

THE VALUE OF DESIGN RESEARCH

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UNIVERSAL DESIGN: UTOPIA OR CITIZENSHIP RESPECT?

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ABSTRACT

This paper verifies how much of the Universal Design guidelines are been followed in the online course. In order to do that, this paper begins with a literature review on Universal Design and interface design. This review is followed by a review on the WCAG 2.0 and the design of the verification instrument. The verification is then performed on a Coursera Course and aims to identify how the seven principles of Universal Design can be designed in this environment. The results suggest that the Coursera platform is a good example of Universal Design because all the guidelines were followed. Therefore, Universal Design is a challenge but is possible to be implemented.

Keywords: Universal Design, online course, interface design

1 INTRODUCTION

According to the UN we are 7.2 billion people in the world and 10% of this population has at least one disability. In addition, the World Health Organization (WHO) addressed that this percentage tends to increase due to population growth and the advances in medicine that prolong the aging process. Furthermore, the report of the United Nations Regional Information Center (UNRIC, 2013), points out that in countries where life expectancy is over 70 years, each individual will live with a disability, eight years on average. This is 11.5% of his/her lifetime. Data such as these emphasize the importance and magnitude of a greater dissemination of Universal Design (UD). This is because Universal Design is an approach to the design of products and environments created to be usable by all people, to the greatest extent possible, with or without disabilities. Thus, the Universal Design is based on seven principles which are as follows:

1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

These principles allow the products and environments to be used without the need for adaptation or specialized design. Therefore, Universal Design should be considered an efficient approach for distance learning environments because the users come from a wide variety of social backgrounds and there are increasing numbers of students with disabilities pursuing education (DOLAN & HALL, 2001). However, Universal Design may not be applied because of technological and

Universal design, utopia or citizenship respect?

Vania Ribas Ulbricht, Luciane Maria Fadel, Viviane Helena Kuntz, Claudia Regina Batista

economic limitations (MEYER & ROSE, 2000). In addition, a broad range of users requires a high quality interface (LIDWELL et al, 2003). Thus, this paper investigates the benefits and limitation of Universal Design as an approach for designing a distance learning environment.

In order to do that, this paper begins with a literature review on Universal Design and interface design. This review is followed by a review on the WCAG 2.0 guidelines and the design of the UD verification instrument.

This instrument is then used to identify how the seven principles of Universal Design can be designed in this environment. Finally this paper discusses how Universal Design can assist users with disabilities using a distance learning environment.

This paper highlights the importance of research about Inclusive Design and Universal Design, especially in the context of information design. This is because it is a duty and an act of social justice to make information accessible to all people. In addition, it is an attitude of respect to others considering the differences between users in terms of their capabilities.

2 UNIVERSAL DESIGN AND ACCESSIBILITY

Toward the design of an instrument to verify the Universal Design in an interface this paper begins by establishing the relationship between Universal Design and accessibility.

According to the definition of Mace (2008), the intent of Universal Design is to generate environments, products, services, programs, and technologies available to meet the greatest number of people, to the largest extent possible, without the need for adaptation or specialized design.

On the other hand the Brazilian Federal Decree no. 5,296 /2004 (1), in its Article 8, I, establishes a definition for accessibility as being " ... condition for use, with security and autonomy, total or assisted, of spaces, furniture and equipment urban, of buildings, in transport services and device, systems and communication media and information, for a disabled person or person with reduced mobility;".

Based in these definitions this paper assumes that the Universal Design encompasses accessibility since this focuses on designing for people with some kind of disabilities while UD focuses on designing for a greater number of people (including people with disabilities).

- **Equitable Use:** The design is useful and marketable to people with diverse abilities.
- **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.
- **Simple and Intuitive Use:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- **Perceptible Information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
- **Tolerance for Error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.

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Universal design, utopia or citizenship respect?

