

Cluster Analysis of Secondary School Students' English Writing Proficiency in Bengali-Medium Schools in West Bengal

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ABSTRACT

This paper showcases a cluster analysis on the English writing proficiency level of the second-level students enrolled in the Bengali-medium schools of West Bengal, India. This paper applies a two-step clustering procedure on the SPSS software version 26. It not only helps identify the homogenous communities within the group of second-level students on the performance level of the English writing proficiency test they undertook but further probes into the linkages existing between these identified communities or level of proficiency and certain pivotal demographic characteristics: the level of schooling the children are presently in, their gender concept, geographical location (whether they belong to a rural or urban setting), and the identity of a first-generation learner. The paper required the participation of 1,204 second-level children from four districts: Birbhum, Purba Bardhaman, Paschim Bardhaman, and Murshidabad. It adopted a random stratified sampling procedure.

Keywords: Two steps Cluster, English Writing Proficiency, Bengali-Medium, first-generation learner

INTRODUCTION

Writing in a second language (L2) represents a complex cognitive activity requiring the simultaneous orchestration of multiple skills, from lexical retrieval and syntactic formulation to rhetorical organization and audience awareness. Proficiency in L2 writing is a critical academic competency, directly influencing learners' educational trajectories and future professional opportunities. However, for students in linguistically diverse contexts, such as those learning English within a Bengali-medium instructional system, achieving this proficiency presents distinct challenges. This study investigates the English writing proficiency of secondary-level students within Bengali-medium schools in the Indian state of West Bengal. By employing cluster analysis, the research aims to identify distinct, homogeneous learner profiles based on writing competency and to subsequently examine the association between these emergent groups and key socio-demographic

variables, including grade level, gender, geographical locale, and first-generation learner status. The findings are intended to provide a nuanced typology of writing proficiency, offering data-driven insights for differentiated pedagogical intervention and educational policy formulation.

Revised Literature Review:

A comprehensive understanding of L2 writing proficiency necessitates examining its constituent sub-skills, pedagogical approaches, and the contextual factors influencing its development.

English Writing Proficiency:

Dimensions and Approaches Research into L2 writing at the secondary level has explored various dimensions. A foundational study by Sharma (2009) assessed Nepalese students' proficiency in discrete grammatical features, revealing significant variability across institutions. Subsequent work has adopted more holistic frameworks. Lahuerta and Isusi Alabarte (2018), for instance, analyzed the development of complexity, accuracy, and fluency in Spanish secondary students' EFL writing, finding age-related improvements. Other studies have focused on pedagogical methodology. Ghosh et al. (2021) advocated for a process-oriented approach to address systemic weaknesses in Indian students' writing, while Vejjayan and Yunus (2022), in a systematic review, highlighted persistent gaps in the adoption of varied teaching approaches (process, product, genre) in ESL classrooms. Research has also examined textual features and external influences. Xuan (2017) identified an over-reliance on specific text types in Chinese students' writing, shaped by examination culture. More recently, the impact of artificial intelligence has become salient; studies by Woo et al. (2023, 2025) have begun to explore how secondary EFL students engage with AI tools like ChatGPT, examining prompt engineering and text-editing behaviors as new facets of the writing process. In the South Asian context, Wu et al. (2013) demonstrated

considerable variation in writing sub-skills among Pakistani students, correlated with school type (public/private) and location (urban/rural). This aligns with the core investigative focus of the present study on the West Bengali context. The Application of Cluster Analysis in Educational Research Cluster analysis is a valuable multivariate technique for identifying latent subgroups within a population based on shared characteristics, moving beyond average-based comparisons. Its application in educational psychology is well-established. In studies relevant to the current methodology, Sen et al. (2021) used clustering to categorize leadership styles, finding geographical location to be a strong predictor. Similarly, Saha et al. (2021) and Ansary et al. (2023) successfully employed clustering to analyze student attitudes towards yoga and value-based education, respectively, with location repeatedly emerging as a significant differentiating factor. More recently, Sen et al. (2025) demonstrated the utility of multi-model cluster analysis to profile undergraduate environmental attitudes, showing how the influence of predictors like academic stream and gender intensifies with larger cluster solutions. This methodological precedent confirms the appropriateness of cluster analysis for the present aim of classifying students into distinct writing proficiency profiles and examining the socio-demographic factors associated with each cluster.

