EasyChair Preprint

№ 1027

Accessibility Evaluation of Multimedia Resources in selected Latin America Universities

Patricia Acosta-Vargas, Luis Salvador-Ullauri,
Jorge Luis Pérez Medina and Yves Rybarczyk

May 27, 2019

Accessibility Evaluation of Multimedia Resources in selected Latin America Universities

Patricia Acosta-Vargas
SI2 Lab
Universidad de Las Américas
Quito-Ecuador
patricia.acosta@udla.edu.ec

Luis Salvador-Ullauri
CEC-EPN
Escuela Politécnica Nacional
Quito-Ecuador
lsalvador@cec-epn.edu.ec

Jorge Luis Pérez-Medina
SI2 Lab
Universidad de Las Américas
Quito-Ecuador
jorge.perez.medina@udla.edu.ec

Yves Rybarczyk
SI2 Lab
Universidad de Las Américas
Quito-Ecuador
yvesrybarczyk@udla.edu.ec

***Abstract*— In the present day, it is a challenge for web accessibility experts to test whether educational and informational resources are accessible. There are no adequate tools and methods to evaluate the accessibility of multimedia resources, which makes the type of video resource not accessible to all users, especially for users with disabilities. Currently, there are millions of multimedia, including video-type resources that we use as an educational input during teaching-learning processes. However, the designers of these resources have neglected in their development the parameter of accessibility to make them more accessible. This research suggests applying a combined method between the automatic tool for photosensitive epilepsy and manual evaluation with the Website Accessibility Conformance Evaluation Methodology 1.0. We applied this method in 10 video resources of the Latin American universities located in the first places according to Webometrics. This research may contribute to future studies related to the accessibility of multimedia resources.**

Keywords—accessibility, evaluation, Latin America Universities, multimedia, resources, video, Web Content Accessibility Guidelines 2.1

I. INTRODUCTION

According to "We are social" [1] Global Digital Report for January 2019, statistical indicators reveal that in 2019 we have 4,390 million Internet users, this represents a considerable increase of 9% compared to January 2018. On the other hand, it is essential to point out that YouTube has more than one billion users; this number of users is equivalent to almost a third of Internet users. Undoubtedly, YouTube [2] is the second largest search engine in the world and ranks third among the most visited websites after Google and Facebook. Statistics [2] indicate that users consume around one billion hours of video per day.

At present, how we watch videos is changing rapidly. Instead of turning to television to watch our favorite shows [3], now the trend is to gather in an environment of digital communities where we watch short and long-term videos according to our tastes, preferences or needs.

The digital educational resources, in this case, the videos are appreciated differently as support for the education and learning processes [4]. Therefore, we suggest applying the accessibility guidelines in videos that agree with the inclusion of all people regardless of their situations and preferences. This research proposes the evaluation of accessibility in multimedia resources, especially those of video type, by applying Web Content Accessibility Guidelines (WCAG) 2.1 and with a combined method to evaluate the level of accessibility of multimedia resources (videos).

Accessibility [5] refers to the degree to which users can easily use a service, regardless of the conditions of their physical and intellectual capacities. In the meantime, accessible educational resources should provide universal access, for example, for people with visual impairment or reduced vision, we suggest including a description of the audio; for hearing impaired users, we recommend placing the subtitles.

The United Nations (UN) [6] "Recognizes the importance of access to an economic, physical, social and cultural space, education, health information, and communication, so that users with disabilities can fully enjoy all human rights and fundamental freedoms."

This research presents an assessment of educational videos accessibility. In the randomly selected videos, we apply the WCAG 2.1 [7] that allow us to identify possible accessibility violations.

In this research, the Web Accessibility Conformance Evaluation Methodology (WCAG-EM) 1.0 [8] was applied to determine if the content of the videos assessed meets the accessibility guidelines of WCAG 2.1 or not. It is essential to know the information related to educational videos, such as size, duration, and format. The resource information serves as an input to analyze the video with the photosensitive epilepsy analysis tool (PEAT[1]) [9], [10] of the University of Wisconsin Monitoring Center. As a case study, we have applied this method to 10 videos taken at random from the websites of the best universities in Latin America according to the Webometrics[2].

