



Dot to Dot: Accessibility, Readability, Site-Ranking Evaluation of Indian University Websites

Chinna Rao Kurangi

Department of Computer Science, Pondicherry University, Puducherry, India.

kchinnarao142@gmail.com

Abstract

Web portals are being considered as excellent source for sharing information and visibility to teach and learn activities electronically. Creation the web resources obstacles-free for all groups of operators needs exploit diagonally readability and accessibility of numerous magnitudes. In this research paper, top ranking universities in India are analysis by accessibility, site-ranking and readability (N=40) based on the report of National Institute Ranking Framework (NIRF), MHRD, India (2017). The accessibility study of university websites takes be situated approved to using aChecker (WCAG 2.0) and WAVE tools. Six dissimilar readability catalogues such as Flesch-Kincaid reading ease (FKRE), Flesch-Kincaid grade level (FKGL), Gunning Fog, SMOG, Coleman Liau index and Automated Readability Index (ARI) are measured for understanding of contents in the websites. Also compared top graded university websites and their corresponding rankings by site ranking services with Alexa (National & Global). The correlations among site-ranking, accessibility and readability were computed with Spearman's rank correlation.

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1. Introduction:

Web portals are being considered as effective means to reach out to the students by providing user-friendly interfaces. Universities across the world have demonstrated an exceptional level of enthusiasm for their presence by hosting web portals electronically. Students find convenient to search and access information through websites [1]. To achieve web accessibility, we have used WCAG 2.0 guidelines projected through World Wide Web Consortium (W3C). Designed for examination and assessing accessibility position of top university websites in India, we are applied assessment tools accessibility

such as aChecker [33], WAVE [27], which are based on the above-mentioned guidelines. Also, it is significant to crisscross the readability and site position of the university websites in directive mode to development their associations to create the contents simply expended by plentiful groups of users. We have opted Alexa ranking [29] for providing the position of topmost40 university websites presumed by National Institute Ranking Framework [30]. The evaluation of top 40 university websites in India for disability persons in relations of their education the main score in the form of 3 variables such as readability, accessibility and site-ranking. Dots are connected in sequence



order to the different variables. We must quantify the sites with respect to consistent constraints and then invention their associations. The dimension and association of top 36 university sites in relations of different variables has been obtainable in this study. The main motive of this study is as follows.

1. Find the accessibility score on top 40 Indian university sites using evaluation tools.
2. Find the position of the readability of top 40 Indian Universities sites using different evaluation tools.
3. Alexa tool are used to find the sites- ranking of selected top 40 Indian Universities sites.
4. To classify the selected top 40 Indian Universities sites based on complex score.
5. Find the correlation between different variables using statistical techniques.

2. Related Studies

The accessibility of websites which are designed for all categories of people should be usable with the main aim of Universal Design. These strategies are designated web interfaces to feel better and easier for the persons with disabilities [2]. Web accessibility means that everyone using any generous of web browsing technology must be able to visit any site and get a full and wide-ranging understanding of the information as well as have the full and complete ability to interact with the site if that is necessary [3]. Many universities lack of public accessibility guidelines and also unclear features as an incomplete policy [4]. Multi-tool analysis of top 100 global

university home pages was used for analyzing the accessibility standards and its conformance levels, image accessibility, alternative languages and text-only content, quality of accessibility statements. And the results reveals that many top universities continue to have accessibility obstacles and also initiate that many sites absence to clear the web accessibility statements and documentation [5]. The qualitative research design proposed to serve webmasters to use freeware to assess the overall accessibility of university's homepages [6]. A global approach is proposed for designing the websites to enhance web accessibility for the Texas public school system [7]. A conceptual foundation has proposed to scrutinize the efficiency of web accessibility policies for disabled persons at land-grant universities in the United States such as an overview of Web accessibility studies, to legal mandates, to literature on administrative policies [8]. The application of WAI accessibility guiding principle is not satisfactory to assurance website accessibility and also suggested guidelines should be based on validated experimental data for future versions of accessibility guidelines includes "usability" for all [9]. Semi-structure interviews were employed to investigate the use of Information and communication technology (ICT) from a representative sample of 100 visually impaired students from the departments and affiliated colleges of the Calicut University, Kerala [10]. The evaluation of accessibility of the 20 public universities in Malaysia based on the WCAG 2.0 and also the results



suggested that some improvements including distinguish ability, key board accessibility, navigability, adaptability and text alternative for non-text elements for disability people[11]. Author study explored the accessibility of topmost ranking university websites in terms of accessibility rates from 2005 to 2015 was evaluated using the a Checker[12-26]. The study has critically analyzed the web portals of 30 Indian Universities of different categories (IIT's, NIT's and Central Universities) based on the WCAG2.0 guidelines. An analysis of top ranked Government websites (N=20) based on the report of National Informatics Ranking (NIC), readability, accessibility and site-ranking in India The accessibility study of government websites takes be situated approved to using aChecker (WCAG 2.0) and WAVE tools, and also using Readability Test tool, to calculated Six dissimilar readability Indices score, and also to calculated correlation between different variables. [13].

Readability checkers are used to highlight text passages that are difficult to read. They can help authors to write texts in an easy-to-read style. There are different formulas that are broadly used by the researchers in various fields such as education, business, health care, publishing, industry etc for computing readability of the websites. Many researchers are reported using readability formula in diversified fields such as [14, 15, 16, 17, 18] etc. A study presented a cross-sectional education of 50 health information websites in India. Among 32 health information websites out of 50

were evaluated in terms of quality (LIDA tool) and readability tool (FRES, FKGL and SMOG). And it was initiate that LIDA score have high only three websites and six –grade level readability score has endorsed only five websites [19]. A study was performed to examine the text readability of Bangla language based on machine learning approach [34]. A survey prepared for computational evaluation of text readability and novel tests and chances for future researchers by Author [20]. A study conducted to compute readability of Arabic text by OSMAN-Open Source Metric for Determining Arabic Descriptions, an improved version of readability formula termed as a Flesh and Fog by Author [21]. A report compared content and readability of online patient educational material (PEM) either establishments having companionships and deprived of partaking companionship using Text Stat 0.1.4 word-based examination for python 2.7 and also found the readability score falls within sixth evaluation level or lesser [22].

A study provided an accessible system explanation for distance education as a test of user interface for all categories of users including persons with disabilities and it was initiate to be modest, effective and successful [23]. Correlation coefficient was used to measure the Japanese texts based on textbook corpus [24]. A study performed correlation coefficient among Language features in TIMSS science and outcomes from dissimilar groups of Swedish 8th-gradelearners. The education also explored readability and info load by examining four features (stuffing, accuracy, representation, and



performance of statistics) of technical linguistic [25].

Based on this paper, we have motivated on the accessibility, readability and site-ranking evaluation of topmost 40 Indian University homepages by National Institute Ranking Framework (NIRF 2017) report [30]. A study was performed to examine the text readability of Bangla language based on machine learning approach [34]. This study clearly explains Indian University websites are sources of information delivery, accessing the web contents for all categories of people including persons with disabilities by using statistical process.

3. Readability:

It is main focuses on the interface between the text and the students of well-known levels of ability, info, and awareness. It gives two contributors namely the student and the text, too easy understanding. The features contain information, analysis, readability skill, awareness of the student that make the reading is easily understand;

3.1. Guidelines

Generally, there are eight guidelines principle [32] for making the good result sore on readability on web. Therefore, the developer wants to develop positive ideas, and the readability can be completed in a better way. The 8 guiding principle are given in Table 1.

Table 1 8 guidelines

S.no.	Guidelines
01	Selected Fonts Sensibly
02	Font size and Link Arrangement are important.
03	Usage of High Dissimilarities.
04	Preserve the lines small.
05	Keep subsections also small.
06	Develop conventional to the idea.
07	Don't use Gobbledygook.
08	Usage lists, pictures and highpoints

3.2. Level of algorithms in reading

Many reading level algorithms are given below and explained with their formula [28] readability indices (Readability Formulas, 2016). Based on the study, to analyze the readability score of top 40 Indian university ranked websites. Readability indices



measurements are based on reading level algorithms generally used for calculation of websites.

3.2.1. Automated Readability Index (ARI)

The ARI grades text based on a combination of word and sentence structure. Computers find it trouble to analyze syllables, so the ARI uses a formulation based on the number of letters per word.

$$ARI = 4.71 \left(\frac{\text{characters}}{\text{words}} \right) + 0.5 \left(\frac{\text{words}}{\text{sentences}} \right) - 21.43 \quad 1$$

It is outcomes from the relations to representative word and sentence is hard. ARI provides numeral as output that estimates the oldness need to understand and the situation is also based on US grade level method is shown in Table 2.

