Application of Alpert Scale to Set Priorities for Apply Accessibility Guidelines

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Abstract— *In a web environment few sites has accessible structure and content to all kinds of users. The suitability of these is necessary to promote an egalitarian environment. The WCAG 2.0 has established a set of guidelines that make the page accessible to any type of user, but did not define a procedure for implementing these. In this way, this paper presents a process containing five activities that help the developer during the adaptation of their websites for containing guidelines from WCAG 2.0. One activity of this process is the definition of the guidelines that should be implement first. This is accomplish by using the Alpert measurement scale.*

Keywords— *Accessibility, Guidelines, Process, Measurement Scales.*

I. INTRODUCTION

The web accessibility intends to enable the information to be present without losses to all users, regardless of their sensory or motor characteristics [21]. To perform the changes on page, the W3C (World Wide Web Consortium) through Web Content Accessibility Guidelines established a set of guidelines that make a web page accessible [21].

However, the mechanism to adjust or build web pages based on these guidelines may become difficult in order to know where to start, what guidelines must be use and how these can be insert into a web page.

With the objective of assist the development of accessible pages, procedures have been created for applying these guidelines, for example, the Pantaneiro Framework [12] ACCESSA [6] Implementation of Guidelines Using Web Modeling Language [20] and PDWAU [7].

Those procedures have absences, such: supply of procedures for the application of guidelines, lack of uniformity to define how the adaptation of the page will be make and establish priorities for implementation of accessibility guidelines on a page. This paper proposes a process that features a set of five activities that help the developer during the adaptation of their websites to WCAG 2.0 Accessibility Guidelines. The main feature of the process is the identification of the priorities implementation from WCAG 2.0 guidelines in any web page in order to help developers define how to adapt their pages.

This paper is organize into ten sections. The first section describes the concepts related to web accessibility. The second section defines the WCAG 2.0 accessibility guidelines. The third section describes the procedures for the application of web accessibility in the literature. The fourth section explores the Measurement Scale of Attitudes. The fifth section analyzes the Measurement Scales of Attitudes.

The sixth section describes all the proposed process in this paper. The seventh section reports the implementation of accessibility guidelines based on the priorities set by the proposed process in FrameMK page. The eighth section provides an analysis between the procedures of literature and the proposed process. The ninth section describes the conclusions that are reach by this work and the researches that can be perform in the future. Finally, the last section expressed acknowledgment to funding agency that financed the research.

II. WEB ACCESSIBILITY

Accessibility is define as the condition to use with security and autonomy fully or assisted of the spaces, buildings, services, devices, systems and communication media and information by a disabled person [1].

In this sense, the web accessibility came with the aim to allow all users with or without limitations have democratic access to information [21]. This access must be checking the interaction of users in the page, see what kind of limitations they have in order to make appropriate modifications in the structure of the content.

In a general way, an accessible page should have characteristics such: ease of reading, alternatives of browsing among others to facilitate use of the page for the four basic types of special needs, defined by: Visual, Listening, Motor and Mental or Intellectual [8].

The implementation of these features is relevant and necessary due the fact to promote equality in a public environment. To apply these features effectively, the WCAG 2.0 [20] defines the twelve accessibility guidelines that aim to make the content accessible to every kind of user.

III.　ACCESSIBILITY GUIDELINES

The World Wide Web Consortium (W3C) through WCAG established a set of guidelines to make a web page accessible [21]. These guidelines were first define in version 1.0 and improved in 2.0, used today.

The 2.0 version dissever accessibility guidelines into four principles, that should work together to allow accessibility and are define in: Perceivable, which refers to the presentation of the content to the user; Operable, that correspond to the user interface components, manipulation of the information and the navigation control.

Understandable, dedicated to the treatment and presentation of information resources for users; and Robust, that deals with the need to incorporate assistive technologies and user support [20]. The Table 1 shows the twelve guidelines of WCAG 2.0 grouped into their respective principles.

TABLE 1
ACCESSIBILITY GUIDELINES

Principles	Guidelines of WCAG 2.0
Perceivable	Text Alternatives
	Time-Based Media
	Adaptable
	Distinguishable
Operable	Keyboard Accessible
	Enough Time
	Seizures
	Navigable
Understandable	Readable
	Predictable
	Input Assistance
Robust	Compatible

The applications of these twelve guidelines ensure the accessibility of a web page as expressed in the WCAG 2.0 document [21].

