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Clustering technique for analysing environmental attitude among undergraduate students in Purulia district, West Bengal

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ABSTRACT

This study aims to explore inter-dimension relationships in the environment, identifying clusters based on independent variables (Stream, gender, location) and their consequences on Environmental Behaviour (EB), Environmental Opinion (EO), and Environmental Emotion (EE) among undergraduates in Purulia district, West Bengal. Using a descriptive survey method with randomly sampled participants, the study employs the “Environmental Attitude Scale” developed by Uzun et al. (2019) and statistical techniques such as the Product Moment Method for calculate and Two-Step Clustering techniques. The results reveal significant correlations between Environmental Behaviour (EB), Environmental Emotion (EE), Environmental Attitude (EA), and Environmental Opinion (EO). Factors like Stream, gender, and location contribute to distinct clusters, emphasizing their influence on environmental aspects. Overall, the study provides valuable insights into the multifaceted dynamics of environmental attitudes and behaviours, underscoring the importance of considering various factors in addressing environmental issues.

Keywords: Environmental Attitude, cluster analysis, Environmental behaviour, Predictors, Environmental opinion, Undergraduate students, Environmental emotion, Simple random sampling.

INTRODUCTION

We all are very closely associated with the modern technology, therefore we erosion our awareness towards our environment day by day. In a world grappling with the escalating challenges of climate change, pollution, and resource depletion, the significance of individual and collective environmental attitudes cannot be overstated. The term "environmental attitude" encapsulates the complex web of beliefs, values, and behaviours that shape our relationship with the natural world.

Environmental factors significantly shape human health outcomes, including air and water quality, exposure to toxins, access to green spaces, and clean energy sources. Conversely, human and societal health directly affects the environment, with unhealthy practices like excessive consumption, pollution, and deforestation hastening environmental degradation and endangering sustainability (Das et al., 2023). It advocates for the safeguarding of the environment, the establishment of social fairness, the maintenance of economic stability, the conservation of resources, efforts to mitigate climate change, and the preservation of cultural heritage (Das et al., 2023). Navigating the complexities of this new era requires a crucial understanding of the multifaceted dimensions of 21st-century lifestyle (Adhikari, 2023). Clustering, a core statistical method, plays a crucial role in data analysis, pattern recognition, and machine learning (Das, 2023). Employing specific traits, this technique clusters akin data points, unveiling concealed patterns within a dataset (Das et al., 2023). In clustering, the main objective is to group data into clusters where data points within the same cluster are more similar to each other than to those in other clusters. This simplifies large datasets, aiding knowledge of statistics and data science in better understanding and decision-making (Mahato et al., 2023). Various studies have employed this technique such as Mahato et al. (2024), Das et al. (2024) etc.

LITERATURE REVIEW

Uzun et al. (2019) carried out "environmental attitude scale for secondary school, high school and undergraduate (UG) students: validity and reliability study." Major goal of the study is to create a valid and trustworthy Environmental Attitude Scale. The findings thereafter demonstrate that the scale may be used to gauge students' environmental attitudes at various levels. Islam & Bhuiyan (2018) proposed a comprehensive approach for the Sundarbans mangrove forest's preservation, addressing threats from human activities and natural factors. Salloum et al. (2021) explored the impact of Cancer Centre Cessation Initiative (C3I) on national tobacco treatment. Their study revealed that C3I played a pivotal role in catalysing tobacco treatment, providing continuous learning, adaptive programs, sustainability assessment, implementation strategy, health impact sustainability, research advancement, policy alignment, and SWG knowledge dissemination for cancer care organizations within and beyond C3I. Dian et al. (2022) explored the interplay between green human resources management, green supply chain, environmental sustainability, and green businesses in Central Java. Their conceptual model provided practical recommendations for enhancing manufacturing company performance, contributing significantly to HRM and supply chain management literature. Kumari (2022) studied the impact of lifestyle choices on the environment, emphasizing sustainable practices in food, transportation, and daily life for an eco-friendlier future. Roberts et al. (2022) discovered a link between positive lifestyle behaviours, emotional health factors, and low back pain resilience, highlighting the importance of optimal choices for maintaining high function despite pain. Stillwell et al. (2023) delved into resource consumption and sustainability in the built environment, examining infrastructure through various lenses. Their study addressed local and global factors, urban dependencies, and digital technology's role, emphasizing adaptive planning, climate neutrality, equity, and well-being. Hendriyani et al. (2023) investigated the Independent Curriculum's implementation through a project on sustainable lifestyle for Grade 10 students. Results indicated a 70.7% positive impact on environmental awareness, showcasing the effectiveness of the curriculum. Duarte et al. (2023) focused on lifestyle entrepreneurship as a vehicle for sustainable tourism, promoting economic progress, environmental balance, public health, and social context through decision tools and renewable biomass energy. Scozzese & Gelli (2023) discussed lifestyle branding as a sustainable strategy, fostering eco-consciousness through climate solutions and environmental stewardship advocacy. Dey & Bairagya