The rest of this document is structured as follows: details about the literature review and related work presented in Section II. The method used in this investigation presented in Section III. Section IV dedicated to the results and discussion of the dataset of this study. Finally, Section V aims to conclude this document and future research work.

II. LITERATURE REVIEW AND RELATED WORKS

World Wide Web Consortium (W3C) [11] indicates that multimedia resources are related to texts, images, animations,

[1] http://trace.umd.edu/peat
[2] http://www.webometrics.info/en/Latin_America

graphics, simulations, video, and sound that communicate specific information.

Statistics provided by the World Health Organization[17] indicate that 15% of the world's population has a disability, which makes it difficult for them to access and understand the media. For example, blind people [12] cannot access visual information in videos, for whom it is essential to include alternative audio information.

Accessibility refers to removing barriers that avoid interaction between the web and users [13]. Web accessibility helps people with disabilities to use and interact easily on the web. In which case, we refer to a web design that will assist these people navigate, understand, perceive, and interact with the web, in turn contributing contents. As long as web accessibility also aids other users, including older senior who have seen their skills diminished because of age.

The accessibility guidelines of the W3C [7], has evolved, includes the W3C standard of accessibility, by implementing verifiable and applicable technology. Also, in this investigation, we apply WCAG 2.1 [7], which contains four principles, 13 guidelines, 78 compliance criteria, plus an indeterminate number of techniques. The four principles are the same as those that existed in WCAG 2.0 [14]:

Perceptibility corresponds to principle 1 [14]; the components and the information of the user interface must be perceptible to the users. There are four guidelines and 29 compliance criteria.

- Guideline 1.1 [14]. Alternative text: provides alternative text for content that is not textual, so that we can transform it into other formats that people need, such as large characters, braille, verbal language, symbols or a more direct language.
- Guideline 1.2 [14]. Multimedia content dependent on time provides synchronized alternatives for multimedia content that depends on time.
- Guideline 1.3 [14]. Adaptable: create content that we can present without losing information or structure.
- Guideline 1.4 [14]. Distinguished: facilitates users to see and hear content, as well as the distinction between the most essential and the least important.

Operability corresponds to principle 2 [14]; the navigation components and the user interface must be operable. We can apply five guidelines and 29 compliance criteria.

- Guideline 2.1 [14]. Accessible keyboard: controls all functions from the keyboard.
- Guideline 2.2 [14]. Enough time: provides enough time for users to read and use the content.
- Guideline 2.3 [14]. Epileptic attacks: controls the design of content that can cause epileptic seizures.
- Guideline 2.4 [14]. Navigation: provides ways to help users navigate, search for content, and determine where they are.
- Guideline 2.5 [14]. Input modes: it helps users to operate the functionality through several input methods in addition to the keyboard.

Comprehensibility corresponds to principle 3 [14]; the management and information of the user interface must be understandable. There are three guidelines and 17 compliance criteria.

- Guideline 3.1 [14]. Legible: make text content legible and understandable.
- Guideline 3.2 [14]. Predictable: get the appearance of predictable web pages.
- Guideline 3.3 [14]. Data entry assistance: help users will avoid and correct errors.

Robustness corresponds to principle 4 [14]; the content must be robust and easy to interpret by any user and assistive technology. We have one guideline and three compliance criteria.

- Guideline 4.1 [14]. Compatible: maximizes compatibility with present and future user agents, including assistive technologies.

Recall that that WCAG 2.1 has three levels [15]: Level "A": the minimum level of accessibility. Not reaching it implies that a group of users can not access the content of the web. It complies when it is reached with all the criteria related to the level. Level "AA": intermediate level. If it fails, it will be a challenge for the user group to access the web content. Level "AAA": the maximum level. Not reaching it means that a group of users has some difficulty accessing web content. A website that reaches the "AAA" level is a website that all users can access. About video and audio, self-description consists of a system that helps compensate for the lack of visual observation, so that a person with visual impairment perceives the video message as if he were a person without visual impairment.

In 2007, Braun [16] argued that i) the audio description for people with visual impairment or reduced vision focuses on mental modeling, and ii) different types of inferences. The author proposes to investigate the subject in depth, especially on the various modes of communication in comprehension and production processes.

