UNIVERSAL DESIGN FOR INCLUSIVE EDUCATION

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With enforced distance learning based teaching during the Covid-19 pandemic, educators were urged to reflect on their teaching practices and best approaches to reach out to a variety of students. Universal Design allows for an inclusive world that considers the specificities that characterize and apply to each individual. The concept of Universal Design, advanced by Architect Ronald Mace, proposes that, whenever possible, all products and buildings should be deemed visually pleasing and usable by most individuals, regardless of age, ability or financial status. Seven principles are at the core of Universal Design: Equitable Use, Flexibility in Use, Simple and Intuitive, Perceptible Information, Tolerance for Error, Low Physical Effort, and Size and Space for Approach and Use. This study proposes the adaptation of Universal Design to the digital world of teaching Statistics. It will offer a roadmap through Universal Design for Inclusive Education, focusing on simple solutions when teaching Statistics online.

INTRODUCTION

Ronald Mace (1940-1998) suffered from polio at the age of nine and was confined to a wheelchair from that moment on. Nevertheless, in 1966, he obtained a degree in Architecture from North Caroline State University and four years after completing his training, he dedicated himself to the design of affordable housing according to the general concept of Universal Design, that is, the principle underlying the design of all products and buildings should be one that, as much as possible, is visually pleasing and usable for the majority of individuals regardless of age, ability or financial status (The Center for Universal Design, 1989).

The 7 principles of Universal Design are designated as follows: (1) Equitable use, (2) Flexibility in use, (3) Simple and intuitive, (4) Perceptible information, (5) Tolerance for error, (6) Low physical effort, and (7) Size and space for approach and use. Some of the products and architectural features that resulted from adherence to these principles are lever handles instead of ball-style knobs to open doors, smooth building entrances, the elimination of stairs, and wider hallways and doors. Universal Design thus allows for an inclusive world that considers the specificities that characterize and apply to each individual.

With enforced distance learning based teaching during the Covid-19 pandemic, educators were urged to reflect on their teaching practices and best approaches to reach out to all types of students.

The study originated from a final year research project course with 7 students where one of their first tasks was to define *Inclusive Education*. Three groups were formed and after a few online discussions rounds, they reached a consensus, defining *Inclusive Education* as a teaching paradigm that promotes the inclusion of all the diversity encountered within the student body, considering their distinctive characteristics, without ever looking at this diversity as an insurmountable obstacle. It was also characterized by a two-way channel of communication between teachers and students that would respect the general principle that all students should have equal opportunities to participate. It went on to focus on recognizing the other's differences and affording them the possibility to grow and to feel more integrated. This can involve making changes to class content or stress using different approaches, structures or strategies in order to make learning accessible to all students at the same level of education. Inclusive education aims to deinstitutionalize exclusion and include all students in regular education.

Recognizing that the Covid-19 pandemic has created an ever-widening the gap of learning inequalities globally, never has the initiative *Education Equity* been more urgent in the fight against the horrifying UNESCO projections that over 24 million individuals from pre-school to tertiary education will not return to school after the disruption of teaching during Covid-19 pandemics (UNESCO, 2020). Goal 4 of the 17 Sustainable Development Goals by 2030 proposed by UNESCO, which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", has therefore become more urgent to *Inclusive Education* as it becomes a viable solution to fight against

discriminatory attitudes towards a society open to real diversity in terms of socioeconomic status, ethnicity, culture, disability or LGBTQ+ individuals.

CAST (Center for Applied Special Technology), a nonprofit education research and development organization created in 1984 has been the developer of the Universal Design for Learning (UDL) framework and UDL Guidelines (CAST, 2018). Three main principles are at the foundation of UDL, namely *Engagement* representing the WHY of learning, *Representation* for the WHAT of learning, and *Action and Expression* for the HOW of learning. Each of these principles are expressed into three main guidelines with multiple checkpoints to guarantee students' meaningful knowledge, understanding and skills. Flood & Banks (2021) pointed to the complexity of the many guidelines and the different representations of the three UDL principles, creating a possible barrier for the adoption and understanding of the advantages of UDL. It is also alluded to the abundance of research work on the neuroscience foundations of UDL and on the advantages of using UDL in an inclusive teaching environment, but most of these works focused on teacher training and practice as opposed to student's outcomes.

In this study we are not striving to fully explore UDL within the context of the Covid-19 pandemic that each and every educator is experiencing; instead, our aim was to consider the 7 principles of Universal Design proposed for the field of Architecture and transpose this concept to the digital world of education. Helena Duppre (2019) presents an excellent work of adapting these principles to the digital world, one which can be fundamental for the development of inclusive online materials.

UNIVERSAL DESIGN'S 7 PRINCIPLES IN PRACTICE

Let's look at each of the seven principles of Universal Design and explore its challenges and possible solutions for a digital implementation in a classroom.

1. Equitable Use

Creation of interfaces that can be used by the most diverse user profiles, with or without special educational needs.