IV.　PROCEDURES FOR APPLICATION OF WEB ACCESSIBILITY

There are processes, applications and approaches to implement and validate the WCAG 2.0 guidelines, such as the Pantaneiro Framework [12], ACCESSA [6], WebML [20] and the PDWAU [7].

The Pantaneiro framework aims to provide a tool to generate accessible e-Gov applications with the Level A of accessibility (Guidelines WCAG 2.0). To generate the application accessible, the framework uses the Wizard Pantaneiro that is an integrated tool to a repository component, which acts as a facilitator to instantiate applications [12].

The ACCESSA is an approach that aims to improve the accessibility and usability of a web system. For this, he makes use of four phases that deal with four different perspectives of evaluation: Inspection's Perspective, Tool's Perspective, User's Perspective and Expert's Perspective [6].

The application of accessibility guidelines using WebML occur through a process that considers the problems of accessibility in the stages of design and implementation, separating each related concern to the guidelines in their layer of WebML model for generate into the end of the process the transformations necessary for a page has the accessible features [20].

With the objective of support the development of Accessible Web Systems that include usability. Dias [7] developed the PDWAU – Process for Developing Web system with Accessibility and Usability, five-phase process (Communication, Planning, Modeling, Construction and Deployment) derived from the generic framework model of web engineering defined by Pressman[18], the perpetual beta paradigm, which describe the constant improvement of a product [16] and the principles of usability and accessibility guidelines.

V.   MEASUREMENT SCALES OF ATTITUDES

The use of appropriate tools for performance measures project of reality are relevant in order to increase reliability and effectively correspond what want to be measured in order to obtain results that may reflect reality [5].

In general, this measurement is perform through measurement scales of attitudes in order to obtain reliable and satisfactory results that permit appropriate conclusions to the analyzed project [14].

There are different scales of attitudes that can be use on questionnaires: the Semantic Differential [17], Stapel [19], Likert [11] and Alpert [2].

The Semantic Differential scale was established in 1957 [17] and enables the measuring the reaction of the interviewee in a bipolar scale that sets in their extreme opposites adjectives that provide registration, quantification and comparison of specific properties from one or more concepts [9].

The method consists of a seven-point scale whose closest edge of 1 are define by positive adjectives of compliance with the characteristic of the attribute analyzed and the closest edge of 7 determines through negative adjectives the level of disagreement with the characteristic of the investigated attribute. The Point 4 of the scale defines a neutral level in relation to the attributes [4].

The Stapel Scale [19] is a modification of the semantic differential scale with a bigger number of points that determines the direction and intensity of attitudes. The Stapel method is unipolar and has ten evaluation categories numbered from -5 to +5, disregarding the neutral point, that is represented by 0 [10].

The results of the Stapel scale are similar to results achieved with the Semantic Differential scale, taking Stapel method the advantage of not needing bipolar adjectives to the item evaluated [10].

The Likert scale is often use in questionnaires. Chisnall [4] claims that the scale is popular through the simplicity and reliability that allows the interviewee has a greater freedom to set the level of feeling.

The scale has five points where the respondent indicates the level of agreement or disagreement with the statement [11] through the analysis of phrases or terms that express information about an item.

Later the sentences are classify into text format through assertions: Strongly Agree, Agree partially, indifferent, Partly Disagree and Fully Disagree; or numerical format by means of a range of values from 1 to 5, 1 being full disagreement, 3 neutral point (indifference) and 5 total agreement.

The Alpert scale was design with the purpose of identifying the possible reasons that determine the choice of a product [2]. The method of Alpert use five points, like the Likert scale, however, on the scale of Alpert the product is evaluate in dimensions.

The number of dimensions to be analyze is bases on characteristics of attributes for the product. Alpert [2] classifies attributes into three categories: Presents, Importants and Determinants.

In the scale of Alpert, each attribute is evaluate in dimensions through a score from 1 to 5 where 1 represents "no importance", 5 "fully important" and 3 "indifferent". In general, Alpert questionnaires have three dimensions; however, the interviewer may vary the number of dimensions according to his need.