In 2008, Moreno et al. [17] indicate that the multimedia resource should be accessible by providing alternatives, such as subtitles, audio, transcripts. It concludes that all resources must be accessible in all their dimensions to reach as many as the most significant number of users.

In 2010, Hong et al. [18] indicate that more than 66 million people suffer from hearing impairment, which makes it challenging to understand video content, which involves the loss of audio information. They recommend subtitling videos to help understand the content. The authors suggest improving accessibility in videos through a dynamic subtitling approach.

In 2011, Szarkowska [19] proposed two types of audio description: i) the standard that played as long as the video is running, and ii) an extension that consists on having a paused

video, as long as the audio description reproduced.

In 2018, Funes et al. [20] propose to implement initiatives such as WCAG 2.0 for the development of video reproductions, and suggest to research on how to improve the accessibility of videos on the web for blind and low vision users. The authors argue for the possibility of customizing user gestures, which might better meet user requirements for specific tasks.

In 2019, Acosta-Vargas et al. [21] propose to apply WCAG 2.0 for educational content, according to WAI. The article analyzes the accessibility of teaching-learning resources for elderly seniors and suggests applying new methods to help generating comprehensive and easily accessible resources.

Consequently, we recommend applying WCAG 2.1 [7] for multimedia resources, primarily for videos, to have a significant impact on the ultimate accessibility of a multimedia resource.

III. Method and Materials

In this research, we apply [8] a variation of WCAG-EM 1.0 to determine whether the video content complies with WCAG 2.1. The authors have previous studies on the accessibility in educational resources applied in telerehabilitation platforms [10], [21], [22]. Figure 1 summarizes the method used to evaluate the videos.

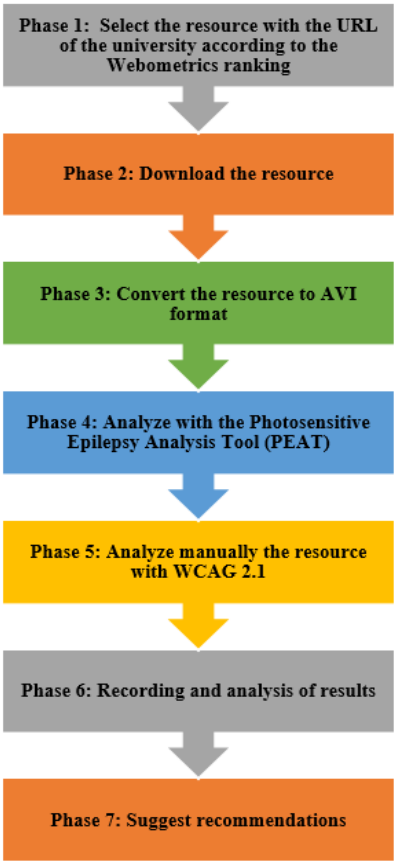

Fig. 1. Diagram of Accessibility Evaluation in Educational Videos

Phase 1 [22]: This first phase is essential because we selected the video resources to evaluate. For which, i) we entered the YouTube platform; ii) we searched for the resources associated with the Uniform Resource Locator (URL) of each Latin American university according to Webometrics; iii) we selected the videos randomly; finally, iv) we took a total sample of ten videos. The dataset from this research and the process are available in Mendeley's repository [22]. Table I shows the name of the university and the corresponding acronym.

TABLE I: Universities in Latin America, taken from the Webometrics ranking

University	Acronym
University of São Paulo USP	USP
National Autonomous University of Mexico	UNAM
Universidade Estadual de Campinas UNICAMP	UNICAMP
Federal University of Rio de Janeiro	UFRJ
University of Chile	UCHILE
Federal University of Rio Grande do Sul UFRGS	UFRGS
State University Paulista Júlio de Mesquita Filho	UNESP
Buenos Aires' University	UBA
Federal University of Minas Gerais UFMG	UFMG
Federal University of Santa Catarina UFSC	UFSC

Figure 2 shows a screenshot of the analyzed video, which corresponds to the University of São Paulo (USP).

