RESEARCH ARTICLE

Digital socialization, psychological beliefs, environmental literacy and altruism: A structural equation modelling analysis

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Digital socialization is vital for today's adolescents, shaping their identities and peer interactions, even their views on their community and environment through online experiences. It was the purpose of this study to analyze through structural equation model the digital socialization, psychological beliefs, environmental literacy and altruism of students from the School of Teacher Education of J.H. Cerilles State College, Dumingag Campus, during the academic year 2025-2026. Two-hundred thirty-two students were involved and provided information relative to the variables through the adapted questionnaires. The data collected were treated with reliability and validity, direct and indirect effects through estimates and *z*-values.

High levels of validity and reliability are evident across digital socialization, environmental literacy, awareness, ecological concern and altruism, providing a robust basis for exploring their interconnections. Strong internal consistency is confirmed by Cronbach alpha and composite reliability scores, while clear convergent validity is shown with AVE values surpassing established thresholds.

Environmental literacy emerges as the most effective means to foster empathy and a desire to help, with digital platforms that enhance objective knowledge being particularly successful. Digital socialization significantly encourages empathy and voluntary behavior through cognitive processing, compensating for the absence of direct emotional ties. This can lead to improved environmental consciousness among students, particularly when education is integrated into digital experiences.

Key Words: *Digital socialization; Environmental awareness; Environmental literacy; Psychological beliefs; Structural equation modelling*

INTRODUCTION

Digital socialization plays a crucial role in the lives of adolescents today, determining how young individuals are developing their identities, interacting with peers, and engaging with the world. As the digital platforms flourish, the ways in which teenagers socialize have changed, encompassing beyond traditional face-to-face interactions in incorporating a vast collection of online experiences. Digital socialization has paved the way students view and manifest environmentally significant behaviors and practices [1]. Xin et al. noted that students considered digital networks as vital tools in promoting pro-environmental volunteering. By engaging in digital socialization platforms, the individuals particularly adolescents, acquire skills, develop norms and behaviors. In recent years, this phenomenon has gathered substantial attention, as the researchers have pursued in comprehending how the socialization process has been influenced by the digital environments.

Different attributes like awareness, knowledge, attitudes, and practical action skills formed part of the term environmental literacy. Individuals who are more adept at processing data arrived at sustainable decisions more often that those who are not. These individuals manifest their high level of literacy rates. Consciousness with the environment enhance knowledge as validated by researches analyzing sequential paradigm. When individuals are environmentally conscious, they tend to have developed their attitudes and abilities which characterized pro-environmental behavior. It has been noted that among engaged individuals, it is their practical action skills that matter most in developing their real behavior. Heck and Hallinger emphasized that enhancing one's theoretical knowledge and applied competencies are essential for individuals to live meaningful environmentally attuned lives [2].

Converting external knowledge into action is the essence of an environmentally aware individuals. One's core beliefs usually resulted from the feeling of duty and obligation to act. In this case, it is the beliefs of the students which propelled them to act positively on the environment. The concept of caring the environment or ecological concept could influence how individuals relate with nature [3]. Admin strengthened this idea when he emphasized that environmental messaging is grounded on cognitive frameworks.

The selfless desire to preserve the environment for the sake of the people described environmental altruism. Slaitan noted that this has remained as a basic tenet of environmental ethics. Digital literacy has a far greater impact on green consumption knowledge and confidence for those individuals with a strong altruistic disposition according to Admin [4]. Suaib added that positive ecological outcomes could be achieved through value orientation. Incorporating altruism into behavioral models manifests the individual's priority in taking care of the health of the ecosystem [5].

The concepts of digital socialization, environmental awareness, psychological beliefs and environmental altruism were embedded in the curriculum of technology for teaching and learning especially on global digital citizenship. The complex relationships of these concepts were analyzed using the partial least square structural equation modelling. This was done by utilizing a robust framework in testing hypotheses using PLS-SEM. Through this model, the direct and indirect effects of the variables were determined.

Statement of the problem

This study was conducted to determine if digital socialization, environmental literacy, and psychological beliefs predict environmental altruism of the School of Teacher Education students of J.H. Cerilles State College-Dumingag Campus during the academic year 2025-2026.