Table 2 The grade Level V/S age

Age(yrs)	Grade	Age(yrs)	Grade
5-6 old	Kindergarten	12-13 old	Seventh
6-7 old	First	13-14 old	Eighth
7-8 old	Second	14-15 old	Ninth
8-9 old	Third	15-16 old	Tenth
9-10 old	Fourth	16-17 old	Eleventh
10-11 old	Fifth	17-18 old	Twelfth
11-12 old	Sixth	18-22 old	College

3.2.2. Coleman-Liau Index

This method given by Meri Coleman and T.L.Liau [31]. It makes for every word and sentence length and it also usages US grade level system. this formula also called as CL Index as shown in Eq. (2).

$$CLIndex = 5.89 \times \left(\frac{\text{characters}}{\text{words}} \right) - 0.3 \times \left(\frac{\text{sentences}}{\text{words}} \right) - 15.8 \quad 2$$

3.2.3. Flesch Reading Ease

This formula calculating the FKRE method as shown in Eq. (3). Representation of this readability method, the finest text had better cover smaller sentences and words. To understand statistics number generally ranges from 0 to 100 and additional ranking also shown in American school year necessity for understanding the text. Flesch –Kincaid Readability Ease formulation continuing of the total result of readability scores and Understanding position of text by FKRE method as shown in Table 3.

$$FKRE = 206.835 - 1.015 \times \left(\frac{\text{words}}{\text{sentences}} \right) - 84.6 \times \left(\frac{\text{syllables}}{\text{words}} \right) \quad 3$$

Table 3 Result of summary Understanding status of text in FKRE



Score of Readability	Status of Understanding
90–100	Very Easy
80–89	Easy
70–79	Fairly Easy
60–69	Standard
50–59	Fairly Difficult
30–49	Difficult
0–29	Very Confusing

3.2.4. Flesch-Kincaid Grade Level

This method is an advanced description of FleschReading Ease technique as show in equation 4. The US Government of Defense department usages this formulation as a standard examination. It is also explaining the dissimilar grade values and different scores.

$$FKGrade = 0.39 \times \left(\frac{words}{sentences} \right) + 11.8 \times \left(\frac{syllables}{words} \right) - 15.59 \quad (4)$$

3.2.5. Gunning Fog Index

It is considered by average length of a sentence and the percentage of complex words. It's invented by Robert Gunning. The Gunning Fog Index formula as show in Eq. (5). It explains the GF scores and grades is shown in table 4.

$$GFScore = 0.4 \left[\left(\frac{words}{sentences} \right) + 100 \times \left(\frac{complex\ words}{words} \right) \right] \quad (5)$$

Table 4 Result of Reading level score in Fog Index

GFscore	Grade	GF score	Grade
6	Sixth grade	12	High school senior
7	Seventh grade	13	College freshman
8	Eighth grade	14	College sophomore
9	High school freshman	15	College junior
10	High school sophomore	16	College senior
11	High school junior	17	College graduate

3.2.6. SMOG

SMOG (Simple Measure of Gobbledygook), it is an advanced as a replacement for the Gunning fog index and the method of the SMOG Index is represented in Eq. (6), as shown below.



$$SMOGIndex = 1.0430 \times \left(\sqrt{30 \times \frac{\text{complex words}}{\text{sentences}}} \right) + 3.1291 \quad 6 \quad 6$$

The explanation of the method is as given: In this formula (equation) 30 selected sentences), to calculate for each and every word three or more syllables per word is named as compound word. Finally, the SMOG grade method is adding three to estimated square root of polysyllable count and also is given below.

$$SMOGGrade = 3 + \sqrt{(\text{polysyllable count})} \quad 7$$

4. Experimental and Results

4.1. Readability test tools and analysis

The snapshot of the aChecker tool webpage is shown in Fig 1. Many readability tools are available in online that tools are used to calculate readability score. In this study, we used Online-Utility.org to cover the six measures of readability checkers such as Coleman Liauindex (CLI), Flesch- Kincaid Readability Ease (FKRE), Flesch-Kincaid Grade level (FKGL), Automated Readability Index (ARI), Gunning Fog score (GFS) and Simple measure of Gobbledy-gook (SMOG). Readability testing tool is used to ‘examination by URL’ technique for top most 37 Indian university websites to count the total number of sentence words, compound words, fraction of words, average words per sentence, and average syllables per word.

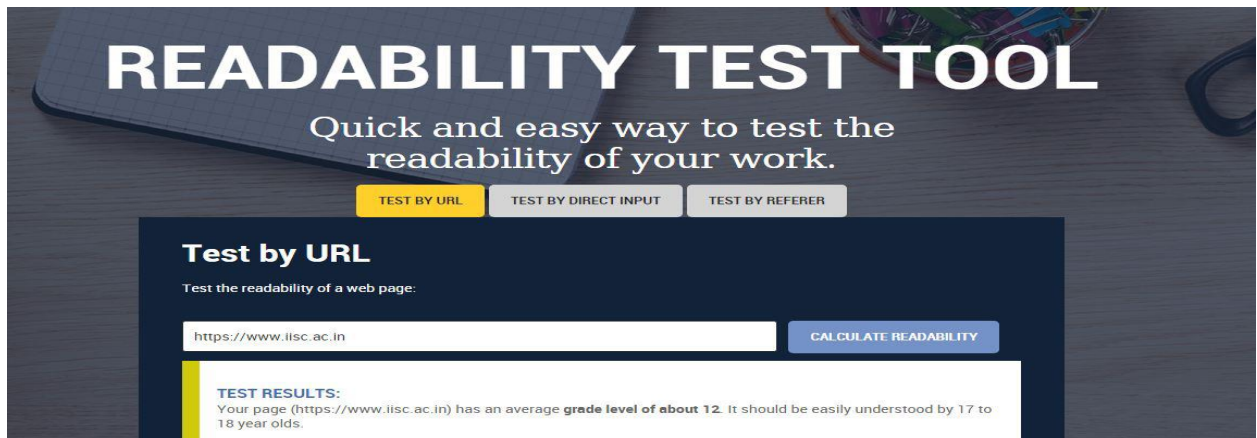


Fig. 1. Webpage of Readability Test tool

Table 5 List of Top 40 ranked Indian university websites

S.No.	University Names	URLs
1	Indian Institute of Science Bangalore	https://www.iisc.ac.in
2	Jawaharlal Nehru University	https://www.jnu.ac.in/main/
3	Banaras Hindu University	https://www.bhu.ac.in/
4	Jawaharlal Nehru Centre for Advanced Scientific Research	https://www.jncasr.ac.in/
5	Jadavpur University	https://www.jaduniv.edu.in/
6	Anna University	https://www.annauniv.edu/
7	University of Hyderabad	https://www.uohyd.ac.in

8	University of Delhi	https://www.du.ac.in/
9	Amrita VishwaVidyaapeetham	https://www.amrita.edu/
10	SavitribaiPhule Pune University	https://www.unipune.ac.in
11	Aligarh Muslim University	https://www.amu.ac.in/
12	JamiaMillialIslamia	https://jmi.ac.in/
13	Birla Institute of Technology & Science -Pilani	https://www.bitmesra.ac.in
14	Vellore Institute of Technology	https://www.vit.ac.in
15	Indian Agricultural Research Institute	https://www.iari.res.in
16	Calcutta University	https://www.caluniv.ac.in
17	Tamil Nadu Agricultural University	https://www.tnau.ac.in
18	Manipal Academy of Higher Education- Manipal	https://manipal.edu/
19	VisvaBharati	https://www.visvabharati.ac.in/
20	Siksha `O` Anusandhan University	https://www.soauniversity.ac.in
21	HomiBhabha National Institute	https://www.hbni.ac.in
22	Bharath Institute of Higher Education & Research	https://www.bharathuniv.ac.in
23	Osmania University	https://www.osmania.ac.in/
24	Punjab Agricultural University, Ludhiana	https://www.pau.edu/
25	Institute of Chemical Technology	https://www.ictmumbai.edu.in/
26	JamiaHamdard	https://jamiahamdard.edu
27	Gauhati University	https://www.gauhati.ac.in
28	Bharathiar University	http://www.b-u.ac.in/
29	Kerala University	https://www.keralauniversity.ac.in/
30	Tezpur University	https://www.tezu.ernet.in/
31	Tata Institute of Social Sciences	https://www.tiss.edu/
32	Shanmugha Arts Science Technology & Research Academy (SASTRA)	https://www.sastra.edu/
33	Panjab University	https://puchd.ac.in/
34	S.R.M. Institute of Science and Technology	https://www.srmuniv.ac.in/
35	Indian Institute of Space Science and Technology	https://www.iist.ac.in/
36	University of Mysore	https://www.uni-mysore.ac.in/
37	Pondicherry University	https://www.pondiuni.edu.in/
38	Tamil Nadu Veterinary & Animal Sciences University	https://www.tanuvac.ac.in/