VI.   ANALYSIS OF MEASUREMENT SCALES OF ATTITUDES

The choice of measurement scale of attitudes is associated with a several factors: desired level of information, capacity of respondents, characteristics of the stimulus objects, method, context of application and cost [13], which should be analyze by the interviewer before deciding what type of scaling will be apply.

In this sense, the choice of scale of the proposed process has as main objectives: the highest level of information that can be generate by the scale and a larger range of values for setting priorities when choosing the guidelines.

This way, was been ignored in the first instance the Semantic Differential and Stapel Scales for presenting a lower level of information about the choice of attributes and for being more effective for telephone surveys, as described by Oliveira [15].

Tests were perform with the Likert scale by means of a scientific article [3] and Alpert through this research, the first for being the most accepted method by respondents and the second by having a more trusted analysis because of the evaluation in three dimensions.

The Likert scale returned satisfactory results on setting priorities of the guidelines as analyzed by Camenar et al. [3]. However, it was perceive that the range of values that the scale could take was small since only contemplate values 1-5, with possible duplications of needs in defining the order of application of the guidelines.

For this reason, we opted for the use the Alpert scale that generates more reliable results due to feature requires an assessment in different dimensions, preventing multiple guidelines has the same value at the time of application of the process.

VII.   PROPOSED PROCESS

The proposed process consists in five activities as presented in Fig 1 and is intended offer a sequence of activities to identify implementation priorities of accessibility guidelines on any web page in order to help developers define how the process start and how apply the guidelines to create their pages.

The five activities will be present in tables that will simulate the application of the process proposed for the adequacy of FrameMK page, case study of this research. The data presented in each one these tables have been obtain from extracted values from the Census and from information provided by the responsible company.
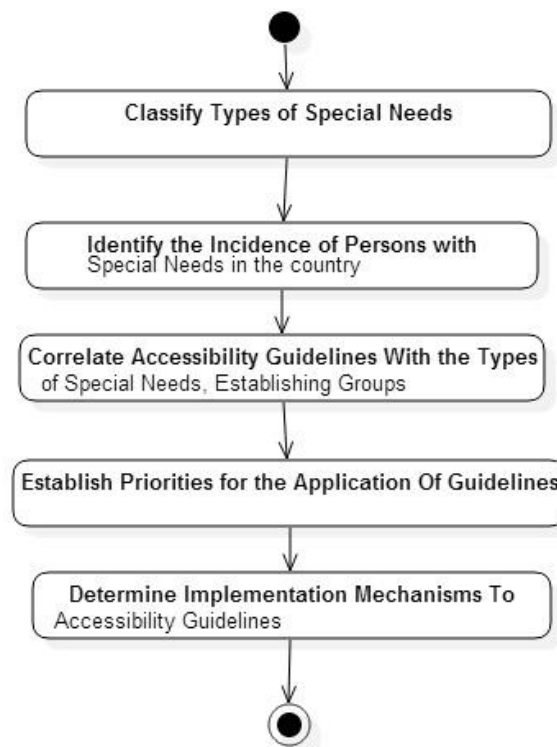
FIGURE 1. PROCESS FOR APPLY ACCESSIBILITY GUIDELINES

7.1   First Activity: Classify Types of Special Needs

The first activity is classify the types of special needs that will be attend by the company during the creating of the pages, identifying which group they belong. Taking the Brazil as an example, the special needs are include in four categories [15]: Visual, Listening, Motor and Mental or Intellectual.

The result of this activity referencing the Brazil is show in Table 2.

TABLE 2
CLASSIFICATION OF SPECIAL NEEDS

Group	Special Need	Description
Visual	Low Deep Vision	Visual Accuracy Snellen 20/500 to 20/1000
	Blindness	Total absence of vision and light perception
Listening	Weightless	Hearing Loss from 20 to 40 db
	Deep	Hearing Loss from 70 to 90 db
Motor	Tetraplegia	Total loss of motor functions of the lower and upper limbs
	Paraplegia	Total loss of motor function of the lower limbs
Mental or Intellectual	Autism	Developmental disorder that affects the normal development of the brain related to social and communication skills
	Down's Syndrome	Genetic disorder caused by the presence of the extra 21 chromosome

7.2 Second Activity: Identify the Incidence of Persons with Special Needs in the country

The second activity aims to identify in the country where the page will be develop the incidence in percentage of people with special needs by the Population Census, to, an overview of the amount of people need that the page meets accessibility guidelines.

