WHAT LESSONS HAVE EDUCATORS LEARNT FROM THE PANDEMIC? HOW TO MOVE TOWARDS AN INCLUSIVE EDUCATION

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The Covid-19 pandemic forced the educational community to adopt distance learning, causing us all to reflect on teaching practices and find new ways to reach out to our students. The internationalization of educational programs has redefined concepts such as inclusion, one that is no longer restricted to special needs students, but expanded to embrace a much broader concept where different cultures, languages, and sexual orientation and gender expressions need to be considered and integrated. But, with the enforcement of distance learning due to pandemics, are we truly creating a more inclusive learning environment or are we just enabling existing inequalities? The seven principals of Universal Design proposed by architect Ronald Mace (1985) provide the guidelines of the present case study, with the roadmap created here offering a reflection on the teaching practices and approaches used in order to include a wide range of students.

INTRODUCTION

Teaching Statistics can be very challenging regardless of whether it is taught face-to-face, online or in a hybrid environment. The internationalization of educational programs brought together a diverse corps of students not only with very different backgrounds in terms of knowledge in Statistics, but also where different cultures, languages, gender and sexual orientation will interact on a daily basis, making it imperative to rethink the concept of inclusive education and adapt our teaching practices in order to reach out to all of our students.

The fact that UNESCO predicted that over 24 million individuals from pre-school to tertiary education will not return to school after the closing of the schools during Covid-19 pandemics (UNESCO, 2020), only underscores the importance of inclusive education as a way to fight against the lack of access to education and discriminatory attitudes towards a society open to real diversity in terms of socioeconomic status, ethnicity, culture, disability or LGBTQ+ individuals.

UNIVERSAL DESIGN LEARNING - UDL

Universal Design for Learning (UDL) is a framework that has been promoted as an inclusive and flexible learning environment which assumes and integrates the diversity present in our courses. 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 provide the underpinning for UDL, namely *Engagement* representing the WHY of learning, *Representation* the WHAT of learning, and finally *Action and Expression* the HOW of learning. Each of these principles is expressed by way of three main guidelines with multiple checkpoints to guarantee students' meaningful acquisition of knowledge, understanding and skills. *Engagement* is associated with the need to employ different strategies in a diverse classroom to engage students through the variety of choices provided, thus reducing their anxiety and rewarding their efforts. *Representation* addresses the particular need to provide a range of materials to students beyond those in the ordinary oral or printed format, such as videos, websites or tactile objects which will promote accessibility among students with different or other needs. *Action and Expression* aims to provide alternative ways for students to demonstrate what they have learnt, other than the common written tests and essays. Flood and Banks (2021) have 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. They have 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 have focused more on teacher training and practice as opposed to examining student's outcomes.

In a meta-analysis by King-Sears et al. (2023) on the achievement of learners receiving UDL instruction, out of the original 12,454 articles, only 20 articles met the inclusion criteria which were: original research done in English, experimental design with treatment and control groups (including true

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experimental and quasi-experimental studies), measurement of learners' achievement, data available for effect size calculations, and UDL intentionally and proactively applied to interventions' designs. The 20 articles selected are quite diverse in terms of areas and educational levels where they were applied, with the majority of the studies (14) performed by elementary of secondary teachers, with one study in mathematics (7^{th} grade) and none in Statistics. The results showed a moderate improvement in the academic achievement of learners from UDL-based instructional settings in comparison to traditional based class designs. Nevertheless, these differences were of different levels when comparing adult learners to pre-university school level learners, learners with and without disabilities, and different content areas where they were applied. The study also concluded that UDL was more beneficial for students receiving instruction in smaller groups as opposed to larger classes.

It is worth noting some earlier results from a meta-analysis performed by Capp (2017) containing 18 peer-reviewed studies between 2013 and 2016 with pre and post testing. Again, the diversity of areas and level of education was present, with only 4 studies coming from a university background in multiple areas such as psychology, pedagogy or nursing, but none in Statistics. The results identified improvements in the learning process regarding a diminishing in levels of student stress, and increasing student confidence, but also identified an increase in the teachers' workloads. Carefully planning students' lessons within the UDL framework helped students in the teaching process; nevertheless, this evidence in student improvement maybe tainted by the few pre- and post-test designs available when studying UDL effectiveness.

