Applying Universal Design for Learning guidelines to a blended learning course for prospective teachers

Andrea Mangiatordi
Department of Human Sciences for Education "Riccardo Massa". Università degli Studi di Milano Bicocca, Italy

Abstract

Universal Design has been studied and applied in Education for some decades now, yet it seems still far from becoming a standard in instructional design practices. Teaching educators and prospective teachers how to make a curriculum accessible to students with different needs seems to be a priority, as making instruction more and more accessible and inclusive is relevant in a Networked Learning perspective. The redesign of a blended learning course about Educational Technology to incorporate Universal Design principles is presented here. The participants, who were prospective teachers attending the fourth of a five-year graduate programme, were taught how to introduce Educational Technology in their lesson plans according to some basic principles of Universal Design, while the same principles were actually being used with them. Pre- and post-course survey data show an increase in various aspects, but mainly in the perceived self-efficacy in using Educational Technology, and in performance outcome expectations. The vast majority of participants also stated that the difficulty level of the course was not too distant from their confidence level. Some considerations are finally exposed, about the design challenges that are involved in universally designing a blended learning course.

Keywords

Universal Design, blended learning, teacher preparation, Educational Technology, textbooks

Introduction

Accessibility or, in general, access, is a complex problem, that can present itself in many domains and can be considered from many angles. In the 1970s architect Ronald Mace, as an example, (re)conceptualized the problem of the accessibility of buildings. He proposed a paradigm to be followed by those who want to design spaces and objects that do not present any barriers to their users, following an approach based on intervention on the environment, rather than on people with special needs. This is now commonly referred to as Universal Design (Mace, 1985; Story, Mace, & Mueller, 1998) and is mainly based on the idea that it is more convenient to design buildings and objects (or even services) that are already accessible, as in respectful of the users' diversity, rather than to adapt inaccessible spaces retrofitting them to fill their gaps.

Generally speaking, the concept of "design" is characterized by an evolutionary approach, the same that allowed to prehistorical utensils to evolve into modern, precise, specialized and state-of-the-art tools (Maisel & Steinfeld, 2012). Universal Design adds inclusion and inclusiveness to the picture: it is oriented towards satisfying the needs of extreme cases, rather than those of average users. Its main focus is on designing products and services that

ISBN 978-1-86220-337-2

can be of use to anybody. This seems particularly relevant in the context of Networked Learning, which mentions inclusiveness among its principles since its early manifesto (Beaty, Hodgson, Mann, & McConnell, 2002). Universal Design, when applied in the Educational Technology field, considers technology as an effective means to remove barriers to information and, ultimately, to learning. Its main objective is to support people with disabilities, but its "Universal" nature extends its reach and effectiveness beyond such groups. Since the end of the 1980s, the field of instructional content design saw an increase in interest towards the novel approaches brought forward by Universal Design. This created the conditions for the development of new instructional design frameworks, with redundant names such as Universal Instructional Design (Higbee, 2001), Universal Design for Learning (Rose & Meyer, 2002) and Universal Design for Instruction (S. S. Scott, Mcguire, & Shaw, 2003). They all proposed sets of guidelines to be followed by educators, instructional designers, teachers and other practitioners to design inclusive learning content and evaluate its accessibility and, ultimately, its inclusiveness. Albeit it has been available in this fashion for some decades now, Universal Design seems still far from becoming a standard in instructional design practices.

The main inspiration for the redesign that will be described in the following pages comes from the idea that teaching educators and prospective teachers about how to make a curriculum accessible to students with different needs seems to be a priority for making instruction more and more accessible in the future. After discussing the state of the art of the implementation of Universal Design frameworks in Higher Education, the design and implementation of a blended learning course will be discussed, presenting the main results coming from data collected by the means of standardized scales and custom questionnaires. Some reflections about the implications of adopting a Universal Design approach in the development of Higher Education blended courses will be discussed in the final part of the paper.