This incidence is measure by the percentage of people with special needs in the country, being 100% the total of population. The result of this activity by referencing Brazil is show in Table 3.

TABLE 3
SPECIAL NEEDS X INCIDENCE ON COUNTRY

Group	Special Need	Incidence on Country (%)
Visual	Low Deep Vision	2
	Blindness	4
Listening	Weightless	5
	Deep	13
Motor	Tetraplegia	10
	Paraplegia	15
Mental or Intellectual	Autism	9
	Down's Syndrome	2

7.3 Third Activity: Correlate Accessibility Guidelines with the Types of Special Needs, Establishing Groups

The third activity demands that it be make a link between accessibility guidelines defined by WCAG 2.0 [21] and the special needs found in the earlier stages. This phase is important to define what guidelines should be apply on the page.

The construction procedure of the relationship between guidelines and requirements should be determined by through the analysis of limitations of each special need linked to the guidelines defined on the WCAG 2.0 document.

An example of this relationship is show in Table 4.

TABLE 4
RELATION BETWEEN SPECIAL NEEDS AND GUIDELINES

Group	Special Need	Guidelines
Visual	Low Deep Vision	Text Alternatives; Time-Based Media; Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Navigable; Readable; Predictable; Compatible; Input Assistance
Listening	Weightless	Text Alternatives; Time-Based Media; Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Navigable; Readable; Predictable; Compatible; Input Assistance
Motor	Paraplegia	Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Seizures; Navigable; Readable; Compatible; Input Assistance
Mental or Intellectual	Autism	Text Alternatives; Time-Based Media; Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Navigable; Readable; Predictable; Seizures; Input Assistance

7.4   Fourth Activity: Establish Priorities for the Application of Guidelines

The fourth activity is the most important focus of the proposed process and has five sub-activities. This activity has the intention to establish the priorities for implement the accessibility guidelines. Priorities will be defined by a mathematical importance calculation using the Alpert scale without taking into account the priorities already set by WCAG 2.0 in the levels A, AA e AAA from accessibility.

The sub activity order the incidence data in the country in descending order, should check the needs with the highest incidence in the country through the result of the activity Identify the incidence of people with special needs in the country and Reorder them in decreasing order to determine what special needs have a higher incidence. An example of the reordering of the data is show in Table 5.

TABLE 5
REORDERING SPECIAL NEEDS X INCIDENCE IN COUNTRY

Group	Special Need	Incidence on Country (%)
Motor	Paraplegia	15
Listening	Deep	13
Motor	Tetraplegia	10
Mental or Intellectual	Autism	9
Visual	Low Deep Vision	9
Listening	Weightless	5
Visual	Blindness	4
Mental or Intellectual	Down's Syndrome	2

The sub activity **Define the degree of importance of the need for the company by Alpert scale** aims to identify the importance of comply the special need for the company. For this, the company must set by a scale of Alpert, one score from 1-5 where 1 is "no importance" and 5 "totally important" for three dimensions of analysis.

Presence (Level presence of carriers of special needs that make use of page), **Importance** (Importance in meeting that specific audience for the company) and **Satisfaction** (Satisfaction of users and organization in implement accessibility guidelines to the need analyzed). The values set for the three dimensions must be multiply in order to obtain the total amount from item for the company. An example of fill each of the dimensions show in Table 6.

TABLE 6
IMPORTANCE TO THE COMPANY

Group	Special Need	Presence	Importance	Satisfaction	Final Result
Motor	Paraplegia	5	5	5	125
Listening	Deep	4	5	5	100
Motor	Tetraplegia	1	1	1	1
Mental or Intellectual	Autism	4	3	4	48
Visual	Low Deep Vision	2	3	2	12
Listening	Weightless	5	5	5	125
Visual	Blindness	1	1	1	1
Mental or Intellectual	Down's Syndrome	3	2	2	12

The sub activity **Establish a track to the incidence in the country, by weight**, must establish a track to the incidence in the country, converting the values originally expressed in percentage by weight, in order to, facilitate the final calculation process. The conversion will be perform using the equation (1):

$$Incidence = \frac{BiggerIncidenceInTheCountry}{5} \tag{1}$$

An example of the conversion of weights using the formula is show in Table 7.