39	Sri Ramachandra University	https://www.sriramachandra.edu.in/
40	Anand Agricultural University	https://www.aau.in

Table 6 Top 40 Indian university websites for Readability Indices score

S.No	Name of the University Website	Flesch Kincaid Readability Ease	Flesch Kincaid Grade Level	Gunning Fog Score	SMOG Index	Coleman Liau Index	Automated Readability Index
1	Indian Institute of Science Bangalore	12.4	12.4	7.5	6.6	22.5	10.9
2	Jawaharlal Nehru University	38.3	8.9	4.9	6.1	14.8	5.1
3	Banaras Hindu University	47.2	8.1	4.9	7	12.2	3.9
4	Jawaharlal Nehru Centre for Advanced Scientific Research	19.6	12.8	5.6	9.6	20.1	11.8
5	Jadavpur University	29.6	10	4.2	6.2	20.3	9.4
6	Anna University	16.9	11.3	4.2	4.1	16.9	5.6
7	University of Hyderabad	22	10.9	6.2	5.9	19.9	8.6
8	University of Delhi	67	4.9	5	5.4	10.6	1.8
9	Amrita VishwaVidyapeetham	30.4	10.4	6.6	7.7	16.1	6.8
10	SavitribaiPhule Pune University	42.8	8.7	7.1	7.2	15.2	6.3
11	Aligarh Muslim University	16	11.7	5.8	6	22	10.2
12	JamiaMilliaIslamia	42.1	8.8	5.8	7.3	14.8	5.9
13	Birla Institute of Technology & Science -Pilani	44.9	8.3	5	6.6	14	5
14	Vellore Institute of Technology	20.9	11.2	4.5	6.3	21.15	10.3
15	Indian Agricultural Research Institute	25.4	10.9	6.2	7.2	17	7.2
16	Calcutta University	14.9	11.8	69	5.7	21.4	9.6
17	Tamil Nadu Agricultural University	36.6	9.3	5.7	6.6	15.8	6.1
18	Manipal Academy of	31.7	9.5	3	5.3	17.7	6.8



	Higher Education- Manipal						
19	VisvaBharati	68.3	4.7	2.9	4.7	6.4	-1.7
20	HomiBhabha National Institute	121.2	-3.4	0.4	1.8	-16.1	-20.9
21	Bharath Institute of Higher Education & Research	29.1	10.5	5.9	6.8	17.6	8
22	Osmania University	36.9	9	7.2	6.2	15.6	5.6
23	Punjab Agricultural University, Ludhiana	46.2	8.1	3.7	6.5	12.5	3.8
24	JamiaHamdard	41.4	9	5	7.4	16.5	7.4
25	Gauhati University	31.8	9.8	5.8	6.1	17.1	6.9
26	Bharathiar University	21	11.3	6	6.7	20.4	9.4
27	Kerala University	45.8	7.5	5.7	5.1	12.8	2.9
28	Tezpur University	43.3	8.5	6.9	6.5	14.5	5.4
29	Tata Institute of Social Sciences	40.4	8.9	7.5	6.8	17.1	7.6
30	Shanmugha Arts Science Technology & Research Academy (SASTRA)	36.8	8.8	3.9	5	14.7	4.4
31	Panjab University	40.3	9	6	6.9	14.4	5.5
32	S.R.M. Institute of Science and Technology	25.7	10.5	4.1	5.9	19.2	8.3
33	Indian Institute of Space Science and Technology	46.1	7.6	6	5.5	14.9	4.8
34	University of Mysore	36.1	9.4	6.1	6.6	14.3	5
35	Pondicherry University	46.8	7.7	6.2	5.8	14	4.4
36	Tamil Nadu Veterinary & Animal Sciences University	23.4	12.6	5.1	10.4	18.3	11
37	Sri Ramachandra University	44.5	8.9	6.8	7.7	13.4	5.7

Estimation report of different readability indices to check readability score of top ranking 40 Indian university websites are given in Tables 5-6. While testing the readability indices, three university websites among forty have not properly worked for checking the readability



score. Likewise, we find their position of readability success in complexity levels, organization so on, very low, low, normal, high and very high levels are shown in Table-7 and represented in the Fig. 5. The result of graphical representation of top 40 Indian University websites are given by Flesch-Kincaid Readability Ease (FKRE) as shown in Fig. 2, and the other readability indices such as Flesch-Kincaid Grade level, Gunning Fog Index score, SMOG Index, Coleman Liau Index and Automated Readability Index as shown in Fig. 3. The results of readability index score as shown in Fig. 4.

Table 7 Result of percentage for readability Indices score in Complexity level score

Percentage Readability Indices Value (Top 37 University Websites)						
Complexity	Flesch Kincaid Readability Ease	Flesch-Kincaid Grade Level	Gunning Fog Score	SMOG Index	Coleman Liau Index	Automated Readability Index
Very Low	35	0	0	0	40	0
Low	57	0	0	0	47	0
Normal	0	57	2	6	10	22
High	5	40	84	91	0	62
Very High	3	3	14	3	3	16

Table 8 Top-40 Indian University websites in Text Statistics

S.No.	University Name	No. of Sentences	No. of Words	No. of Complex Words	Percent of Complex Words	Average Words per Sentence	Average Syllables per Word
1	Indian Institute of Science Bangalore	154	459	158	34.42	3.31	2.21
2	Jawaharlal Nehru University	78	198	35	17.68	4	1.76
3	Banaras Hindu University	223	1238	289	23.34	5.92	1.81
4	Jawaharlal Nehru Centre for Advanced Scientific Research	48	364	100	27.47	8.95	2.03
5	Jadavpur University	136	431	115	26.68	3.63	2
6	Anna University	15	23	6	26.09	1.47	2.23
7	University of Hyderabad	665	1610	434	26.96	2.8	2.03
8	University of Delhi	52	200	37	18.5	4.13	1.6
9	Amrita VishwaVidyapeetham	211	1112	358	32.19	5.35	2.02
10	SavitribaiPhule Pune	115	709	160	22.57	5.81	1.83



	University						
11	Aligarh Muslim University	8.4	229	85	37.12	2.73	2.22
12	JamiaMilliaIslamia	33	1.78	49	27.53	5.53	1.88
13	Birla Institute of Technology & Science -Pilani	341	1734	418	24.11	5.1	1.85
14	Vellore Institute of Technology	107	386	115	29.79	3.66	2.15
15	Indian Agricultural Research Institute	477	1900	386	20.32	4.73	1.88
16	Calcutta University	58	123	39	31.71	2.35	2.19
17	Tamil Nadu Agricultural University	190	639	130	20.34	4.49	1.84
18	Manipal Academy of Higher Education- Manipal	39	104	30	28.85	2.67	2.04
19	VisvaBharati	1592	6626	867	13.08	3.92	1.55
20	HomiBhabha National Institute	1	1	0	0	1	1
21	Bharath Institute of Higher Education & Research	425	1259	200	15.89	5.32	1.85
22	Osmania University	747	2159	421	19.5	3.75	1.82
23	Punjab Agricultural University, Ludhiana	194	893	199	22.28	5.02	1.8
24	JamiaHamdard	107	574	148	25.78	5.96	1.88
25	Gauhati University	183	676	186	27.51	3.77	2.02
26	Bharathiar University	252	942	319	33.86	3.74	2.15
27	Kerala University	227	593	143	24.11	2.7	1.85
28	Tezpur University	181	873	201	23.02	5.07	1.86
29	Tata Institute of Social Sciences	495	1996	391	19.59	5.25	1.8
30	Shanmugha Arts Science Technology & Research Academy (SASTRA)	257	607	112	18.45	2.71	1.86
31	Panjab University	101	527	131	24.86	5.39	1.89
32	S.R.M. Institute of	437	1072	215	20.06	3.39	1.95



	Science and Technology						
33	Indian Institute of Space Science and Technology	162	463	101	21.81	3.06	1.8
34	University of Mysore	116	528	143	27.08	4.55	1.96
35	Pondicherry University	225	834	198	23.74	3.77	1.84
36	Tamil Nadu Veterinary & Animal Sciences University	59	576	177	30.73	10.36	2.04
37	Sri Ramachandra University	43	329	73	22.19	7.65	1.83

Readability test tool are three types, there are one is Test by URL, second is Test by direct input and third is Test by Referrer. Here the Readability test tool used by only Test by URL. Based on the study, we test only top 40 Indian University websites. When, we were pasting the URL on Readability test tool that tool gives the three types of results such as Readability Indices, Text Statistics and an Average grade level and No. of Years Old to easily understood. The readability Indices covered the Flesch-Kincaid Reading Ease, Flesch-Kincaid Grade level, Gunning Fog Index, SMOG Index, Coleman Liau Index and Automated Readability Index as shown in Table 6. The Text Statistics covered the No. of sentence, No. of words, and No. of complex words, Average words per sentence and Average Syllables per word as shown in Table 8.

