

Web Attributes Offered by Websites of Universities of West Bengal to Run E-Learning System: A Hierarchical Clustering Based Study

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Abstract

E-learning enabled education system has grabbed the world higher education market in a skyrocketing manner. Most of the internationally acclaimed universities have already installed e-learning and ICT (Information and Communication Technologies) based education by which students in due course do their studies in their own place and own pace as well. The rapid growth of e-learning based education in parallel boosts the GER of the specific zone too. In this paper a study has been undertaken to canvas the present scenario of Universities and central institutes of West Bengal in terms of information and service.

Keywords: GER; E-learning; Hierarchical cluster analysis; Web attributes

Introduction

Recent trends echo that any organization's face is its website. Physically it is not always possible to visit an organization. But, if its website becomes informative as well, people can have a clear picture about the organization. And the same is so true for any university or academic institute too. To set up a university or institute e-learning enabled, its website should have to be equipped enough with information and service both [1,2]. Otherwise, students or their guardians residing from remote place cannot have a detailed picture regarding the university.

West Bengal as particular, as a state of India is also rich in higher education following traditional systems. They produce thousands of Grads yearly with bachelors and master's degree. Still the GER of West Bengal is not at all worthy especially in higher education. E-learning based education can be a plausible avenue to enrich enrollments in higher studies. To do so, it is highly eventual to assess the status of the websites of universities in terms of information and service. It is to check whether the websites of universities of West Bengal are at all capable enough to offer e-learning system successfully using their out of box features. Hierarchical clustering technique is employed in this paper to know the presence of e-learning attributes in websites of the universities [3,4].

Preliminaries

Hierarchical clustering technique

Cluster analysis is a technique where no assumptions are done pertaining to the number of groups. These groups are formed based on the similarities or distances. The similarities of input values are computed to frame the grouping. There are two types of clustering techniques:

- i. Hierarchical clustering method
- ii. Non hierarchical clustering method

Hierarchical clustering methods are based on a variety of linkages for example single linkage, average linkage and complete linkage. Non hierarchical clustering method is based on k-means method.

Single linkage: Primarily the smallest distance in $D=\{d_{ik}\}$ is to be found and need to merge the corresponding objects, like, U and V to

obtain upper cluster(UV). The distance between upper cluster (UV) and any other cluster W are calculated by:

$$d_{(UV)W} = \min\{d_{UW}, d_{VW}\}$$

Here the quantities d_{UW} and d_{VW} are the distance between the nearest neighbors of cluster U and W and cluster V and W correspondingly.

Complete linkage: The algorithm finds the minimum entry in $D=\{d_{ik}\}$ first and then merges the corresponding objects, like, U and V, to get cluster (UV). Here the distance between (UV) and any other cluster W are computed by

$$d_{(UV)W} = \max\{d_{UW}, d_{VW}\}$$

Here the quantities d_{UW} and d_{VW} are the distance between the nearest neighbors of cluster U and W and cluster V and W respectively.

Average linkage: The distance between (UV) and any other cluster W are computed by

$$d_{(UV)W} = \frac{\sum_i \sum_k d_{ik}}{N_{(UV)} N_W}$$

Where, d_{ik} is the distance between object i in cluster (UV) and object k in the cluster W and N_{uv} and N_w are the numbers of items in clusters (UV) and W respectively.

K-means method: This method follows the steps like,

- i. Do partition the items into k initial cluster.
- ii. Go on with the list of items, assigning an item to the cluster whose centroid is nearest. Here, distance is usually calculated by means of Euclidian distance with either standardized or non-standardized observation. Now, again calculate the centroid for the cluster receiving the new item and for the cluster losing the item.

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iii. Repeat earlier step until no more reassignments happen.

Literature Review

Das et al. indicated [5] that in West Bengal 76% eligible students are willing to go for higher studies based on e-learning and rest 24% students are unwilling to go for higher education [6]. Das, Banerjee, Basu proposed a concept [1] of e-learning classrooms local to the students' residence and the e-learning control room will be in higher education ministry of West Bengal. Grew, Pagani stated an e-learning portal as an online learning service which is like an interface through which both teachers and students will be able to fulfill their learning and instructing objectives. This portal will pull the people, product and services together, where people refers to the intended higher education aspiring students, teachers or instructors and the administrator, responsible to administrate portal [7,8].