TABLE 7
WEIGHT RANGE OF THE INCIDENCE OF SPECIAL NEEDS IN THE COUNTRY

Band	Weight
0%-2%	1
3%-6%	2
7%-10%	3
11%-14%	4
15%	5

The sub activity Make a weighted average of the weights of the incidence in the country and importance to the company has for objective realize a weighted average between the country's incidence and the importance for the company to define the priorities of each special needs that must be met by the company. ''The average is perform using the equation (2):

$$Importance = \frac{WeightOfIncidenceInCountry + WeightOfImportanceToCompany}{2} \tag{2}$$

An example of the averaging is illustrate in Table 8.

TABLE 8
AVERAGE WEIGHTED INCIDENCE OF THE COUNTRY AND IMPORTANCE FOR THE COMPANY

Group	Special Need	Incidence of Special Need	Importance for the Company	Average between Incidence of Special Need and Importance for the Company
Motor	Paraplegia	5	5	5
Listening	Deep	4	5	5
Motor	Tetraplegia	1	1	1
Mental or Intellectual	Autism	4	3	4
Visual	Low Deep Vision	2	3	2
Listening	Weightless	5	5	5
Visual	Blindness	1	1	1
Mental or Intellectual	Down's Syndrome	3	2	2

The last sub activity **Order the average between the weights in decreasing order** shall order the result of the average found in the activity **making a weighted average of the incidence of weights in the country and importance to the company** in descending order, that is, of importance to check through the values found where the process must start. In the

event of the presence of equal values in the ordering, the page developer with those responsible for the company's interests must decide which audience should be attend first. An example of this order is illustrate in Table 9.

TABLE 9
REORDERING WEIGHTED AVERAGE TO DETERMINE THE IMPORTANCE OF NECESSITY

Group	Special Need	Average between the Weights
Motor	Paraplegia	65
Listening	Weightless	63,5
Listening	Deep	62
Mental or Intellectual	Autism	25,5
Mental or Intellectual	Down's Syndrome	6,5
Visual	Low Deep Vision	6,5
Motor	Tetraplegia	2
Visual	Blindness	1,5

After the reordering, the developer must be analyze the result of the third activity to check which guidelines are relate to group of people with special needs who wants to meet. An example of the third phase taking into account the priorities set out in Table 9 are show in Table 10.

TABLE 10
EXAMPLE OF NEED X GUIDELINES

Group	Special Need	Average between the Weights
Visual	Low Deep Vision	Text Alternatives; Time-Based Media; Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Navigable; Readable; Predictable; Compatible; Input Assistance
Listening	Weightless	Text Alternatives; Time-Based Media; Adaptable; Distinguishable; Keyboard Accessible; Enough Time; Navigable; Readable; Predictable; Compatible; Input Assistance

After obtaining the results of the accessibility guidelines related to each special need (Table 10) is necessary to define which will be implement initially. In these article it is suggested in the first instance meet the success criteria that represent the recommendations for accessibility guidelines, A-level, followed by recommendations for the AA and AAA levels. This suggestion is because the level A is the lowest level of accessibility and reach the greatest number of users, how as defined in the WCAG 2.0 document [21].

In the case of a tie between success criteria, must come terms with the head of the company, for choose what criterion is most relevant to the project.

7.5   Fifth Activity: Determine Implementation Mechanisms to Accessibility Guidelines

Finally, the fifth and final activity aims to establish implementation mechanisms of the guidelines, showing alternatives to insert them in the web page. For this, must be correlated the activity data Correlate the Accessibility Guidelines with the types of special needs, establishing groups with the Technical Implementation Guidelines defined by WCAG 2.0 [22]. An example of this definition is show in Table 11.

TABLE 11
EXAMPLE OF ALTERNATIVES TO IMPLEMENTATION OF GUIDELINES

Group	Special Need	Guideline	Objective of Guideline	How to Implement the Guideline
Motor	Paraplegia	Adaptable	Content can be presented in different ways without losing information or structure	CSS HTML
		Readable	Make the text content readable and understandable	HTML XHTML Flash
Listening	Weightless	Predictable	Web pages appear and operate in predictable ways	CSS HTML
		Time-based Media	Provides alternatives to audio or video based on time	SMIL SAMI

Following these five phases is possible insert the WCAG 2.0 accessibility guidelines in a web page with an order of priorities.

