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Pedagogical Evaluation of the Design Thinking MOOCs

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Abstract: *Design Thinking and Massive Open Online Courses (MOOCs) have enjoyed a widespread attention and uptake by both institutes of higher education and media. These two increasingly popular phenomena have joined forces in the recent years with several reputable universities offering MOOCs on Design Thinking. However the MOOC model of learning and Design Thinking education seem very contradictory at the first glance: Design Thinking is taught in a learning-by-doing fashion in small teams and through various hands-on activities. In contrast, MOOCs are most often completed individually. Hence the seemingly unfitting characteristics of MOOCs and Design Thinking are worth further investigation. This paper presents the initial stage of a research project that explores the potential of teaching Design Thinking at scale. It offers a pedagogical evaluation of the existing Design Thinking MOOCs using the Taxonomy Table and the Seven Principles of Good Practice in Undergraduate Education. The results shed light on how Design Thinking is being taught today in a MOOC environment and the learning objectives that the course providers are expecting.*

Keywords: *Design Thinking; Massive Open Online Courses (MOOCs); Seven Principles of Good Practice in Undergraduate Education; Taxonomy Table.*

Introduction

The advent of Massive Open Online Courses (MOOCs) sparked a heated debate over their potential and role for the prospect of higher education in the recent years (Yuan and Powell, 2013). The increasing popularity of MOOCs challenged the traditional model of education, leaving residential universities concerned about their role and of becoming outdated (Holford, Jarvis, Milana, Waller and Webb, 2014). However, most of the MOOCs that are popularized today are not far from the big lecture hall model of traditional universities themselves and not as revolutionary as some have claimed (Eisenberg and Fisher, 2014; Bali, 2014).

The surge in media attention on MOOCs and their so-called revolutionary prospect for education has declined but still continues. Now that the dust has settled, it is time to take a closer and more realistic look at MOOCs and their potentials. Taking into account that MOOCs are only the latest chapter in the long history of distant and open education (Liyaganawardena, Adams and Williams, 2013) there is a long path ahead for researchers to investigate their impact and role for complementing current education and lifelong learning.

One of the distinctive characteristics of MOOCs, which is superior to the traditional lecture model, is their degree of flexibility (Nkuyubwatsi, 2013). MOOC is a powerful medium to reach a wide range of audience independent from time and location; individuals can watch the course videos according to the setting and time that is best suited to their own learning needs. However, some critics argue that the MOOC model of teaching and learning might not be compatible with all types of courses and disciplines. In other words, while MOOCs seem to be a good fit for those courses that are already taught in big lecture halls, they may not be appropriate for those requiring specific physical settings such as labs and studios (Eisenberg and Fisher, 2014). In this light, design education is among the latter group.

The application of creativity and design has stepped beyond creative industries and into a wider range of business and real life challenges, largely due to the fact that solving today's complex problems demands different ways of thinking and designing (Lloyd, 2013). Increasing numbers of universities and educational institutions are joining this trend by incorporating the teaching and learning of Design Thinking, as a human-centered approach to innovative problem solving (Withell and Haigh, 2013; Dunne and Martin, 2006). The popularity of the method has proceeded into the world of online learning to the point where some prestigious universities are now offering MOOCs on Design Thinking (e.g. Design Thinking Action Lab by Stanford University).

This current trend raises the question of how compatible such courses are with a real life Design Thinking learning experience. Design Thinking is taught and learned in a rather unconventional and learning-by-doing fashion: interdisciplinary teamwork, hands-on activities, rapid prototyping, various iterations, warm-ups and team building exercises are inevitable parts of a Design Thinking learning experience. Thus Design Thinking and the current model of MOOCs are seemingly incompatible in their core nature. Given the emergence of Design Thinking as a discipline (Withell and Haigh, 2013) and its gradual yet increasing uptake by MOOC providers, there is a strong case for this research project, which investigates the main research questions of:

- How can Design Thinking be best taught in an online environment?
- To what degree can students gain Design Thinking expertise through the MOOC model of learning?
- How can we assess the outcomes and the students' learnings?