Table 9 Top 40 Indian University websites along with number of years to understand the text and Average Grade level test results

S.No.	University Name	URLs	Average Grade Level	No.of Years Old to Easily Understand
1	Indian Institute of Science Bangalore	www.iisc.ac.in	12	17 to 18
2	Jawaharlal Nehru University	www.jnu.ac.in/main/	8	13 to 14
3	Banaras Hindu University	www.bhu.ac.in/	7	12 to 13
4	Jawaharlal Nehru Centre for Advanced Scientific Research	www.jncasr.ac.in/	12	17 to 18
5	Jadavpur University	www.jaduniv.edu.in/	10	15 to 16
6	Anna University	www.annauniv.edu/	8	13 to 14
7	University of Hyderabad	www.uohyd.ac.in	10	15 to 16



8	University of Delhi	www.du.ac.in/	6	11 to 12
9	Amrita VishwaVidyapeetham	www.amrita.edu/	10	15 to 16
10	SavitribaiPhule Pune University	www.unipune.ac.in	9	14 to 15
11	Aligarh Muslim University	www.amu.ac.in/	11	16 to 17
12	JamiaMilliaIslamia	jmi.ac.in/	9	14 to 15
13	Birla Institute of Technology & Science - Pilani	www.bitmesra.ac.in	8	13 to 14
14	Vellore Institute of Technology	www.vit.ac.in	11	16 to 17
15	Indian Agricultural Research Institute	www.iari.res.in	10	15 to 16
16	Calcutta University	www.caluniv.ac.in	11	16 to 17
17	Tamil Nadu Agricultural University	www.tnau.ac.in	9	14 to 15
18	Manipal Academy of Higher Education- Manipal	manipal.edu/	8	13 to 14
19	VisvaBharati	www.visvabharati.ac.in/	3	8 to 9
20	HomiBhabha National Institute	www.hbni.ac.in	-8	-3 to -2
21	Bharath Institute of Higher Education & Research	www.bharathuniv.ac.in	10	15 to 16
22	Osmania University	www.osmania.ac.in/	9	14 to 15
23	Punjab Agricultural University, Ludhiana	www.pau.edu/	7	12 to 13
24	JamiaHamdard	jamiahamdard.edu	9	14 to 15
25	Gauhati University	www.gauhati.ac.in	9	14 to 15
26	Bharathiar University	www.b-u.ac.in/	11	16 to 17
27	Kerala University	www.keralauniversity.ac.in /	7	12 to 13
28	Tezpur University	www.tezu.ernet.in/	8	13 to 14
29	Tata Institute of Social Sciences	www.tiss.edu/	10	15 to 16
30	Shanmugha Arts Science Technology & Research	www.sastra.edu/	7	12 to 13



	Academy (SASTRA)			
31	Panjab University	puchd.ac.in/	8	13 to 14
32	S.R.M. Institute of Science and Technology	www.srmuniv.ac.in/	10	15 to 16
33	Indian Institute of Space Science and Technology	www.iist.ac.in/	8	13 to 14
34	University of Mysore	www.uni-mysore.ac.in/	8	13 to 14
35	Pondicherry University	www.pondiuni.edu.in/	8	13 to 14
36	Tamil Nadu Veterinary & Animal Sciences University	www.tanuv.ac.in/	11	16 to 17
37	Sri Ramachandra University	www.sriramachandra.edu.in/	9	14 to 15

Readability Test tool also covered the Average Grade Level and No. of years old to Easily Understood as shown in Table 9. To find the complex level score for readability Indices score with percentage such as Very easy to understood (5%), easy to understood (14%), hard (76%) and very hard (5%) and also shown in Table 5.

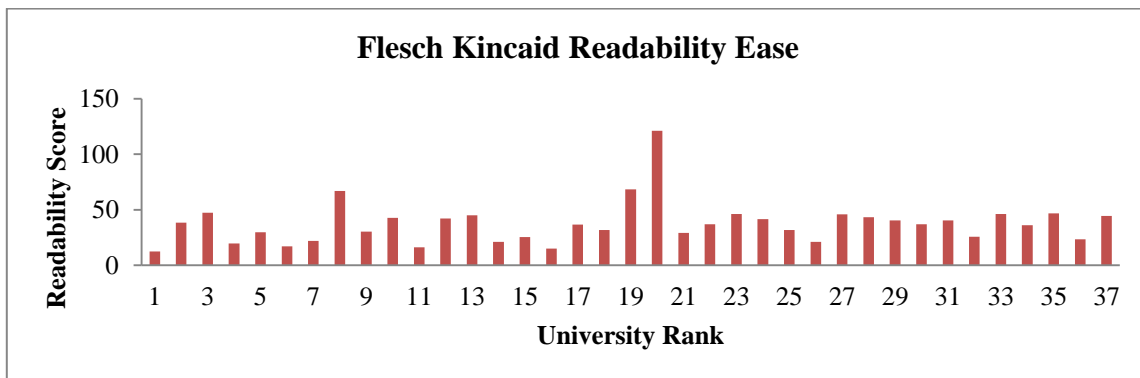


Fig. 2. FKRE Result of graphical representation of Top37 Indian University websites

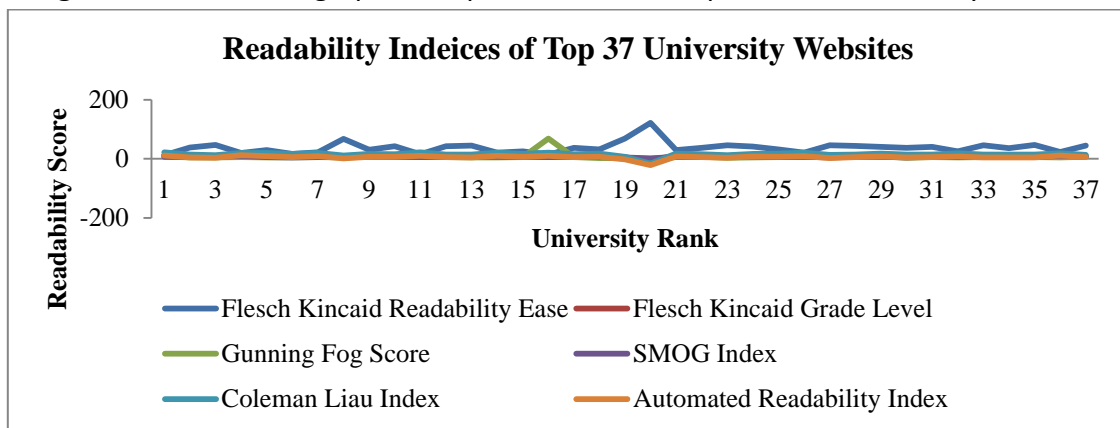


Fig. 3. Result of graphical representation of Top37 University websites in India by using FKRE, FKGL, GFS, SMOG Index, CLI and ARI



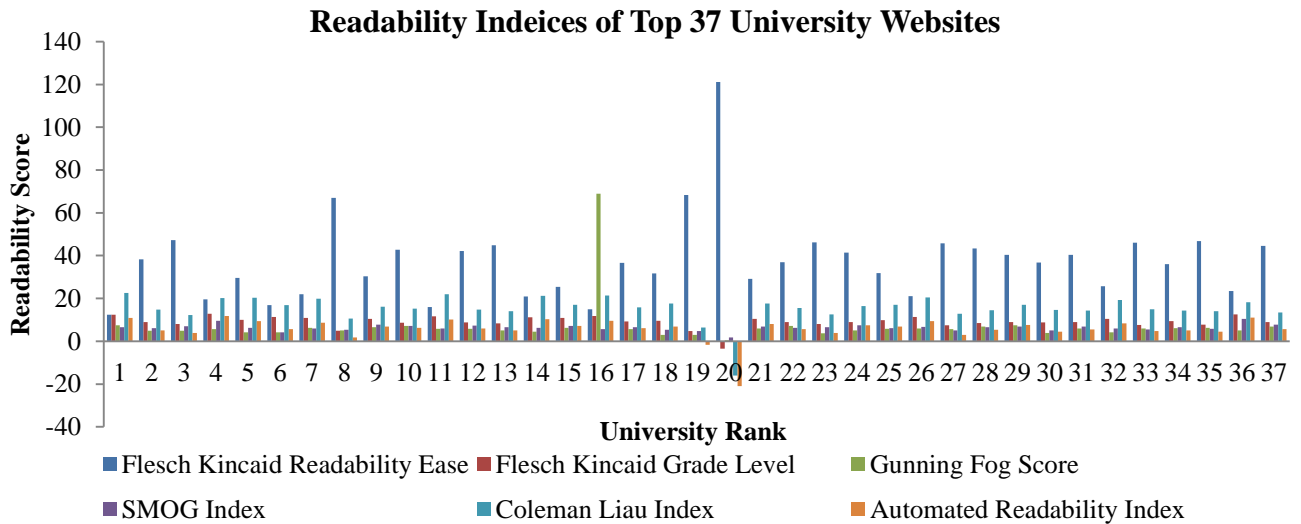


Fig. 4. Graphical representation of readability indices with calculated data of Top37 Indian University websites

