it. In the past, scholars conducted empirical research based on transnational survey data and a mainstream theoretical framework and found that social trust has a moderating effect on the realization of transforming environmental awareness into pro-environmental behaviors [31]. Collective actions in the field of ecological environment protection usually lead to social dilemmas in which individual interests conflict with collective interests. If individuals only care about their own interests or worry about free riders and are unwilling to implement pro-environmental behaviors, then the social dilemma will be difficult to solve [32]. To solve this dilemma, it is necessary for the public to form extensive and effective cooperation based on trust. Social trust makes everyone expect others to adopt cooperative behaviors and collective action based on common values [33]. Therefore, social trust can encourage people to participate in the education of ecological literacy and ecological protection behavior by reducing the risk of cooperation. Previous studies have found that the lack of social trust usually inhibits the implementation of public pro-environmental behaviors, and social trust will have an impact on collective action [34-36]. Therefore, this paper proposes the following research hypotheses:

H15: The positive impact of emotions and attitudes on participation behavior is moderated by social trust.

According to Value-Belief-Norm Theory, there are a series of regulating variables among individual moral beliefs, value standards, and environmental behaviors, among which the most critical ones are awareness of conflict and ascription of response [37]. Interpersonal behavior theory also points out that the influence of attitude and intention on behaviors is regulated by external promotion conditions. After the investigation, it was found that the public generally has an intention-behavior gap in ecological environmental protection actions, including "high awareness-low practice" and "low awareness-high practice". This is because the assignment of responsibility will also have an impact on the community public's willingness and behavior to participate in the education of ecological literacy and environmental protection, which are the same as altruistic values, place attachment, and nature-relatedness. After realizing the importance of improving ecological literacy, the public will not take action without a sense of responsibility. Ascription of responsibility refers to "the responsibility for the negative consequences of not participating in community education on ecological literacy and environmental protection actions". Previous scholars mostly interpreted the attribution of responsibility from the perspective of individual implementation of pro-environmental behaviors. It was found that the stronger the attribution of responsibility, the more driving force it could generate, thus promoting the public to transform environmental awareness, emotions, and attitudes into practical actions [38-40]. Therefore, this paper proposes the research hypotheses below:

H16: The positive impact of subjective norms on participation behavior is moderated by the ascription of responsibility.

To sum up, the variable model of this study is shown in Fig. 1.

Research Design and Empirical Analysis Results

Questionnaire Design

This study collected data by means of questionnaires and interviews. The Questionnaire on Public Participation Behavior in Community Education of Ecological Literacy used in the study was mainly divided into two parts: basic information and a public participation scale. The first part is the basic information questionnaire survey of college students among community residents, which investigates individual characteristics such as gender, age, residence, and major. The second part is the scale of public participation behavior and its driving mechanisms. The variable design includes 8 dimensions: ecological recognition and environmental awareness, emotions and attention, subjective norms, perceived behavior control, behavioral intention, internal driving factors (assignment of responsibility), external facilitating conditions (social trust), and participation behavior, with a total of 24 items. All measurement items were measured using the Likert scale, and the points from 1 to 5 represented "very disagree", "disagree", "general", "agree", and "very agree", respectively. A high score indicates a high degree of conformity between the behavior described in this item and the actual situation. The variables and measurement items of this study are shown in Table 1. Community residents from central, eastern, and western provinces of China were collected by random sampling, and questionnaires were distributed and collected through online and offline methods. Finally, 300 questionnaires were issued, and 286 questionnaires were recovered. The sample size was balanced in gender, age, and regional distribution, which met the research needs.

Test for Reliability and Validity

In this study, the validity of the variables was tested through factor load values, percentage of cumulative explanatory variance, and goodness of fit indicators of confirmatory factor analysis. Finally, the factors whose eigenvalue was greater than 1 and the factor load was greater than 0.5 were retained, and the inappropriate factor load was excluded from the analysis of this study. In addition, the recommended value of the goodness-of-fit index was RMESA less than 0.05, and NNFI, CFI, and AGFI were all greater than 0.9. In terms of reliability tests, CITC and Cronbach's α coefficient were used to verify the consistency and reliability of the scale. Generally, it was acceptable that CITC was greater than