Vania Ribas Ulbricht, Luciane Maria Fadel, Viviane Helena Kuntz, Claudia Regina Batista

- **Low Physical Effort:** The design can be used efficiently and comfortably with minimum fatigue.
- **Size and Space for Approach and Use:** Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Focusing on learning the so called Universal design for Learning (UDL) is a new way of thinking about education that has the potential of curricular reform and makes learning experiences more meaningful and accessible to all students. The recommendations and current specifications available that involve online learning are the W3C Web Accessibility Initiative (WAI), the IMS and DublinCore (MACEDO, 2010). Interface Design

The importance of the interface design of learning environments has been documented in several studies which seek to establish how the design can support learning (Ramakrisnana, Jaafarb, Razaka, & Ramba, 2012), contribute to user satisfaction (Izzo, 2012) or develop design methods (Wong, Khong, & Thwaites, 2012).

In the same way, the importance of the implementation of universal design in systems that are dedicated to education are object of several studies (Türk, 2014)(Gregga, Changa, & Toddb, 2012). For Gregga, Chenga and Toddb (2012) the principles of universal design are one of the key factors for the success of the BreakThru (platform of teaching at a distance from the University of Georgia) in addition to the virtual access, tools for social contact, e-mentoring, encourage persistence, resources for reasoning based on cases. In this platform, the UD was related to the shortcomings of literacy and for each deficiency detected it was chosen to apply the principles that could help to overcome this deficiency.

For Rose and Meyer (2002) there are three principles of a universal design that can be applied to educational technologies (UDL). These principles are based on the idea of flexibility in relation to the means of representation, forms of expression and engagement and are summarized below:

- Multiple means of representation - to present the content using different modes of representation enables the students to choose the mode that most favors them. In addition, the more senses are stimulated better the assimilation of content.
- Multiple forms of engagement strategy - it is well known that students learn better if they are actively engaged in an activity (Csikszentmihalyi, 1991). Then the system needs to offer key concepts and provide guidance to students to think independently.
- Multiple means of expression - the system must offer different ways for students to express themselves, whether through multimedia projects, texts, or different forms of assessment.

In this perspective Izzo (2012) sought to implement these principles through the solution of problems of real customers. The multiple forms of expression were resolved with the possibility of students completing 4 or 5 projects in team. They can also choose test form (being able to choose questions of multiple choices or true and false etc). To increase the engagement are used machine of electronic voting to answer questions. In addition, the teachers offer multiple opportunities for assessment, without time limit.

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In this same sense Amado-Salvatierraa, Hernández and Hilera (2012) listed the main accessibility standards for the preparation of courses in virtual learning environments. These standards were established by agencies such as AENOR (2003, 2009, 2012), ANSI (2008), CANCORE (2009), IMS (2003, 2004, 2005), ISO (2008), ISO/IEC (2008), W3C (2000, 2008, 2009). Based on some of these standards, Akoumianakis and Stephanadis (2001) reported the efforts of the scientific community to bring universal design for the area of interaction human-computer. After analyzing these efforts the authors reported that the universal design applied to interfaces is more a challenge than a utopia.

One of these challenges is to understand the criteria that are used by these standards. For example, the WCAG 2.0 (standard that specifies accessibility for web) reports criteria which are presented as testable statements that, according to the document, are not for a specific technology. Due to the complexity of applying the criteria, it is possible that there is some difficulty in understanding the operation of the document. This is because the WCAG 2.0 introduces several levels of approach, which include principles, recommendations of a general nature, testable success criteria and a large set of techniques. In addition, the document shows common failures documented with examples, links to resources and source code (WCAG 2.0, 2012).

At the top of this hierarchy are four principles that represent the foundation of Web accessibility: noticeable, operable, understandable and robust. For each one of these principles are listed recommendations that gather 12 basic objectives that Web designers must achieve in order to make your content accessible.

In addition, for each recommendation there are testable criteria of success, which can be used when there is a need for compliance tests. The document provides three levels of compliance depending on the group to be answered (A to the lowest, AA and AAA for the highest level).