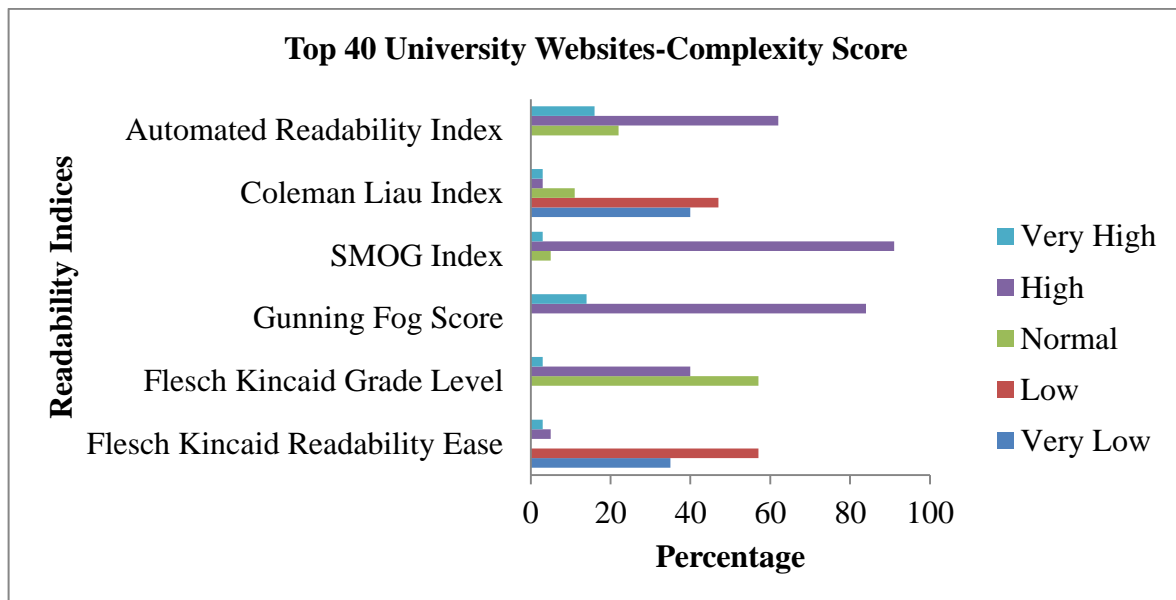


Fig. 5. Complexity score of Top40 ranking Indian university websites in Readability Indices

4.2. Web Accessibility Analysis

Different types of evaluation tools are available in online such as web Accessibility aChecker (AChecker, 2016) [33] and Web Accessibility Versatile Evaluator (WAVE, 2016) [27]. These tools are used to analysis of Top 40 Indian university websites.

4.2.1. aChecker Tool

The snapshot of the aChecker tool webpage is shown in Fig 6. AChecker is employed to analyze the HTML content to check accessibility issues by giving the URL of a web page, uploading HTML source code of the Web page. The snapshot of the AChecker tool webpage is shown in Fig 6. The AChecker tool is used to test the conformance of accessibility standards to identify the web content which is accessible ball kinds of people. There are various options are existing to check the web pages. For this study, we utilized 3 priority

levels namely Priority 1, Priority 2 and Priority 3 to check the accessibility with respect to WCAG 1.0 guidelines. For this study, we utilized 3 priority levels namely Priority 1, Priority 2 and Priority 3 to check the accessibility with respect to WCAG 1.0 guidelines. For in addition, 3 levels are also used such as Level A Means Lowest, Level AA means Medium and Level AAA means Highest to check the accessibility with respect to WCAG 2.0 guidelines. AChecker is also used to evaluate web pages under Section 508, BITV1.0 (Level2) and, Stanca Act guidelines. The primary testing of websites is done with the automatic evaluation tools followed by manual testing. AChecker generates the outcome based on the chosen guidelines among WCAG 1.0, WCAG 2.0 AND Section 508. It is used to find three types of problems such as Known problems, likely problems and Potential problems respectively.

- Known problems: This is considered as accessibility barriers which must be rectified.
- Likely problems: This is considered as probable barriers, but it needs a manual operation to change the pages and solve the problems
- Potential problems: They are not identified by the AChecker and needs a manual decision.

We have to implement all three levels for measuring the accessibility score of the Top 40 Indian University websites. The calculation of three problems and then create last web accessibility violation score. To find the status of the top 40 Indian University websites based on this score and also the height score violation websites have lower rank by using SPSS 20.0.

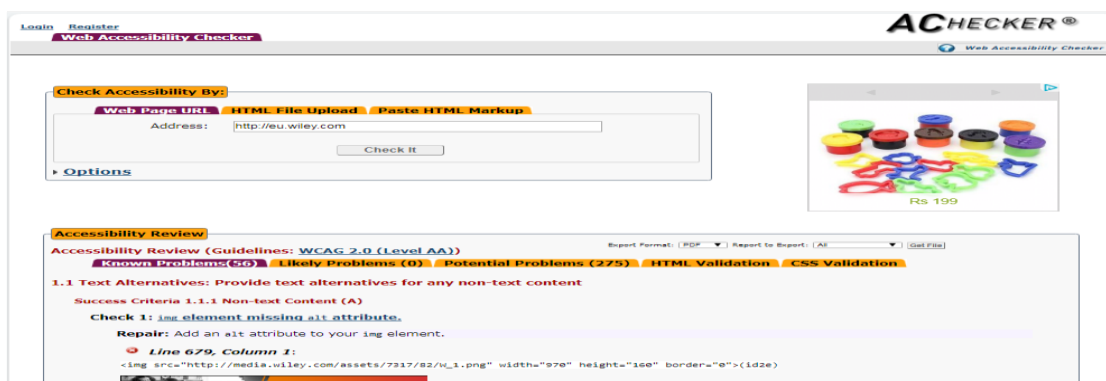


Fig. 6. Webpage of AChecker evaluation tool

The evaluation of result report for topmost36 ranking Indian university websites is given by a Checkertool as show in Table-10 and the graphical representations of result is shown in Fig. 7, 8, and 9 for Level A, Level AA and Level AAA.

Table 10 aChecker tool: Accessibility report of Top 36university websites.

	Level-A			Level-AA			Level-AAA		
	Known	Likely	Potential	Known	Likely	Potential	Known	Likely	Potential
Total Errors	1068	21	15161	3194	30	16912	2251	43	16516
Mean	29.67	0.58	421.14	88.72	0.83	469.78	62.53	1.23	458.78
Standard Deviation	63.17	1.57	263.48	124.74	1.70	269.06	88.94	3.79	267.86



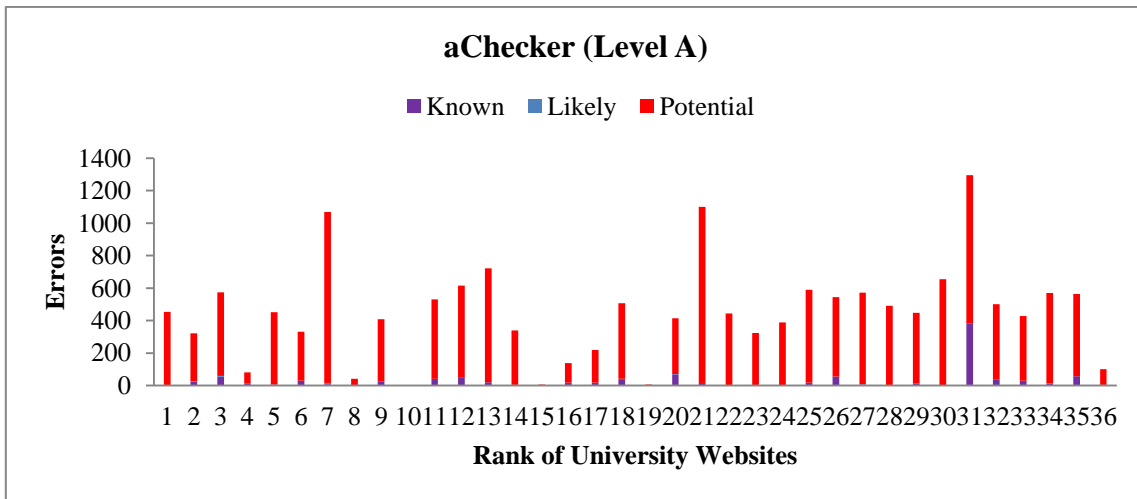


Fig. 7. aChecker Tool (Level-A): Graphical representation of Top 36 university websites in India