Specifically, this dealt with the following subproblems:

- What is the level of the students' digital socialization?
- What is the level of the students' environmental literacy in terms of environmental consciousness and environmental anxiety?

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- What is the level of students' psychological beliefs in terms of environmental awareness and ecological concern?
- What is the level of the students' environmental altruism?
- Do digital socialization, environmental literacy, and psychological beliefs predict environmental altruism using PLS-SEM?

MATERIALS AND METHODS

The research utilized mediation analysis in determining which among the digital socialization, environmental literacy, and psychological beliefs predict environmental altruism. The study was conducted in J.H. Cerilles State College-Dumingag Campus, particularly the School of Teacher Education. The data were collected from 232 students from the School of Teacher Education, J.H. Cerilles State College – Dumingag Campus during the academic year 2025-2026. The sample included students from BSEd English (57); BSEd Mathematics (84); BPEd (49); and BEEd (42). In running mediation analysis, Taylor, MacKinnon, and Tein required a minimum of 200 samples for a mediation analysis [6]. This study utilized 232 samples which the researcher considered to be sufficient enough to conduct a mediation analysis.

The data collection was two-way process. The researcher distributed printed questionnaires to some participants. A google form was created and survey link was disseminated through Facebook messenger chat groups. An informed consent was included in the questionnaire and form. Only those who expressed their intention to participate in the data collection were included in the said process. The informed consent assures the confidentiality of the responses and anonymity of the participants.

The adapted questionnaires were utilized to determine the levels of the digital socialization, environmental literacy, and psychological beliefs and environmental altruism of the students. The five-point Likert scale was used as responses of the questionnaires.

Composite reliability for all constructs was assessed using the McDonald's coefficient omega, computed. This approach provides a more robust estimate of internal consistency than Cronbach's alpha although as reflected in the table, the Cronbach's alpha coefficient was also computed.

The convergent validity of the variables was assessed using the average variance extracted (AVE). For AVE, the value must be at least 0.50 and significant (p-value must be at most 0.05) to say that the constructs exhibit convergent validity [7-10].

For all the analysis carried out in the study, the researcher set a probability value of 0.05. All the analyses in the study were performed using Jamovi and JASP softwares. Items of the questionnaires were subjected to face validity and content validity and internal consistency. The face validity was determined using the Aiken's validity and Kappa Interrater Reliability while the content validity was determined using the Lawshe's Content Validity Ratio (CVR) and the Content Validity Index (CVI).

The study utilized two stages of data analysis: measurement model evaluation and structural model evaluation [11]. The measurement model assessment examined indicator reliability, internal consistency, and convergent validity. The structural model assessed focused on path coefficients, explained variance and hypothesis testing.

In the present study, both direct and indirect relationships were measured. The direct effects include the measurement of the relationships between environmental literacy and digital socialization; psychological beliefs and digital socialization; environmental literacy and environmental altruism; and psychological beliefs and environmental altruism. As for the indirect effect, the study examined the intervening role of digital socialization on the relationship between environmental literacy and environmental altruism and psychological beliefs and environmental altruism.

RESULTS AND DISCUSSION

In this study, the measurement model was evaluated in terms of reliability and construct validity to ensure that all variables were measured appropriately. The results of the reliability and convergent validity analyses are shown in Table 1.

TABLE 1
Reliability and convergent validity of the measurement model

Variables	Cronbach's alpha	Composite reliability	Average Variance Extracted (AVE)
Digital socialization	0.961	0.965	0.63
Environmental consciousness	0.854	0.887	0.565
Environmental anxiety	0.85	0.847	0.535
Environmental awareness	0.952	0.76	0.66
Ecological concern	0.82	0.88	0.554
Empathy	0.96	0.96	0.684
Desire to help	0.93	0.93	0.77
Voluntary	0.96	0.96	0.73

As indicated in Table 1, the Cronbach's alpha values ranged from .82 to . 96, while CR values ranged from .66 to .965, suggesting acceptable good internal consistency overall. In terms of Cronbach's alpha, environmental consciousness, environmental anxiety and ecological concern were good and were acceptable as these have values above 0.70. Some variables indicated high values like digital socialization, environmental awareness, empathy, desire to help and voluntary indicating that these are within a group which are closely related and homogeneous. It also shows that digital socialization and empathy show excellent internal consistency having exceeded the threshold value of .70.