Product refers to the skill set shared by the instructors, digital content of the online course materials etc. and services are like emailing, blogging, chatting, online helps, online registration to examinations, digital library, video conferencing etc [9,5]. Das, Banerjee, Basu [1] recommended the establishment of e-learning centers in remote regions of West Bengal where the gross enrollments in higher education is poor. Das, Panigrahi, Basu indicated that in universities of West Bengal the implementation of e-learning is not at all satisfactory [10,11].

Methodology

In this study the specific web parts of the entire university website are considered as those sections are only involved for e-learning. As per the annual report of the ministry of higher Education, West Bengal, there exist seventeen (17) universities providing higher education. An exhaustive survey was conducted on the presence of web attributes,

UNIVERSITY ↓ Web attributes →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	1	1	0	0	1	1	0	1	0	1	0	0	1	0	1	0
2	1	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0
3	0	0	1	0	1	0	1	0	1	1	1	0	1	1	1	1	0
4	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
5	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	1
6	0	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	1
7	1	1	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0
8	1	1	1	1	1	0	0	0	1	0	1	0	0	1	1	1	0
9	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	1
10	1	1	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	0	1	1	1	1	1	0	1	0	1	0	0	1	1	1	1
13	1	1	1	0	1	1	0	1	1	0	0	0	1	0	0	0	0
14	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0
15	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1
17	0	1	1	0	1	0	0	1	1	0	0	0	0	1	0	0	0
18	1	1	1	0	1	1	0	1	0	1	1	1	0	1	1	1	1
19	1	1	1	0	1	1	1	0	0	1	1	1	0	1	1	1	1
20	1	1	1	0	1	1	1	0	0	0	0	1	1	1	1	0	1
21	0	0	1	0	1	0	1	1	1	1	1	0	1	0	0	0	0
22	1	0	1	0	1	1	0	0	1	1	1	0	1	0	1	0	0
23	1	0	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1
24	1	1	1	0	1	1	1	1	0	0	1	1	1	0	1	1	1
25	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	1	0
26	1	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0	0
27	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1
28	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1
29	0	1	0	0	0	1	0	0	0	1	1	0	1	1	1	0	0
30	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
31	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	0	0
32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 1: Binary table to show the presence of web attributes in the university websites.

may be used as e-learning attributes, of the university websites. One table is framed based on the presence of the web attributes in websites. The attributes are collected on the basis of the belief that presence of attributes reflects effectiveness in every regard of e-learning based education. Thirty two (32) parameters are considered as web attributes. One binary table is created to show the status of the universities in terms of the presence of the attributes.

Subsequently one dissimilarity matrix is formed. Applying the single linkage on the dissimilarity matrix we can group the different universities as well as the attributes [12-14]. Attributes what are considered are:

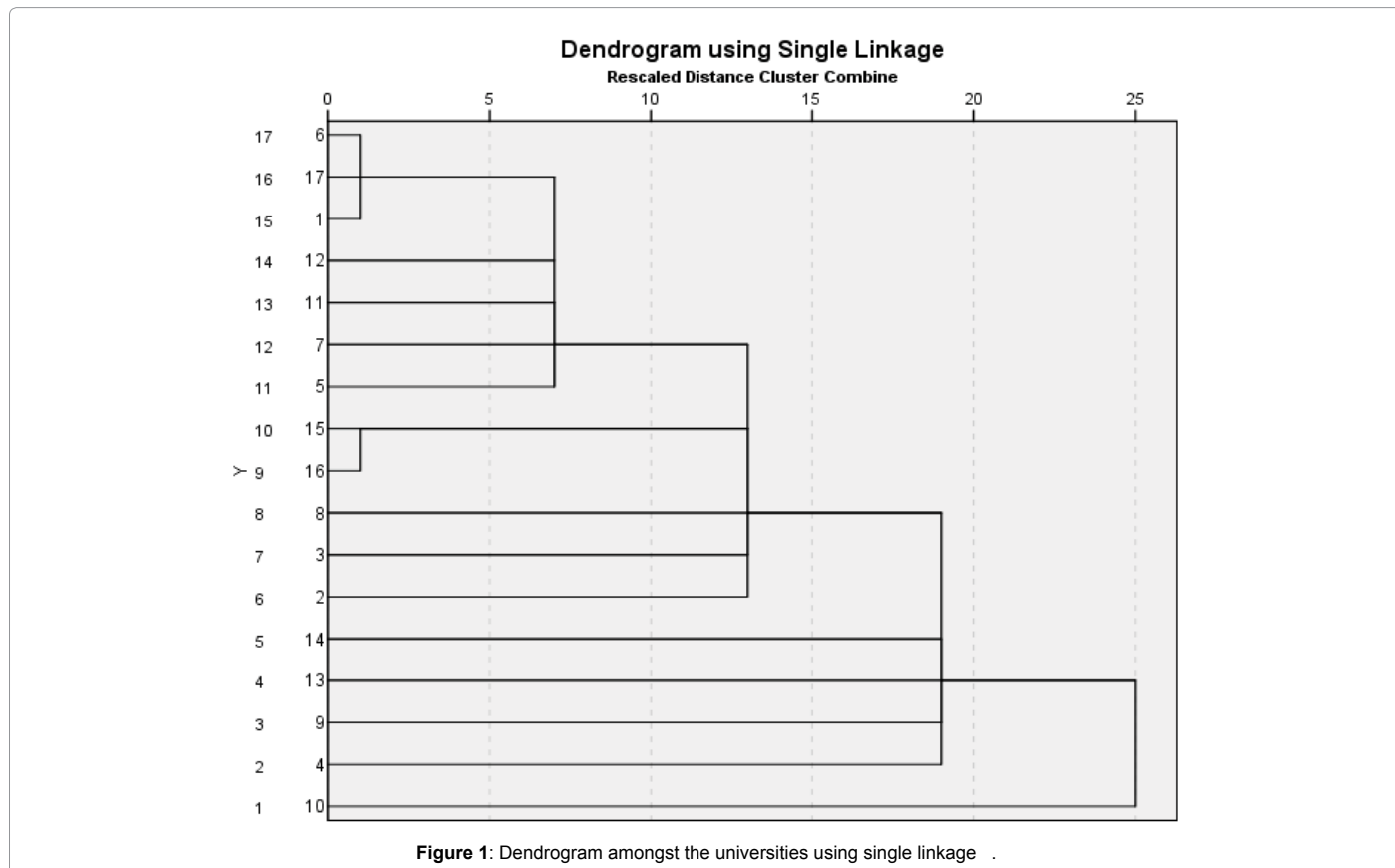


Figure 1: Dendrogram amongst the universities using single linkage .

0	9	9	13	11	7	10	15	13	16	11	16	13	11	10	9	12
9	0	10	18	16	12	17	14	14	13	12	17	14	12	17	16	15
9	10	0	20	10	14	15	18	10	15	12	19	14	16	15	14	17
13	18	20	0	14	12	13	12	14	17	14	11	14	14	15	10	11
11	16	10	14	0	8	11	10	14	17	10	15	12	14	11	10	11
7	12	14	12	8	0	9	12	16	15	8	13	10	12	11	10	7
10	17	15	13	11	9	0	13	17	14	11	14	11	11	10	9	8
15	14	18	12	10	12	13	0	16	13	16	11	10	16	15	12	9
13	14	10	14	14	16	17	16	0	15	12	23	16	12	21	16	21
16	13	15	17	17	15	14	13	15	0	11	16	11	13	14	17	14
11	12	12	14	10	8	11	16	12	11	0	17	14	12	13	10	13
16	17	19	11	15	13	14	11	23	16	17	0	15	15	12	11	8
13	14	14	14	12	10	11	10	16	11	14	15	0	18	11	14	11
11	12	16	14	14	12	11	16	12	13	12	15	18	0	11	10	13
10	17	15	15	11	11	10	15	21	14	13	12	11	11	0	7	10
9	16	14	10	10	10	9	12	16	17	10	11	14	10	7	0	9
12	15	17	11	11	7	8	9	21	14	13	8	11	13	10	9	0

A: Proximity matrix (17x17) of clustering among the universities

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0	4	7	6	11	12	8	5	8	9	8	7	6	8	9	5
2	4	0	9	2	9	8	6	5	8	11	12	9	6	4	5	7