(2023) emphasized the green economy as a roadmap for a sustainable lifestyle, transforming quality of life, promoting sustainability, and driving economic and social development through a carbon-free environment and non-conventional energy. Saha et al. (2021) investigated Yoga Attitudes among College Students using Clustering Techniques. They found the college location to be a significant factor, forming clusters, especially among rural male and female students who shared similar opinions on yoga practices. Gorain et al. (2022) examined the "Relationship and Cluster Analysis among Internet Dependency, Social Isolation, and Personality." They found low to mediocre correlations in arts and science learners, revealing three distinct clusters: separate male and female arts clusters and a distinct science cluster. Ansary et al. (2023) delved into "Attitudes towards Value-oriented Education among UG Students using Clustering Techniques." They identified location as the most significant predictor, noting no correlation between academic achievement and attitudes toward value-oriented education. Mohanta et al. (2023) explored Institutional Commitment using Cluster Analysis, revealing clusters (Female and Male, Rural and Urban Institutions) that positively impacted Predictor influence. Professional Commitment emerged as the most influential dimension in cluster formation. In a study by Sen et al. (2023a), they explored Leadership Style in Institutions using Clustering Techniques. As cluster count increased, so did predictors, with location consistently being the most crucial predictor. Similar leadership styles were observed based on institution location. Mahalanobis Distance gauges the strength of Cluster Analysis in educational contexts (Adhikari, 2023; Adhikari et al., 2023a; 2023b; Mahato & Sen, 2021; Sen & Pal, 2020; Sen et al., 2023a; 2023b; 2023c; Ahamed et al., 2020; 2021; 2022a). Adhikari & Sen (2023a) focused on Cluster Analysis of Institutional Commitment and Organizational Climate. Across gender and rural-urban settings, teachers' views on institutional commitment and organizational climate remained similar. In another study by Adhikari & Sen (2023b) on Recent Trends of Cluster Analysis in Education, they highlighted the role of predictor counts, their relation to socio-psychological variables, and the increase in predictor values with cluster count.

Present study explores various clusters using dichotomous variables steam, gender and locality on Environmental Attitude with its dimensions Environmental Behaviour (EB), Environmental Opinion (EO), and Environmental Emotion (EE). Different number of clusters are considered for analysing cluster formation and respective predictors with their degree of prediction (high, mediocre, low and very low). Two step clustering technique use for detection of clusters.

OBJECTIVES OF THE STUDY

- To Explore inter-dimension relationships in the Environment.
- To Identify clusters based on independent variables (Stream, gender, location) and their consequences on Environmental Behaviour (EB), Environmental Opinion (EO), and Environmental Emotion (EE).
- To Assess predictor significance in cluster formation.

METHODOLOGY

Method: Descriptive survey is utilized in this study.
Population: All undergraduates of Purulia district in West Bengal.
Sample: 149 undergraduates were randomly sampled for the research.
Sampling procedure: Sampling was done using simple random sampling technique.
Tool used: "Environmental Attitude Scale developed by Uzun et al. (2019) used in this study to collect the data from samples.

Statistical technique used: The study applies the Product Moment Method to calculate correlation coefficients and employs a Two-Step Clustering technique to categorize the entire sample into distinct clusters.