Figure 1. Accessibility - Play the video by clicking on the image

In the first part of this video we observe how a blind student enters a Zoom meeting, and in the second part we live the experience of a deaf student. For example, the entry in Zoom would be much easier if the initial menu was "Full Screen", avoiding all the noise caused by the other windows when using a screen reader like NVDA. When using different online tools, it is fundamental to ensure that they can be used and experienced by all students in an equitable way. One of the main issues that we encountered when teaching synchronized online classes was the different levels of quality in terms of students' Internet connections. For students with connection problems, being able to download the various materials of a course, or accessing the recording of a class offline, would guarantee access to the contents in an equitable way.

2. Flexibility in Use

This is one of the essential principles when we discuss accessibility. Are the materials posted online equally accessible to all types of students? Can we get the appropriate font size and color contrast for a low-vision student? We have to think about how we can build learning objects so that a student who is blind, deaf or with any other special educational needs can use these objects to the fullest.

Let's consider the most common tool that we have used over this pandemic – a video from one of our classes. How can one make such a recording accessible to a deaf student? One possible solution is to use the online subtitles software, Subtitle Edit online BETA (https://www.nikse.dk/SubtitleEdit/Online). Notice that Zoom already produces a transcript file in English in most recorded sessions. If this is not the case, take for example a short video on "How to construct a histogram on SPSS". A first step is to automatically transcribe the audio from the video from an online transcription system (e.g. https://vocalmatic.com/ or https://sonix.ai/). The result is not always a perfect transcription and even this short video of 1 minute and 27 seconds can take more time than expected to edit in a software like BETA, before you have the full transcript ready to be played (left of Figure 2).

```
1
00:00:00,770 --> 00:00:05,740
Olá novamente. Ainda na nossa base de dados<br>Alunos Externos da Universidade
de Coimbra

2
00:00:05,726 --> 00:00:14,726
Vamos então explorar o menu Gráficos (GRAPHS), ou seja,<br>se formos aqui ao
GRAPHS nós temos várias opções.

3
00:00:14,707 --> 00:00:19,746
Desde construir com algum pormenor os nossos<br>gráficos a partir do menu CHART
BUILDER

4
00:00:19,754 --> 00:00:24,754
ou usar já alguns formatos pré-definidos<br>no SPSS (LEGACY DIALOGS).

5
00:00:24,746 --> 00:00:33,876
Vamos começar por aqui e vamos ver que o nosso objetivo,<br>desta vez, é ter um
histograma da variável idade.

6
00:00:33,872 --> 00:00:38,988
Por isso se vocês vírem os vários tipos<br>de gráficos que nós podemos desenhar,

7
00:00:38,993 --> 00:00:48,656
desde gráficos de barras, gráficos de barras a 3 dimensões,<br>gráficos de
linhas, áreas, gráficos circulares, high-and-low

8
00:00:48,653 --> 00:00:57,448
dando os nossos limites de máximo e mí-nimo para os nossos
dados,<br>caixas-com-bigodes, ou seja, boxplots, e assim sucessivamente muitos
deles.

9
00:00:57,451 --> 00:01:04,157
Scatter ou diagramas de dispersão<br>e por fim os nossos histogramas.

10
00:01:04,157 --> 00:01:11,020
Vamos clicar então no menu HISTOGRAM(A) e no HISTOGRAM aparece-nos<br>novamente
aqui o menu para introduzirmos as nossa variáveis.

11
00:01:11,020 --> 00:01:21,129
Vamos introduzir a variável idade e a partir da variável idade nós<br>vamos
construir o nosso histograma. Se repararem, se clicarem OK,

12
00:01:21,105 --> 00:01:27,607
no nosso output há-de aparecer<br>o histograma desejado.
```

```
1
00:00:00,000 --> 00:00:06,000
COMO FAZER UM HISTOGRAMA EM SPSS

2
00:00:06,990 --> 00:00:10,001
O MENU GRAPHS

3
00:01:04,909 --> 00:01:09,892
O MENU HISTOGRAMA - SIGA OS DIVERSOS PASSOS
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Figure 2. Full (left) versus Short Version (right) of a video transcript. Access the full and short versions by clicking on their names.

A quicker way to transform a video in a more inclusive way is to identify a few crucial moments in this video that will allow a deaf student to understand what he/she is about to watch in the video. On the right side of Figure 2, we selected 3 moments in the video that allows a student to realize the main contents of the video, namely 1) HOW TO MAKE A HISTOGRAM IN SPSS, 2) THE MENU GRAPHS, and 3) THE MENU HISTOGRAM – DO THE FOLLOWING STEPS.

