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UNDERSTANDING INTERNET ADDICTION THROUGH CLUSTERING: A STUDY OF UNDERGRADUATE STUDENTS IN PURULIA DISTRICT

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RESEARCH ARTICLE

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Abstract

This study explores the clustering patterns focusing on undergraduate students from West Bengal's Purulia District based on Internet addiction and selected demographic variables - Gender, Residence and Stream. Employing a descriptive survey approach, data were gathered from 400 students through simple random sampling. The Internet addiction test scale (Young, 1998) was utilized to identify Internet addiction levels. A two-step clustering technique was applied to identify clustering and analyse the significance of predictors. Findings reveals that both demographic and research variables contribute to cluster formation with predictor importers varying by the number of clusters. Residents emerge as the key predictor in a two-cluster model, while gender gain, significance with additional clusters. When five clusters are formed, gender remains influential and with seven or 10 clusters, the stream also plays a crucial role. Notably, the smallest cluster remains stable across different cluster configuration. These results highlight the dynamic role of demographic predictors in clustering, providing insights into the factors influencing Internet addiction among undergraduate students.

Keywords: *Clustering patterns, Undergraduate students, Internet addiction, Predictor Importance*

Introduction

The Internet plays a vital role in our daily lives, influencing communication, education, business and entertainment. It has made staying connected easier through social media, emails, and video calls. Online learning platforms provide access to education from anywhere in the world. Businesses thrive with E-commerce, Digital marketing and remote work opportunities. Entertainment is more accessible through streaming services, gaming and social media. The Internet also helps in gathering information instantly, making research and decision making faster. However, it comes with challenges like cybersecurity threats and misinformation. Responsible usage is essential to ensure digital safety. Despite its risk the Internet remains a powerful tool for growth and connectivity. Its impact will continue to shape the future of society. Many people struggle with screen time management, leading to social isolation and reduced focus. Responsible usage is crucial to balance online and offline life. While the Internet is powerful tool, moderation is key to avoiding its negative effects.

In the 21st century, educational research has seen remarkable progress, driven by the integration of advanced statistical techniques. Researchers now utilise a range of analytical methods, including t-tests, correlation analysis, Mahalanobis distance and the Mann-Whitening U test, among others, to enhance the depth and accuracy of their studies.

The t-tests, in particular, has been widely adopted across numerous studies. Notable contributions in this area include works by Mahanti, Mondal, and Saha (2016); Das, Gayen, and Sen (2023b); Adhikari et al. (2023c); Mahato and Sen (2021a, 2023a); Mondal and Saha (2023); Mondal et al. (2018); Karmakar et al. (2016); Saha (2012a, 2021); Sen, Mondal, and Saha (2013); Mondal and Saha (2013); Ansary, Saha, and Gorain (2021); Khan et al. (2023); Khatun, Ansary, and Adhikari (2022); Ansary, Ansary, and Adhikari (2022); Dandapat et al. (2021); Gayen and Sen (2023a, 2023b); Rajak and Gayen (2022); and Gayen et al. (2021); Das (2025b).

Correlation analysis also played a significant role in recent research efforts. Key studies in this domain include those by Das and Mahato (2024b); Das and Mahato (2024c); Gayen and Sen (2021); Mahato and Das (2024a); Sutradhar and Sen (2022a, 2022b); Sutradhar et al. (2023); Mahato and Sen (2023b); Gayen, Sen, and Adhikari (2023); Adhikari, Mahato, and Sen (2023); Mahato, Gayen, and Mahato (2023a, 2023b, 2023c); Gayen (2024); Das, Gayen, and Sen (2023a); Mahato, Das, and Gayen (2024); Das, Mahato, and Gayen (2024); Sen et al. (2023b); and Kar and Saha (2021a, 2021b).

Furthermore, Mahalanobis Distance has been applied in various research contexts. Important studies include those by Sen and Pal (2020); Das (2023); Mahato and Sen (2021b); Ahmed et al. (2022); Sen et al. (2023c); Adhikari (2023a, 2023b); Mohanta et al. (2023b, 2023c); Sen, Pal, and Adhikari (2023); Das (2025a); Mahato and Das (2024b).