This conceptual paper is the first step in investigating the MOOC potential of Design Thinking and its impact on individuals' learning. It offers a pedagogical evaluation of the current Design Thinking MOOCs, shedding light on how Design Thinking is being taught today in a MOOC environment and the learning objectives that the course providers are expecting.

As Bali (2014) argues, since the popularized MOOC model of education is similar to college courses, for evaluating MOOCs it is more suitable to apply those frameworks and approaches used for higher education than those for distance education. Thus, for the purpose of this work, we apply the Taxonomy Table (Krathwohl, 2002) and the Seven Principles of Good Practice in Undergraduate Education developed by Chickering and Gamson (1987). Given the limited research on learning and teaching Design Thinking in a MOOC environment, this research will make a significant contribution to the field of Design Thinking education.

Design (Thinking) Education over Distance

Teaching and learning design-related disciplines is traditionally associated with a physical setting or a design studio. The role of studio learning for design education has been emphasized by many scholars (e.g. Lynas, Budge and Beale, 2013). Brown (2005) discusses the importance of the studio context from various aspects: as students develop their design, they are constantly exposed to their peers' works as well as their respective thinking processes. In addition they benefit from listening to feedback given by experts and instructors to their peers' as well as to their own work. This continuous exposure and interaction between students offers a great learning opportunity.

Despite the above mentioned emphasis on the role of the design studio, design education has been taught and learned in a distant model for many years in the absence of a conventional physical studios. The Open University in the UK, for instance offered its first course on Design, called *Man-Made Future: Design and Technology* in 1975 (Lloyd, 2013). Furthermore, the technological developments in recent years have offered new ways of educational delivery and thus the opportunity to redefine teaching and learning in some design disciplines (Walpole, 2012).

Lloyd (2013) identifies three main developments which play an important role in enabling teaching and learning design over distance: firstly, the advent of creative social networks that allow for individuals to expose their work and design to a broader audience and consequently receive feedback. Secondly the recent development of the design discipline itself: design is no longer limited to creating aesthetic artifacts, but has expanded into different areas e.g. into communication. Finally, with the help of technological development, design education itself has moved from the studio-based learning model towards a more digital environment in which students work at home and communicate the results online for feedback.

Similar to the classic design education, Design Thinking is traditionally taught in a studio-based learning environment. During a conventional Design Thinking workshop, students collaborate in interdisciplinary teams, in an open and creative environment, and participate in hands-on activities to develop innovative solutions (Plattner, Meinel and Leifer, 2011). As interdisciplinary teamwork is an inevitable part of Design Thinking problem solving, it poses an additional challenge in replicating the real life experience in an online environment.

Despite the seemingly incompatible nature of learning experiences of MOOCs and Design Thinking education, there is a significant value of teaching Design Thinking at scale; in today's world, the impact of design goes beyond creative industries and can be applied to a range of

areas (Lloyd, 2013). Managers are becoming more interested in approaching problems afflicting businesses using design methods (Dunne and Martin, 2006). Moreover many day-to-day problems that people face around the globe are design challenges in their nature (Lloyd, 2013).

As Lloyd (2013) pointed out, there is a potential advantage of teaching Design (Thinking) in a MOOC environment. While many academic design schools have a rather homogenous selection of students, the MOOC model can tap into the potential of diversity among its audience. He further argues that the design knowledge transfer in any given design school is a mix of one-to-one (between mentor and student and therefore more formal) and many-to-many (among students in an informal manner). In an online environment a many-to-many knowledge transmission should be in the center of the course design and supported by learning activities. This will allow for participants from different backgrounds and expertise to be involved in the problem solving process.