The t-test remains a fundamental tool in hypothesis testing, with substantial recent contributions advancing its application. Key developments include work by Bauri and Mahato (2025), building on earlier foundations from Karmakar et al. (2016) and Chatterjee et al. (2016). Subsequent advances came from Mondal et al. (2018), Gayen et al. (2021), and Dandapat et al. (2021). Notable 2023 contributions include Das, Adhikari et al., Gayen and Sen, Mahato and Sen, Mondal and Saha, and Ansary. Recent work by Mahato and Das

(2024a, 2024b) continues to push methodological boundaries.

Clustering methodologies have seen significant innovation through the works of Roy and Mahato (2025), Mondal and Mahato (2025), and Sen, Mahato, Mahato, Das (2025). Das and Mahato (2024) and Das, Mahato, Sen (2023) provided important refinements, while Sen, Adhikari, Ansary and Roy (2023) and Adhikari and Sen (2023a), (2023b) established theoretical frameworks guiding current research. The works of Das and Mahato (2024), Mahato and Das (2024), and Das, Mahato, and Gayen (2024) have contributed much to the correlation methodologies and have enriched our understanding of variable relationships. The standardization techniques have evolved through works by Das et al., (2024), Mahato et al., (2024), and Das & Mahato, (2024), which have shown practical implementations across research contexts. Patra and Mahato (2025a, 2025b) have substantially developed the CFA methodologies that enhance the empirical validation of theoretical constructs. Also (Ghosh et al., 2025) conducted SEM to Validating writing skill dimensions in School Education.

The current research involves various clusters with the dichotomous variables Class, Gender, Residence, and FGL to determine the proficiency in English Writing in the Bengali Medium School. Different clusters with varying variables have been utilized for the identification of the formulation of clusters, variables, or the extent of prediction (high, mediocre, low, or very low) for the formulation of the clusters. The two-step clusters method is applied for the purpose of identifying the clusters.

The research work explores different clusters based on the Secondary School

Students' English Writing Proficiency in the Bengali Medium Schools through the use of dichotomous variables. The number of different clusters is considered for the analysis of the formation of the clusters, together with their predictors and the level of prediction (high, mediocre, low, and very low) for each. The two-step clustering method is applied in the process of identifying the clusters.

Objectives of the Study:

1. To identify the cluster using research variables – Class, Gender, Residence and FGL (First Generation Learner) English Writing Proficiency in Bengali Medium School.
2. To assess predictor significance in cluster formation.

METHODOLOGY OF THE STUDY

Method: Descriptive Survey method was use by the researcher.

Population and Sample

All secondary school students enrolled in Bengali-medium schools under the West Bengal Board are included in the research. 1204 pupils from four districts – Murshidabad, Purba Bardhaman, Paschim Bardhaman, and Birbhum – make up the sample.

Sampling

Stratified random sampling used to collect the data from Respondent.

Software utilised: SPSS version 26 will be used to analyse the collected data using Two Step clustering.

RESULT AND DISCUSSION

Two step cluster

Table 1: Formation of two clusters

Clusters						
Input (Predictor) Importance						
	1.0	0.8	0.6	0.4	0.2	0.0
Cluster Label	1		2			
Description						
Size	60.5% (728)		39.5% (476)			
Inputs	Content 3.24		Content 2.14			
	Organisation 3.39		Organisation 1.86			
	Vocabulary 3.21		Vocabulary 1.61			
	Grammar 3.09		Grammar 1.49			
	Mechanics 2.91		Mechanics 1.41			
	FGL NFGL (88.6%)		FGL FGL (80.3%)			
	Gender Female (65.1%)		Gender Male (60.5%)			
	Reidence Urban (61.7%)		Reidence Rural (69.9%)			
	Class IX (62.5%)		Class IX (56.3%)			