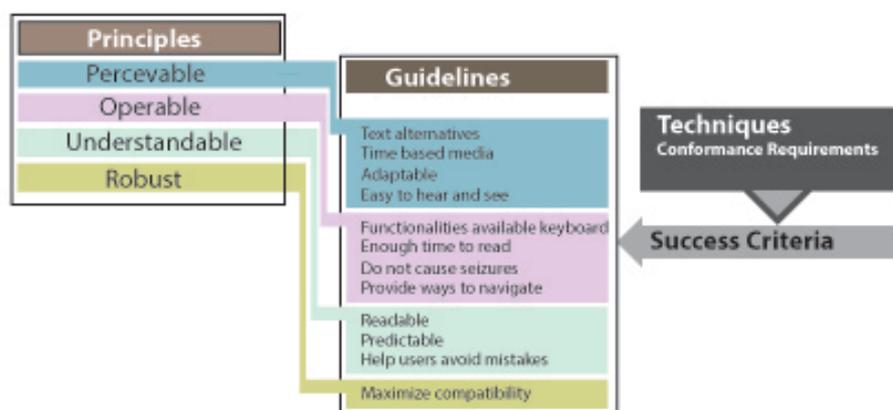


Figure 1 - Levels of approaching - WCAG 2.0 (based on (WCAG 2.0, 2012)).

In addition to the recommendations and success criteria, the W3C documents techniques of an informative character into two categories: Sufficient techniques and techniques are advisory. The sufficient techniques meet the criteria of success established by WCAG 2.0; the type recommended go beyond what is required in each one of the criteria for success and allows authors to a better compliance with the recommendations, approaching the barriers of accessibility not yet covered by the testable criteria of success (see Figure 1).

Universal design, utopia or citizenship respect?

Vania Ribas Ulbricht, Luciane Maria Fadel, Viviane Helena Kuntz, Claudia Regina Batista

The Center for Universal Design has also established guidelines for each principle of Universal Design (Woodard). These guidelines are shown in Figure 2 associated with the WCAG 2.0 guidelines.

3 VERIFICATION INSTRUMENT

This paper aims to identify how the seven principles of Universal Design can be designed in Massive Open Online Course (MOOC), the Coursera platform.

For Grunewald, F. et al. (2013) the origin of the concept the MOOC is commonly assigned to an experiment in 2008 carried out by educational researchers from Canada, George Siemens and Stephen Downes. They developed a theory for the digital age, called connectivism, which conceives learning as the creative and social process of connecting nodes of knowledge.

“The course content and instructions frequently are hosted on different platforms, such as EdX, Coursera, Udacity, Udemy, MOOC2Degree, from online learning, such as BlackBoard Learn, Moodle.” (Chih-Hsiung, 2013, p.1)

For this article chose as the object of study the Coursera platform. This is a non-probabilistic and intentional sample. Coursera, the online education platform founded at Stanford by Andrew Ng and Daphne Koller (Midha, 2013). This platform was accessed on 26 October 2014 and the course was Design: Creation of Artifacts in Society by Karl T. Ulrich (see Figures 2 to 6).

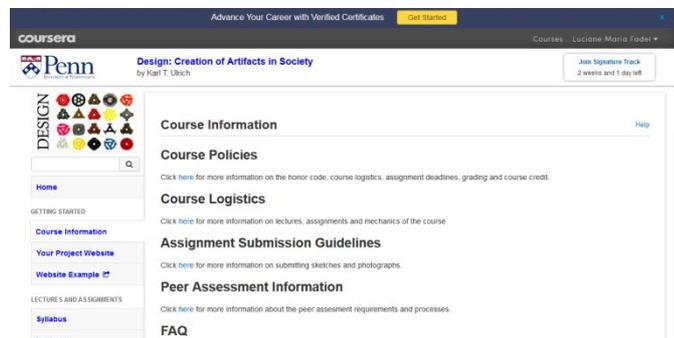


Figure 2 - Course information page

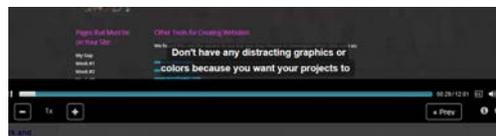


Figure 3 - Video lecture

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Figure 4 - Interface design using text and icons