Finally, Design Thinking is a human-centered approach to problem solving with the focus on the needs of the people for whom the solutions are designed for, thus it can be applied in different cultural contexts. Considering the ever increasing need to apply the Design Thinking methodology and lessons to address today's complex challenges (Owen, 2007), and the fact that there are still limited opportunities internationally to learn and apply Design Thinking compared to other disciplines, teaching this methodology at scale has the potential to make a significant contribution in empowering individuals.

As the first step towards identifying how Design Thinking can be best taught in a MOOC environment, it is necessary to explore the existing MOOCs on Design Thinking and review the pedagogies across these courses.

Research Approach

In this section we first clarify the steps in which the Design Thinking MOOCs were identified and present our selection criteria. Then we discuss the role of learning objectives and their importance for the MOOC research, followed by the placement of the retrieved objectives of the selected MOOCs into the Taxonomy Table (Krathwohl, 2002). Applying the model of Seven Principles of Good Practice in Undergraduate Education (Chickering and Gamson, 1987) will allow for assessing to which extent the expected learning objectives were supported by the pedagogies of the courses. For this purpose we examined each MOOC individually rather than a genre (Bali, 2014) and took the perspective of participant observers (Nkuyubwatsi, 2013).

Selection of MOOCs on Design Thinking

Considering the constant change in the MOOC environment, using a source that provides an overview of the related courses was crucial to this work. Four MOOC aggregators were used, namely: Class Central, Course Talk, Open Education Europa and MOOCSE. As a first step, we searched for the terms Design Thinking and Human Centered Design as these terms are used interchangeably (e.g. IDEO.com uses human-centered design). This approach resulted in identification of courses that contained these two keywords in their titles.

Secondly, to ensure consistency in our study, the following boundaries were defined: Courses offered in languages other than English were not considered for this review. However, only one non-English course, taught in French was dismissed as a result. In order to apply our

pedagogical assessment across all courses, we focused on university-level MOOCs, thus dismissing those offered by individuals on skill sharing platforms (here only the course Design Thinking: Innovation in Style on Udemy was dismissed). Finally, only those courses that were free of charge were included (here the course Design Thinking for Innovative Problem Solving was dismissed).

Table 1 List of existing Design Thinking MOOCs (offered in English)

Course Name	Provider	Duration	Course Code	Platform
Design Thinking Online Course	Macromedia University	4 Weeks	DTOC	Iverson
Innovation and Design Thinking	University of Cincinnati	7 Weeks	IDT	UC MOOCs University of Cincinnati
Design Thinking Action Lab	Stanford University	5 Weeks	DTAL	Stanford Online
Design Thinking for Business Innovation	University of Virginia	4 Weeks	DTBI	Coursera
Design Kit: The Course for Human-Centered Design	+Acumen	7 Weeks	DK	NovoEd

All these courses are offered on an introductory level requiring no prior knowledge on Design Thinking from participants. At the time of this study, the following courses were terminated and no upcoming iterations were offered: Design Thinking Action Lab (Stanford University), and Innovation and Design Thinking (University of Cincinnati). Therefore the research sample for our investigation consists of the three courses that were accessible, namely: Design Thinking Online Course (DTCO), Design Thinking for Business Innovation (DTBI) and the Design Kit: The Course for Human-Centered Design (DK). The characteristics of the selected courses will be discussed further in this paper.

Learning Objectives of the Selected MOOCs

Since the advent of MOOCs and consequently the access to large data sets on learners' activities, researchers have been fascinated by the use of big data through learning analytics. However, big data does not answer all the questions about learning and teaching by the virtue of their size (Reich, 2015). Learning analytics are useful for helping students to make fewer mistakes and allowing course providers to adapt the pace of the course to patterns of students' answers. The important question that arises is how primary these goals are in the overall learning objectives of a given course and how much they contribute to the improvement of students' learning experience? (Eisenberg and Fisher, 2014). Thus, it is valuable to focus on the improvement of those objectives and goals, which have a higher and more direct impact on students' learning. As a first step, curricular objectives of a given course need to be defined clearly. Once these objectives are prioritized, MOOC research can pose those types of questions that address the most primary objectives of an online learning experience.