RESULT AND DISCUSSION

Table 1 value of r for Environmental Attitude and its component

Correlations

		EB	EO	EE	EA
EB	r	1	-.005	.494**	.843**
	Level of significance		.951	.000	.000
EO	r	-.005	1	-.350**	.178*
	Level of significance	.951		.000	.030
EE	r	.494**	-.350**	1	.756**
	Level of significance	.000	.000		.000
EA	r	.843**	.178*	.756**	1
	Level of significance	.000	.030	.000	

.01 level significance is detected

.05 level significance is detected

From table 1 Environmental behaviour is correlated (.01 level of significance) with Environmental Emotion and Environmental Attitude. Environmental Opinion (EO) is significantly correlated (.01 and .05 level of significance) with Environmental Emotion and Environmental Attitude. Environmental Emotion is significantly correlated (.01 level of significance) with Environmental Attitude. Above mentioned results showed that pair wise relationships are significant at .01 and .05 level of significances. This is the conclusion about objective 1 which states “Explore inter-dimension relationships in the environment”.

Table 2: formation of 2 clusters

Clusters

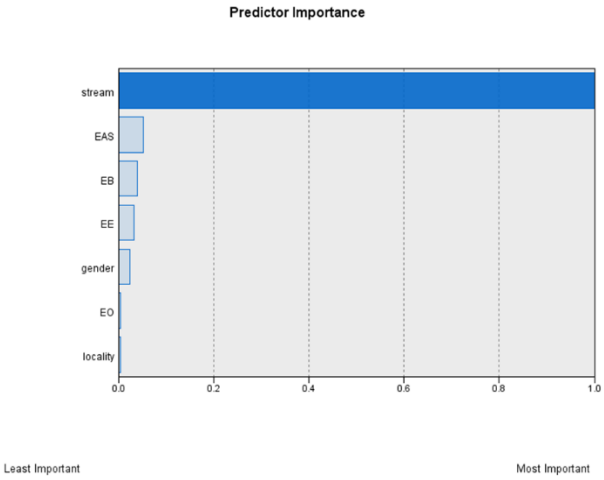
Input (Predictor) Importance

1.0 0.8 0.6 0.4 0.2 0.0

Cluster	1	2
Label		
Description		
Size	78.5% (117)	21.5% (32)
Inputs	stream arts (100.0%)	stream science (100.0%)
	EAS 123.26	EAS 130.88
	EB 39.97	EB 43.47
	EE 57.27	EE 60.88
	gender male (65.0%)	gender male (78.1%)
	EO 26.02	EO 26.53
	locality urban (75.2%)	locality urban (78.1%)

Urban students (75.2%) mainly formed by the stream arts (100%) and male UG students (65.0%) formed cluster 1 (represented in table 2), with 78.5% of the total sample size. Cluster 2 is consisting of urban UG students (78.1%), dominated by science UG students (100.0%), and male UG students (78.1%) and made up of 21.5% of total sample size.

Figure 1: Clusters according to impotence of predicters (from table 2)



From figure 1, it is clear that stream is the major predictor of clusters, where Environmental Attitude (EA), Environmental Behaviour (EB), Environmental Emotion (EE) and gender are low and environmental opinion and locality are negligible predictors.

Table 3: formation of 3 clusters

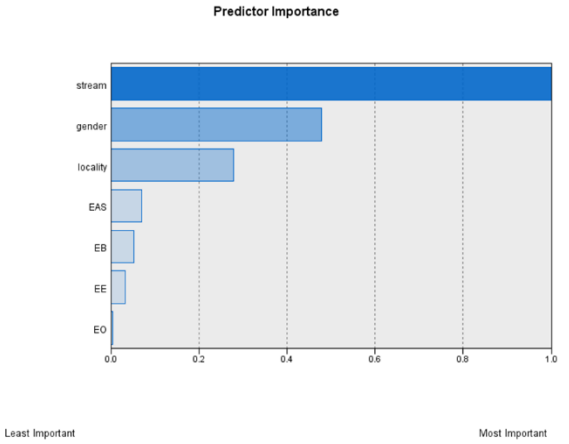
Clusters

Input (Predictor) Importance
1.0 0.8 0.6 0.4 0.2 0.0

Cluster	3	1	2
Label			
Description			
Size	40.3% (60)	38.3% (57)	21.5% (32)
Inputs	stream arts (100.0%)	stream arts (100.0%)	stream science (100.0%)
	gender male (100.0%)	gender female (71.9%)	gender male (78.1%)
	locality urban (100.0%)	locality rural (50.9%)	locality urban (78.1%)
	EAS 126.45	EAS 119.91	EAS 130.88
	EB 41.48	EB 38.39	EB 43.47
	EE 58.48	EE 56.00	EE 60.88
	EO 26.48	EO 25.53	EO 26.53

Rural students (50.9%) mainly formed by the stream arts (100%) and female UG students (71.9%) formed cluster 1 (represented in table 3), with 38.3% of the total sample size. Cluster 2 is consisting of urban UG students (78.1%), dominated by science UG students (100.0%), and male UG students (78.1%) and made up of 21.5% of total sample size. Cluster 3 consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%) and is total sample size 40.3%.