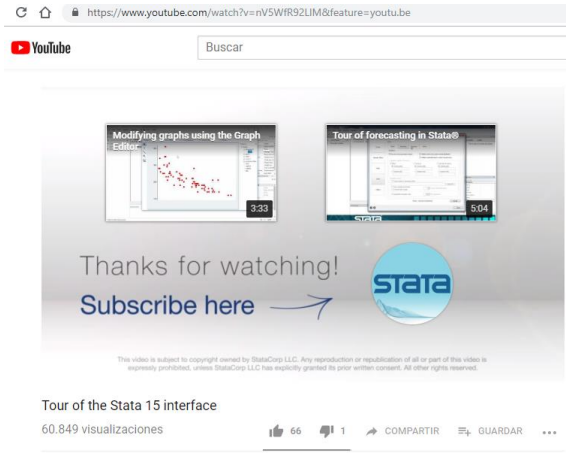

Fig. 2. Screenshot of the resource to evaluate

Phase 2 [22]: In this second phase, we download the video from YouTube to analyze with PEAT. The tool allows to evaluate the content of the video or simulation, mainly identifies the intermittent or fast transitions between light and dark background colors that can affect patients with epilepsy.

Phase 3 [22]: In this third phase we proceed: i) review that the video is in AVI (Audio Video Interleave); ii) if it is not in AVI format we proceed to convert to that type of format. PEAT tool is freely usable for developers to review the risks of brightness in video content that can affect users with epilepsy.

Phase 4 [22]: In this fourth phase we do the following: i) we place the video in AVI on PEAT; ii) we configure the parameters in PEAT; iii) we apply the photosensitivity analysis; finally, iv) we record the results in a spreadsheet. Figure 3 shows a screenshot of PEAT during the video analysis process.

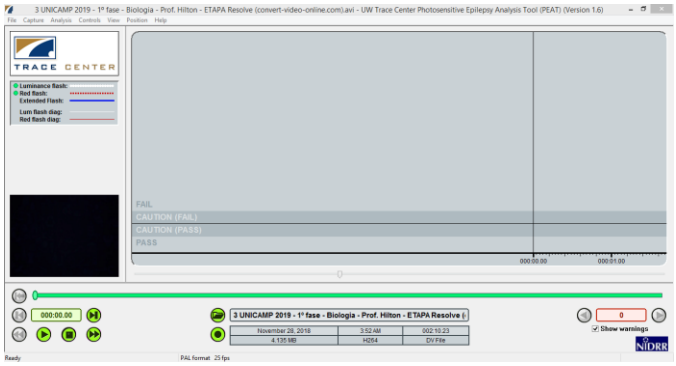

Fig. 3. Screenshot of the resource with PEAT

Phase 5 [22]: In the fifth phase, we applied the standards proposed by WCAG 2.1. Table II contains the guideline, the principle, and the level of accessibility applied manually during the analysis process.

TABLE II: WCAG 2.1 APPLIED IN THE MANUAL ANALYSIS

Guideline	Principle	Level
1.2.1 Audio-only and Video-only (Prerecorded) [14]	Perceptibility	A[14]
1.2.2 Captions (Prerecorded)	Perceptibility	A[14]
1.2.3 Audio Description or media alternative [14]	Perceptibility	A[14]
1.2.4 Captions (Live) [14]	Perceptibility	AA[14]
1.2.5 Audio Description [14]	Perceptibility	AA[14]
1.2.6 Sign Language [14]	Perceptibility	AAA[14]
1.2.7 Extended Audio Description [14]	Perceptibility	AAA[14]
1.2.8 Media Alternative [14]	Perceptibility	AAA[14]
1.2.9 Audio-only [14]	Perceptibility	AAA[14]
2.3.1 Three Flashes or Below Threshold [14]	Operability	A[14]
2.3.2 Three Flashes [14]	Operability	AAA[14]
2.3.3 Animation from Interactions [14]	Operability	AAA[14]

Phase 6 [22]: In the sixth phase, we recorded the results of the analysis in a spreadsheet. Data logging and analysis of the results of this research are available to replicate in the Mendeley repository[3].