Lastly, Mann-Whitney U test has been employed extensively in statistical research. Some prominent studies utilizing this method include those by Halder et al. (2022); Sen et al. (2021a, 2021b); Mahato et al. (2022); and Saha and Adhikari (2021).

Literature Review

Sen et al. (2021) analysis leadership style using clustering techniques and found location to be the most significant predictors, with its impact, increasing as cluster numbers rise. Milkha et al. (2022) identified that 6% of Czech University students exhibit Internet addiction with a higher prevalence among males, younger individuals and full-time students. Saha et al., (2021) studied college students' attitude towards yoga and discovered that rural male and female students share similar views with location, playing a key role in cluster formation. Dermani and Perdikaris (2022) highlighted the detrimental impact of Internet addiction on adolescents' mental health advocating for targeted interventions. Adhikari and Sen (2023) explored institutional commitment and organisational climate revealing that teachers' perspectives remain consistent of gender and rural-urban areas. Molina et al. (2025) linked excessive internet use of increased rates of depression, anxiety and low self-esteem in adolescent. Ansary et al. (2023) examined attitude towards value-oriented education identifying location as the high influential factor while academic performance showed no correlation with attitudes. Bisen and Deshpande (2018) Compared problematic internet use of substance addiction particularly in adult males. Mohanta et al. (2023) Used cluster analysis to study institutional commitment and found that predictor influence increase with plaster count with professional commitment being the strongest factor. Mukand (2023) observed a negative correlation found between Internet addiction and academic performance emphasizing the need for responsible usage. Adhikari and Sen (2023b) Investigated trend in education related clustering, highlighting the role of predictor variables and their increasing values as cluster numbers grow. Raina and Bhatt (2021) Highlighted gender-based differences noting, higher anxiety level in boys and a greater depression in girls due to Internet addiction. Gorain et al. (2022) analysed Internet dependency and social isolation and personal traits, finding low of moderate correlations and three distinct clusters among art and science students. Sharma et al. (2020) linked excessive Internet use of psychosocial issues such as anxiety and OCD. Kaur et al., (2020) found that Internet addiction negatively impact the mental health and social well-being of medical students. Menon et al. (2018) reported moderate addiction levels among Indian students, with older males being more effected. Singh et al. (2023) associated social media addiction with ADHD and heightened stress among medical students. Sen et al., (2025) analysed environmental attitude among undergraduates in Purulia, West Bengal using clustering techniques revealing a consistent small cluster 2.0 % and growing influence of stream, gender and location on environmental behaviour, opinion and emotion across 3, 5, 7 and 10 clusters models.

Objectives of the study

The present research aims to fulfil the following objectives:

1. To identify clusters based on demographic variables such as gender, place of residence and academic stream, in conjunction with the research variable – Internet addiction.
2. To evaluate the relative significance of these predictors in the formation of the identified clusters.

Methodology of the study

Method: A descriptive survey design was adopted for the purpose of this study.

Population of the study: All the undergraduate students of Purulia District of West Bengal.

Sample and Sampling Technique: A representative sample of 400 undergraduate students were selected through a simple random sampling method.

Tools used: The primary tool used for data collection was The Internet Addiction Test Scale, developed by Young in 1998, to assess the level of Internet addiction among the participants.

Statistic used: To Categorize the sample into meaningful groups, a two-step clusters analysis was performed.