Figure 2: Clusters according to impotence of predicters (from table 3)



From figure 2 it is clear that stream, shows us major predictor of clusters, mediocre in gender and locality is low predictor. where Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) Environmental Opinion (EO) are the low predictors of the cluster mentioned in Table 3.

Table 4: formation of 5 clusters

Clusters

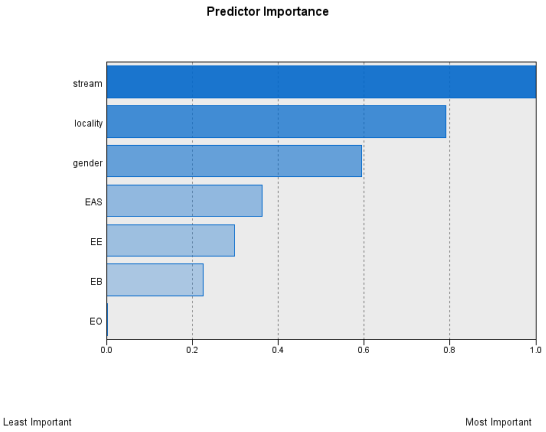
Input (Predictor) Importance 1.0 0.8 0.6 0.4 0.2 0.0

Cluster	3	2	1	5	4
Label					
Description					
Size	26.8% (40)	21.5% (32)	19.5% (29)	18.8% (28)	13.4% (20)
Inputs	stream arts (100.0%)	stream science (100.0%)	stream arts (100.0%)	stream arts (100.0%)	stream arts (100.0%)
	locality urban (100.0%)	locality urban (78.1%)	locality rural (100.0%)	locality urban (100.0%)	locality urban (100.0%)
	gender male (100.0%)	gender male (78.1%)	gender male (55.2%)	gender female (100.0%)	gender male (100.0%)
	EAS 135.50	EAS 130.88	EAS 117.55	EAS 122.36	EAS 108.35
	EE 64.15	EE 60.88	EE 54.62	EE 57.43	EE 47.15
	EB 45.45	EB 43.47	EB 37.31	EB 39.50	EB 33.55
	EO 25.90	EO 26.53	EO 25.62	EO 25.43	EO 27.65

Rural students (100%) mainly formed by the stream arts (100%) and male UG students (55.2%) formed cluster 1 (represented in table 4), with 19.5% of the total sample size. Cluster 2 is consisting of urban UG students (78.1%), dominated by science UG students (100.0%), and UG students of male category (78.1%) and counting 21.5% of total sample size. Cluster 3 consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and UG students of male category (100.0%) and is total sample size 26.8%. cluster 4 is UG students of urban category (100.0%), dominated by arts UG students (100.0%), and UG students of male category (100.0%), and is total sample size 13.4%. cluster 5 is UG students of urban

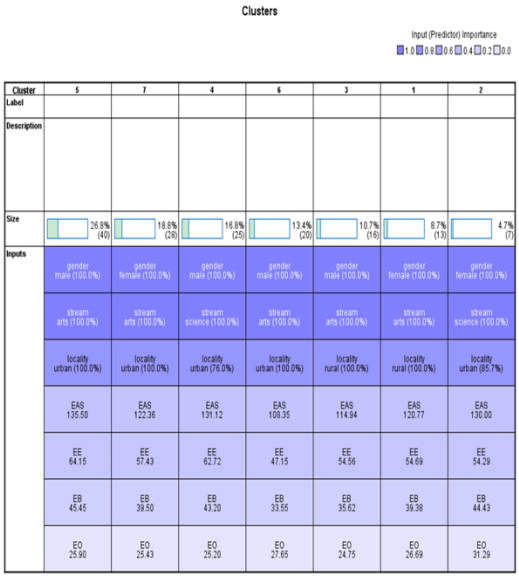
category (100.0%), dominated by arts UG students (100.0%), and female UG students (100.0%), and is total sample size 18.8%.