State of the Art

As seen in the previous section, the adoption of Universal Design approaches in Education is some decades old and some literature reviews are available that can give a picture of what we know about its consequences. Orr and Bachman Hammig (2009) identified five primary themes by analysing 38 research articles, namely: backward design, or the immediate clarifications of learning goals; the use of multiple means of presenting information; the use of various teaching strategies, to give learners the best possible support; the use of flexible, inclusive assessment methods; the approachability and empathy of the instructor. Later, the work of Roberts et al. (2011), besides stating that more research evidence was needed, highlighted the need to operationalize the principles of Universal Design for Instruction and to investigate its impact on the outcomes of postsecondary education students with and without disabilities. Rao, Ok and Bryant (2014) showed that studies in this field use a wide range of research designs to examine student outcomes and participant perceptions of Universally Designed curriculum and instruction. There is hence a sort of indetermination in the way these concepts and frameworks are implemented and studied, which lead some other researchers to question if Universal Design is in itself an oxymoron or an opportunity (McGuire, 2014). In more recent work, Al-Azawei, Serenelli and Lundqvist (2016) concentrated on Universal Design for Learning and its implementations, reckoning that the framework seems really efficient in supporting the design of flexible learning environments and accessible content.

ISBN 978-1-86220-337-2

The principles of Universal Design also seem to be able to satisfy the expectations and the needs of university students with disabilities: they experience barriers to learning, and they tend to value the autonomy granted them by accessible learning environments (Black, Weinberg, & Brodwin, 2015). Another interesting research outcome relates to improvements in test results, mainly in STEM and in contexts where tests were also built with accessibility in mind (King-Sears et al., 2015; Rappolt-Schlichtmann et al., 2013).
Among the benefits of Universal Design that are not directly linked to learning outcomes, there is an improved perception of control and awareness of one's learning path (Kumar & Wideman, 2014) and increased engagement of the students (Marino et al., 2014).
In a recent article Scott and McGuire (2017) studied Universally Designed instruction adopting the lens of Diffusion of Innovation Theory (Rogers, 2003): evidence about the consequences of infusing inclusive instructional strategies into college curricula is limited, due to the relative recency of the movement. There have been sporadic attempts to document outcomes, presented in a small but growing research-based literature. Ultimately, it is legit to ask questions about the sustainability of such an approach, and those questions need to become the basis for research hypotheses that can eventually be confirmed or disconfirmed. The redesign described in the following sections tried to take all this research base into consideration, by proposing a course that aimed first at meeting the variability of the students.

The course

This study revolved around a course that is one of three related to Educational Technology in the Teacher Education Curriculum, a five-year University Degree in Primary and Pre-Primary Education. Its title, that can be translated as "Digital Learning Environments", clearly states that its focus is on the use of digital technology and that it is not meant to be just a tool - it is meant to create the environment where learning happens.
By interviewing the teacher that held the course in the previous two years it was possible to collect some useful information about the past: it received a low evaluation during the two previous Academic Years. Among the main painful points for students there was the required workload, considered excessive, and more specifically the impact that assignments had on it: two group activities were proposed in the previous editions, requiring a consistent effort to be completed. Another common complaint was about the contents of the program: it was often seen as too technical, and less computer-literate students did not feel to own the required skills and knowledge to enter it.

Baseline assessment

In order to produce a baseline assessment of the relationship that the participants had with Educational Technology, a questionnaire was administered to them one week before the beginning of the course. The chosen instrument was the Intrapersonal Technology Integration Scale (ITIS) by Niederhauser and Perkmen (2008), and specifically, the Italian translation produced and validated by Benigno et al. (2013). The scale is composed of four sub-scales that measure respectively: the perceived Self-Efficacy (SE), the Performance Outcome Expectations (POE), the Self-Evaluative Outcome Expectations (SEOE), the Interest towards the topic of instructional technology (INT) and finally the Social Outcome Expectations (SOE). The scale requires to give a value of 1 to 5 to the respondent's level of agreement with 21 statements, that can then be aggregated to calculate the four main factors. The overall

ISBN 978-1-86220-337-2

results showed a high INT score (average 3.90 - s.d. 0.69), while the SOE had the lowest score (average 2.82 - s.d. 0.88). The other sub-scales yielded normally-distributed results (see the 'Results' section for the complete data) averaging between 3.15 and 3.75. This data was taken into consideration in the redesign of the course: a specific focus was put on the social dimension of technology use.