Phase 7 [22]: In the seventh phase, some recommendations are implemented [10], [22] to make the video resource more inclusive, according to WCAG 2.1. Figure 4 contains a summary of some suggestions that we propose to generate accessible videos:

[3] http://dx.doi.org/10.17632/9sysgxf5zv.1

1. To add subtitles and multimedia alternatives, for people with hearing and visual disabilities.
2. To include text transcriptions and subtitles for audio content.
3. To place the option to personalize the language and the speed of audio and video.
4. To place a configuration option for the size and colors of the font.
5. To include sign language for deaf and mute people.
6. To include dynamic text transcripts that contain the correct categorization of any audio and video information.

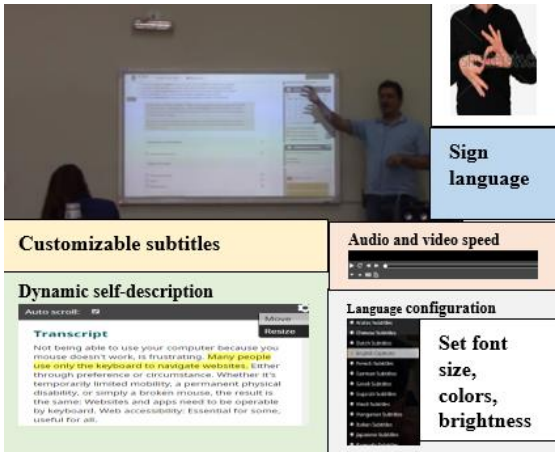

Fig. 4. Recommendations to create an accessible video [10]

IV. ANALYSIS OF RESULTS AND DISCUSSION

As a case study, we apply the method in 10 video-type resources, taken at random, from Latin American universities. Table III includes the acronym of the university, the video URL, and the identifier assigned to the resource.

TABLE III: RESOURCES ANALYZED

Acronym	Video URL	ID
USP	https://youtu.be/nV5WfR92LIM	V1
UNAM	http://tiny.cc/k5mw6y	V2
UNICAMP	https://youtu.be/kRLGaa6l0zQ	V3
UFRJ	http://tiny.cc/l6mw6y	V4
UCHILE	https://youtu.be/EL5FCU5-hr0	V5
UFRGS	https://youtu.be/fLSZxUKvsv8	V6
UNESP	https://youtu.be/UWxqDc5jbxE	V7
UBA	https://youtu.be/q7ZKCSeDX_M	V8
UFMG	https://youtu.be/oIuyLgRFt8I	V9
UFSC	https://youtu.be/sg_BdUQodro	V10

Table IV includes the resource identifier, the description, the state of the video after evaluating with PEAT. Where "F" is "fails" and "P" is "passes." When there is a failure, it indicates that the frames of the video must be fixed to correct the luminosity that affects users with epilepsy.

TABLE IV: EVALUATION OF RESOURCES WITH PEAT

ID	Description	Result status	Value
V1	Stata tutorial, statistical tool	P	1
V2	Educational promotion of the university	F	0
V3	UNICAMP 2019 - 1st phase - Biology - Prof. Hilton	P	1
V4	Palestra: Virtual Learning Environment AVA UFRJ	P	1
V5	Theories suggest that the universe is made up of many 'small universes,' each with its laws of physics	F	0
V6	Explanation of water resources	F	0
V7	Explanation about Fishing Engineering to train professionals.	F	0
V8	The help of the platform to study the subjects	P	1
V9	This video shows the infrastructure, the added administrator's integration and a small presentation of the demonstration	P	1
V10	Creating quotes and references using the MORE platform	P	1

When applying the photosensitivity evaluation analysis with PEAT, we observe that 60% of the resources comply with the parameter, while 40% do not comply with the parameter. Therefore, it is suggested to improve the video type resources that have some frames that would affect users who have epilepsy.

Figure 5 shows a screenshot of some images that can disturb people with epilepsy. We observe the values in timecode related to the brightness of the images.