Another layer of verifying internal consistency is the composite reliability or construct reliability. The data show that the highest values were attributed to digital socialization (.965); and empathy (.96) and voluntary (.96) which are the constructs of environmental altruism. Environmental awareness shows a slightly lower value of .76 compared to its Cronbach's alpha value of .952.

The table also reflects the convergent validity measured in terms of Average Variance Extracted (AVE). As seen in the table, the values of AVE exceeded .50 which are within the required threshold for AVE, the convergent validity is evident. This implies that the variables have good convergent validity.

TABLE 2
Direct and indirect effects

Direct effects				
Variables	**Estimates**	**Std. error**	**z-value**	**P**
Digital socialization → Empathy	0.104	0.09	-1.156	0.248
Digital socialization → Desire to help	0.057	0.101	0.561	0.575
Digital socialization → Voluntary	0.168	0.076	2.199	0.028
Indirect effects				
Digital socialization → Environmental literacy → Empathy	0.434	0.097	4.476	<.001
Digital socialization → Environmental awareness → Empathy	0.272	0.047	5.789	<.001
Digital socialization → Ecological concern → Empathy	0.027	0.033	0.834	0.404
Digital socialization → Environmental literacy → Desire to help	0.438	0.108	4.045	<.001
Digital socialization → Environmental awareness→ Desire to help	0.081	0.047	1.71	0.087
Digital socialization → Ecological concern → Desire to help	0.138	0.038	3.594	<.001
Digital socialization → Environmental literacy → Voluntary	0.331	0.082	4.053	<.001
Digital socialization → Environmental awareness → Voluntary	0.195	0.039	5.063	<.001
Digital socialization → Ecological concern → Voluntary	0.02	0.028	0.711	0.477

The above table illustrates the direct and indirect effects of digital socialization to environmental altruism using environmental literacy, awareness and concern as mediators. The findings pointed out that environmental awareness worked as partial mediators in the relationship between digital literacy and ecological concern. These findings were supported by Yang et al., who claimed that digital literacy favorably impact green consumption behavior through environmental awareness as mediator.

In the same table of the analysis of direct effects, it shows that digital socialization has little to no effect on environmental altriusm specifically on students' willingness or desire to help (estimate=.057, p=.575) and empathy (estimate=-.104, p=.248). These two measures of environmental altruism showed not significantly enhanced by digital socialization. However, digital socialization has slightly attributed the students' voluntary behavior with an estimate of .168 at p-value of .028. The findings suggested that digital environments alone is not enough to cause changes in empathy, desire to help and voluntary behaviors. According to Tian and Qiao, pro-environmental behaviors are fostered by the formation of mobile mini programs and students' involvement with them, but this is only achievable when control, responsiveness, and connectedness are mediated.

It can be noted that digital socialization is most successful when ecological concepts and environmental awareness were strengthened as indicated by the indirect pathways. In terms of environmental literacy as mediator to empathy, the estimate of .434 and p-value of <.001 indicated that environmental literacy significantly mediated the relationship between digital socialization and empathy.

Environmental awareness acted as strong secondary mediator for voluntary conduct (p<.001) and empathy (p<.001). Ecological concern did not significantly mediate digital socialization and empathy as the p-value is .404; and that of the desire to help with p-value of .477. However, ecological concern moderately mediate desire to help at p<.001.

The data indicates that environmental literacy was perceived as the most reliable and strongest mediator of all aspects of environmental altruism like empathy, desire to help and voluntary behavior. Cognitive elements such as environmental literacy and awareness perform better than simply emotive

aspects like ecological concern when taking about converting digital encounters into behavioral intent according to Liao [12].

Emotional connections are not as effective tools as digital platforms for environmental education as suggested by the findings. Hoodas et al., emphasized that campaigns should focus on offering actionable knowledge and literacy instead of emotional appeals. It is because the direct impact on empathy is negative and even negligible. To effectively promote voluntary conduct and enhance the students' objective comprehension of environmental issues, there is a need for a relevant, more engage and functional digital socialization [13]. Jeong and Kim reinforced when they highlighted that digital socialization could inevitably set off psychological processes vital for long-term action [14].