There are two clusters. They are dominated by Female and Male students. One of them is fully comprised of rural students, while the other cluster has a majority of students from urban areas. One female-dominated cluster is fully comprised of NFGL (Non-First-Generation Learners) students, and the other cluster is dominated by more than half of FGL students. *Cluster 1 (60.5%): Mostly urban (61.7%), female (65.1%), and non-FQL (88.6%). Cluster 2 (39.5%): Mostly rural (69.9%), male (60.5%), and FQL (80.3%).*

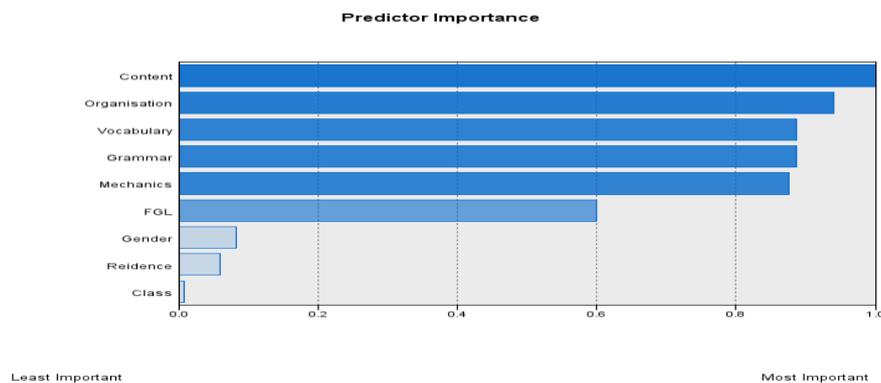


Figure 1: Predictor importance of cluster 2

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

From Figure 1, it is clear that Content and Organization are the most important predictors, while Grammar and Mechanics are moderately important.

Table 1. Highest Predictors: Content, Organization, Moderate Predictors: Vocabulary, Grammar, Mechanics, Lower but Notable Predictors: FGL, Gender, Residence, Least Important Predictor: Class.

Table 2: Formation of three clusters

Clusters

Input (Predictor) Importance
■ 1.0 ■ 0.8 ■ 0.6 ■ 0.4 ■ 0.2 ■ 0.0

Cluster	3	2	1
Label			
Description			
Size	38.0% (458)	34.6% (416)	27.4% (330)
Inputs	Content 2.18 Organisation 1.87 Vocabulary 1.63 Mechanics 1.43 Grammar 1.52 FGL FGL (84.5%) Gender Male (61.6%) Residence Rural (60.5%) Class IX (55.7%)	Content 3.62 Organisation 3.46 Vocabulary 3.29 Mechanics 2.97 Grammar 3.15 FGL NFGL (81.2%) Gender Femals (100.0%) Residence Urban (74.5%) Class IX (52.9%)	Content 3.32 Organisation 3.19 Vocabulary 2.99 Mechanics 2.72 Grammar 2.87 FGL NFGL (100.0%) Gender Male (78.8%) Residence Rural (54.8%) Class IX (75.2%)

There are three clusters. Two are dominated by male students and another one is female dominated. Two of them is fully comprised of rural students, while the other cluster has a majority of students from urban areas. One female-dominated cluster is fully comprised of FGL (First Generation Learners) students, and the other cluster is dominated by more

than half of female non-FQL students. *Cluster 1 (27.4%): Rural (54.8%), Male (78.8%), NFGL (100%), and class IX 75.2%. Cluster 2 (34.6%): Mostly Urban (74.5%), female (100%), NFGL (81.2%) and class IX 52.9%. Cluster 3 (38.0%): Rural (60.5%), Male (61.6%), FGL and class IX (55.7%).*