Result and Discussion

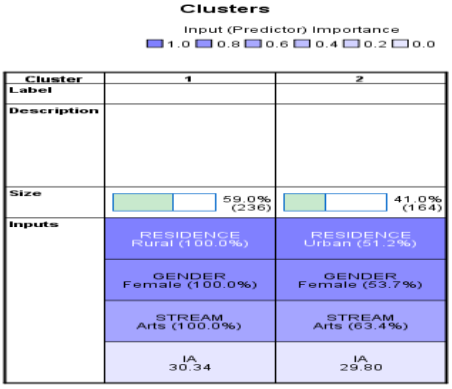

Table 1: Formation of two-clusters

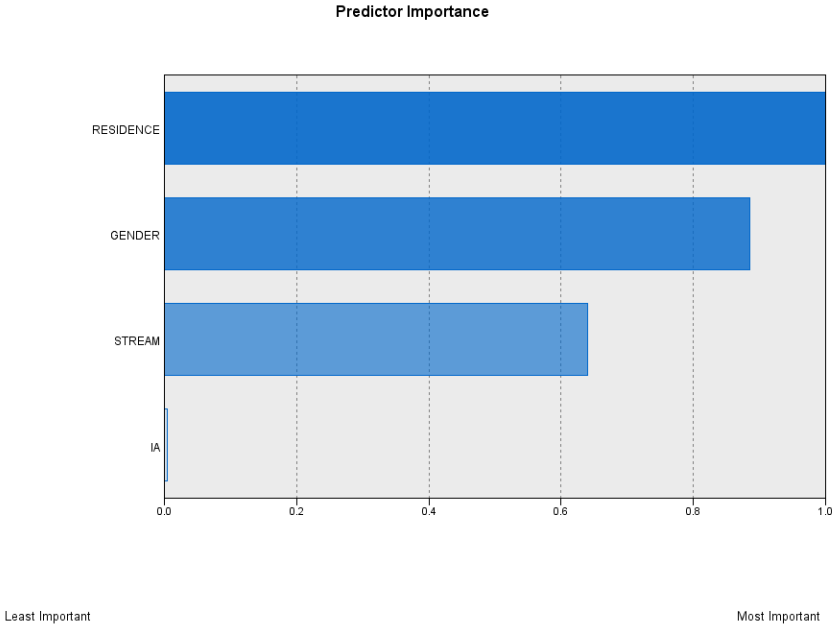

Figure 1: Predictor importance for the clusters described in table 1

Table 1 illustrates the Grouping of undergraduate students into two distinct clusters. Cluster 1 is entirely composed of rural (100%) students, all of whom are female (100%) and enrolled in arts (100%) programs, making up 59.0% of the overall sample. In contrast, cluster 2 comprises 51.2% urban students, with a majority studying arts (63.4%) and a slight for predominance of female students (53.7%), accounting for 41.0% of the sample. As depicted in figure 1, residential background emerges as the strongest factor influencing cluster formation, while academic stream and gender play moderate roles. Internet addiction, however, appears to have minimal influence on the clustering presented in table 1.

Clusters

Input (Predictor) Importance
1.0 0.8 0.6 0.4 0.2 0.0

Cluster	1	3	2
Label			
Description			
Size	59.0% (236)	22.2% (89)	18.8% (75)
Inputs	GENDER Female (100.0%)	GENDER Female (98.9%)	GENDER Male (100.0%)
	RESIDENCE Rural (100.0%)	RESIDENCE Urban (76.4%)	RESIDENCE Rural (78.7%)
	STREAM Arts (100.0%)	STREAM Arts (52.8%)	STREAM Arts (76.0%)
	IA 30.34	IA 29.75	IA 29.85