VIII.   IMPLEMENTATION OF GUIDELINES ON FRAMEMK WEB PAGE

Priorities once defined through the process begin the analysis from what guidelines are best suited to the pages of FrameMK, case study of this work.

Through Table 9 found that the guidelines related to the need Paraplegia should be implement first, since, this need has the highest priority. So the Guidelines Adaptable, Distinguishable, Keyboard Accessible, Time Enough, Seizures, Navigable, Readable, Compatible, Input Assistance were implemented.

Then should be satisfied guidelines related to special needs listening that is the second in priority level. So the guidelines that differ from those specified for Paraplegia: Alternative Text, Media time-based and Predictable was implemented. Joining the guidelines regarding the two special needs, we arrive at the total of the WCAG 2.0 accessibility guidelines.

The first step in the adaptation of the pages was the analysis of the interface CSS, JavaScript functions and JSP pages - Java Server Pages already implemented in FrameMK. Through the analysis, was noted that the FrameMK pages do not have video or audio component, for this reason, the guidelines of Time-based media, Enough Time, Text alternatives for content non-text and Seizures are discard.

Then began the process of applying the remaining guidelines: Adaptable, Distinguishable, Keyboard Accessible, Input Assistance, Predictable, Readable, Compatible and Navigable using the recommendations for the level A compliance, which was the level treated for implementation.

The application of the guidelines occurred following the recommendations expressed in Table 11. Have been modified properties of CSS, HTML tags and was inserted JavaScript routines for keyboard shortcut control, contrast and change text size control.

The Fig 2 illustrates the result of applying the guideline distinguishable by a JavaScript code that modifies the page contrast.

FIGURE 2. PAGE IN HIGH CONTRAST

Already Fig 3 shows the behavior performed by selecting the Increase Font routine.

FIGURE 3. PAGE WITH LARGE TEXT

After application of the accessibility guidelines from A - level, the FrameMK page was subject to the three automatic validators (Markup Validation Service, CSS Validation from W3C and Cynthia Says). These validators define whether the page is or not accessible by checking of CSS, HTML, XHTML and accessibility guidelines.

With execution of the tests, the page has considered apt to have a CSS validation stamp, XHTML validation stamp and a validation stamp of Guidelines from A level. These seals are insert into the page footer and demonstrate to the users the concern of the developer to create a valid CSS and XHTML code. The Automatic Validator - Total Validator that provided the seal to the accessibility are unavailable and so could not insert the seal to the accessibility page level. The page with the validation stamps is illustrate in Fig 4.
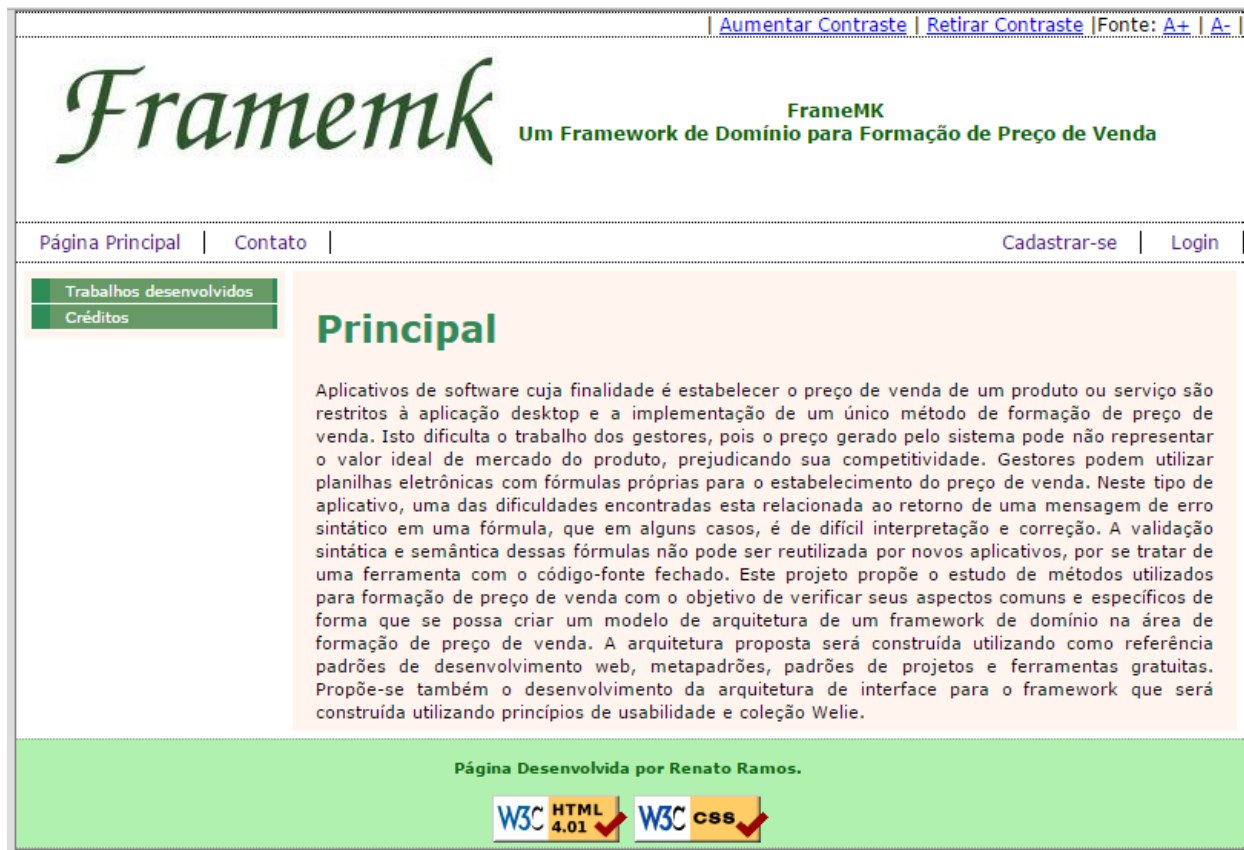