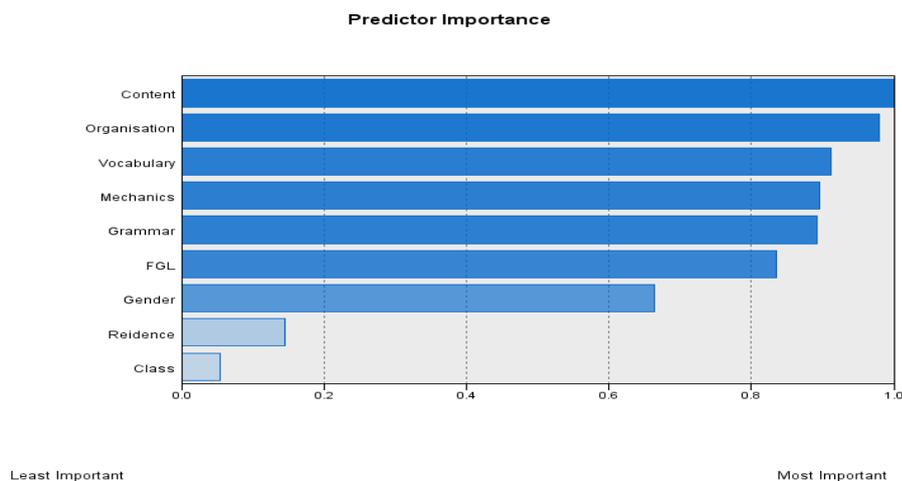


Figure 2: Predictor importance cluster 3

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

From Figure 2, it is clear that Content and Organization are the most important predictors, while Vocabulary, Grammar and Mechanics are moderately important.

Table 2. Highest Predictors: Content, Organization, Moderate Predictors: Vocabulary, Grammar, Mechanics, Lower but Notable Predictors: FGL, Gender, Residence, Least Important Predictor: Class.

Table 3: Formation of five clusters

Clusters

Input (Predictor) Importance
■ 1.0 ■ 0.8 ■ 0.6 ■ 0.4 ■ 0.2 ■ 0.0

Cluster	3	4	2	5	1
Label					
Description					
Size	36.4% (438)	17.6% (212)	16.3% (196)	16.0% (193)	13.7% (165)
Inputs	Content 2.15	Content 3.47	Content 3.70	Content 3.23	Content 3.45
	Organisation 1.86	Organisation 3.27	Organisation 3.56	Organisation 3.07	Organisation 3.38
	Vocabulary 1.61	Vocabulary 3.10	Vocabulary 3.36	Vocabulary 2.89	Vocabulary 3.15
	Mechanics 1.42	Mechanics 2.75	Mechanics 3.06	Mechanics 2.60	Mechanics 2.93
	Grammar 1.51	Grammar 2.95	Grammar 3.22	Grammar 2.73	Grammar 3.08
	FGL FGL (85.8%)	FGL NFGL (76.4%)	FGL NFGL (81.1%)	FGL NFGL (99.5%)	FGL NFGL (99.4%)
	Gender Male (62.6%)	Gender Female (100.0%)	Gender Female (100.0%)	Gender Male (100.0%)	Gender Female (54.5%)
	Reidence Rural (62.6%)	Reidence Urban (100.0%)	Reidence Urban (54.6%)	Reidence Urban (81.3%)	Reidence Rural (100.0%)
	Class IX (54.8%)	Class IX (95.3%)	Class X (95.4%)	Class IX (55.4%)	Class IX (100.0%)

There are five clusters. Two are dominated by male students and another three are female dominated. Two of them are fully comprised of rural students, while the other three clusters have a majority of students from urban areas. Three female-dominated clusters are fully comprised of NFGL (Non First Generation Learners) students, and the other two male dominated clusters are dominated by more than half of male non-FQL students. Four clusters are dominated by class ix students and one cluster is

dominated by class x students. *Cluster 1*(13.7%): Rural (100%), female (54.5%), NFGL (99.4%), and Class ix 100%. *Cluster 2* (16.3%): Mostly Urban (54.6%),female (100%), and NFGL (81.1%) and Class X 95.4%. *Cluster 3* (36.4%): Rural (62.6%), Male (62.6%), FGL (84.5%) and Class IX 54.8%. *Cluster 4*(17.6%):Urban(100%),female(100%),NFGL(76.4%),Class IX(95.3%). *Cluster 5* (16%) :Urban (81.3%), Male(100%), NFGL(99.5%), Class IX(55.4%)