Figure 3: Clusters according to impotence of predicters (from table 4)



From figure 3 it is clear that stream, and locality are major predictor and gender is mediocre of clusters, where Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) are low predictors and Environmental Opinion (EO) is very low predictors of the cluster mentioned in Table 4.

Table 5: formation of 7 clusters

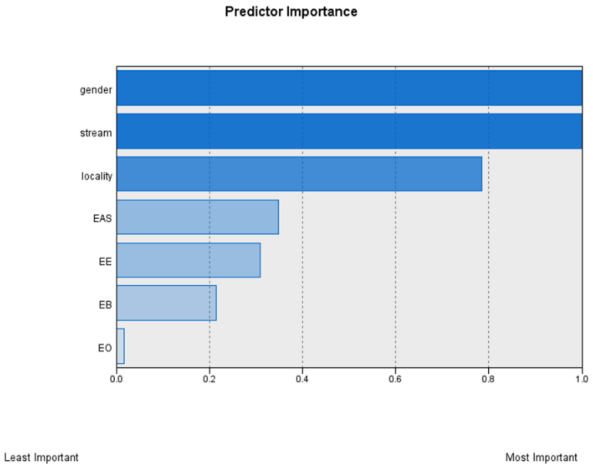


Cluster	5	7	4	6	3	1	2
Label							
Description							
Size	26.8% (40)	18.8% (28)	16.8% (25)	13.4% (20)	10.7% (16)	8.7% (13)	4.7% (7)
Inputs	gender male (100.0%)	gender female (100.0%)	gender male (100.0%)	gender male (100.0%)	gender male (100.0%)	gender female (100.0%)	gender female (100.0%)
	stream arts (100.0%)	stream arts (100.0%)	stream science (100.0%)	stream arts (100.0%)	stream arts (100.0%)	stream arts (100.0%)	stream science (100.0%)
	locality urban (100.0%)	locality urban (100.0%)	locality urban (76.0%)	locality urban (100.0%)	locality rural (100.0%)	locality rural (100.0%)	locality urban (85.7%)
	EAS 135.50	EAS 122.36	EAS 131.12	EAS 109.35	EAS 114.94	EAS 126.77	EAS 130.00
	EE 64.15	EE 57.43	EE 62.72	EE 47.15	EE 54.56	EE 54.69	EE 54.29
	EB 45.45	EB 39.50	EB 43.20	EB 33.55	EB 35.62	EB 39.38	EB 44.43
	EO 25.90	EO 25.43	EO 25.20	EO 27.65	EO 24.75	EO 26.69	EO 31.29

Rural students (100%) mainly formed by the stream arts (100%) and female UG students (100%) formed cluster 1 (represented in table 5), with 8.7% of the total sample size. Cluster 2 is consisting of urban UG students (85.7%), dominated by science UG students (100.0%), and female UG students (100.0%) and made up of 4.7% of total sample size. Cluster 3 consisting of rural UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%) and is total sample size 10.7%. cluster 4 is consisting of urban UG students (76.0%), dominated by science UG students (100.0%), and male UG students (100.0%), and is total sample size 16.8%. cluster 5 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%), and is total sample size 26.8%. cluster 6 is

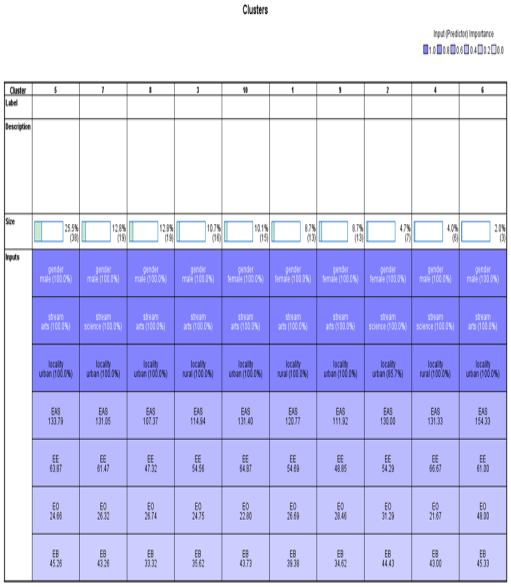
consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%), and is total sample size 13.4%. cluster 7 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and female UG students (100.0%), and is sample size 18.8% of total sample.

Figure 4: Clusters according to impotence of predicters (from table 5)



From figure 2 it is clear that stream, gender and locality are major predictor of clusters, where Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) are low predictors and Environmental Opinion (EO) is very low predictors of the cluster mentioned in Table 5.