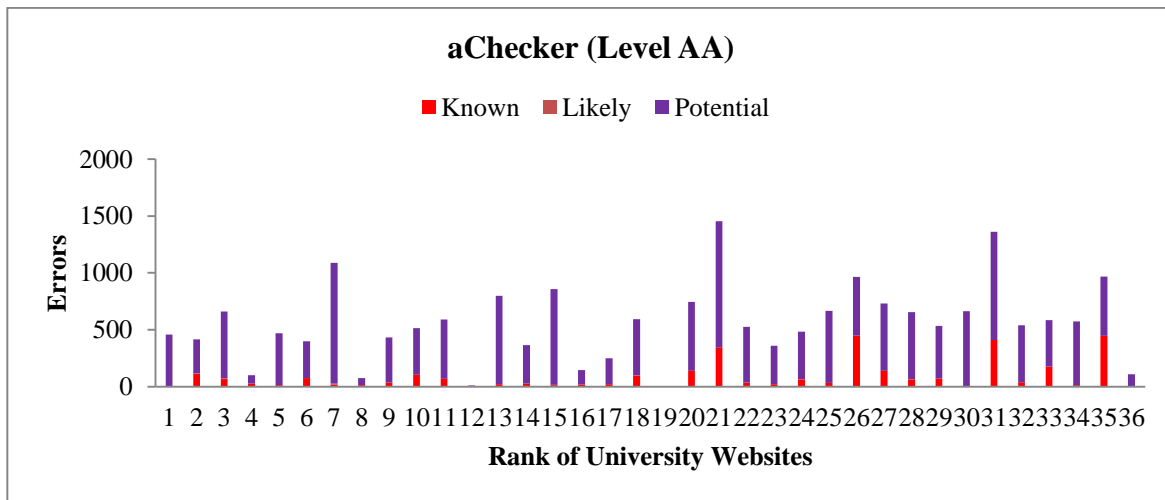


Fig. 8. aChecker Tool (Level-AA): Graphical representation of Top 36 University websites in India

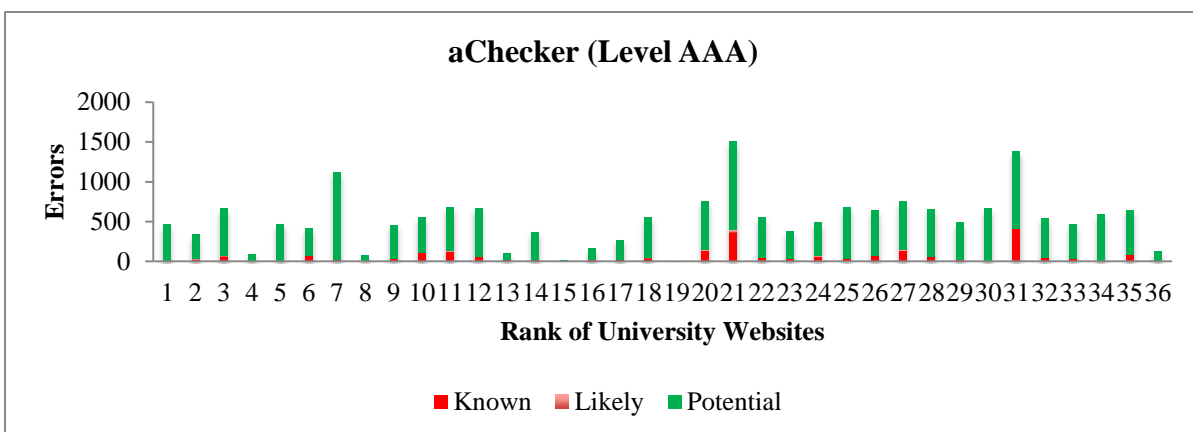


Fig. 9. aChecker Tool (Level-AAA): Graphical representation of Top 36 University websites in India

4.2.2. Web Accessibility Versatile Evaluator (WAVE)



WAVE is an automated evaluation tool used to test the accessibility of the website's content by adding icons and indicators to the web page. The entire investigation process is done inside the web browser itself. The snapshot of the WAVE tool webpage is shown in Fig 10. The results of WAVE are highly helpful for web developers to design the website more accessible. It gives three types of the accessibility information such as Styles, Non Styles and Contrast. The WAVE tool can be easily used simply by opening the tool and then entering the URL of the website which needs to be evaluated. By clicking the submit button of the form, the result will be produced with embedded indicators and icons. The WAVE tool gives the following errors about the web page and the errors are Errors, Alerts, Features, Structural Elements, HTML5 and ARIA and Contrast Errors. Likewise, we will develop particulars of WCAG 2.0 violations about styles, no styles and contrast by using this tool. Base on the violations scores, we additional them and to create an ending report. The Indian university websites having high score and also gives the less rank about accessibility score by using SPSS 20.0. To analysis of Top 37 Indian university websites are using WAVE tool, and to find the total, average and standard deviation results are shown in Table 11. Likewise, their resultant of graphical representation as shown in Fig. 11.