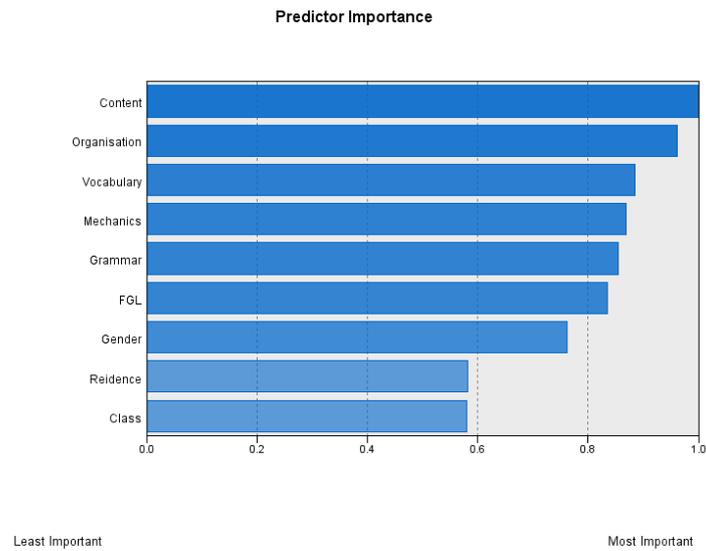


Figure 3: Predictor importance cluster 5

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

From Figure 3, it is clear that Content and Organization are the most important predictors, while Vocabulary, FGL, Grammar, and Mechanics are moderately important. Table 3. Highest Predictors: Content, Organization, Moderate Predictors: Vocabulary, Grammar, Mechanics, FGL Lower but Notable Predictors: Gender. Least Important Predictor: Class and Residence.

Table 4: Formation of seven clusters

		Clusters						
		Input (Predictor) Importance						
		1.0	0.8	0.6	0.4	0.2	0.0	
Cluster Label		4	2	5	3	1	6	7
Description								
Size		18.2% (219)	15.8% (190)	14.9% (179)	14.5% (174)	13.7% (165)	13.3% (160)	9.7% (117)
Inputs	Gender	Female (100.0%)	Female (100.0%)	Male (100.0%)	Male (74.1%)	Female (55.2%)	Male (100.0%)	Female (100.0%)
	Content	3.44	3.68	3.29	2.19	3.44	2.04	2.40
	FGL	NFGL (74.4%)	NFGL (85.3%)	NFGL (100.0%)	FGL (97.1%)	NFGL (100.0%)	FGL (59.4%)	FGL (100.0%)
	Class	IX (91.3%)	X (97.4%)	IX (58.7%)	IX (100.0%)	IX (100.0%)	X (86.2%)	X (55.8%)
	Organisation	3.22	3.54	3.11	1.83	3.37	1.79	2.19
	Vocabulary	3.06	3.34	2.96	1.65	3.13	1.51	1.88
	Mechanics	2.73	3.05	2.65	1.42	2.91	1.39	1.61
	Grammar	2.92	3.22	2.79	1.55	3.07	1.42	1.74
	Residence	Urban (100.0%)	Urban (56.3%)	Urban (84.4%)	Urban (58.6%)	Rural (100.0%)	Rural (65.0%)	Rural (95.7%)

There are seven clusters. Three are dominated by male students and another four are female dominated. Three are fully comprised of rural students, while the other four clusters have a majority of students from urban areas. Three female-dominated clusters are fully comprised of NFGL (Non First Generation Learners) students, and the other one female dominated cluster is dominated by more than half of female NFGL students. Four clusters are dominated by class ix students and other three clusters are dominated by class x students. Cluster 1(13.7%): Rural (100%), female (55.2%),

NFGL (100%), and Class IX 100%. Cluster 2 (15.8%): Urban (56.3%), Female (100%), NFGL (85.3%) and Class X (97.4%). Cluster 3 (14.5%): Urban (58.6%), Male (74.1%), FGL (97.1%) and Class IX (100%). Cluster 4 (18.2%): Urban(100%),Female(100%),NFGL(74.4%) and Class IX(91.3%).Cluster 5(14.9%): Urban (84.4%),Male(100%),NFGL(100%) and Class IX (58.7%).Cluster 6(13.3%): Rural(65%),Male(100%),FGL(59.4%) and Class X(65%).Cluster 7 (9.7%): Rural (95.7%),Female (100%),FGL(100%) and Class X(55.6%).