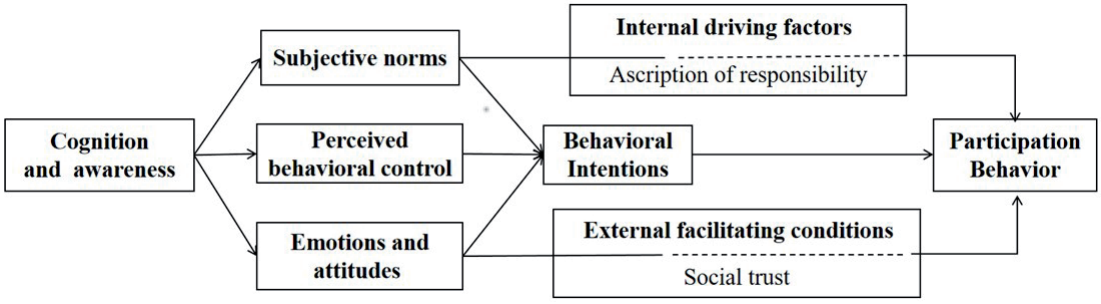

Fig. 1. Variable model.

0.3 and Cronbach's α coefficient was greater than or equal to 0.65. It can be seen from Table 2 that the factor load values were in line with the research standards, the cumulative variance percentage was greater than 80%, and the goodness-of-fit indicators were up to standard. The overall results reflect that the structure and validity of the research variables were better. In addition, the reliability analysis results of each research variable show that Cronbach's α coefficient is kept above 0.70, and CITC is also kept above 0.5. All research variables have good internal consistency, which was suitable for the next empirical test.

Results of Empirical Analysis

Types of Community Education of Ecological Literacy and Public Participation

Through investigation, it was found that community education on ecological literacy pays attention to the cultivation of values and the support of environmental protection behaviors, which are usually voluntary and organized. In the cultivation of values, educational types include egoistic values, altruistic values, and ecological values. As shown in Table 3. In the cultivation of self-interested ecological values, the main focus is to encourage the public to cultivate good living habits, save resources, and create a clean living environment for themselves, saving on living costs. The specific manifestation is to encourage community residents to carry out garbage sorting, water-saving, and electricity-saving actions, and the participants include grass-roots autonomous organizations, community residents, environmental protection NGOs, government departments, enterprises, and so on. In China, some cities have introduced policies to force the public to classify garbage, and if they do not classify garbage, they will face fines from government departments. These behaviors are subjectively "self-interested" and objectively have produced the effect of "altruism". In the process of cultivating altruistic ecological literacy

Table 1. Core variables, operational definitions, and measurement items.

Variable (Code)	Item (Code)
Cognition and Awareness (CA)	1. Do you know about the knowledge of environmental protection (CA1) 2. Are you aware of the system of ecological civilization (CA2) 3. Do you know about community education of ecological literacy (CA3)
Emotions and Attitudes (EA)	Do you think it is important to protect the environment (EA1) Do you think the construction of ecological civilization is important and urgent (EA2) Do you support the education for ecological literacy in the community (EA3)
Subjective Norms (SN)	Do your family members, friends, etc. support your participation in the education of ecological literacy in the community (SN1) Do the local government and social organizations support your participation in the education of ecological literacy in the community (SN2) Do you think you need to participate in the education of ecological literacy and related activities in the community (SN3)
Perceived Behavior Control (PBC)	The participation in the education of ecological literacy and related activities in the community is less difficult, and the cost is not high (PBC1) The threshold of participation in the education of ecological literacy and related activities in the community is very low, and I have the ability to participate (PBC2) There are many channels and ways to participate in the education of ecological literacy and related activities in the community (PBC3)
Behavioral Intentions (BI)	I am willing to participate in the education of ecological literacy and related activities in the community (BI1) I plan to participate in the education of ecological literacy and related activities in the community in the future (BI2) I would like to recommend others participate in the education of ecological literacy and related activities in the community (BI3)
Ascription of Responsiveness (AR)	I think it is my responsibility to participate in the education of ecological literacy and related activities in the community (AR1) I think everyone has the responsibility to participate in the environmental protection action of the community (AR2) I think if environmental pollution occurs in the community, everyone should take responsibility (AR3)
Social trust (ST)	I think the residents in the community have a relationship of trust and friendly cooperation with each other (ST1) I think people around me are reliable and trustworthy (ST2) I think the government agencies, social organizations, and community self-governing organizations that carry out the education of ecological literacy are trustworthy (ST3)
Participation behavior (PB)	Have you participated in the education of ecological literacy and related activities in the community before (PB1) Frequency of previous participation in the education of ecological literacy and related activities in the community (PB2) Types of previous participation in the education of ecological literacy and related activities in the community (PB3)

Table 2. Reliability and Validity.