Re-Design and Development of the Course

The course was redesigned from scratch, taking into consideration the topics that were presented in previous editions. The old course syllabus focused mainly on the topics of electronic publishing, OERs, content creation and the relationship between so-called 'digital natives' and 'digital immigrants', which is a debated theory (Bennett, Maton, & Kervin, 2008). The main change in course topics was represented by the introduction of accessibility and Universal Design as basic concepts to be taken into consideration. The native-immigrants categorization was dropped in favour of a broader view of the variability that is typical in all learning settings (Riviou, Kouroupetroglou, & Bruce, 2014). During the course, a large number of technological tools was presented, categorized and made available for experimenting in the form of assignments. The categorization was organized according to previous research that led to the definition of three levels of intervention: digitization, content organization, and support to action in teaching (Mangiatordi, 2017).
The main inspiration for the whole redesign came from the Universal Design for Learning framework mentioned above, which suggests a strong focus on "providing options" for engagement, perception, action and expression (CAST, 2011). In this renewed edition, topics were organized on a weekly basis, offering students the possibility to concentrate on one specific subtopic at a time. Every week followed the same structure: a preparatory reading was proposed to the students via the course VLE (a simple Moodle course page), then a class took place, in presence, where the weekly topic was addressed. This was meant to help "heighten salience of goals" (as per UDL guideline 8: "Provide options for sustaining effort and persistence"). Before each class, slides and other materials were made available to the students in two formats, one best fit for viewing them from a computer screen, and one more printer friendly (in response to the suggestions given by UDL guideline 1: "Provide options for perception"). In this way, they would be able to follow the class and take notes more comfortably, using a digital device or pen and paper to take their notes (so also UDL Guideline 4: "Provide options for physical action" was addressed). Starting from the second day of each week, assignments were given, following a simple rule: each week had two assignments, related to the topics that had been discussed in presence. Participants were required to select at least one of the two assignments, for a minimum total of five assignments to be completed by the end of the course. This strategy aimed again at complying with UDL Guideline 8 but can also be seen in general as a way to optimize personal preferences. As the two (total) assignments requested in the previous editions were considered too heavy, the new edition assignments were downsized in order to require efforts that varied from a few minutes to a few hours in terms of time to complete. On the methodological side, the UDL recommendation that encourages to use different teaching strategies was also taken into consideration: the course tried to facilitate learning through acquisition, through inquiry, through discussion, through practice and through collaboration, as these five techniques have been proposed and discussed by Laurillard (2012) for the role that Educational Technology can play in facilitating them.

ISBN 978-1-86220-337-2

Final data collection

At the end of the five weeks of the course, the ITIS scale was re-administered to participants, together with another questionnaire, built specifically for the course. This last part of data collection was carried out anonymizing results, for two main reasons: it was not necessary to confront the data with a previous assessment, and students needed to feel free to evaluate the course before the final exams would take place. The questions in this additional set were focused on the following topics, all linkable to redesign elements and to UDL Guidelines:

- the appropriateness of the number of total assignments that were proposed in the course - due to the fact that this was one of the redesign choices (UDL Guideline 8: Provide options for sustaining effort and persistence");
- the general level of satisfaction about how the assignments were balanced, in the way they allowed students to deepen their own personal interests - interesting because a high satisfaction rate here can be considered a success in terms of Universal Design (UDL Guideline 7: "Provide options for recruiting interest");
- the perceived usefulness of both technological tools and methodologies that were presented in the course - again, interesting because relevance is among the checkpoints of the UDL framework (UDL Guideline 7: "Provide options for recruiting interest");
- the perceived self-efficacy towards digital technology in general and the appropriateness of the assignments to the participant's skill level - these two variables were meant to measure the way in which the provided options actually offered graduated levels of support (UDL Guideline 5: "Provide options for expression and communication").