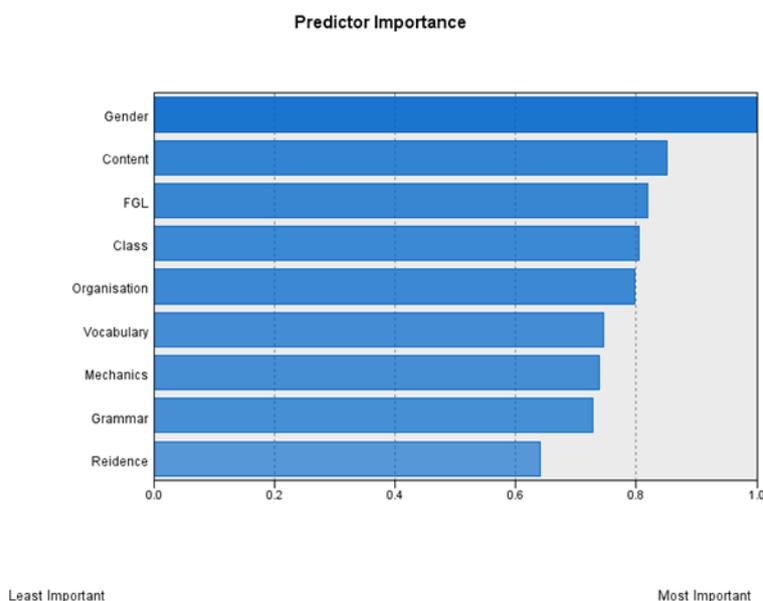


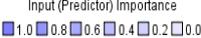
Figure 4: Predictor importance cluster 7

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

From Figure 4, it is clear that Gender is the most important predictors, while Content and FGL are moderately important. Table 4. Highest Predictors: Gender. Moderate Predictors: Content, FGL. Class, organisation, Vocabulary, and Mechanics are Lower but Notable Predictors: Grammar. Least Important Predictor: Residence.

Table 5: Formation of Ten clusters

Clusters

Input (Predictor) Importance


Cluster	2	1	8	4	5	6	10	9	3	7
Label										
Description										
Size	 14.7% (177)	 13.6% (164)	 12.2% (147)	 10.9% (131)	 9.9% (118)	 9.0% (108)	 8.6% (104)	 7.8% (94)	 6.7% (81)	 6.6% (80)
Inputs	Grammar 3.29	Grammar 3.08	Grammar 1.41	Grammar 2.21	Grammar 3.48	Grammar 2.58	Grammar 1.84	Grammar 0.57	Grammar 2.46	Grammar 3.00
	Content 3.73	Content 3.45	Content 2.03	Content 2.92	Content 3.78	Content 3.14	Content 2.54	Content 1.40	Content 2.93	Content 3.41
	Organisation 3.59	Organisation 3.38	Organisation 1.77	Organisation 2.62	Organisation 3.67	Organisation 2.97	Organisation 2.32	Organisation 0.99	Organisation 2.63	Organisation 3.24
	Mechanics 3.11	Mechanics 2.92	Mechanics 1.37	Mechanics 2.05	Mechanics 3.22	Mechanics 2.45	Mechanics 1.72	Mechanics 0.56	Mechanics 2.26	Mechanics 2.85
	Vocabulary 3.41	Vocabulary 3.15	Vocabulary 1.50	Vocabulary 2.40	Vocabulary 3.56	Vocabulary 2.78	Vocabulary 2.00	Vocabulary 0.71	Vocabulary 2.53	Vocabulary 3.08
	Gender Female (100.0%)	Gender Female (54.9%)	Gender Male (100.0%)	Gender Female (100.0%)	Gender Female (100.0%)	Gender Male (100.0%)	Gender Female (100.0%)	Gender Male (55.3%)	Gender Male (100.0%)	Gender Male (100.0%)
	Class X (97.2%)	Class IX (100.0%)	Class X (89.8%)	Class IX (72.5%)	Class IX (100.0%)	Class IX (100.0%)	Class X (57.7%)	Class IX (98.9%)	Class IX (100.0%)	Class X (100.0%)
	FGL NFGL (85.3%)	FGL NFGL (100.0%)	FGL FGL (63.9%)	FGL FGL (57.3%)	FGL NFGL (100.0%)	FGL NFGL (100.0%)	FGL FGL (100.0%)	FGL FGL (99.4%)	FGL FGL (100.0%)	FGL NFGL (98.8%)
	Residence Urban (53.1%)	Residence Rural (100.0%)	Residence Rural (66.0%)	Residence Urban (100.0%)	Residence Urban (100.0%)	Residence Urban (100.0%)	Residence Rural (100.0%)	Residence Urban (58.5%)	Residence Rural (53.1%)	Residence Urban (57.5%)