3	7	9	0	9	10	11	7	6	9	8	7	8	9	9	8	8
4	6	2	9	0	9	6	6	7	8	13	14	11	6	4	3	9
5	11	9	10	9	0	7	11	10	9	6	5	10	7	7	10	6
6	12	8	11	6	7	0	6	13	8	9	12	13	8	6	7	9
7	8	6	7	6	11	6	0	9	10	7	10	11	8	6	7	7
8	5	5	6	7	10	13	9	0	11	8	7	6	7	9	8	8
9	8	8	9	8	9	8	10	11	0	9	12	5	10	8	5	9
10	9	11	8	13	6	9	7	8	9	0	3	6	9	11	12	6
11	8	12	7	14	5	12	10	7	12	3	0	7	8	12	15	5
12	7	9	8	11	10	13	11	6	5	6	7	0	11	13	10	8
13	6	6	9	6	7	8	8	7	10	9	8	11	0	10	7	7
14	8	4	9	4	7	6	6	9	8	11	12	13	10	0	5	9
15	9	5	8	3	10	7	7	8	5	12	15	10	7	5	0	12
16	5	7	8	9	6	9	7	8	9	6	5	8	7	9	12	0
17	8	4	9	2	7	6	8	7	8	11	12	11	4	6	3	11
18	9	9	10	11	6	9	9	8	9	4	5	8	9	7	10	10
19	7	9	8	11	8	11	7	8	7	4	5	6	11	7	10	8
20	8	10	9	10	9	10	6	9	8	7	6	9	6	10	9	7
21	8	8	3	8	7	8	8	9	8	9	8	11	6	8	7	7
22	8	6	5	8	7	10	6	7	8	7	8	7	6	8	7	7
23	11	13	10	13	8	11	9	10	9	4	5	6	9	13	10	10
24	8	10	9	12	7	10	8	9	8	3	4	7	8	10	11	9
25	5	5	8	7	6	11	9	4	9	6	7	6	5	9	8	6
26	5	3	8	3	10	7	5	6	11	12	11	12	5	5	6	6
27	6	10	5	12	7	10	8	7	10	3	2	7	6	12	13	5
28	6	10	5	12	7	10	8	7	10	3	2	7	6	12	13	5
29	8	8	7	8	9	6	6	9	8	9	10	11	8	6	9	7
30	8	4	7	2	9	6	6	9	8	13	14	11	8	4	3	9
31	6	8	9	10	7	10	10	7	8	7	6	7	6	10	11	5
32	8	12	7	14	5	12	10	7	12	3	0	7	8	12	15	5

B: Proximity matrix (32x32) of clustering among the web attributes

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	8	9	7	8	8	8	11	8	5	5	6	6	8	8	6	8
2	4	9	9	10	8	6	13	10	5	3	10	10	8	4	8	12
3	9	10	8	9	3	5	10	9	8	8	5	5	7	7	9	7
4	2	11	11	10	8	8	13	12	7	3	12	12	8	2	10	14
5	7	6	8	9	7	7	8	7	6	10	7	7	9	9	7	5
6	6	9	11	10	8	10	11	10	11	7	10	10	6	6	10	12
7	8	9	7	6	8	6	9	8	9	5	8	8	6	6	10	10
8	7	8	8	9	9	7	10	9	4	6	7	7	9	9	7	7
9	8	9	7	8	8	8	9	8	9	11	10	10	8	8	8	12
10	11	4	4	7	9	7	4	3	6	12	3	3	9	13	7	3
11	12	5	5	6	8	8	5	4	7	11	2	2	10	14	6	0
12	11	8	6	9	11	7	6	7	6	12	7	7	11	11	7	7
13	4	9	11	6	6	6	9	8	5	5	6	6	8	8	6	8
14	6	7	7	10	8	8	13	10	9	5	12	12	6	4	10	12
15	3	10	10	9	7	7	10	11	8	6	13	13	9	3	11	15
16	11	10	8	7	7	7	10	9	6	6	5	5	7	9	5	5
17	0	9	11	10	6	8	11	10	7	5	10	10	10	4	8	12
18	9	0	2	7	11	7	6	3	8	10	5	5	9	11	9	5
19	11	2	0	5	11	7	6	3	8	10	5	5	9	11	9	5
20	10	7	5	0	10	8	5	4	9	9	6	6	8	12	10	6
21	6	11	11	10	0	6	11	10	9	7	6	6	8	6	6	8
22	8	7	7	8	6	0	9	8	5	7	6	6	6	6	8	8
23	11	6	6	5	11	9	0	3	8	14	7	7	13	13	11	5
24	10	3	3	4	10	8	3	0	7	13	4	4	10	14	10	4
25	7	8	8	9	9	5	8	7	0	8	7	7	9	9	7	7
26	5	10	10	9	7	7	14	13	8	0	9	9	7	3	7	11
27	10	5	5	6	6	6	7	4	7	9	0	0	8	12	6	2
28	10	5	5	6	6	6	7	4	7	9	0	0	8	12	6	2