FIGURE 4. VALIDATION SEALS OF FRAMEMK PAGE.

IX.   ANALYSIS OF THE PROCEDURES OF LITERATURE AND THE PROPOSED PROCESS

The proposed process consolidates itself as a differentiator from other studies analyzed by the fact that applying accessibility following an order of priorities focused on the special needs of each user. This prioritization is intimately related to application of Alpert scale in the calculation process.

The Pantaneiro [12] is efficient in generating assistance for mounting and construction of the page. However, it is limited to define any kind of priorities and describe what guidelines are apply.

The ACCESSA [6] is relevant to make the verification from the guidelines that will be insert. However, the fact of not provide means for the guidelines be inserted, hinders the development process.

The approach based on WebML [20] is an identification of how guidelines will be implement with the end of the process. However, the needs of a company that wants to apply the guidelines are not considered.

The PDWAU [7] is similar in many aspects to proposed process having as the main difference the fact of not define the focus to implementation of priority on user needs and expectations of the company. It is important for specify the life cycle of a project through a spiral development, but does not discuss the implementation details of both the guidelines for the usability principles.

Table 12 adapted Camenar et al. [3] defines certain features that can be find in the literature procedures. The analyzed characteristic aims to verify the similarities between the procedures and the proposed process.

TABLE 12
COMPARISON OF PROCEDURES

Feature	Pantaneiro	ACCESSA	WEBML	PDWAU	Proposed Process
Set of Phases	NO	YES	NO	YES	YES
Priority in Guidelines	NO	NO	NO	NO	YES
Is automatically validated	NO	YES	YES	NO	YES
Provide mechanisms to implement the guidelines	YES	NO	YES	NO	YES

Through the table 12 is evident the fact that the proposed process is the only one that considers an order of priorities for implementation of the guidelines

X. CONCLUSION

This paper presented a process based on priorities for implementation of the guidelines of WCAG 2.0, which uses five activities to define the requirements that must be met primarily, the related accessibility guidelines and implementation mechanisms of these guidelines on a web page.

The main contribution was the establishment of the priorities, defined by the result of the arithmetic average of the incidence in the country and the benefit to the company to meet the special needs, calculated for an Alpert measurement scale attitudes in three dimensions (Presence, Importance and Satisfaction).

The Alpert scale was choose for measuring the benefit to attend the special needs into three dimensions and use the result of the multiplication between the scale values to generate the final value of importance to the company.

As future works, we intend to establish a set of metrics to measure the actual contributions of the proposed process, applying the proposed process in enterprise environments to validate their activities and generate a computer system that implements the proposed process.

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