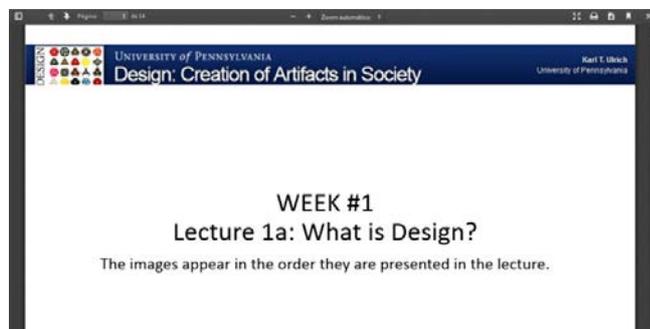


Figure 5 - Pdf file for lecture #1

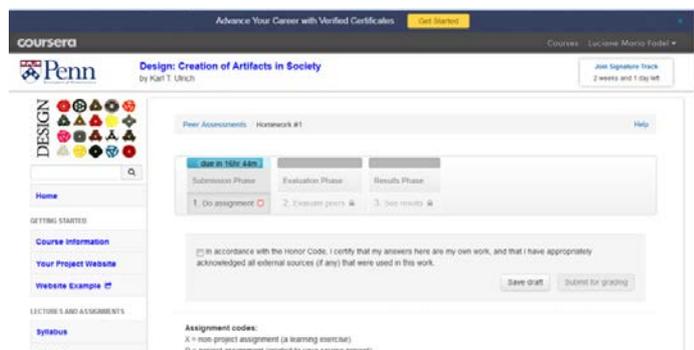


Figure 6 - Homework Page

The verification instrument was based on the seven principles of universal design and the principles and guidelines of WCAG 2.0

For each guideline was verified the existence of elements of Coursera interface that could establish whether the guideline was followed or not.

The graphical representation of the verification instrument is shown in Figure 7.

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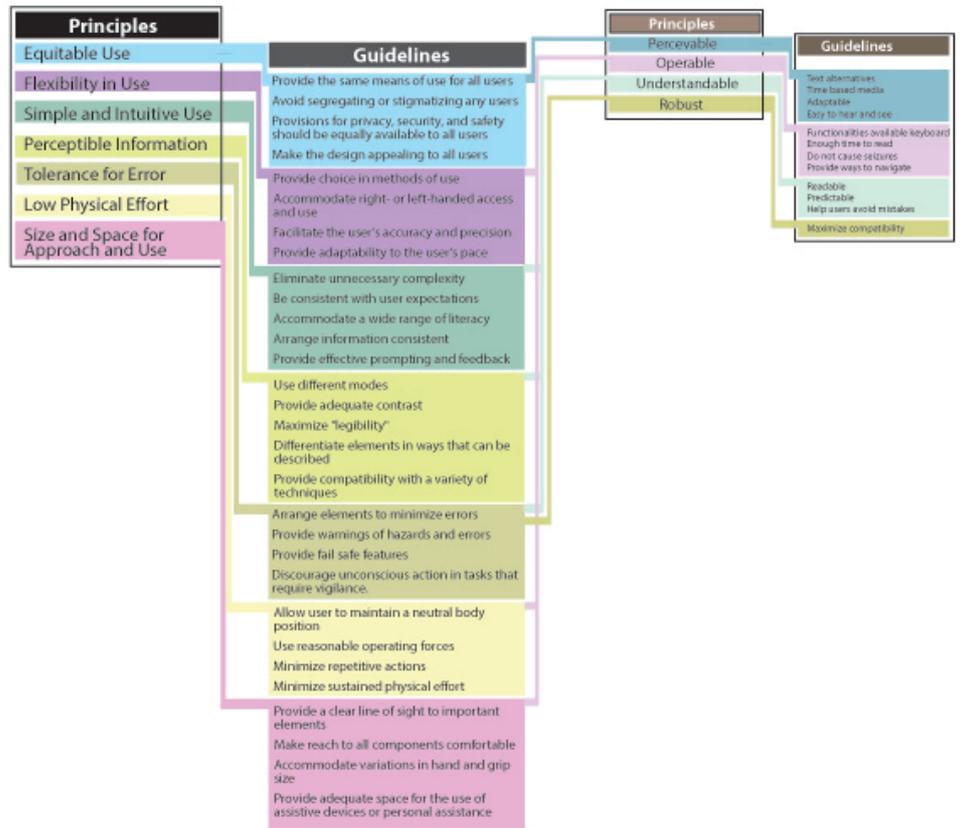