Nieminen and Pesonen (2020), in the context of an undergraduate course in Mathematics, address the struggles and the neglect that disabled students face in mathematics education. They also identify the traditional expository, non-interactive methods of teaching classes in the field of Mathematics - which seems to still be a current practice – as a barrier to the learning process. In this study, they have created a course model for undergraduate mathematics supported by the principles of UDL. By introducing a variety of options such as materials in two different languages, concept maps tasks regarding relationships of concepts, anonymous discussion forums, feedback from self-assessment tasks, flipped classrooms, feedback on mathematical tasks and a chance to revise them, among many others, the results were very successful among students. Nevertheless, when addressing the needs of the three disabled students who took part in the study, a common concern was the isolation that these students experienced in the learning process. Some of the social digital tools were not adequate for their needs, creating a barrier for greater integration of these students. Thus, due consideration of this dimension when planning UDL environments in the future must not be forgotten. Finally, the authors fully advocate the need for UDL to be aligned with the social model of disability.

Scanlon et al. (2018) argue that for a course using UDL principles to be successful in addressing the needs of a diverse corps of students depends greatly on our capacity and knowledge as educators to prepare a course design with UDL principles clearly at the forefront. The recent qualitative study by Sanderson et al. (2022) with 35 faculty members in Computer Science and Engineering departments reveled a lack of sufficient understanding of most participants in terms of digital barriers and assistant technology. Most individuals, sadly, are unaware of any type of legislation as to the guidelines regarding Universal Design. The study also concluded that solutions to lack of accessibility of digital materials are only provided in the most simple and obvious cases. The study thus concludes underscoring the urgency for institutions of higher education to provide training in this area to promote a more inclusive education experience.

Although applications of UDL to Mathematics are rare, and probably non-existent in Statistics, the integration of its principles in course plans strives to create a unique, inclusive and flexible environment in the learning process. The success of such an approach seems to be connected with the careful planning of each lesson in advance, taking into consideration the diversity of students and their needs, thus avoiding the need to retrospectively address those students who struggle to pass the course. But how to operationalize UDL in a Statistics course?

BACK TO THE ORIGINS OF UNIVERSAL DESIGN

The origins of Universal Design can be found in the context of architecture as strongly connected with the general principle that all products and buildings should be designed, as much as possible, in such a way to be visually pleasing and usable for the majority of individuals regardless of age, ability or financial status (The Center for Universal Design, 1989). This was the seminal work

proposed by Ronald Mace (1940-1998) who, at the age of nine, was stricken with from polio and confined to a wheelchair for the rest of his life.

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 which characterize and apply to each individual (The Center for Universal Design, 1989).

How to translate and adapt these principles when planning a UDL course? What follows is not intended to be presented as either exhaustive or a unique path to UDL in Statistics. It does, however, simply urge us as Statistics educators to start thinking of our courses as being inclusive as possible and to start creating evidence of the effectiveness of UDL through rigorous design empirical studies.

Let's look at each of the seven principles of Universal Design and extend the work presented in de Sousa (2021), exploring some of the opportunities to incorporate a UDL design perspective.

Principle 1 – Equitable Use

The aim here is to create interfaces that can be used by the most diverse group of students, regardless of whether that individual presents special educational needs. Zoom or Teams have limited utility for the deaf or hearing-impaired person, and entering an online meeting platform may be challenging for a blind or visually impaired student. In the European context, for international student exchange opportunities administered through ERASMUS programs (https://erasmus-plus.ec.europa.eu/), materials provided in both the native language and in English would facilitate the integration of the international students. In addition, when in an online or hybrid environment we should not automatically assume that all students have the same high quality of internet service. Finally, teachers should make sure that materials and video recordings can be accessed offline by all students.