29	10	9	9	8	8	6	13	10	9	7	8	8	0	8	8	10
30	4	11	11	12	6	6	13	14	9	3	12	12	8	0	10	14
31	8	9	9	10	6	8	11	10	7	7	6	6	8	10	0	6
32	12	5	5	6	8	8	5	4	7	11	2	2	10	14	6	0

C: Proximity matrix of clustering among the web attributes Continued

Table 2: Proximity matrix: clustering amongst universities

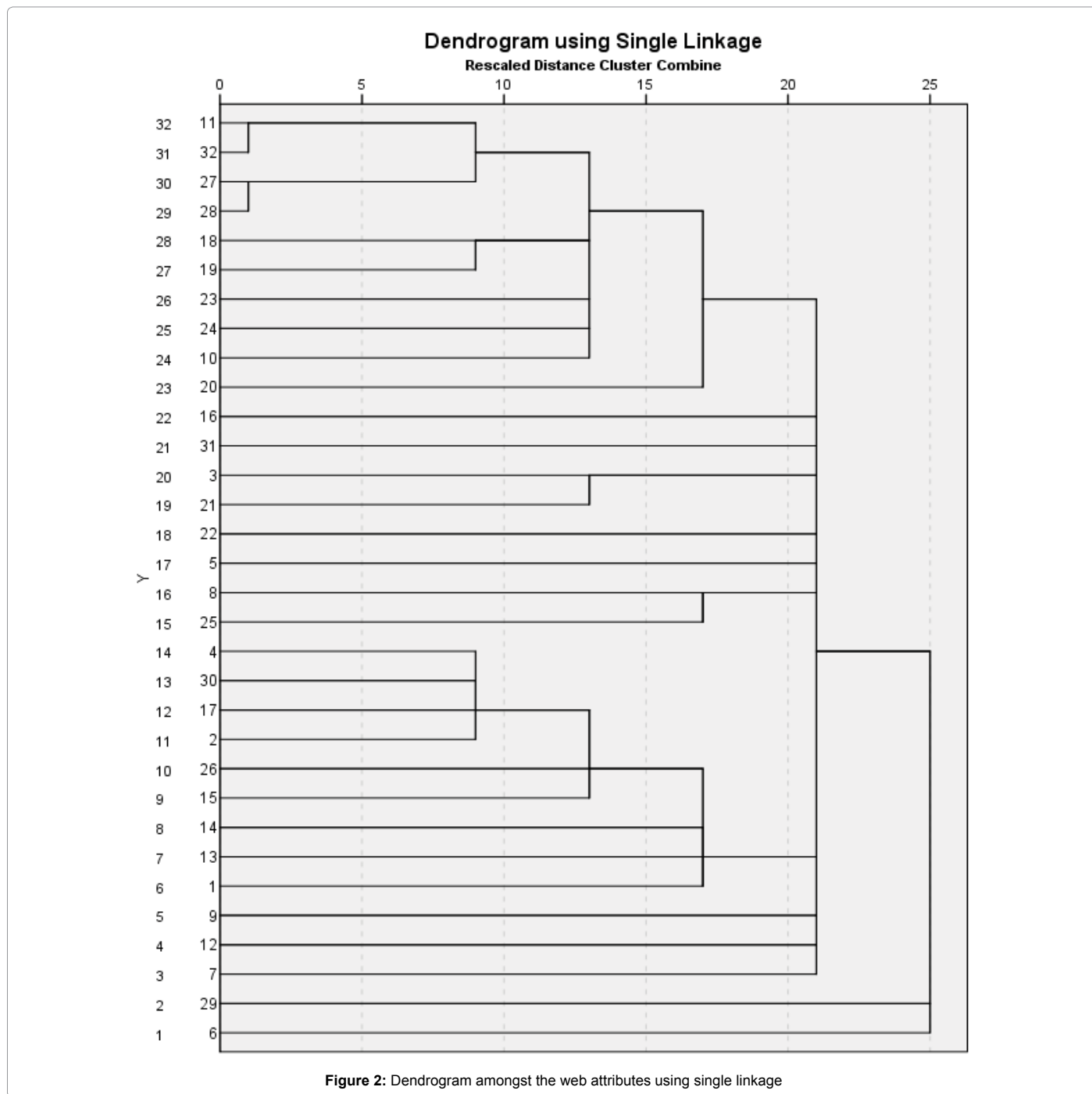


Figure 2: Dendrogram amongst the web attributes using single linkage

1. Distance education	12. Arts	23. Registration
2. Special education	13. Engineering	24. Online payment service
3. Anti ragging committee	14. Awards and honors	25. Convocation
4. Press	15. Statutory committee	26. Digital library service
5. Student's union	16. Faculty council	27. Alumni
6. Club and society	17. Anti sexual harassment cell	28. About us
7. Foreign students	18. Associates institution	29. Overviews
8. National service scheme	19. Faculty list	30. Media room
9. Student's welfare committee	20. Hospital service	31. Photo gallery
10. Academic calendar	21. Placement cell	32. Tender
11. Science	22. Information brochure	

Seventeen (17) state level and national level universities [15] are considered as follows:

1. Calcutta University	7. Biswa Bharati University	13. NIT, Durgapur
2. IIT, Kharagpur	8. ISI, Kolkata	14. Rabindra bharti University
3. Jadavpur University	9. BESU, Hawrah	15. PU
4. West Bengal State University	10. IIM Kolkata	16. North Bengal University
5. Kalyani University	11. Vidyasagar University	17. Gour Banga University
6. Burdwan University	12. WBUHS	

The binary table (Table 1) shows the presence of web attributes in the websites of the said universities. Here, the universities are kept as columns and row wise the web attributes are kept.

Now hierarchical clustering technique will be applied for amongst universities and web attributes as well. SPSS 17.0 is the statistical tool used to perform the entire analysis.

Results and Discussion