Table 2: Formation of Three-clusters

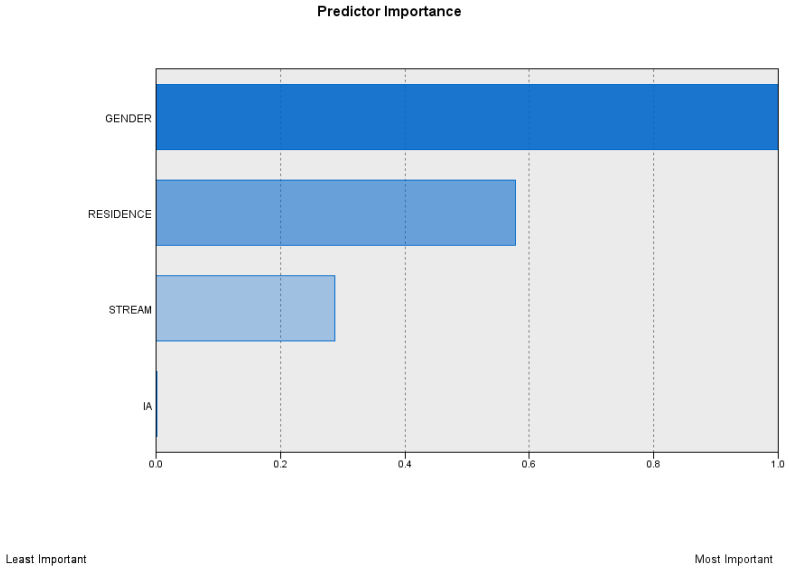

Figure 2: Predictor importance for the clusters described in table 2

Table 2 outlines the clustering of undergraduate students into three distinct groups. Cluster 1 is entirely composed of rural students (100%), all of whom are female (100%) and pursuing arts degrees (100%). This group constitutes 59.0% of the total sample. Cluster 2 primarily includes rural students (78.7%) is entirely male (100%), and has a majority of artists students (76.0%) Accounting for 18.8% of the total sample. Cluster 3 mainly features urban students (76.4%), predominantly female (98.9%) with a significant portion studying arts (52.8%). This cluster represents two 22.2% of the sample. As illustrated in figure 2, gender emerges as the most influential factor in cluster formation, followed by academic stream and place of residence, while Internet addiction has minimal influence on the clustering patterns described in table 2.

Clusters

Input (Predictor) Importance
1.0 0.8 0.6 0.4 0.2 0.0

Cluster	2	1	3	5	4
Label					
Description					
Size	36.2% (145)	22.8% (91)	18.2% (73)	11.8% (47)	11.0% (44)
Inputs	GENDER Female (100.0%)	GENDER Female (100.0%)	GENDER Male (100.0%)	GENDER Female (100.0%)	GENDER Female (93.2%)
	STREAM Arts (100.0%)	STREAM Arts (100.0%)	STREAM Arts (78.1%)	STREAM Arts (100.0%)	STREAM Science (72.7%)
	RESIDENCE Rural (100.0%)	RESIDENCE Rural (100.0%)	RESIDENCE Rural (78.1%)	RESIDENCE Urban (100.0%)	RESIDENCE Rural (52.3%)
	IA 21.15	IA 44.99	IA 29.88	IA 32.74	IA 26.52