The cluster analysis produced ten distinct profiles. A gender-based analysis reveals a pronounced segmentation: five clusters (3, 6, 7, 8, 9) are exclusively or predominantly male-dominated, while the remaining five (1, 2, 4, 5, 10) are exclusively or predominantly female-dominated.

Geographical origin further differentiates the clusters. Three clusters (1, 3, 10) are composed entirely of rural students. Conversely, five clusters (4, 5, 6, 7, 9) are exclusively urban. The remaining two clusters (2, 8) exhibit a mixed rural-urban composition, with urban majorities in

Cluster 2 (53.1%) and a rural majority in Cluster 8 (66%).

The status as a First-Generation Learner (FGL) or Non-First-Generation Learner (NFGL) also defines key groupings. Three clusters (1, 5, 6) are composed entirely of NFGL students. Another three clusters (3, 9, 10) are almost entirely composed of FGL students (89.4% to 100%). The remaining four clusters (2, 4, 7, 8) show a mixed composition, with varying majorities of either NFGL or FGL students.

Finally, class-level distribution shows that six clusters (1, 3, 4, 5, 6, 9) are dominated by Class IX students (comprising 72.5% to

100% of members). The other four clusters (2, 7, 8, 10) are dominated by Class X students (comprising 57.7% to 100% of members).

Cluster 1(13.6%): Rural (100%), female (54.9%), NFGL (100%), and Class IX 100%. Cluster 2 (14.7%): Urban (53.1%), Female (100%), NFGL (85.3%) and Class X (97.2%). Cluster 3 :(6.7%): Rural (53.1%), Male (100%), FGL (100%) and Class IX (100%). Cluster 4 (10.9%) : Urban(100%),Female(100%),FGL(57.3%) and Class IX(72.5%).Cluster 5(9.8%) :

Urban (100%),Female(100%),NFGL(100%) and Class IX (100%).Cluster 6(9%): Urban(100%),Male(100%),NFGL(100%) and Class IX(100%).Cluster 7 (6.6%): Urban(57.5%),Male (100%),NFGL(98.8%) and Class X(100%).Cluster 8 (12.2%): Rural(66%),Male (100%),FGL(63.9%) and Class X(89.8%).Cluster 9(7.8%) :Urban(58.5%),Male (55.3%),FGL(89.4%) and Class IX(98.9%).Cluster 10 :(8.6%) Rural(100%),Female (100%),FGL(100%) and Class X(57.7%).