The proximity matrix of clustering among the universities is formed where the distances are measured using binary squared euclidean distance and single linkage method. The dendrogram amongst the universities is represented as per the Figure 1. Here the distances are rescaled. The insight coming from the dendrogram is that if we increase the distance no such universities are forming any cluster. Burdwan University and Kalyani University both are having similar types of web attributes but their score is much lesser than Calcutta University or NIT Durgapur or IIT Kharagpur. Based on the formed clusters the quality and standard of websites of the universities can be assumed. The proximity matrix of clustering among the web attributes, as shown in (Table 2), is formed where the distances are measured using binary squared euclidean distance and single linkage method.

The dendrogram amongst the web attributes is represented as per the Figure 2. Here the distances are rescaled. This dendrogram represents that the presence of web attributes formed clusters where they have similarity in service and information. Here web attributes 11, 32, 27, 28 are to some extent similar and provides similar services. Similarly the web attributes 18, 30, 4, 19, 17 and 2 serve similarity of attributes. This shows that the web attributes formed clusters in the Dendrogram have obtained the almost same rating in terms of importance. Moreover the web attributes formed clusters are equally important in designing a website of a university. Figures 1 and 2 pens the status of the university websites about their capacity of providing e-learning education in West Bengal. The presence of web attributes in university websites is highly essential to pursue e-learning education which in turn will boost the gross enrollment ratio of West Bengal.

Conclusion

In parallel with the traditional learning systems, there is an essence to channelize the e-learning based education so that any student from any corner of any region can avail the education. Several universities of West Bengal are taken into account to measure their capacity to start for e-learning based education. This study shows the presence of web attributes in the websites of the universities and ultimately validates that a specific university is up to what extent ready to offer e-learning education.

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