All the above topics were measured using 5-point scales, in the same fashion of the ITIS scale.

Results

The initial and final questionnaires, together with the additional anonymous survey, were given to all enrolled students, collecting N=101 complete initial-final answers and N=118 anonymous feedbacks.
In the initial baseline assessment, the average SE score was of 3.15 out of 5, which qualifies as a middle score. The other factors had higher average results: 3.75 for both POE and SEOE and 3.9 for INT.
At the end of the course, the average scores had all increased. Table 1 shows each factor score in the initial and final assessments, their standard deviations and the average difference between the two values. Effect size is represented by Cohen's d. The *p-value* is calculated using a two-tailed, paired T-Test.

Table 1 – Pre- and post-course results for the ITIS scale factors, with Cohen's *d* used as a measure effect size

Factor	Initial	Final	Delta	Cohen's *d*	*p*
Self-efficacy	3.15 (s.d. 0.61)	3.78 (s.d. 0.45)	+0.63	1.18	0,001 ***
Performance Outcome Expectations	3.75 (s.d. 0.64)	4.23 (s.d. 0.53)	+0.49	0.83	0,001 ***

ISBN 978-1-86220-337-2

Self-Evaluative Outcome Expectations	3.75 (s.d. 0.65)	4.10 (s.d. 0.58)	+0.35	0.57	0,001 ***
Interest	3.90 (s.d. 0.69)	4.23 (s.d. 0.59)	+0.33	0.51	0,001 ***
Social Outcome Expectations	2.82 (s.d. 0.88)	3.36 (s.d. 0.87)	+0.54	0.62	0,001 ***

The anonymous questionnaire produced the following results:

- the number of total assignments proposed in the course was judged to be appropriate by 58.6% of the participants, with another 29.3% giving an intermediate answer and 12.1% considering them to be too many - as the assignments of the previous course were only two, it is safe to say that the number of activities did not impact on the satisfaction of students;
- students were also generally satisfied with how the assignments were allowing them to deepen what mattered more to them (82.1%), with 11.1% being neutral and 6.8% expressing lower satisfaction - this represents a success according to UDL Guideline 7;
- methodologies and tools presented in the course were considered useful or highly useful for future classroom use by 94.9% and 95.8% of the participants respectively, with 0.9% students considering the methods (not the tools) not to be reusable in their future work - this represents a success according to UDL Guideline 8;
- students tended to consider themselves as average (45.3%) or above average computer users (41.9%), with 4.3% considering their skills very high and 8.6% considering them to be below-average; the assignments were considered appropriate or highly appropriate to their skill level by 75.2% of participants, with 5.9% considering them inappropriate - UDL Guideline 5 and the general UDL recommendation of "providing alternatives" were addressed in an effective and satisfactory way.

Discussion

Students started the course with a very high average interest score, high outcome expectations and average self-efficacy scores. The four factors had a significant increase over the course of the research experience, that was accompanied by a reduction of the standard deviation of scores. The highest differences in pre and post measurements were registered in the self-efficacy area (+0.63), with a very large effect size (the effect size represented by Cohen’s d is nearly 1.20). Performance outcome expectations had a sensible increase too (+0.49), with an effect size that qualifies as high (above 0.80). But the most interesting data comes from the questions about the structure of the course, which represented the main effort towards the adaptability and personalization that are recommended by UD approaches: the adoption of a flexible assignment system was perceived by students as an effective way to deepen what mattered more to them while undergoing assignments that were considered appropriate to their skill levels. With regards to the number of assignments, keeping them small and very focused on results (i.e., students could directly see if an assignment was successful by the final product they created by experimenting with specific Educational Technology software) produced the result that their number was considered to be appropriated by the vast majority of participants. In the final oral exams, that took place after the completion of the course and of all the questionnaires, the “personal story” of participation of each student was examined: even if they did not receive quantitative marks for the assignments (they were simply marked