Table 3: Formation of Five-clusters

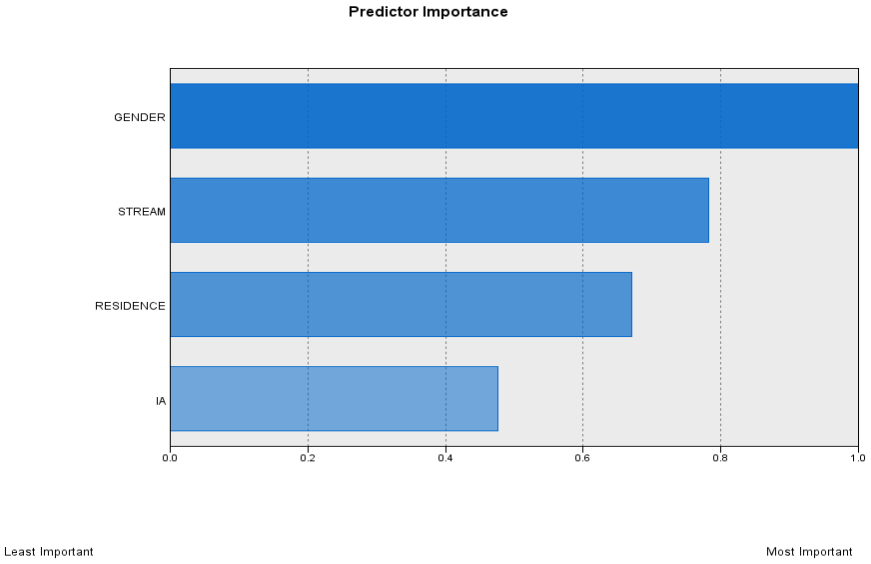

Figure 3: Predictor importance for the clusters described in table 3

Table 3 illustrates the clusters identified among undergraduate students. Cluster 1 comprises exclusively rural students (100%), with a complete representation of female students (100%) and those studying in the arts streams (100%). This group accounts for two 22.8% of the total sample. Cluster 2 also includes entirely rural undergraduates (100%), dominated by students in the arts stream (100%) and female (100%), representing 36.2% of the overall sample. Cluster 3 contains a majority of rural students (78.0%) and is heavily composed of arts students (78.1%), with male students making up the entirely (100%) of this group. This cluster constitutes 18.2% of the sample. cluster 4 features (52.2%) of rural undergraduates, predominantly from the science stream (72.7%), and mostly female (93.2%), accounting for 11.0% of the total sample size. Cluster 5 is made up entirely of urban students (100%), all of whom are female (100%), and enrolled in the arts stream (100%), contributing 11.8% to the overall sample. As illustrated in figure 3, gender emerges as the most significant factor influencing cluster formation in contrast academic stream and place of residence hold moderate importance, while Internet usage behaviour appears to have minimal impact on the clustering patterns shown in table 3.

Clusters

Input (Predictor) Importance
1.0 0.8 0.6 0.4 0.2 0.0

Cluster	2	1	3	7	4	6	5
Label							
Description							
Size	36.2% (145)	22.8% (91)	11.8% (47)	11.8% (47)	8.0% (32)	6.5% (26)	3.0% (12)
Inputs	STREAM Arts (100.0%)	STREAM Arts (100.0%)	STREAM Arts (100.0%)	STREAM Arts (100.0%)	STREAM Science (100.0%)	STREAM Science (61.5%)	STREAM Commerce (100.0%)
	GENDER Female (100.0%)	GENDER Female (100.0%)	GENDER Male (100.0%)	GENDER Female (100.0%)	GENDER Female (100.0%)	GENDER Male (100.0%)	GENDER Female (75.0%)
	RESIDENCE Rural (100.0%)	RESIDENCE Rural (100.0%)	RESIDENCE Rural (100.0%)	RESIDENCE Urban (100.0%)	RESIDENCE Urban (53.1%)	RESIDENCE Urban (61.5%)	RESIDENCE Rural (66.7%)
	IA 21.15	IA 44.99	IA 29.55	IA 32.74	IA 26.47	IA 30.46	IA 26.67