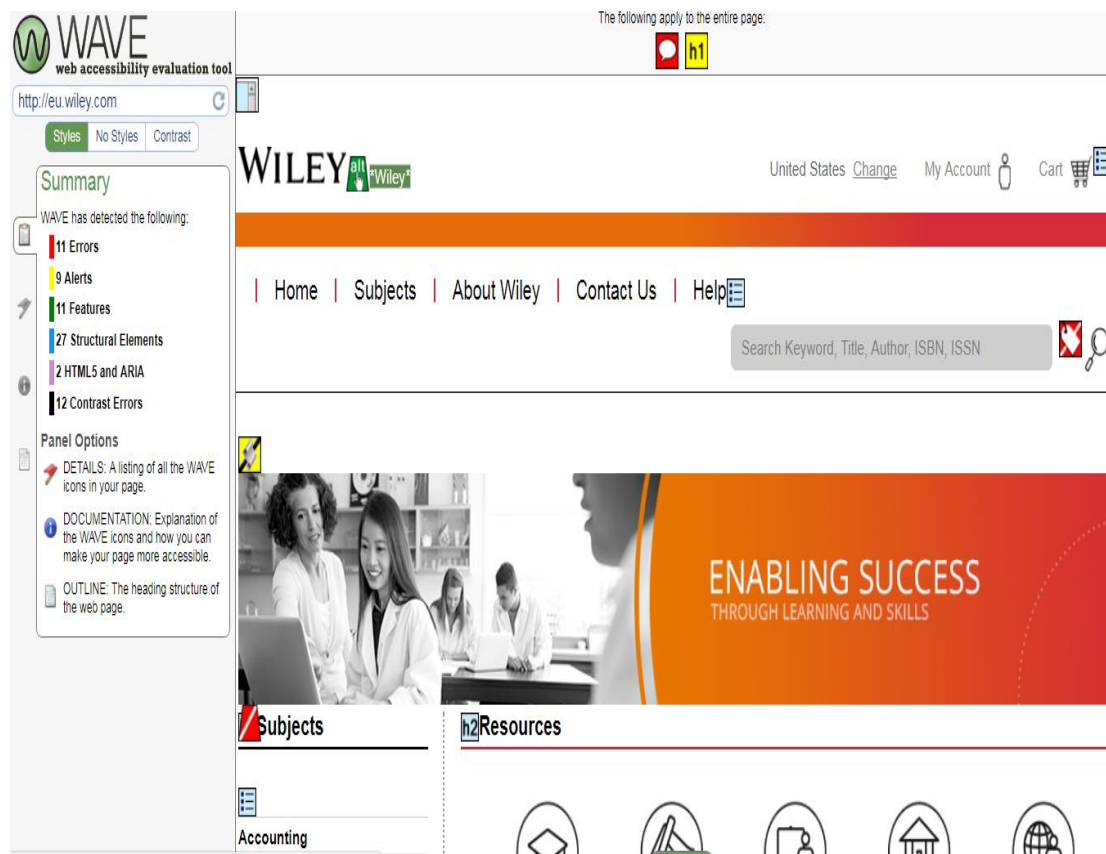


Fig. 10. Webpage of WAVE evaluation tool

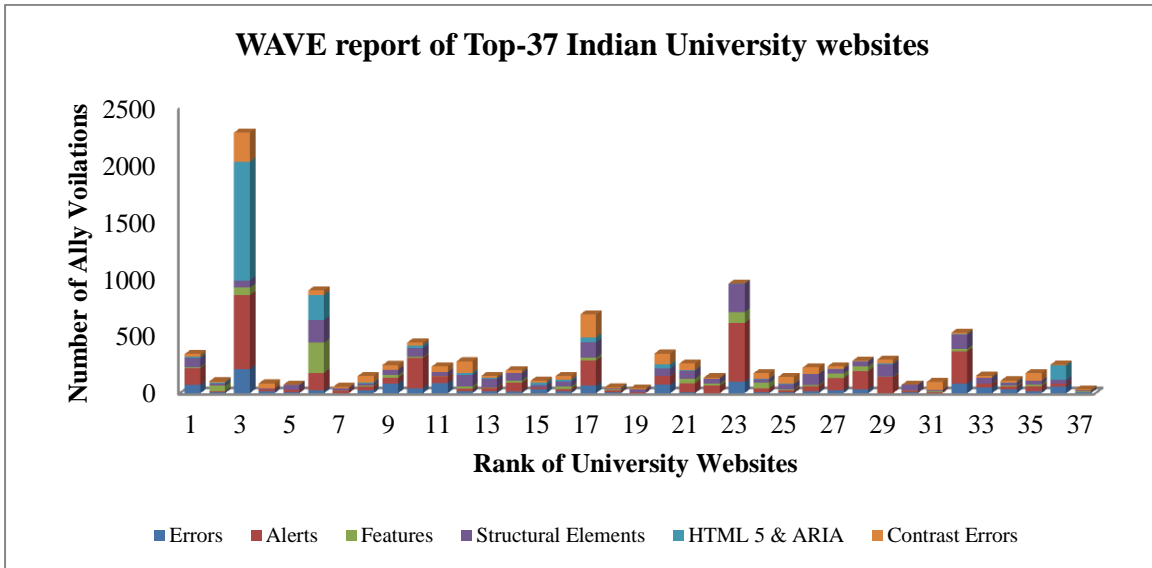


Fig. 11. Graphical representation of WAVE tool results of Top 37 University Websites in India

Table 11. Result of Top 37 Indian University websites using Wave tool

Tools/Statistical inferences	Errors	Alerts	Features	Structural Elements	HTML5&ARIA	Contrast Errors
Total Errors	1287	3502	905	2187	1643	1531
Mean	34.78	94.65	24.46	59.11	44.41	41.38
Standard Deviation	41.57	138.83	45.70	51.34	173.02	52.49

5. Ranking of Site

The evaluation of automatic tool is available in online and is also called as Alexa (Alexa, 2016) for sight status of the correlation between ranking is given by NIRF 2016, Alexa (Global& National). The total ranking of websites with their coefficient correlation as shown in Fig. 12. Likewise, the status of connected dots such as accessibility, readability and site-ranking (NIRF & Alexa) generated by test in SPSS 20.0. Also we have applied Spearman’s rank correlation for finding their associations.

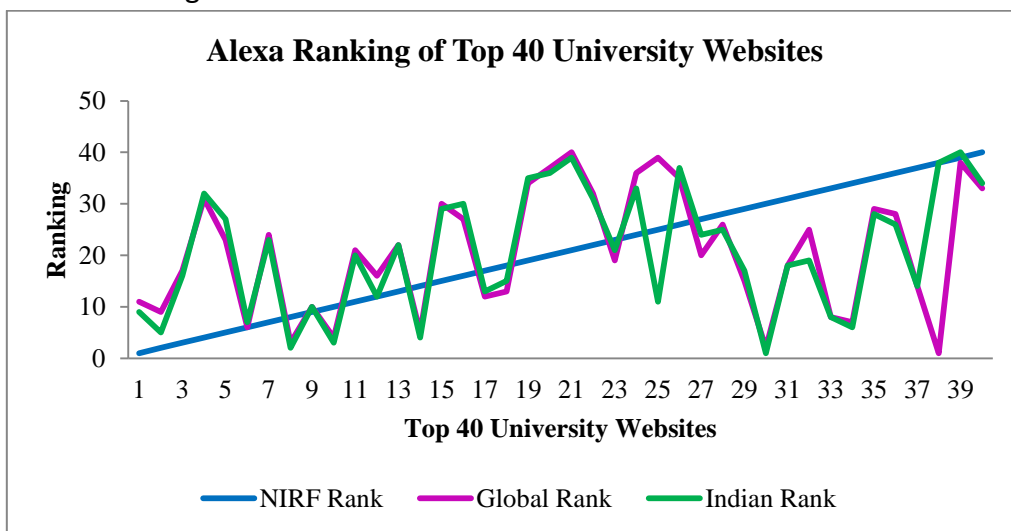


Fig. 12. Site Ranking



Table 12 Spearman’s Correlations between selected seven variables

Correlations	FKER	Level A	Level AA	Level AAA	WAVE	Global	National
FKER	1	-0.199	-0.097	-0.066	-0.197	0.074	-0.032
Level A	-0.199	1	0.539**	0.523*	0.541**	-0.151	-0.040
Level AA	-0.097	0.539**	1	0.824*	0.320	-0.272	-0.137
Level AAA	-0.066	0.523**	0.824**	1	0.369*	-0.313	-0.209
Wave	-0.197	0.541**	0.320	0.369*	1	-0.326	-0.268
Global	0.074	-0.151	-0.272	-0.313	-0.326	1	0.838**
National	-0.032	-0.040	-0.137	-0.209	-0.268	0.838*	1

1. Correlation between FKRE ranking and Level A ranking variable:

Level-A ranking and FKRE ranking is having negative correlation with Spearman’s correlation coefficient=-0.199 and determination coefficient, $r^2=3.96\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

2. Correlation between FKRE ranking and Level AA ranking variables:

Ranking between Level-AA and FKRE is having negative correlation with spearman’s correlation coefficient, $r=-0.097$ and determination coefficient, $r^2=0.94\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

3. Correlation between FKRE ranking and Level AAA ranking variables:

Level-AAA ranking and FKRE ranking is having negative correlation with Spearman’s correlation coefficient, $r=-0.066$ and determination coefficient, $r^2=0.44\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated

4. Correlation between FKRE ranking and WAVE ranking variables:

Wave ranking and FKRE ranking is having negative correlation with Spearman’s correlation coefficient, $r=-0.197$ and determination coefficient, $r^2=3.89\%$. Therefore, the correlation between them is not strong mean sthat the association of the variables are negatively correlated



5. **Correlation between FKRE ranking and Alexa Global ranking variables:** FKRE ranking and Global ranking variables are having positive correlation with Spearman's correlation coefficient, $r=0.074$ and determination coefficient, $r^2=0.55\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated.
6. **Correlation between FKRE ranking National ranking variables:** FKRE ranking and National ranking is having negative correlation with Spearman's correlation coefficient, $r=-0.032$ and determination coefficient, $r^2=0.10\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated
7. **Correlation between Level-A ranking and Level -AA raking variables:** Level-A ranking and Level -AA raking variables are having positive correlation with Spearman's correlation coefficient= 0.539 and determination coefficient, $r^2=29.05\%$. Therefore, the correlation between them is strong means that the variables are positively correlated.
8. **Correlation between Level -A ranking and Level-AAA ranking variables:** Level A ranking and Level-AAA ranking variables are having positive correlation between Level A ranking and Level AAA ranking with Spearman's correlation coefficient= 0.523 and determination coefficient, $r^2=27.35\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated.
9. **Correlation between Level A ranking and Wave ranking:** Level-A ranking and Wave ranking variables are having positive correlation with Spearman's correlation coefficient, $r=0.541$ and determination coefficient, $r^2=29.26\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated
10. **Correlation between Level-A ranking and Global ranking variables:** Level-A ranking and Global ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.151$ and determination coefficient, $r^2=2.28\%$. Therefore, the correlation between them is not strong means the association of that the



variables are negatively correlated.