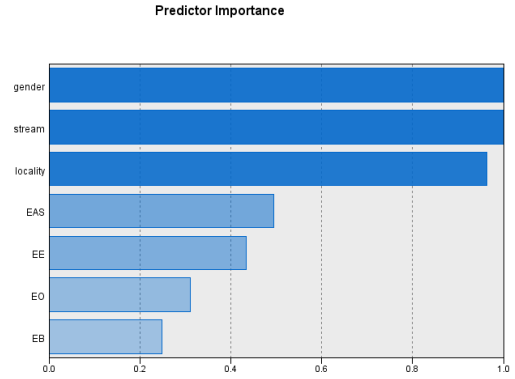
Table 6: formation of 10 clusters



Rural students (100%) mainly formed by the stream arts (100%) and female UG students (100%) formed cluster 1 (represented in table 5), with 8.7% of the total sample size. Cluster 2 is consisting of urban UG students (85.7%), dominated by science UG students (100.0%), and female UG students (100.0%) and made up of 4.7% of total sample size. Cluster 3 consisting of rural UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%) and is total sample size 10.7%. cluster 4 is consisting of rural UG students (100.0%), dominated by science UG students (100.0%), and male UG students

(100.0%), and is total sample size 4.0%. cluster 5 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%), and is total sample size 25.5%. cluster 6 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%), and is total sample size 2.0%. cluster 7 is consisting of urban UG students (100.0%), dominated by science UG students (100.0%), and male UG students (100.0%), and is total sample size 12.8%. cluster 8 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and male UG students (100.0%), and is total sample size 12.8%. cluster 9 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and female UG students (100.0%), and is total sample size 8.7%. cluster 10 is consisting of urban UG students (100.0%), dominated by arts UG students (100.0%), and female UG students (100.0%), and is total sample size 10.1%.

Figure 5: Clusters according to impotence of predicters (from table 6)



From figure 5 it is clear that stream, gender and locality, are major predictor of clusters, where Environmental Attitude (EA), Environmental Opinion (EO) and Environmental Emotion (EE) are mediocre predictors and Environmental behaviour is very low predictors of the cluster mentioned in Table 6.

To achieve objectives 2 and 3, refer to the table below:

Table 7: Cluster and Predictor summary

Number of clusters	High predictor	Mediocre predictor	Low predictor
2	Stream		Environmental Attitude (EA), Environmental Behaviour (EB), Environmental Emotion (EE) and Gender Environmental Opinion (EO) and Locality
3	Stream	Gender and Locality	Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) Environmental Opinion (EO)
5	Stream	Gender	Locality, Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) Environmental Opinion (EO)
7	Stream and Locality	Gender	Environmental Attitude (EA), Environmental Behaviour (EB) and Environmental Emotion (EE) Environmental Opinion (EO)
10	Stream, Gender and Locality	Environmental Attitude (EA) and Environmental Emotion (EE)	Environmental Opinion (EO) Environmental Behaviour (EB)

Table 7 displays the clusters and their predictors, revealing variations in cluster size and predictors, especially notable when examining clusters with 3, 5, 7, and 10 elements. Remarkably, the smallest cluster (2.0%) remains consistent across these numbers. Addressing objective 2, focusing on identifying clusters based on independent variables (Stream, gender, location) and their influence on Environmental Behaviour (EB), Environmental Opinion (EO), and Environmental Emotion (EE), suggests that specific dependent and independent variables contribute to cluster formation. Moving to objective 3, which involves evaluating predictor significance in cluster formation, it was observed that with two clusters, Stream emerges as a crucial predictor. As the number of clusters increases, Stream, Gender, and Locality become significant predictors, emphasizing their role in cluster formation, particularly with ten clusters.

CONCLUSION

In summary, this study successfully achieved its objectives by establishing significant correlations between environmental behaviour, emotion, attitude, and opinion. The intricate inter-dimension relationships within the environmental context were highlighted, and the exploration of clusters revealed variations in size and predictors. Factors such as Stream, gender, and location were identified as contributors to distinct clusters, shedding light on their influence on environmental behaviour, opinion, and emotion. The study's findings provide valuable insights into the multifaceted dynamics of environmental attitudes and behaviours, emphasizing the importance of considering various factors in understanding and addressing Environmental issues.

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