Figure 7 - UD's guidelines and WCAG 2.0's guidelines (based on WCAG 2.0 and (Woodard))

To better understand the following table (Tables 1 to 11). First the UD principles e after that WCAG 2.0 Principle. The consider the following legend:

✓ - Observed on pages | x - Not observed on pages | NA - Not Applicable, because the functionality was not implemented.

UD Principle 1- Equitable Use: The design is useful and marketable to people with diverse abilities. Equitable means just and impartial		Results	
Provide the same means of use for all users: identical whenever		✓	✓
Content based on text		✓	100%
Video with close caption		✓	
Avoid segregating or stigmatizing any users		x	x
Pictures with description		x	
Provisions for privacy, security, and safety should be equally available		✓	✓
Login		✓	100%
		✓	
Make the design appealing to all users.		✓	✓
Interface design simple		✓	100%

Table 1- Results of principle Equitable Use

It was observed that in Principle 1 - Equitable Use, the item only the Avoid segregating or stigmatizing any users unverified.

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UD Principle 2 - Flexibility in Use: The design accommodates a wide range of individual preferences and abilities.		Results	
Provide choice in methods of use. possible; equivalent when not so		✓	✓
Video demonstration		✓	100%
Pdf downloads		✓	
Accommodate right- or left-handed access and use		NA	NA
Pictures with description		NA	
Facilitate the user's accuracy and precision to all users		✓	✓
Course logistics - Provides the mechanics of how the course will operate.		✓ ✓	100%
Provide adaptability to the user's pace		✓	✓
Due date for the assignments - There is only the homework submission deadline		✓	100%

Table 2 - Results of principle Flexibility in Use

UD Principle 3 - Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.		Results	
Eliminate unnecessary complexity that it can be changed into other		✓	✓
Interface based on text		✓	100%
Links to video explanation		✓	
Be consistent with user expectations and intuition		NA	NA
Course is organized in lectures and assignments		NA	
Accommodate a wide range of literacy and language skills		✓	✓
Videos with captions - The videos have translated subtitles and closed captions		✓ ✓	100%
Arrange information consistent with its importance		✓	✓
Course organization - The course follows a sequence		✓	100%
Provide effective prompting and feedback during and after task completion		✓	✓
Feedback		✓	100%

Table 3 - Results of principle Simple and Intuitive Use

In tables 2 and 3 (Principle 2 - Flexibility in Use and Principle 3 - Simple and Intuitive Use) has been satisfactory results, with only two items without application.

UD Principle 4 - Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.		Results	
Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.		✓	✓

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	The information can be accessed in different formats: picture (pdf), text, SubRip Subtitle File and video	✓		100%
Provide adequate contrast between essential information and its		✓		✓
	Contrast - As seen in Figures 9 and 10 the contrasts between links and text and subtitle and text are adequate	✓		100%
Maximize "legibility" of essential information.		✓		✓
	The typeface size is adequate and can be changed using Ctrl +'+'	✓	✓	100%
'Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).		✓		✓
	Well defined instructions - As seen in Figure 10 the instruction are well defined	✓		100%
Provide compatibility with a variety of techniques or devices used by people with sensory limitations.		✓		✓
	Different modes - Different modes help people with sensory limitations	✓		100%

Table 4 - Results of principle Perceptible Information

For the Principle 4 - Perceptible Information all items have been met.

UD Principle 5 - Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.	Results	
Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.	✓	✓
There is resources to help users	✓	
Provide warnings of hazards and errors.		NA
Provide fail safe features.		NA
Discourage unconscious action in tasks that require vigilance		NA

Table 5 - Results of principle Tolerance for Error

In table 5 the item "Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded" was observed, the other did not obtain application.