Variables	Item code	Factor load	Cumulative explanatory variance%	Goodness of fit indicators	CITC	α After deleting the question item	α
Cognition and awareness (CA)	CA1	0.869	81.236	CFI = 0.980, NNFI = 0.972, AGFI = 0.931, RMSEA = 0.035	0.832	.925	0.933
	CA2	0.825			0.811	.919	
	CA3	0.818			0.806	.912	
Emotions and attitudes (EA)	EA1	0.871	85.125	CFI = 0.987, NNFI = 0.976, AGFI = 0.951, RMSEA = 0.031	0.857	.968	0.941
	EA2	0.866			0.851	.955	
	EA3	0.856			0.840	.938	
Subjective norms (SN)	SN1	0.818	80.051	CFI = 0.975, NNFI = 0.965, AGFI = 0.912, RMSEA = 0.040	0.821	.911	0.905
	SN2	0.812			0.814	.905	
	SN3	0.825			0.802	.902	
Perceived behavioral control (PBC)	PBC1	0.811	81.052	CFI = 0.979, NNFI = 0.969, AGFI = 0.921, RMSEA = 0.038	0.829	.923	0.908
	PBC2	0.826			0.817	.918	
	PBC3	0.839			0.805	.909	
Behavioral Intentions (BI)	BI1	0.803	80.017	CFI = 0.961, NNFI = 0.952, AGFI = 0.908, RMSEA = 0.041	0.818	.910	0.904
	BI2	0.809			0.819	.912	
	BI3	0.801			0.801	.907	
Ascription of responsibility (AR)	AR1	0.826	80.025	CFI = 0.966, NNFI = 0.958, AGFI = 0.913, RMSEA = 0.039	0.824	.919	0.906
	AR2	0.818			0.820	.917	
	AR3	0.807			0.814	.904	
Social trust (ST)	ST1	0.802	80.018	CFI = 0.959, NNFI = 0.952, AGFI = 0.908, RMSEA = 0.043	0.803	.913	0.903
	ST2	0.816			0.815	.911	
	ST3	0.821			0.818	.909	
Participation behavior (PB)	PB1	0.815	80.016	CFI = 0.953, NNFI = 0.949, AGFI = 0.906, RMSEA = 0.045	0.810	.912	0.902
	PB2	0.811			0.801	.909	
	PB3	0.809			0.802	.906	

values, it is emphasized that ecological environment protection is everyone's responsibility, and every community resident should participate extensively. The specific manifestation is to encourage community residents to participate in ecological environment volunteer activities initiated by environmental protection NGOs and community institutions, support altruistic and spillover "pro-environmental behaviors", and encourage the public to engage in green travel and consumption. In the process of cultivating ecological values, emphasis is placed on harmonious coexistence between humans and nature, focusing on the interaction between humans and nature, getting close to nature, and protecting ecology. The specific manifestation is to encourage community residents to participate in various forms of afforestation activities. Some environmental

Table 3. Typological study on community education of ecological literacy and public participation.

Types of ecological literacy and community education	Types of public participation	Participants
Ecological literacy, community education, and egoistic value	Garbage classification, water, electricity conservation, etc	Grassroots autonomous organizations, community residents, environmental NGOs, government departments, enterprises, etc
Ecological literacy, community education, and altruistic value	Environmental Volunteer Services, Green consumption, etc	
Ecological literacy, community education , and ecological value	Afforestation, Harmonious coexistence with nature, etc	