11. Correlation between Level-A ranking and National ranking variables:

Level-A ranking and National ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.040$ and determination coefficient, $r^2=0.16\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated

12. Correlation between Level-AA ranking and Level-AAA ranking variables:

Level-A ranking and Wave ranking variables are having positive correlation with Spearman's correlation coefficient $r=0.824$ and determination coefficient, $r^2=67.89\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated

13. Correlation between Level-AA ranking and Level-AAA ranking variables:

Level-A ranking and Wave ranking variables are having positive correlation with Spearman's correlation coefficient, $r=0.320$ and determination coefficient, $r^2=10.24\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated.

14. Correlation between Level AA ranking and Global ranking variables:

Level-AA ranking and Global ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.272$ and determination coefficient, $r^2=7.40\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

15. Correlation between Level-AA ranking and National ranking variables:

Level-AA ranking and National ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.137$ and determination coefficient, $r^2=1.8\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

16. Correlation between Level-AAA ranking and WAVE ranking variables:

Level-AAA ranking and Wave ranking variables are having positive correlation with Spearman's correlation coefficient, $r=0.369$ and determination coefficient, $r^2=13.61\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated.

17. Correlation between Level-AAA ranking and Global



ranking variables: Level-AAA ranking and Global ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.313$ and determination coefficient, $r^2=9.79\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

18. **Correlation between Level AAA ranking and National ranking variables:** Level AAA ranking and National ranking variables are having negative correlation with Spearman's correlation coefficient, $r=0.209$ and determination coefficient, $r^2=4.36\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

19. **Correlation between Wave ranking and Global ranking variables:** Level-AAA ranking and Global ranking variables are having negative correlation with Spearman's correlation coefficient $r=-0.326$ and

22.

determination coefficient, $r^2=10.62\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

20. **Correlation between Wave ranking and National ranking variables:** Wave ranking and National ranking variables are having negative correlation with Spearman's correlation coefficient, $r=-0.268$ and determination coefficient, $r^2=7.18\%$. Therefore, the correlation between them is not strong means that the association of the variables are negatively correlated.

21. **Correlation between Global ranking and National ranking variables:** Global ranking and National ranking variables are having positive correlation with Spearman's correlation coefficient, $r=0.838$ and determination coefficient, $r^2=70.22\%$. Therefore, the correlation between them is strong means that the association of the variables are positively correlated



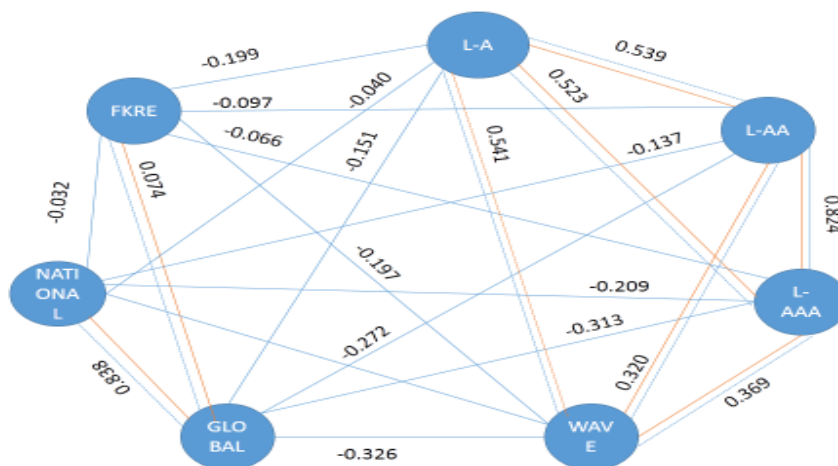


Fig. 13. Graphical representation of connection of dots involving different variables

6. Discussions and Interpretation of data

Based on the study, we employed several readability methods to check the readability score of top 40 Indian university websites. The results show that very low very category websites are 13%, low category websites are 17%, normal category websites are 16%, high category websites are 47% and very high category websites are 7%. These type of complexity score in term of their readability position. The experiential result of average grade level value is 8.46 which specify that 14 years are required for understanding the text of university websites. Still there is a need for further improvement of university websites so as the overall readability score is good. In this paper, the evaluation of web accessibility by using two standard tools namely aChecker tool and Wave tool. These two tools are used to check the accessibility score of these top university websites interms of WCAG 2.0 guidelines. AChecker tool is used for testing the Indian university websites and based on the result we observed potential problems more than Known problems. Also, we observed in Table 10 the values of total average problems are 451.39,

559.33, 522.54 and standard deviation errors are 328.22, 395.5, and 360.59 in Level A, Level AA, and Level AAA. Finally, we observed manual evaluation of accessibility of websites to indicate barriers for people with disabilities and fix these problems with suitable context exact resolutions. Base on the result of WAVE tool report, alerts values are highest value and errors values are least value as show in Table 11. Also we observed in Table 11 the mean values of error values are 34.78, alerts value 94.65, feature values are 24.46, Structural elements was 59.11, HTML5 and ARIA was 44.41 and Contrast errors was 41.38. The standard deviation of Errors, Alerts, Features, Structural Elements HTML5&ARIA, and Contrast Errors are 41.57, 138.83, 45.70, 51.34, 173.02 and 52.49 respectively. So, the result shows that the number of structural elements and alerts values are high. To improve the better results in terms of accessibility, we want minimize these problems such as alerts and structural elements. Alexa tool is used to evaluate the Top 40 ranking Indian university websites in terms of Global ranking and Indian ranking or



National ranking (National means country based websites). we observed result in Table 12. The correlation between Alexa Global ranking and Alexa Indian University ranking is having high correlated value (0.838) and have a strong connection. In this paper, Generally Spearman's correlation among the selected seven variables namely aChecker, (Level-A, Level-AA and Level-AAA), WAVE, Alexa Global, Alexa National and FKRE ranking variables are show in Table 12. We observed statistically significant associations and positive correlations between the variables like Level A with Level AA, Level AAA and WAVE, FKRE with Alexa Global, Level AA with Level AAA and WAVE, Level AAA with WAVE and finally Alexa Global with National. Negative correlations observed among the remaining variables. The results of graphical representation of relation between variables between variables as shown in Fig 13. The above graph show that, the lines of orange color is negative correlation and the line of blue color is positive correlation between variables. The lines of Connect the dots show that, how the dots lines (Accessibility, Readability and Site-ranking) are correlated them each other. The difference size of these lines are shows the strength of coefficient correlation between the dots.

7. Limitations

The results reveal that many kinds of limitations explored for each section. The expected outcome of readability evaluated in the initial stages of learning English. Many tools are available for teaching and learning the English

language whereas less of other languages. In US readability is very less to provide web-based learning in grade system. Expect the US there is no clear a specific grading system for every grade mentioned. The future research should be the specific methodology for every grade level using web-based teaching and learning and also readability techniques for plain text. There are some elements such as hyperlink and tables and so on ignored in readability test. There was no manual evaluation took place instead automatic testing tools used for calculation of the results. These tools used based on different parameters and there were different results. We have used SPSS 20.0 for evaluation of the results from the ranking system. This system helped us to find the relationship between the many variables and also the negative coefficient correlation between the NIRF and aChecker and Wave variables and NIRF ranking and with FKRE readability variables. But, the correlation between all other variables are positively correlated with Alexa ranking.

8. Suggestion

The formulas or techniques used to test the readability in web-based teaching and learning. There is a high demand in future for the development of readability procedures or test that should focus on language independent. There are two things possible firstly language independent the second determinations to form metrics which would link the specific features of any language. The grading system implemented for readability test for the US. Hence, we should focus on choice based credit



system in the grading system. In order to fulfill the requirements plain text documents built in the readability testing but they do not associate with the configuration of elements. A web-based contents includes many other elements separately from content includes many other elements separately from the basic text like tables, hyperlinks and so on. There should be special provisions for the web page for readability measurement which would format the elements and also plain text characteristics. The future work should focus on improvement on web page system along with readability and assessment tool.

9. Conclusions

Readability score was calculated using six popular techniques. The style of learning was leaning by doing the system of the readability score was satisfactory. Other countries want to improve the grading tools with respect to readability as like as grading system in the US. The Spearman Rank correlation method used to find the correlation between scores in order to reduce the differences between the variables accessibility and readability. The graphical representation shows the correlation between the variables. The three important factors such as accessibility, readability and site-ranking in the system of learning are useful for a large number of users. If web-based learning would not have found, it had been a great disadvantage of learning for a large number of users. Nevertheless, the pages on the top list the web accessibility positions are not good then there would be a big loss for the elderly and disabled persons. For usefulness of

the readability, the understanding level of the content does not match with target group then it would not be reachable for the users. The importance should be given to the accessibility, readability, and site-ranking in the web-based teaching and learning.

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