Total effects

With estimates ranging from .628 to .714, the overall effects for the variable empathy, willingness to assist, and voluntary activity are highly significant (o<.001). Considering the entire pathway of impact, digital socialization promotes environmental altruism, particularly an estimate of .714 for an overall influence on voluntary beahvior and the desire to help. The effect indicates a significant influence on the students' enthusiasm to collaborate with activities and initiatives relative to ecological conservation and preservation.

Environmental literacy and awareness play a major role in mediating the impact of digital socialization. This finding is supported by the outcomes of the overall indirect impact which are reflected in the data analysis. The indirect effect on empathy is noteworthy as this is larger than its overall impact estimate (estimate=.733, p<.001). Digital platforms are particularly successful when they use educational or cognitive mediators to bridge the gap between digital connection and charity, rather than fostering empathy through direct contact alone. The ability of the digital environment to channel information through structured cognitive layers is its core value, as evident by the indirect paths to voluntary activity (.546) and the desire to help (.657), both of which maintain significant statistical significance.

The results suggest that although direct use of digital tools and applications may not have much of an impact on environmental altruism on its own, its cumulative effect through indirect impacts is transformative for pro-environmental behavior. The data reveals a mediation-heavy paradigm in which a series of internal alterations are triggered by the digital socialization process.

These findings suggest that digital engagement tactics should be seen by educators as the beginning of a more comprehensive cognitive journey rather than as stand-alone solutions. It is possible to optimize the overall good influence on an individual's empathy and ultimate commitment to voluntary environmental action by concentrating on the indirect pathways, particularly by increasing literacy and understanding through digital methods.

The route analysis revealed a large disparity between the magnitude of the direct and indirect effects, especially with regard to empathy. The overall indirect effect of digital socialization on empathy actually reaches as higher value of .733, despite the total effect being recorded at .628. This implies that the non-significant direct effects observed in the earlier phases of the investigation are offset by the powerful indirect pathways made possible by mediators like literacy and awareness. This emphasizes the need for a planned strategy in digital environments because the emotional connection to environmental issues is a fostered result of the cognitive processing of information rather than a direct consequence of screen time and social media involvement.

The z-value of 13.34 manifests a strong support to the total effects suggesting the model's statistical significance. The z-value of 16.55 further strengthens the relationship between digital socialization and voluntary behavior. These z-values evidently show of the overall effect of digital socializing for this particular group of sampled students. The z-values of 7.066 to 8.471 clearly indicates that the overall synergy of the combined pathways could be considered as the most reliable predictor for behavioral intention in ecological contexts.

A highly integrated psychological process is manifested between digital socialization and the act and the purpose to act. This is evident in the identical total effect estimates of .714 for voluntary action and the desire to assist. The development of the underlying desire may be somewhat more dependent on mediation than the shift into physical action. This is shown in the values of indirect components (.667 for desire and .546 for voluntary). Transition to actual voluntary participation may be supported by internal motivation to assist as well as direct digital cues or social influences. This can be achieved through education and awareness in the context of structural equation modeling.

TABLE 3
Total effects and total indirect effects

Variables	Estimates	Std. error	z-value	P
Digital socialization → Empathy	0.628	0.054	11.73	<.001
Digital socialization → Desire to help	0.714	0.054	13.34	<.001
Digital socialization → Voluntary	0.714	0.043	16.55	<.001
Total indirect effects				
Digital socialization → Empathy	0.733	0.086	8.471	<.001
Digital socialization → Desire to help	0.657	0.093	7.066	<.001
Digital socialization →Voluntary	0.546	0.072	7.603	<.001

Path coefficient

The path coefficient is a value that is useful to indicate the direction of the relationship to the variable, whether a hypothesis has a positive or negative direction. The path coefficient has a value in the range of -1 to 1. If the value is in the range of 0 to 1, it can be stated as positive, whereas if the value is in the range of -1 to 1, it can be stated as negative. The positive and negative relationship between latent variables and their indicators can be seen in Table 4.