NGOs have also launched the "One Meter Vegetable Garden" project to support community residents in growing flowers and vegetables. Some departments also regularly organize community residents to visit botanical gardens, zoos, and wetland parks, cultivate value, and carry out ecological protection actions in the process, for example, by observing the life evolution of animals and plants, going to wetland parks to pick up garbage, etc. On the whole, the three types of public with a higher ecological literacy level are mainly distributed in groups and regions with a higher education level and higher social and economic development level. Through investigation, it was found that the public is more inclined to participate in egoistic ecological literacy education and environmental protection actions and less active in altruistic and ecological literacy education and environmental protection actions, and there are differences in types, groups, and regions. The lack of public participation behaviors is an important practical problem, which is due to the externality of environmental governance. In practice, there is still a contradiction between "cognition and behavior". How to internalize externalities is the current mainstream governance idea. In the process of educating ecological literacy in the future, altruistic and ecological values should be actively guided and encouraged. By encouraging public participation through the development of ecological education and promoting the implementation of ecological education by achieving the widest possible public participation, a virtuous cycle and mutual promotion between the two can be achieved.

Research on the Driving Mechanism of Public Participation in Community Education of Ecological Literacy

Due to the complex relationships between variables involved in the conceptual model of this study and the presence of multiple mediating variables, AMOS 21.0 was used to validate the research hypothesis. In the end, the modified model fitting results were relatively ideal, as shown in Table 4. The fitting indexes of the model meet the requirements, and the fitting effect is good.

(1) Direct effect and mediating effect tests

Table 4 shows that the path coefficients and normalized path coefficients (NPC) of each path are positive numbers greater than 0, and P values are significant. The conclusions are as follows: ① CA has a significant positive effect on EA, SN, PBC, and PB, and the effect coefficient on EA is greater; ② EA, SN, and PBC all have significant positive effects on BI, and PBC has the largest path coefficient; ③ CA has a significant positive effect on BI, so EA, SN, and PBC all have mediating effects. ④ EA, SN, and PBC all have significant positive effects on PB and PBC has the largest path coefficient. ⑤ BI has a significant positive effect on PB, so the mediating effect of behavioral intention has also been verified.

Table 4. The modified model fitting results.

Path	Path coefficients	S.E.	C.R.	**P value**	**NPC**
EA←CA	0.679	0.062	8.137	***	0.661
SN←CA	0.473	0.068	7.372	***	0.458
PBC←CA	0.512	0.041	6.825	***	0.501
BI←EA	0.368	0.071	5.863	***	0.337
BI←SN	0.351	0.075	5.627	***	0.326
BI←PBC	0.389	0.065	5.369	***	0.356
BI←CA	0.329	0.063	4.858	***	0.319
PB←CA	0.307	0.058	2.377	***	0.305
PB←EA	0.319	0.061	3.985	***	0.318
PB←SN	0.316	0.063	3.641	***	0.312
PB←PBC	0.465	0.056	6.887	***	0.448
PB←BI	0.510	0.059	7.892	***	0.479

Fit indicators	X^2	896.526	RMSEA	0.043	CFI	0.967
	df	673	NFI	0.956	GFI	0.879
	X^2/df	1.463	TLI	0.958		

Note: *** p<0.01, **p<0.05, *p<0.1

(2) Moderating effect test

In this study, SPSS software was used to analyze the moderating effect. First, the independent variables and regulatory variables were centralized, and then the interactive items were calculated and hierarchical regression analysis was carried out. In the specific analysis process, taking the score of responsibility attribution and social trust as the classification standard, taking the score mean plus or minus a standard deviation as the classification point, taking the sample score value lower than the mean minus the standard deviation as the classification, a group of samples with lower scores was obtained, while taking the sample score value higher than the mean plus the standard deviation, a group of samples with higher scores was obtained, and then regression was performed on each group of samples to verify the moderating effect of the ascription of responsibility and social trust. The results show that: (1) In the situation of large responsibility attribution, subjective norms, especially individual norms, can significantly promote participation behaviors, and the coefficient is large. However, in the case of small responsibility attribution, although subjective norms can promote participation behavior, their significance and coefficient are small. Therefore, the positive impact of subjective norms on participation behavior is moderated by the ascription of responsibility. (2) When the degree of social trust is high, emotions and attitudes have a significant positive influence on participation behaviors, and the coefficient is large. When social trust is low, the positive influence of emotions and attitudes on participation behaviors is weak, and the coefficient is small. Therefore, the positive impact of emotions and attitudes on participation behavior is moderated by social trust.