The final result can be viewed through a video player, for example the VLC Media Player (download for Windows or macOS from https://www.videolan.org/vlc/), where you can select the subtitles to use in the video in Figure 3.

Figure 3. Using subtitles - Play the video by clicking on the image

3. Simple and Intuitive

The uncertainty that is presently affecting the educational world that we live in makes the choice of digital tools in the learning process essential. Zoom has quickly and almost universally become an indispensable tool in teaching classes online, but are we using it to its full potential? Do you know the shortcut keys to Zoom's features? Knowing for example how to mute all the participants (Alt+M), to start recording a video (Alt+R) or to pause it (Alt+P) can save you considerable time in editing the video prior to publishing it to your students.

4. Perceptible Information

Does synchronous streaming or recordings of our classes allow a student to easily navigate the learning content? We have to think about how to break this information into different dynamic learning objects that can be used online or offline so that students can easily navigate through the content of a class. One way to start is by using a video editor (e.g. Video Editor App for Windows 10 or iMovie for MacOS) to break a class video into small parts. Once we do that, we can use these small video clips in different contexts in order for students to be able to reflect on the material. One important detail that should always be kept in mind when recording a class in an inclusive way is how to orally describe the images used and actions performed in your class, avoiding as much as possible the use of demonstrative pronouns such as *this*, *that*, *these*, and *those*.

5. Tolerance for Error

Your materials should allow errors to be corrected or even prevent students from committing them. For example, building an online test allows a student to freely browse the test, resume the test at his/her own convenience, avoid possible connection issues, and enables appropriate feedback when a student incorrectly selects an answer, allowing self-correction of their responses. ClassMarker (https://www.classmarker.com/), Moodle (https://moodle.org/) or Blackboard (https://www.blackboard.com/) are some of the options that can be used when planning these types of activities.

6. Low Physical Effort

Take advantage of the new technologies, such as smartphones or touch screens, and reflect on how this technology can help you regarding the navigation and the construction of digital learning objects for your classes. Challenge your students to use these technologies in a classroom environment, flipping a classroom and making the student the center of the learning process. Select a topic or concept you want to address and let the students plan that lesson, where you will take the role of a mentor or a facilitator in a dynamic learning environment.

7. Size and Space for Approach and Use

This principle naturally leads to the idea of concept maps (e.g. in PowerPoint or CmapTools) which can be an excellent content organizational tool, allowing an online environment with a greater understanding of the information available, thus making it easier to access and be used by students. In Figure 4 we present a concept map with different types of materials highlighted in orange ovals,

connecting students to different types of tools such as videos, data and text files, the learning objects that resulted from the reflection on all the previous principles.

DISCUSSION

Teaching with new technologies can enhance and optimize student learning; however, they may represent a formidable challenge for many teachers. Are your classes planned in such a way that their content does not exclude the learning of certain concepts or does not limit access to certain groups of people? How can we minimize such distortions or deletions? All seven principals of the Universal Design can be viewed and interpreted within the three main principals of UDL: (1) Engagement, (2) Representation, and (3) Action and Expression. The proposed study where we reflected on these simple seven principles of Universal Design is a solid first step that will allow educators to adapt their practices to a more inclusive way of teaching, one that does not exclude the learning of certain concepts or limit their access to certain groups of students. By doing this, Universal Design is opening the door to a more inclusive world that understands and considers the uniqueness that characterizes each individual.
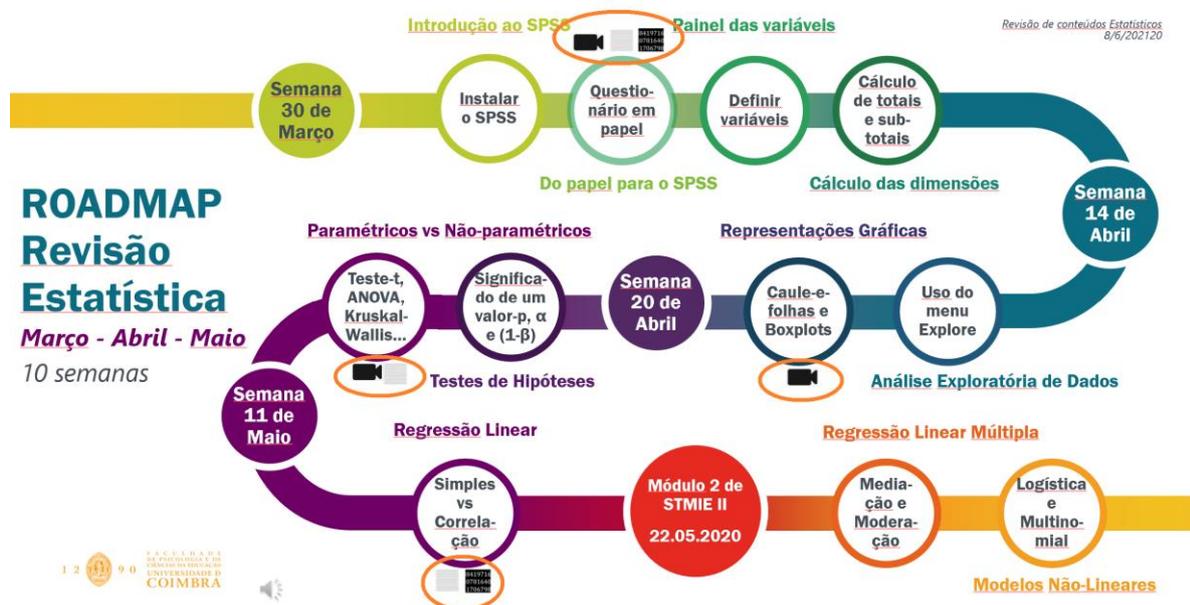

Figure 4. A roadmap example to the learning process

ACKNOWLEDGEMENTS

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