ISBN 978-1-86220-337-2

as “approved”) it was possible to glimpse the high level of engagement in the course by the fact that 35% of the participants had completed more than 5 assignments.
As to the course perceived usefulness for the participants’ future work, the scores of around 95% that referred to both tools and methodologies seem to support the idea that relevance is a very important Universal Design element that favours engagement, as proposed by UDL guidelines in particular. The selection of technological tools presented in the course covered different areas of teaching, spanning from the simple acquisition of analogical content to its transformation into digital resources, to the application of advanced strategies like digital storytelling. One of the activities that were proposed as assignments aimed at strengthening the sense of belonging to a community, which was highlighted as problematic in the baseline study by the low SOE score: participants were allowed to contribute to the course catalogue of technological tools by describing something they had used in the previous years, while practicing as interns in primary schools and kindergartens. This lead to the creation of a database of 133 tools, all described and referenced in order to make them selectable or future intervention. After the end of the course, during final exams, this element was brought up by many students as the most interesting part of the course, because it made them feel the importance of being part of a network of learners engaged in the same venture.
Finally, the Net Promoter Score calculation yielded a very high result, with 66,11% of participants qualifying as “promoters” of the course and only 4,23% qualifying as “detractors”. The reasons of unhappiness for this small group of respondents can be assumed to be related to the main point of criticism that emerged by both the questionnaires and final exams: one of the textbooks chosen for the course was considered to be too difficult (in terms of language, considered too technical) for the target users.

Final considerations

The study presented in this paper allowed to shed some light on the opportunity and on the sustainability of the implementation of Universal Design in Higher Education to address the variability of learners, with a specific focus on Universal Design for Learning. The experience also provided some encouraging results related to making a university course more inclusive by providing students with a flexible learning environment that allows practicing specific aspects of Educational Technology implementation. This was possible thanks to the blended learning structure of the course, that took advantage of the networked environment to provide students with multiple means of representation, interaction and engagement, as the Universal Design for Learning framework suggests.
The most critical design challenge was represented by the high number of students involved, which translated into a highly varied level of technological competence and of self-efficacy. The results showed an improvement in self-efficacy perceptions, yet the fact that there was a small group of unsatisfied students (i.e. the people that found the course level to be inappropriate to their skill level) reminds that a Universal Design approach can be useful, but it is still very difficult to really satisfy all the “users” of a product. The fact that there will always be groups of unsatisfied people accounts for the need of an iterative and evolutionary design approach, as was already highlighted in the introduction to this work.

References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A Content Analysis of Peer-Reviewed Journal Papers from 2012 to 2015. *Journal of the Scholarship of Teaching and Learning, 16*(3), 39–56.

Beaty, L., Hodgson, V., Mann, S., & McConnell, D. (2002). Working Towards E-Quality in Networked E-