Conclusion and Countermeasures

Conclusion

The empirical analysis results of this study show that: (1) Cognition and awareness, emotions and attention, subjective norms, perceived behavior control, and behavioral intention all significantly affect public participation in community education of ecological literacy. After investigation and survey, it was found that personal norms have a more significant impact than social norms; (2) Emotions and attributes, subjective norms, and perceived behavior control play a mediating role between cognition and awareness and behavioral intention; (3) Between emotions and attitudes, subjective norm, perceived behavioral control, and participation behavior, behavior intention play a mediating role; (4) The positive impact of subjective norm on participation behavior is moderated by ascription of responsibility; (5) The positive impact of emotions and attitudes on participation behavior is moderated by social trust.

Previous studies by scholars have only found the impact of cognitive attitudes and subjective norms on behavioral intentions [23-25], without studying the interaction between variables and the moderating effect of social trust and ascription of responsibility. The innovation of this research is reflected in the following aspects: (1) Based on Norm-Activity-Theory, Theory of Planned Behavior, Value-Belief-Norm Theory, and Attitude-Behavior-Context Theory, an empirical analysis is made on the driving factors of public participation behavior. An integrating framework for the influencing factors of public participation in ecological literacy education has been constructed. (2) Not only did we analyze the linear relationship between cognitive awareness, emotional attitude, subjective norms, perceptual behavior control, behavioral intention, and participating behavior, but we also analyzed the direct and indirect effects and studied the moderating effects of internal driving factors and external facilitating conditions. Revealed the complex impact mechanism and multiple chain relationships of public participation in ecological literacy education and established a long-term causal framework. (3) This study reveals the moderating effect of responsibility attribution and social trust. It fills the gap in previous studies that overlooked mediating and moderating variables and is of great significance for the development of theory and practice.

The research conclusions of this article have certain enlightening effects on the development of public participation in ecological education theory and practice, specifically manifested in: (1) Ecological literacy education requires close collaboration among multiple subjects, leveraging the power of "government, market, society, and the public" and other subjects, enhancing public environmental awareness, creating good social norms, and reducing the threshold for public participation. (2) To leverage the dual roles of internal and external factors, establish good social trust, and form an environmental governance pattern of multi-agent cooperation, mutual trust, and mutual promotion, thereby expanding and enhancing the influence and practical effectiveness of ecological literacy education.

Countermeasures

Based on this, the following countermeasures and suggestions were put forward: (1) To improve the public cognitive level of ecological environment protection, carry out extensive research on the education of ecological literacy in the community, promote the formation and improvement of public emotions, attitudes, and subjective norms, reduce the threshold and difficulty of participation, enhance public intention to participate in community education activities of ecological literacy, and encourage community multi-subjects to carry out various types of ecological environment protection behaviors. (2) Cognition and

awareness, emotions and attitudes, subjective norms, perceived behavior control, behavior intention, and participation behaviors can promote each other, so it is necessary to carry out all-round educational activities from the aspects of ecological environment cognition, environmental emotions and attitudes, social norms, perceived behavior control, cultivation of participation intentions and encouragement of participation behaviors. (3) It is necessary to cultivate the self-efficacy and responsibility of community residents and the general public, make the concepts of "ecological literacy" and "environmental protection" deeply rooted in the hearts of the people, and encourage citizens to participate in environmental co-production actively and spontaneously and participate in ecological environmental protection actions consciously. Through on-the-spot investigation and interviews, it was found that media platforms, education, and publicity channels will also affect the public's perception of responsibility. Therefore, it is necessary to rely on various new media platforms and adopt various channels and means to publicize, so that the public can realize that "everyone is responsible for environmental protection". (4) The community is the smallest unit of social governance and the "last mile" of ecological literacy cultivation. It is necessary to build social trust in the community, giving full play to the roles of government departments, grass-roots autonomous organizations, environmental protection NGOs, citizens, enterprises, and other multi-subjects; building a friendly, harmonious, mutually beneficial, ecological, and sustainable social network, developing from a single and individual ecological protection behavior to a multi-group ecological environmental protection circle, and building a community ecological governance pattern of multi-circle coupling, multi-subject embedding, co-construction, sharing, and governance, so as to enhance the level and effectiveness of community education of ecological literacy.