In addition, identifying clear and measurable learning objectives early on in the process of course design, enables curriculum builders and course designers to define learning activities

and instructional design for achieving these goals (Krathwohl, 2002). In this light and with the purpose of identifying those objectives that have significant impact on the overall learning experience, we begin our investigation by reviewing the selected Design Thinking MOOCs and their curricular objectives using the framework of the Taxonomy Table (Krathwohl, 2002).

Bloom's Taxonomy of Educational Objectives provides educators and course designers with a structure for classifying statements of what they expect students to achieve and learn as a result of participation in a given course (Krathwohl, 2002). The original Taxonomy represented a cumulative hierarchy of six categories in the Cognitive Process domain, starting from the lower order thinking (simpler category) towards more complex thinking skills (e.g. evaluation). The Taxonomy has been used as a guidance for educators to develop learning objectives aiming towards higher order thinking (Bali, 2014).

The revised version of the Taxonomy allows for the separation between the Knowledge and the Cognitive Process spectrum. Development of the six hierarchical thinking skills on the Cognitive Process (on the horizontal axis) is tackled on four categories of the Knowledge dimension (on the vertical axis). Thus, suggesting a possibility to represent the objectives in a two-dimensional table called the Taxonomy Table (Krathwohl, 2002).

In this study, we extracted the learning objectives of the selected courses from their landing page. Commonly the first page of a MOOC contains general information about the course, instructor(s), format, as well as what can be expected from the course. It might contain a short introductory video about the course as well. The process of extracting the learning objectives was not straightforward, as the objectives are not always mentioned explicitly. In such cases, they were extracted from the general information about the corresponding course on the first page.

In order to see how the placement of the extracted learning objectives into the Taxonomy Table was accomplished, consider the following example extracted from the course DTOC. One of the objectives mentioned is 'You will learn how to apply teamwork and communications skills'. Following Krathwohl (2002) for placement of objectives along the Cognitive Process dimension we pay attention to the verb *Apply*, in the statement which is associated with the category **Apply**. Consequently in order to place the objective along the Knowledge axis, consideration of the noun phrase, *teamwork and communications skills*, is required, which associates with the **Procedural** Knowledge category.

However, the placement of some of the statements required additional considerations and differed from the process that Krathwohl (2002) demonstrated in his work. In other words, classifying objectives solely by focusing on the verb and the noun phrase of a given statement is limiting for our case; consider the following objective as an example: 'students will create prototype of their solutions'. Following the recommendation of Krathwohl (2002) if we only note the verb *Create*, we would place this objective under the **Create** category and consequently in the highest order thinking skill. However, creating a prototype is one of the steps of the Design Thinking process and therefore should be classified in the cell corresponding with the intersection of **Apply** and **Procedural** Knowledge.

Table 2 Taxonomy Table of the selected Design Thinking MOOCs

	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual	DTOC: <ul style="list-style-type: none"> [...] fundamentals like historical and theoretical aspects of design, design models and design systems 	DTOC: <ul style="list-style-type: none"> You will gain deeper insights into the Design Thinking methodology and the human-centered design approach 				
Conceptual		DTBI: <ul style="list-style-type: none"> [...] we will look at several stories from different organizations [...]all using Design Thinking tools and approaches 				
Procedural			DTOC: <ul style="list-style-type: none"> You will learn how to apply teamwork and communications skills DK: <ul style="list-style-type: none"> [...] equip you with the mind-sets and methods of human-centered design [...] inspire you to approach challenges differently [...] experience speaking to, prototyping for, and testing solutions with the people you're designing for 		DTOC: <ul style="list-style-type: none"> [...] will teach you how to evaluate ideas and concepts [...] 	
Metacognitive			DK: <ul style="list-style-type: none"> [...] identify patterns and opportunities for concept development 	DK: <ul style="list-style-type: none"> [...] experience how human-centered design can add new perspectives to your own work [...] 		