Timecode	Lum	Red	Ext	Image
004:23.02	0.4	0.0		
004:23.03	0.3	0.0		
004:23.04	0.4	0.0		
004:23.05	0.4	0.0		
004:23.06	0.4	0.0		
004:23.07	0.4	0.0		
004:23.08	0.4	0.0		
004:23.09	0.5	0.0		
004:23.10	0.9	0.0		
004:23.11	0.9	0.0		
004:23.12	1.2	0.0		
004:23.13	1.2	0.0		
004:23.14	1.2	0.0		
004:23.15	1.2	0.0		
004:23.16	0.6	0.0		
004:23.17	0.4	0.0		
004:23.18	0.4	0.0		

Fig. 5. Frames that can alter users who suffer from epilepsy

Table V includes the resource identifier, the WCAG 2.1 success criteria. Where one (1) indicates that it meets the success criterion, and zero (0) indicates that it does not.

TABLE V: MANUAL EVALUATION WITH WCAG 2.1

ID	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8	1.2.9	2.3.1	2.3.2	2.3.3
V1	1	0	0	0	0	0	0	0	0	1	1	1
V2	1	0	0	0	0	0	0	0	0	0	0	0
V3	1	0	0	0	0	0	0	0	0	1	1	1
V4	1	0	0	0	0	0	0	0	0	1	1	1
V5	1	0	0	0	0	0	0	0	0	0	0	0
V6	1	0	0	0	0	0	0	0	0	0	0	0
V7	1	0	0	0	0	0	0	0	0	0	0	0
V8	1	0	0	0	0	0	0	0	0	1	1	1
V9	1	0	0	0	0	0	0	0	0	1	1	1
V10	1	0	0	0	0	0	0	0	0	1	1	1

Figure 6 shows that of the ten resources evaluated, six of them comply with 14.3% of the success criteria, and the four resources only reach 3.6% of the WCAG 2.1 success criteria. We detect that the criterion of success 1.2.1 related to only audio and only video is the one that most meets, followed by criterion 2.3.1 which implies three flashes or below the threshold, 2.3.2 which refers to three flashes and criterion 2.3.3 related to the interactive animation.

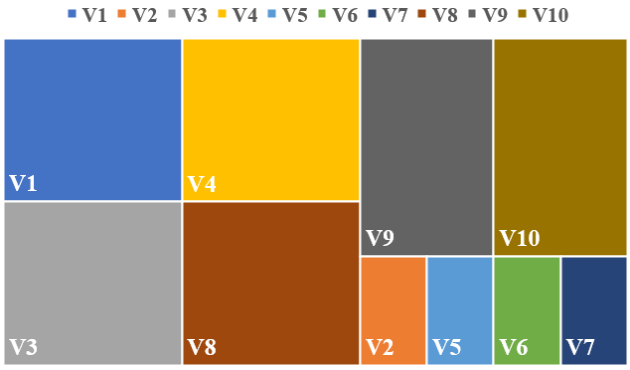

Fig. 6. Analysis of evaluated resources

When applying the descriptive statistics to the total criteria of the videos evaluated, we obtain that the average is 2.8, the typical error corresponds to 0.5, the average is 4.0, the mode is 4.0, and standard deviation corresponds to 1.5. The variance of the sample is 2.4; the kurtosis is -2.3, the asymmetry coefficient is -0.5, the range is 3.0, the minimum is 1.0, and the maximum is 4.0.

Figure 7 shows that the correlation coefficient between the classification and WCAG 2.1 is 0.14, which indicates that there is a very weak correlation. According to the correlation of 0.14, it indicates that being in a high ranking does not necessarily mean that the resource meets the most appropriate WCAG 2.1 standards.

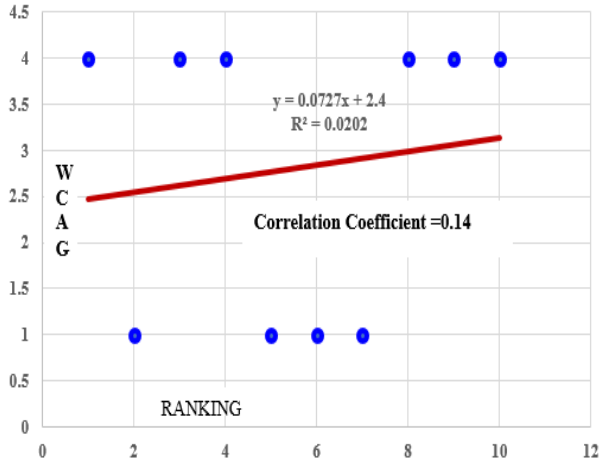

Fig. 7. Correlation ranking vs. WCAG 2.1

Figure 8, when extracting the data from Table II, we observed that 10% have problems of "operability" and 90% have problems with the principle of "perceptibility."