UD Principle 6 - Low Physical Effort: The design can be used efficiently and comfortably with minimum fatigue.	Results	
Allow user to maintain a neutral body position.		NA
Use reasonable operating forces.		NA
Minimize repetitive actions.		NA
Minimize sustained physical effort.		NA

Table 6 - Results of principle Low Physical Effort

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APRIL 22-24 2015

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UD Principle 7 - Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.	Results	
Provide a clear line of sight to important elements for any seated or standing user.		NA
Make reach to all components comfortable for any seated or standing user.		NA
Accommodate variations in hand and grip size.		NA
Provide adequate space for the use of assistive devices or personal		NA

Table 7 - Results of principle Size and Space for Approach and Use

In the principles 6 and 7 there were no application.

In order to further verify the degree of Universal Design at Coursera platform this paper verified if this Course follows the accessibility guidelines, as follows. As showed in Figure 6 it is expected that the Perceivable Principle should correspond to Equitable Use, Operable should correspond to Flexibility in Use and Size and Space for Approach and Use while Understandable should correspond to Simple and Intuitive Use, Perceptible Information, and Tolerance for Error and finally the Robust Principle should correspond to Low Physical Effort and also Tolerance for Error.

WCAG 2.0 Principle 1: Perceivable - Information and user interface components must be presentable to users in ways they can perceive.			Results	
Text Alternatives: Provide text alternatives for any non-text content				✓
Non-text Content	Controls, Input	✓	100 %	100%
	Time-Based Media	✓		
	Test	NA		
	Sensory	NA		
	Decoration, Formatting, Invisible	NA		
	Time-based Media: Provide alternatives for time-based media.			
Audio-only and Video-only (Prerecorded)	Prerecorded Audio-only and Video-only	NA	25%	
	Prerecorded Audio-only	NA		
	Captions (Prerecorded)	✓		
	Prerecorded Video-only	NA		
	Audio Description or Media Alternative (Prerecorded)	NA		
	Captions (Live)	x		
	Audio Description (Prerecorded)	x		
	Sign Language (Prerecorded)	NA		
	Extended Audio Description (Prerecorded)	x		
	Media Alternative (Prerecorded)	NA		
	Audio-only (Live)	NA		

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Adaptable: Create content that can be presented in different ways (for example simpler layout) without losing information or structure				✓
	Info and Relationships		✓	100%
	Meaningful Sequence		✓	
	Sensory Characteristics		NA	
Distinguishable: Make it easier for users to see and hear content				✓
	Use of Color		✓	100%
	Audio Control		✓	
	Contrast (Minimum)		✓	
	Large Text	✓		
	Incidental	✓		
	Logotypes	✓		
	Resize text	✓	✓	
	Images of Text		✓	
	Customizable	NA		
	Essential	NA		
	Contrast (Enhanced):		✓	
	Large Text:	✓		
	Incidental	✓		
	Logotypes	✓		
	Low or No Background Audio:		✓	
	No Background:	✓		
	Turn Off:	✓		
	20 dB	✓		
	Visual Presentation:		✓	
	Foreground and background colors can be selected	✓		
	Width is no more than 80 characters or glyphs (40 if	✓		
	Text is not justified (aligned to both the left and the	✓		
	Line spacing (leading) is at least space-and-a-half	✓		
	Text can be resized without assistive technology up	✓		
	Images of Text (No Exception)		✓	

Table 8 - Result of principle perceivable

For the table 8 was observed that only the item "Time-based Media: Provide alternatives for time-based media" has had performed poorly.