Seven Principles of Good Practice in Undergraduate Education

Based on research Chickering and Gamson (1987) defined seven principles on good teaching in undergraduate education. These principles are still relevant and being used to assure high quality teaching (Bali, 2014). According to Chickering and Gamson (1987), a good practice in undergraduate education contains the following attributes:

- Encouraging contact between the students and faculty
- Encouraging cooperation among the students
- Encouraging active learning
- Providing prompt feedback
- Emphasizing time on tasks
- Communicating high expectations
- Respecting and supporting diverse talents and ways of learning

Beyond their application in the context of traditional course design, these principles translate well into the MOOC environment and can guide course designers to create good instructional practices (Siemens and Tittenberger, 2009).

In discussing different attributes of MOOCs, it is important to define one's point of view (Bali, 2014). Since the authors are well experienced with applying, as well as teaching Design Thinking, taking the perspective of a new learner was not possible. Thus, following Nkuyubwatsi (2013), informed by our role as researchers and our experience with Design Thinking, we enrolled and observed, without fully participating in the three accessible courses, namely: DTOC, DK and DTBI. In each course, we tried different features and functionalities of the platform and engaged in adequate amount of learning activities to gain a thorough understanding of their pedagogies and instructional design. Although these courses shared a common topic, they vary in terms of their content and approach in teaching Design Thinking.

The course DK focuses on the application of Design Thinking in tackling challenges from the social sector. Although it is possible to take the course individually, the course providers highly recommend to form a team, either with colleagues and friends or joining the already existing teams.

On the other hand, DTBI and DTOC do not require teamwork. The course DTBI emphasizes the application of Design Thinking for innovation in business environment, as the selection of examples presented in the course as well the recommended readings imply.

Finally, the DTOC has a theoretical and historical approach in introducing Design Thinking, in that they allocate a significant part of the course to design theories and models.

In the following we will assess the extent to which each of the three courses has met the above mentioned principles and consequently shedding light on some of the attributes of these courses:

Regarding the first principle of encouraging student-faculty interaction, besides unidirectional weekly emails and video lectures, in DTOC there was very little interaction between students and instructors. Some answers to forum posts were occasionally signed as Macromedia MOOC Team, by a contributor who was not mentioned in the teaching team. Additionally, an email address for the course-related questions was provided, as well as a Facebook page with a number of uncommented posts. However, students were not actively

encouraged to utilize them. An invitation to a webinar with the course instructor on the topic of Design Management was announced in the last week of the course.

In DK the main content was provided through various readings and *workshop guides*, thus there are no instructors talking to the camera. These are complemented by short videos with practitioners sharing their experiences in using different tools and methods. The course providers were actively supporting participants in the forums through two roles of *Course Catalysts* (volunteers who are former participants) and the *Teaching Assistants*.

In DTBI apart from the weekly questions posed by the course providers to spark discussions in the forums, in the midst of the course there was an opportunity of one hour Google hangout, where the instructor answered several pre-compiled questions from the tweets and forums.

The second principle of developing reciprocity and encouraging cooperation among the students was hardly addressed in the DTOC. The discussion forum offered the space for informal cooperation, but it was not actively utilized. Formally, no teamwork and collaboration was required.

In DK there were various opportunities for interaction between students. The course highly recommended students to form teams and try to have physical meetings to prepare the assignments (*team workshops*) and tweet pictures of their team activities throughout the course. In addition, participants were encouraged to explore other submissions to contribute feedback and find inspirations for their own project. Moreover, there were a number of opportunities for in-person meetings in some cities.

The interaction between students did not go beyond the discussion forums in DTBI. Apart from course announcements, weekly additional emails provided updates on active discussion threads and encouraged course participants to join.

The third principle is encouraging active learning. The DTOC relied mostly on quizzes along some of the video lectures which required students to recall. In addition, some lessons posed open questions, which were optional for the students to answer. In order to gain a statement of participation, students were required to complete 80% of the course materials (including videos and quizzes).