TABLE 4
Path coefficients

Variables	Estimates	Std. error	z-value	p-value
Environmental literacy → Empathy	0.54	0.119	4.53	<.001
Environmental awareness → Empathy	0.413	0.064	6.505	<.001
Ecological concern → Empathy	0.05	0.06	0.836	0.403
Digital socialization → Empathy	-0.104	0.09	-1.156	0.248
Environmental literacy → Desire to help	0.546	0.134	4.085	<.001
Environmental awareness → Desire to help	0.123	0.071	1.726	0.084
Ecological concern → Desire to help	0.254	0.067	3.773	<.001
Digital socialization → Desire to help	0.057	0.101	0.561	0.575
Environmental literacy → Voluntary	0.413	0.101	4.093	<.001
Environmental awareness → Voluntary	0.297	0.054	5.521	<.001
Ecological concern → Voluntary	0.036	0.051	0.713	0.476
Digital socialization → Voluntary	0.168	0.076	2.199	0.028
Digital socialization → Environmental consciousness	0.803	0.028	28.98	<.001
Digital socialization → Environmental awareness	0.657	0.052	12.69	<.001
Digital socialization → Ecological concern	0.545	0.046	11.79	<.001

Table 4 shows the path coefficients depicting the structural relationships between environmental literacy, digital socialization, awareness, ecological concern and altruism in terms of empathy, desire to help and voluntary behavior.

As manifested in the data analysis, environmental literacy and environmental awareness played significant drivers of empathy with path estimates of .540 and .413, respectively (both p<.001). Environmental literacy maintains a strong positive influence on desire to help (estimate=.546, p<.001) and voluntary actions or behaviors at (estimate=.413, p<.001). However, ecological concern (p=.403) and digital socialization (p=.248) did not statistically and directly impacted empathy.

Viewing digital socialization and its impact, it appeared that digital socialization was highly significantly related to voluntary behaviors, environmental consciousness, environmental awareness, and ecological concern. It acts as a strong catalyst for environmental consciousness (estimate=.803, p<.001), environmental awareness (estimate=.657, p<.001), and ecological concern (estimate=.544, p<.001). However, its direct impact on voluntary behavior as a measure of environmental altruism is relatively modest (estimate=.168, p=.028).

It can be inferred from the path coefficients that digital socialization has the strongest relationship with environmental consciousness. There are paths which reflected non-significance like ecological concern toward empathy, digital socialization toward the desire to help as these did not meet the standard threshold for statistical significance. On the other hand, environmental literacy appeared to have significant estimates for all measures of environmental altruism like empathy, desire to help and voluntary behaviors.

The results indicate objective knowledge and literacy predicted pro-environmental attitudes. This is strengthened by Ienna et al. who noted that educational programs emphasizing cognitive skills and ecological knowledge may be more successful than those that only directs empathy. Environmental literacy has strong path coefficients for empathy (.540) and willingness to help (.546).

According to Poskakalova and Sorokova, digital socialization paved a way for younger individuals to develop a foundation of environmental consciousness and awareness. Helping people to enhance their social skills and guidelines for environmentally friendly behavior is crucial for forming the values of contemporary generations [14].

CONCLUSIONS

High levels of validity and reliability are shown by all variables, including digital socialization, environmental literacy, environmental awareness, ecological concern, and environmental altruism in terms of empathy, desire to help and voluntary behavior. These offer a strong basis for investigating the connections between digital socialization and every other factor. Strong internal consistency across all latent variables is depicted by the Cronbach alpha and composite reliability score values. Clear convergent validity is indicated by the AVE exceeding the threshold.

The most effective way to promote empathy and a desire to help is through environmental literacy. Digital platforms that concentrate on developing objective knowledge are thought to be the most successful.

Digital socialization significantly drives empathy, desire to help and voluntary behavior when all pathways are considered. The cognitive processing of information in digital environments compensates for a lack of direct emotional connection. Digital engagement serves as a catalyst for internal psychological changes provided that education and awareness are integrated into the digital experience. This also pave the way for the

students' enhancement of their environmental consciousness and awareness.

When all paths are taken into account, digital socialization greatly increases empathy, the desire to help and voluntary activity. The absence of a direct emotional connection is made up for by the cognitive processing of information in digital contexts. If education and awareness are incorporated into the digital experience, digital engagement can act as a catalyst for internal psychological changes. This opens the door for the students to become more environmentally concerned and informed.

Since cognitive abilities and objective comprehension are the most accurate indicators of long-term behavioral intention, environmental advertising should place a higher priority on providing actionable knowledge and literacy than on merely making emotional appeals.

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