Learning in Higher Education: A Manifesto. Retrieved from http://csalt.lancs.ac.uk/esrc/manifesto.pdf
Benigno, V., Chiorri, C., Chifari, A., & Manca, S. (2013). Adattamento italiano della Intrapersonal Technology Integration Scale, uno strumento per misurare gli atteggiamenti degli insegnanti nei confronti delle TIC. *Giornale Italiano Di Psicologia*, *40*(4), 815–838. http://doi.org/10.1421/76948
Bennett, S., Maton, K., & Kervin, L. (2008). The "digital natives" debate: A critical review of the evidence. *British Journal of Educational Technology*, *39*(5), 775–786. http://doi.org/10.1111/j.1467-8535.2007.00793.x
Black, R. D., Weinberg, L. A., & Brodwin, M. G. (2015). Universal Design for Learning and Instruction: Perspectives of Students with Disabilities in Higher Education. *Exceptionality Education International*, *25*(2), 1–26.
CAST. (2011). Universal Design for Learning Guidelines version 2.0. Wakefield, MA: Author.
Higbee, J. (2001). Implications of Universal Instructional Design for Developmental Education. *Research and Teaching in Developmental Education*, *17*(2), 67–70.
King-Sears, M. E., Johnson, T. M., Berkeley, S., Weiss, M. P., Peters-Burton, E. E., Evmenova, A. S., … Hursh, J. C. (2015). An Exploratory Study of Universal Design for Teaching Chemistry to Students with and without Disabilities. *Learning Disability Quarterly*, *38*(2), 84–96.
Kumar, K. L., & Wideman, M. (2014). Accessible by Design: Applying UDL Principles in a First Year Undergraduate Course. *Canadian Journal of Higher Education*, *44*(1), 125–147.
Laurillard, D. (2012). *Teaching as a design science*. *Building Pedagogical Patterns for Learning and Technology*. New York/London: Routledge.
Mace, R. (1985). *Universal Design, Barrier Free Environments for Everyone*. Los Angeles: Designers West.
Maisel, J., & Steinfeld, E. (2012). *Universal Design. Designing inclusive environments.* Hoboken: Wiley.
Mangiatordi, A. (2017). *Didattica senza barriere. Universal design, tecnologie e risorse sostenibili*. Pisa: ETS. Retrieved from http://www.edizioniets.com/scheda.asp?n=9788846747754&from=&fk_s=
Marino, M. T., Gotch, C. M., Israel, M., Vasquez, E., Basham, J. D., & Becht, K. (2014). UDL in the Middle School Science Classroom. *Learning Disability Quarterly*, *37*(2), 87–99. http://doi.org/10.1177/0731948713503963
McGuire, J. M. (2014). Universally Accessible Instruction: Oxymoron or Opportunity? *Journal of Postsecondary Education and Disability*, *27*(4), 387–398.
Niederhauser, D. S., & Perkmen, S. (2008). Validation of the intrapersonal technology integration scale: Assessing the influence of intrapersonal factors that influence technology integration. *Computers in the Schools*, *25*(1–2), 98–111. http://doi.org/10.1080/07380560802157956
Orr, A., & Bachman Hammig, S. (2009). Inclusive Postsecondary Strategies for Teaching Students with Learning Disabilities: A Review of the Literature. *Learning Disability Quarterly*, *32*(3), 181–196.
Rao, K., Ok, M. W., & Bryant, B. R. (2014). A Review of Research on Universal Design Educational Models. *Remedial and Special Education*.
Rappolt-Schlichtmann, G., Daley, S. G., Seoin Lim, Lapinski, S., Robinson, K. H., & Johnson, M. (2013). Universal design for learning and elementary school science: Exploring the efficacy, use, and perceptions of a web-based science notebook. *Journal of Educational Psychology*, *105*(4), 1210–1225. http://doi.org/10.1037/a0033217
Riviou, K., Kouroupetroglou, G., & Bruce, A. (2014). UDLnet: A Framework for Addressing Learner Variability. In *International Conference on Universal Learning Design* (pp. 83–94).
Roberts, K. D., Park, H. J., Brown, S., & Cook, B. (2011). Universal Design for Instruction in Postsecondary Education: A Systematic Review of Empirically Based Articles. *Journal of Postsecondary Education and Disability*.
Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York, NY: Free Press.
Rose, D., & Meyer, A. (2002). *Teaching Every Student in the Digital Age: Universal Design for Learning.* Alexandria, VA: ASCD.
Scott, S., & Mcguire, J. (2017). Using Diffusion of Innovation Theory to Promote Universally Designed College Instruction. *International Journal of Teaching and Learning in Higher Education*, *29*(1), 119–128. Retrieved from http://www.isetl.org/ijtlhe/
Scott, S. S., Mcguire, J. M., & Shaw, S. F. (2003). Universal Design for Instruction: A New Paradigm for Adult Instruction in Postsecondary Education. *Remedial and Special Education*, *24*(6), 369–379. http://doi.org/10.1177/07419325030240060801
Story, M., Mace, R., & Mueller, J. (1998). *The Universal Design File: Designing for People of All Ages and Abilities*. Raleigh: Center for Universal Design, North Carolina State University.

ISBN 978-1-86220-337-2