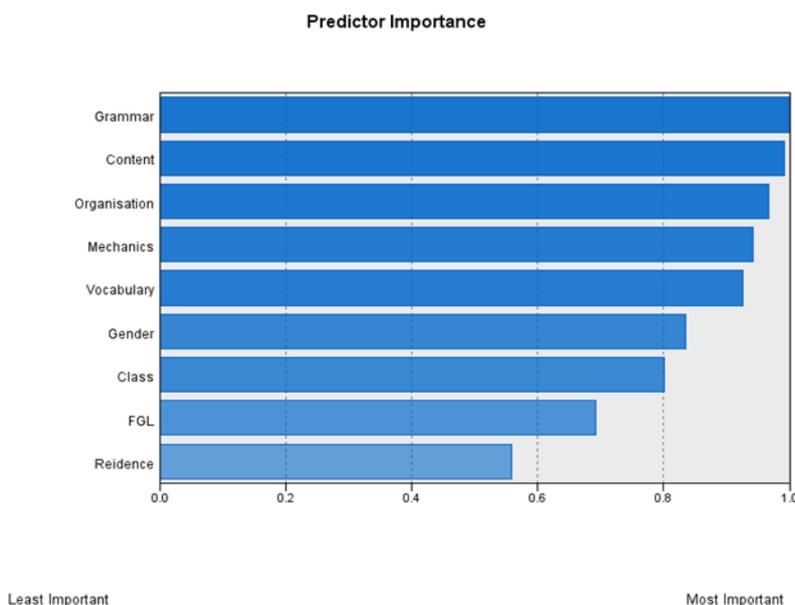


Figure 5: Predictor importance cluster 10

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

From Figure 5, it is clear that Grammar, Content, organisation, Vocabulary, and Mechanics are the most important predictors, while Gender and Class are moderately important.

Table 5. Highest Predictors: Grammar, Content, organisation, Vocabulary, and Mechanics. Moderate Predictors: Gender and Class. Lower but Notable Predictors: FGL. Least Important Predictor: Residence.

CONCLUSION

From Figure 1, it is clear that Content and Organization are the most important

predictors, while Grammar and Mechanics are moderately important. In Table 1 Highest Predictors are Content,

Organization, and Moderate Predictors are Vocabulary, Grammar, and Mechanics. Lower but Notable Predictors are FGL, Gender, Residence, and Least Important Predictor is Class.

From Figure 2, it is clear that Content and Organization are the most important predictors, while Vocabulary, Grammar and Mechanics are moderately important. In Table 2. Highest Predictors are Content, Organization, Moderate Predictors: Vocabulary, Grammar, Mechanics, Lower but Notable Predictors are FGL, Gender, Residence, Least Important Predictor is Class.

From Figure 3, it is clear that Content and Organization are the most important predictors, while Vocabulary, FGL, Grammar, and Mechanics are moderately important. In Table 3 Highest Predictors are Content, Organization, Moderate Predictors: Vocabulary, Grammar, Mechanics, FGL. Lower but Notable Predictors is Gender. Least Important Predictors are Class and Residence.

From Figure 4, it is clear that Gender is the most important predictors, while Content and FGL are moderately important. In Table 4 .Highest Predictor is Gender. Moderate Predictors are Content, FGL. Class, Organisation. Vocabulary, Grammar. and Mechanics are Lower but Notable Predictors. Least Important Predictor is Residence.

From Figure 5, it is clear that Grammar, Content, organisation, Vocabulary, and Mechanics are the most important predictors, while Gender and Class are moderately important. In Table 5 Highest Predictors are Grammar, Content, organisation, Vocabulary, and Mechanics. Moderate Predictors are Gender and Class.

Lower but Notable Predictor is FGL. Least Important Predictor is Residence.

What is known by discussing the results in terms of English writing proficiency of Bengali medium students, among the structural variables Content Organization are playing an important role in cluster formation at some point. Vocabulary Grammar and Mechanics -sometimes these are apparent important or sometimes these are apparent as moderate in terms of English writing skill. Gender is the variable which sometimes is reflected as important or sometimes it is least moderate in cluster formation. Sometimes moderation or sometimes least importantly Residence and class are used in cluster formation. All the time FGL (First Generation Learner) stands as a moderate or notable predictor in cluster formation. So, it is established that all the variables have significant importance in developing proficiency in English writing skill of Bengali medium Secondary school students of West Bengal.

Declaration by Authors

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