Acknowledgments

This research was funded by The Scientific research projects of Tianjin Municipal Education Commission (Grant number 2022SK130). The FundamentalResearch Funds for the Central Universities of China(grant number 3122025064)

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. MCBDURE B., BREWER C.A., BERKOWITZ A.R. Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here. Ecosphere, **4** (5), 1, **2013**.
2. FLEISCHER S. Emerging beliefs frustrate ecological literacy and meaning-making for students. Cultural Studies of Science Education, **6** (1), 235, **2011**.
3. CURTHOYS L.P., CUTHERRSON B. Listening to the landscape: interpretive planning for ecological literacy. Canadian Journal of Environmental Education, **7** (2), 224, **2002**.
4. MARTIN P. Teacher qualification guidelines, ecological literacy and outdoor education. Australian Journal of Outdoor Education, **12** (2), 32, **2008**.
5. NEGEV M., SAGY G., GARB Y. Evaluating the environmental literacy of Israeli elementary and high school students. Journal of Environmental Education, **39** (2), 3, **2008**.
6. KOC H. The level of inclusion of environmental literacy components in the published course books with regard to 2005 geography teaching programmes in Turkey. International Journal of Academic Research, **5** (1), 243, **2013**.
7. PITMAN S.D., DANIELS C.B., SUTTON P.C. Ecological literacy and socio-demographics: who are the most eco-literate in our community, and why. The International Journal of Sustainable Development and World Ecology, **25** (1), 9, **2016**.
8. RUSSELL J.D. Waxing or waning? The changing patterns of environmental activism. Environmental Politics, **28** (4), 530, **2015**.
9. ARNSTTEIN S. A ladder of citizen participation. Journal of the American Institute of Planners, **35** (4), 216, **1969**.
10. YANG R.Y. Public Participation and Risk Prevention in the Process of Digital Governance of Environment: Performance Evaluation, Influence Mechanism and Improvement Path. Polish Journal of Environmental Studies, **32** (4), 3895, **2023**.
11. MENG L., SI W. Pro-Environmental Behavior: Examining the Role of Ecological Value Cognition, Environmental Attitude, and Place Attachment among Rural Farmers in China. International Journal of Environmental Research and Public Health, **19** (24), 17011, **2022**.
12. YANG R.Y., CHEN J.N., WANG C.L., DONG Y.Q. The Influence Mechanism and Path Effects of Pro-Environmental Behavior: Empirical Study Based on the Structural Equation Modeling. Polish Journal of Environmental Studies, **31** (5), 4447, **2022**.
13. SAWITRI D.R., HADIYANTO H., HADI S.P. Pro-environmental Behavior from a Social Cognitive Theory Perspective. Procedia Environmental Sciences, **23**, 27, **2015**.
14. MA H., LI M., TONG X., DONG P. Community-Level Household Waste Disposal Behavior Simulation and Visualization under Multiple Incentive Policies: An Agent-Based Modelling Approach. Sustainability, **15** (13), 10427, **2023**.
15. ALI S., ULLAH H., AKBAR M., AKHTAR. Determinants of Consumer Intentions to Purchase Energy-Saving Household Products in Pakistan. Sustainability, **11** (5), 1462, **2019**.
16. YANG S., LI L., ZHANG J. Understanding Consumers' Sustainable Consumption Intention at China's Double-11 Online Shopping Festival: An Extended Theory of Planned Behavior Model. Sustainability, **10** (6), 1801, **2018**.
17. PAULA V., CATARINA M., ELIZABETH R. Willingness to Pay for Environmental Quality: The Effects of Pro-Environmental Behavior, Perceived Behavior Control, Environmental Activism, and Educational Level. SAGE Open, **11** (4), 1, **2021**.