Table 4: Formation of Seven-clusters

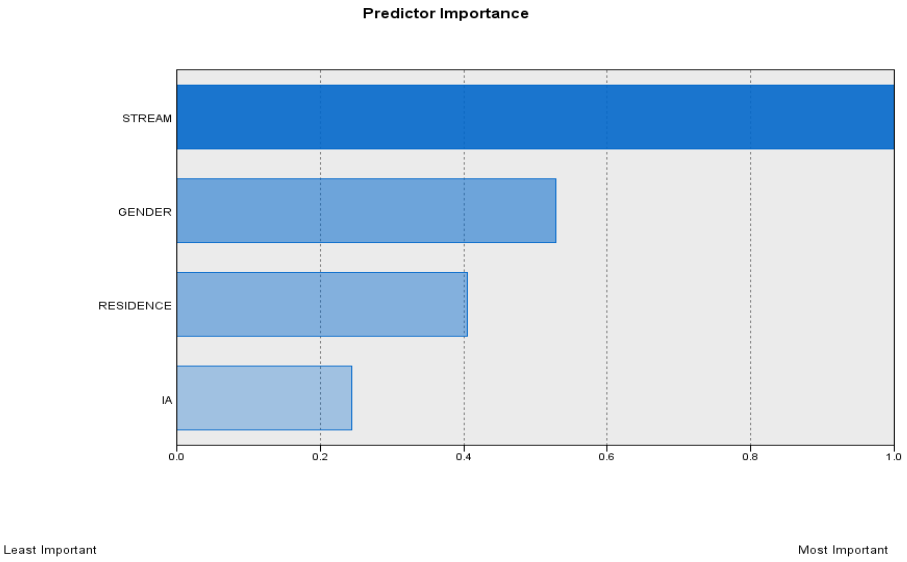

Figure 4: Predictor importance for the clusters described in table 4

Table 4 outlines the clustering of undergraduate students. Cluster 1 is exclusively composed of rural students (100%), all whom are female (100%), and pursuing arts (100%). This group accounts for 22.8% of the total sample. Cluster 2 also consists entirely of rural students (100%), with a complete dominance of female (100%), and arts stream students (100%), making up 36.2% of the sample. Cluster 3 includes only rural students (100%), as well, characterised by a full presence of male undergraduates (100%), from the arts stream (100%) contributing 11.8% to the sample. Cluster 4 comprises (53.1%) rural students, all of whom are female (100%), and from the science stream (100%), representing 8.0% of the total sample. Cluster 5 is formed by (66.7%) rural students, mainly female (75.0%), and entirely from the commerce stream (100%), making up 3.0% of the sample. Cluster 6 is dominated by urban students (61.5%) with a strong presence of science stream student (61.5%), and entirely male population (100%), converting 6.5% of the total sample. Lastly cluster 7 consists entirely of urban undergraduates (100%), all of whom are female (100%), and pursuing arts (100%), comprising 11.8% of the sample. As illustrated in figure 4, academic stream emerges as the most significant factor in cluster formation while gender and residential background have moderate influence and Internet addiction plays a minimal role in determining the clusters listed in table 4.