Principle 2 – Flexibility in Use

Reflecting the original concept of Universal Design aligned with the social model of disability, *flexibility in use* can be related to how the materials or class environments, digital or not, can be designed in order to be accessible to all students. When planning a UDL design class it is imperative to contemplate how to provide different forms or formats for students to experience the concepts being taught. The usual use of videos tend not to work for a deaf, blind, low-vision, or even a color-blind student, not to mention one who simply suffers from math-anxiety. The goal is to think about your students' needs and be creative with how your activities are presented. Simple solutions sometimes go a long way. For example, are your graphical representations using appropriate color contrasts for a color-blind student (https://mysl.nl/cuKO), or is the font size appropriate for a low-vision student? If a video has no subtitles for a deaf or hearing-impaired student, creating them yourself is not burdensome. Zoom does this quite well for English speaking videos but fails terribly in Portuguese. Software to produce your own subtitles is available online at no cost, such as N!kse.dk (https://www.nikse.dk/subtitleedit/online). A good suggestion is to start with a simple task video, for example, when producing a graph using some software, and choosing crucial moments of the video where to place a few subtitles to alert students to the next steps of the task.

Principle 3 – Simple and Intuitive

Do our courses contain simple and intuitive ways for students to express themselves and take action when in doubt? Are the students familiar with the digital tools that are used in class? Can they comfortably participate in group discussions, even anonymously if they prefer? Do working students have the opportunity to study completely and effectively online? Do teachers give sufficient and timely feedback to inform students of where they stand in terms of their knowledge? These are some of the questions that teachers need to reflect on to make our UDL course designs as successful as possible.

Principle 4 – Perceptible Information

Think about a student who experiences anxiety about Statistics and needs to review your materials more than once. Does your (digital) learning environment allow a student to easily navigate

the learning content? Think about what you can do beyond your face-to-face classes or even your video recordings of online sessions. Look at ways to transform your materials and construct concepts maps (or let the students themselves propose them) as this will guide students in their exploration of the course content and enhance their understanding of interconnections.

Principle 5 – Tolerance for Error

Students need to engage when taking a course, so formative assessments, timely feedback and an open learning environment where students can ask for help when needed are a few approaches that keep students connected to the class. The use of online learning platforms such as ClassMarker (https://www.classmarker.com/) for tests and quizzes, or the Moodle (https://moodle.org/) and Blackboard platforms (https://www.blackboard.com/) for content management are just a few of the options that can be chosen when planning and delivering your course activities. These platforms allow teachers to create online assessments activities, formative or summative, that students can experience; in addition, with appropriate feedback, the students themselves can self-correct, with the benefit here being self-regulation.

Principle 6 – Low Physical Effort

Teachers must take advantage of ever-developing new technologies, such as smartphones or touch screens, and should reflect on how these technologies can facilitate in terms of the navigation and the construction of digital learning objects for class activities. Challenge your students to use these technologies in a classroom environment, flipping a classroom in which the student is at 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 more dynamic learning environment.

Principle 7 – Size and Space for Approach and Use

By addressing the six previous principles, your course UDL design plan will most certainly prove to be timeless and with endless applications. Concept maps, assessment tasks with feedback, multiple ways to experience the different contents of your course, and an open support system to your students are just a few of the elements in UDL design that will make your class inclusive and flexible to all types of students.

Acknowledging the original 7 Principles of Universal Design proposed by Ronald Mace (1985) does not interfere with or contradict the three main principals of UDL proposed by CAST (2018), namely *Engagement*, *Representation*, and *Action and Expression*; indeed, they serve to enable and encourage allow us as Statistics educators to reflect on how they can be meaningfully applied in the learning process.

FINAL COMMENTS

Preparing a UDL design course requires a significant investment from us as educators along with a proactive attitude when teaching a class and a bit of creative thinking to offer the flexibility and the necessary diversity in presenting different forms of learning the class content. Measuring the impact on students of such an approach demands that UDL design plans be as specific and clear as possible so that students' achievements can be measure appropriately and new directions can be explored in future interventions. Universal Design for Learning (UDL) has shown some evidence of being effective from pre-kindergarten to adult learners, nevertheless examples in Mathematics or Statistics are rare in the literature. Future research in Statistics Education is needed in order to prove that a Universal Design framework indeed serves to facilitate the learning process and can reach out to all types of students.

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