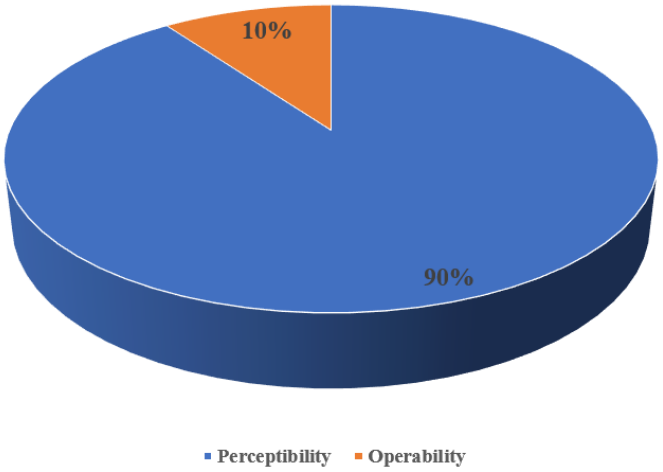

Fig. 8. Problems of operability and perceptibility

The principle "perceptibility" is related to the user interface, directly affects users who have vision or hearing problems. For example, textual alternatives should be provided for all non-textual content so that it gets converted to other formats that people need, such as expanded texts, braille, voice, symbols. For multimedia content, such as animations and videos, subtitles and other equivalent alternatives must be provided. For example, for a recording of a speaking person, a textual transcription should be provided. For a video, we can include an audio description, which is a narrative that describes the essential visual details that appear in a video, as well as providing the sign language, a translation of the audio of a video or a sound recording.

According to Table II, at "A" level, we observe that 40% have problems related to audio-only and video-only, captions, audio description or media alternative, three flashes or below the threshold. At "AA" level, we observe that 20% have problems related to captions, audio description. In the "AAA" level, we observe that 40% have problems related to sign language, extended audio description, media alternative, and audio-only.

Consequently, when generating animated resources type resources or videos, it is necessary to review the luminosity, flash, and contrast in this type of resources that can affect users with photosensitive epilepsy. To pass WCAG 2.1, "A" level a web page cannot contain anything that flashes more than three times in one second, or that the flash is below the general and red flash thresholds. Therefore, web developers should raise awareness and use tools to test whether their animations and videos do not cause epileptic seizures.

V. Conclusions and Future Work

We conclude that the selected ranking of universities is not necessarily an indicator of educational or informational resources to be accessible and inclusive.

The results obtained in the experimentation indicate that the video type resources show that there is a deficiency in the application of accessibility standards.

In order to achieve an adequate level of multimedia resources and to create inclusive videos, it is suggested to combine the evaluation methods with the PEAT tool and request a manual revision with WCAG 2.1.

The proposed method has its limitations in the application of video games to eliminate the risks of epilepsy, so it is necessary for the intervention of an expert in web accessibility, which handles problems of photosensitivity.

This study can serve as a preliminary basis for future work related to the accessibility of multimedia resources.

We hope that this study will contribute to ensuring equal opportunities and non-discrimination of subjects with different disabilities. Finally, we suggest including options to improve accessibility in multimedia resources, such as the application of dynamic subtitles, language settings, font size settings, color, brightness, dynamic self-description, description and speed control in audio and video, and sign language.

References

[1] We Are Social and Hootsuite, "Digital 2019: Global Internet Use Accelerates - We Are Social," 2019. [Online]. Available: https://wearesocial.com/blog/2019/01/digital-2019-global-internet-use-accelerates. [Accessed: 18-Apr-2019].

[2] Brandwatch, "46 Fascinating and Incredible YouTube Statistics | Brandwatch." [Online]. Available: https://www.brandwatch.com/blog/youtube-stats/. [Accessed: 14-May-2019].

[3] L. Moreno, M. González-García, P. Martínez, and Y. González, "Checklist for Accessible Media Player Evaluation," in Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility - ASSETS '17, 2017, vol. 15, no. 4, pp. 367–368.