18. OSTERTAG F. Integrating OCBE Literature and Norm Activation Theory: A Moderated Mediation on Pro-environmental Behavior of Employees. Sustainability, **15** (9), 7605, **2023**.
19. YANG R.Y., WA D., XU K.B. Research on the Influence Mechanism of Public Participation in Environmental Governance in the Context of Big Data: Based on the Theory of Planned Behavior and the Norm Activation Model Integrated Analysis Framework. Polish Journal of Environmental Studies, **31** (6), 5371, **2022**.
20. DYR W., PRUSIK M. Measurement of Pro-ecological Attitudes Within New Ecological Paradigm in Polish Current Settings. Social Psychological Bulletin, **15** (3), 1, **2020**.
21. STERN P.C. Information, Incentives, and Pro-environmental Consumer Behavior. Journal of Consumer Policy, **22**, 461, **1999**.
22. LIOBIKIENE G., POSKUS M. The importance of environmental knowledge for private and public sphere pro-environmental behavior: Modifying the value-belief-norm theory. Sustainability, **11** (12), 3324, **2019**.
23. GUAGNANO G.A., STERN P.C., DIETZ T. Influences on attitude behavior relationships: a natural experiment with curbside recycling. Environment and Behavior, **5**, 699, **1995**.
24. ZHANG K., RUIZ B., GARCIA J.A., AMERIGO M. Pro-environmental behaviour in China: analysing the impact of attitudinal and contextual factors. PsyEcology, **13** (2), 232, **2022**.
25. AHUJA J., YADAV M., SERGIO R.P. Green leadership and pro-environmental behaviour: a moderated mediation model with rewards, self-efficacy and training. International Journal of Ethics and Systems, **39** (2), 481, **2023**.
26. MATTEO I., GABRIELE S., SURYA G.L. How Can Climate Change Anxiety Induce Both Pro-Environmental Behaviors and Eco-Paralysis: The Mediating Role of General Self-Efficacy. International Journal of Environmental Research and Public Health, **20** (4), 3085, **2023**.
27. HUANG H. Media use, environmental beliefs, self-efficacy, and pro-environmental behavior. Journal of Business Research, **69** (6), 2206, **2016**.
28. AHMAD D., SONG Z.N. A meta-analysis of the relationship between place attachment and pro-environmental behaviour. Journal of Business Research, **123**, 208, **2021**.
29. SOLIMAN M., PEETZ J., DAVYDENKO M. The Impact of Immersive Technology on Nature Relatedness and Pro-Environmental Behavior. Journal of Media Psychology Theories Methods and Applications, **29** (1), 8, **2017**.
30. LUBELL M., VEDLITZ A., ZAHRAN S. Collective Action, Environmental Activism, and Air Quality Policy. Political Research Quarterly, **59** (1), 149, **2006**.
31. TAM K.P., CHAN H.W. Generalized trust narrows the gap between environmental concern and pro-environmental behavior: Multilevel evidence. Global Environmental Change, **48**, 182, **2018**.
32. BOHR J. Barriers to environmental sacrifice: the interaction of free rider fears with education, income, and ideology. Sociological Spectrum, **34** (4), 362, **2014**.
33. IRWIN K., BERIGAN N. Trust, Culture, and Cooperation: A Social Dilemma Analysis of Pro-Environmental Behaviors. The Sociological Quarterly, **54** (3), 424, **2013**.
34. TSANG S., BURNETT M., HILLS P. Trust, public participation and environmental governance in Hong Kong. Environmental Policy and Governance, **19** (2), 99, **2010**.
35. IRWIN K., EDWARDS K., TAMBURELLO J.A. Gender, trust and cooperation in environmental social dilemmas. Social Science Research, **50**, 328, **2015**.
36. XING Y., LI M., LIAO Y. Trust, Identity, and Public-Sphere Pro-environmental Behavior in China: An Extended Attitude-Behavior-Context Theory. Frontiers in Psychology, **13**, 919578, **2022**.
37. CHEN M. An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in Taiwan. Asian Journal of Social Psychology, **18** (2), 145, **2015**.
38. GENOVAITE L., ROMUALDAS J. The role of values, environmental risk perception, awareness of consequences, and willingness to assume responsibility for environmentally-friendly behaviour: the Lithuanian case. Journal of Cleaner Production, **112** (4), 3413, **2016**.
39. HEESUP H. The norm activation model and theory-broadening: Individuals' decision-making on environmentally-responsible convention attendance. Journal of Environmental Psychology, **40**, 462, **2014**.
40. JUDITH I.M., LINDA S. Relationships between value orientations, self-determined motivational types and pro-environmental behavioral intentions. Journal of Environmental Psychology, **30**, 368, **2010**.