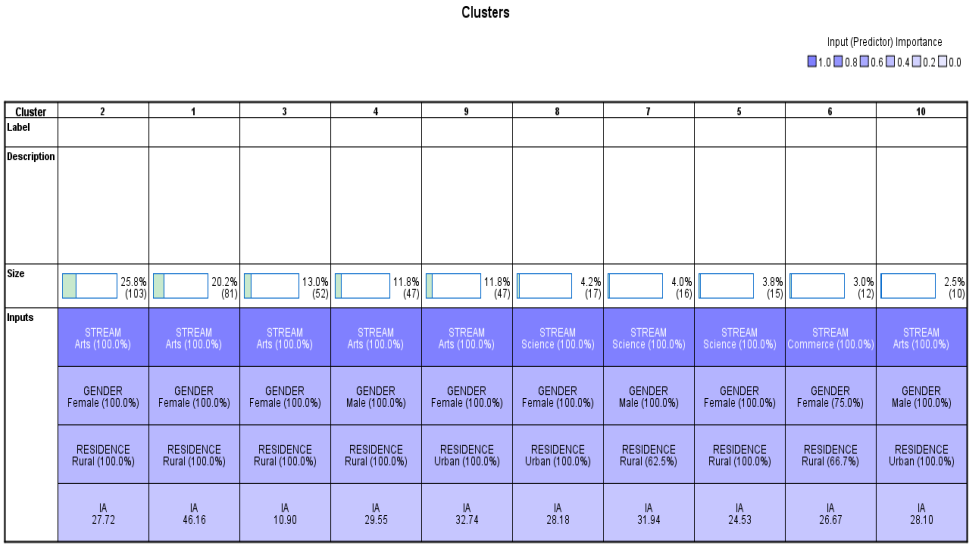

Table 5: Formation of Ten-clusters

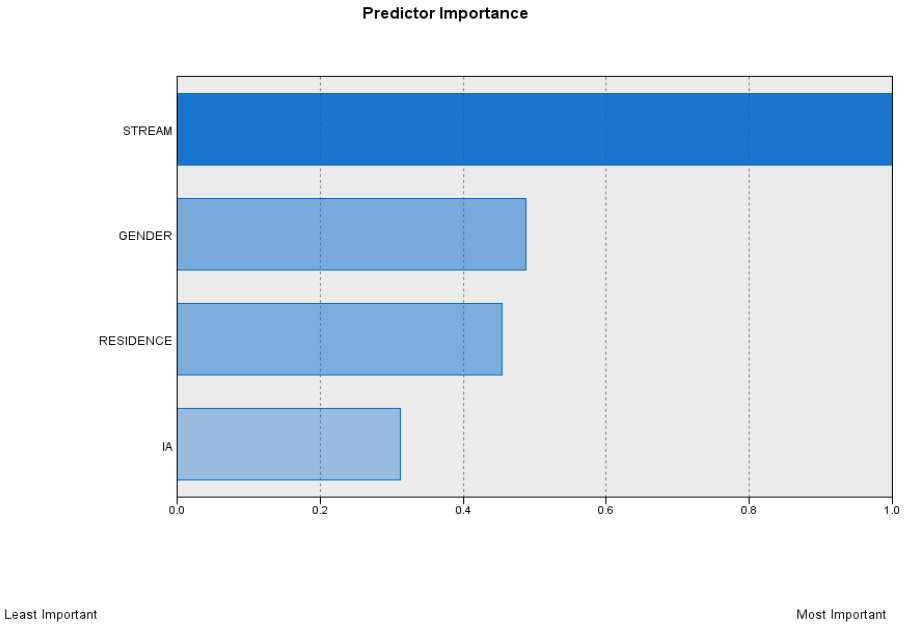

Figure 5: Predictor importance for the clusters described in table 5

Table 5 Outline the class charge identified among undergraduate students. Cluster 1 comprises exclusively rural students (100%), all of whom are female (100%), and pursuing arts (100%). This group accounts for 20.2% of the total sample. Cluster 2 is similarly made up of 100% rural, female and arts students representing 25.8% of the sample. Cluster 3 also consists entirely of rural students (100%), all in the arts stream (100%) and female (100%) making up 13.0% of the sample. Cluster 4 includes 100% rural students dominated by those in the arts (100%), and entirely male (100%), contributing 11.8% to the total sample. In cluster 5 all students are rural (100%), female (100%) and from the science stream (100%), comprising 3.8% of the sample. Cluster 6 contains 66.7% rural students entirely from the Commerce stream (100%) and mostly female (75.0%), representing 3.0% of the sample. Cluster 7 includes 62.5% rural students with full representation from the science stream (100%) and male students (100%), making up 4.0% of the sample. Cluster 8 is made of entirely of urban-based science students (100%), all of whom are female (100%), contributing 4.2% to the overall sample. Cluster 9 is also fully urban (100%), with all students studying arts (100%), and identifying as female (100%), representing 11.8% of the total sample. Cluster 10 consists solely of urban female students (100%), through their academic arts stream (100%), and they comprise 2.5% of the sample. According to figure 5 the academic stream emerges as the strongest predictor of cluster membership, whereas gender and residence play a moderate role and Internet addiction appears to have minimal influence on cluster formation as indicated in table 5.

Number of Clusters	High Predictor	Mediocre Predictor	Low Predictor
2	Residence	Gender and Stream	Internet Addiction
3	Gender	Stream and Residence	Internet Addiction
5	Gender	Stream and Residence	Internet Addiction
7	Stream	Gender and Residence	Internet Addiction
10	Stream	Gender and Residence	Internet Addiction

Table: 6 cluster and predictor summary

Table 6 represents the number of clusters formed and the variable that predict them. Analysing the impact of varying cluster numbers reveals notable changes in both class sizes and key predictors. Interestingly, 2, 3, 5, 7 and 10 clusters were examined, the smallest group consistently comprised 2.5% of the total sample size, remaining unaffected by the changes in cluster count. In relation to objective 1, which aims "To identify clusters based on demographic variables such as gender, place of residence and academic stream, in conjunction with the research variable - Internet addiction." The findings suggest that the research variable along with selected demographic factors, plays a role in shaping the clusters. Turning to objective 2, which seeks "To evaluate the relative significance of these predictors in the formation of the identified clusters." the analysis revealed that with two clusters residence emerged as the primary predictor when an additional cluster was introduced resulting in three clusters gender become a notable predictor as the number of cluster increased to 5 gender continued to be influential and at 7 and 10 clusters the stream was found to play a substantial role in defining the clusters.

Conclusion

In conclusion, researcher demonstrates that both research and demographic variable influence cluster formation. With their significance varying based on the number of clusters the stability of the smallest cluster across different cluster numbers indicates a consistent subgroup within the data. Residence is the key predictor in a 2-cluster model, while gender gains importance as more clusters are introduced with five clusters gender remains significant. And seven and 10 cluster streams also play a crucial role. This finding the dynamic nature of predictor influence in clustering highlighting their varying impact at different cluster levels.

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