[4] P. Champin, B. Encelle, N. Evans, O.-B. Magali, Y. Prié, and R. Troncy, "Towards Collaborative Annotation for Video Accessibility," W4A2010 - Commun., pp. 2–5, 2010.

[5] P. Acosta-Vargas, T. Acosta, and S. Luján-Mora, "Challenges to assess accessibility in higher education websites: A comparative study of Latin America universities," IEEE Access, vol. 6, pp. 36500–36508, 2018.

[6] United Nations (UN), "Convention on the rights of people with disabilities," Treaty Series, vol. 2515, p. 3, 2006.

[7] World Wide Web Consortium, “Web Content Accessibility Guidelines (WCAG) 2.1,” 2018, 2018. [Online]. Available: https://www.w3.org/TR/WCAG21/.

[8] World Wide Web Consortium (W3C), “Website Accessibility Conformance Evaluation Methodology (WCAG-EM) 1.0,” 2014. [Online]. Available: https://www.w3.org/TR/WCAG-EM/.

[9] World Wide Web Consortium (W3C), “Web Accessibility Evaluation Tools List.” [Online]. Available: https://www.w3.org/WAI/ER/tools/?q=mobile-application. [Accessed: 11-Nov-2018].

[10] P. Acosta-Vargas, J. Jadán-Guerrero, C. Guevara, S. Sanchez-Gordon, and T. Calle-Jimenez, “Technical Contributions to the Quality of Telerehabilitation Platforms: Case Study—ePHoRt Project,” in Assistive & Rehabilitation Engineering, IntechOpen, 2019, pp. 1–22.

[11] World Wide Web Consortium (W3C), “Multimedia Accessibility FAQ,” 2016. [Online]. Available: https://www.w3.org/2008/06/video-notes.

[12] World Wide Web Consortium (W3C), “Media Accessibility User Requirements,” 2015. [Online]. Available: http://w3c.github.io/apa/media-accessibility-reqs/.

[13] P. Acosta-Vargas, S. Luján-Mora, T. Acosta, and L. Salvador-Ullauri, “Toward a combined method for evaluation of web accessibility,” in Advances in Intelligent Systems and Computing, 2018, vol. 721, pp. 602–613.

[14] World Wide Web Consortium (W3C), “Web Content Accessibility Guidelines (WCAG) 2.0,” 30-04-2018, 2008. [Online]. Available: https://www.w3.org/TR/WCAG20/.

[15] World Wide Web Consortium (W3C), “Web Accessibility Initiative,” 2017. [Online]. Available: https://www.w3.org/WAI/fundamentals/accessibility-intro/.

[16] S. Braun, “Audio Description from a discourse perspective : a socially relevant framework for research and training,” Linguist. Antverp. New Ser. Transl. Stud., vol. 6, 2007.

[17] L. Moreno, P. Martínez, and B. Ruiz-Mezcua, “Disability Standards for Multimedia on the Web,” IEEE Multimed., vol. 15, no. 4, pp. 52–54, 2008.

[18] R. Hong, M. Wang, M. Xu, S. Yan, and T.-S. Chua, “Dynamic captioning: Video Accessibility Enhancement for Hearing Impairment,” in Proceedings of the international conference on Multimedia - MM ’10, 2010, p. 421.

[19] A. Szarkowska, “Text-to-speech audio description: towards wider availability of AD,” J. Spec. Transl., no. 15, pp. 142–162, 2011.

[20] M. Funes, T. Trojahn, R. Fortes, and R. Goularte, “Gesture4All : a framework for 3D gestural interaction to improve accessibility of Web videos,” in In Proceedings of the 33rd Annual ACM Symposium on Applied Computing, 2018, pp. 2151–2158.

[21] P. Acosta-Vargas et al., “Educational Resources Accessible on the Tele-rehabilitation Platform,” Springer Int. Publ. AG, vol. 781, pp. 210–220, 2019.

[22] P. Acosta-Vargas, “(Dataset) Accessibility Evaluation of Multimedia Resources in Latin America Universities,” ICEDEG 2019, 2019. [Online]. Available: https://data.mendeley.com/datasets/9sysgxf5zv/1.