WCAG 2.0 Principle 2: Operable - User interface components and navigation must be operable.		Results		
Keyboard Accessible: Make all functionality available from a keyboard.				x
	Keyboard		x	
	No Keyboard Trap		x	
	Keyboard (No Exception)		x	
Enough Time: Provide users enough time to read and use content.				✓ 100%
	Timing Adjustable:		✓	

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	Turn off	✓		
	Adjust	✓		
	Extend	✓		
	Real-time Exception	✓		
	Essential Exception	✓		
	20 Hour Exception	✓		
	Pause, Stop, Hide		NA	
	Moving, blinking, scrolling	NA		
	Auto-updating	NA		
	No Timing		NA	
	Interruptions		NA	
	Re-authenticating		NA	
Seizures: Do not design content in a way that is known to cause seizures.				
	Three Flashes or Below Threshold		✓	
	Three Flashes		✓	
Provide ways to help users navigate, find content, and determine where they are.				
	Bypass Blocks:		x	70%
	Page Titled:		✓	
	Focus Order:		x	
	Link Purpose (In Context):		✓	
	Multiple Ways:		✓	
	Headings and Labels:		✓	
	Focus Visible:		x	
	Location:		✓	
	Link Purpose (Link Only)		✓	
	Section Headings		✓	

Table 9 - Result of principle operable

The principle 2 (Operable - User interface components and navigation must be operable) the first item was unsatisfactory with 25%, however the item 2 and 3 attended respectively 100 % and 70 %.

WCAG 2.0 Principle 3: Understandable - Information and the operation of user interface must be understandable.		Results		
Readable: Make text content readable and understandable				✓
	Language of Page		✓	60%
	Language of Parts		✓	
	Unusual Words		x	
	Abbreviations		x	
	Reading Level		NA	
	Pronunciation		✓	
Predictable: Make Web pages appear and operate in predictable ways				✓
	On Focus		✓	100%
	On Input		✓	
	Consistent Navigation		✓	
	Consistent Identification		✓	
	Change on Request		✓	

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APRIL 22-24 2015

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Input Assistance: Help users avoid and correct mistakes				80%
	Error Identification		NA	
	Labels or Instructions		✓	
	Error Suggestion		NA	
	Error Prevention (Legal, Financial, Data)		✓	
	Reversible	NA		
	Checked	NA		
	Confirmed	✓		
	Help		x	
	Error Prevention (All)		✓	
	Reversible	NA		
	Checked	NA		
	Confirmed	✓		

Table 10 - Result of principle understandable

For the principle 3, the average of the three items resulted in 80%.

WCAG 2.0 Principle 4: Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.		Results	
Compatible: Maximize compatibility with current and future user agents, including assistive technologies			✓
	Parsing	✓	100%
	Name, Role, Value:	✓	

Table 11 - Result of principle robust

Finally in item compatible of the principle 4 there was obtained satisfactory results.

4 RESULTS AND DISCUSSION

The results suggest that the Coursera course named Design: Creation of Artifacts in Society by Karl T. Ulrich follows the Universal Design guidelines. This is based on the analyses of the interface that supports the principles 'Equitable Use', 'Flexibility in Use', 'Simple and Intuitive Use', 'Perceptible Information' and 'Tolerance for Error'. The last two principles 'Low Physical Effort' and 'Size and Space for Approach and Use' were not applicable because they refer to physical interaction.

The results of the accessibility instrument suggest that the principle "perceptible" that recommends that "the information and the components of the user interface has to be presented to users in ways that they can understand" is being met in their fullness. This results support the principle Equitable Use.

The results of the principle "operable" indicate that only the option to use the keyboard to act on the functionality of the interface does not seem to have been accomplished. This result corresponds to Flexibility in Use Principle's result and

Universal design, utopia or citizenship respect?

Vania Ribas Ulbricht, Luciane Maria Fadel, Viviane Helena Kuntz, Claudia Regina Batista

suggests the principle Size and Space for Approach and Use could have been verified if the guidelines were understood from the digital point of view.

The results of the principles "understandable" and "robust" indicate that both principles are in accordance with the guidelines which also point out that the principles Simple and Intuitive Use, Tolerance for Error and finally Low Physical Effort principles could have been applied in to a broader approach.

This supports the Akoumianakis and Stephanadis' statement that Universal Design is more a challenge than a utopia. The challenge resides on understanding the principles but most of all implementing then. To do that the designer needs to be compromised with Universal Design and value it above visual aesthetic or style.

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Universal design, utopia or citizenship respect?

Vania Ribas Ulbricht, Luciane Maria Fadel, Viviane Helena Kuntz, Claudia Regina Batista

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