The DK course required participants to apply their learnings to a design challenge and submit their results throughout the course. *Weekly workshop guides* provided teams with instructions on different activities and tasks. There were no quizzes and the statement of accomplishment was published upon completing course materials (readings and videos) and submitting all four assignments.

There were no quizzes or weekly assignments in the course DTBI either. However in order to gain a certificate of accomplishment, students were required to provide an example of how they applied at least two of the tools they learned from the course.

The fourth principle emphasizes the importance of providing prompt feedback. Despite the automatic feedback on the multiple-choice quizzes in DTOC, no hints were provided to improve a wrong answer. This was especially confusing in the case of open questions.

In DK, besides the voluntary peer review and feedback on the assignments, there were occasional comments from the course staff. However, not all submissions received comments and reviews.

The only option for providing feedback in DTBI was the final submission (for those interested in achieving a certificate), as there were no quizzes or assignments. The period

between the final submission deadline and the first news about the review status was about a week.

The fifth principle, emphasizing time on task was missing in the DTOC. There is a four-week course structure that participants are recommended to follow but it is not mandatory. For multiple-choice quizzes and open questions there were no given time constraints.

Similarly, the DK recommended soft deadlines to allow for those who joined late to catch up and be able to submit the assignments before the course closed. Two extra weeks in advance were allocated for the final submission. On the other hand the required time for *team workshops* was estimated about two hours and the *workshop guides* contained information about each task and the allocated time needed.

Finally, in the absence of quizzes and assignments in the DTBI, watching the weekly videos and reading the optional readings were the only time consuming tasks.

Regarding the sixth principle of communicating high expectations, the expectations were rather low in both DTOC and DTBI. In the case of DTOC, as most of the quizzes asked students to recall, the requirements for passing the course were not challenging. In DTBI, apart from the final optional assignment, there were no requirements or deadlines to be fulfilled during the course.

On the other hand the expectations for completing the DK course were rather high. Submitting four assignments required both time and team commitment. For each assignment students needed to complete the course materials and allocate two hours for the *team workshop*.

Finally, the last principle is respecting and supporting diverse talents and ways of learning. Beyond offering a set of standard features such as quizzes, video lectures and recommended readings, DTOC did not actively use multimedia to support diverse learning styles.

In DTBI, the subtitle feature and the option of downloading the lecture slides was helpful in supporting non-native speakers of the audience.

In DK a link to a Dropbox folder that included all the course materials in a single PDF format was provided, for those groups of participants with limited Internet access. Moreover regarding the course project, students had the freedom to choose from either the three pre-crafted design challenges by IDEO.org, or a design challenge from their own social context.

Conclusion

Comparing the retrieved learning objectives of the selected courses and the results of the participant observation, allows for evaluating the extent to which the expected objectives were supported by the practices used in these courses. It also demonstrates the existing variations in pedagogies across these courses. It is important to point out that not all courses need to incorporate all the principles by Chickering and Gamson. In other words the application of good practices depends on how they can support the expected learning objectives (Bali, 2014).

Despite the absence of assignments and peer interaction in the course DTBI, the instructional practices of the course match its primary goal of introducing the Design Thinking methodology and its application in real life, as the following statement extracted from the course suggests: 'In this course we will look at several stories from different organizations [...] all using Design Thinking tools and approaches to achieve better outcomes.'

The pedagogies of the course DK allows for seeking its goal of enabling students to apply their learnings to a real life design challenge. Thus, moving towards developing higher order thinking (*Apply*). The final submissions of the teams that demonstrates how they applied their learnings to their design project support this claim.

Finally, although the pedagogical approaches used in DTOC are suitable for introducing ‘...the fundamentals like historical and theoretical aspects of design, design models and design systems’ (retrieved from the course website), they fall short in fulfilling some of the expected objectives. For instance ‘learning how to apply teamwork and communications skills’ in a course where cooperation between students is not encouraged, seem hard to achieve.

As *Table 2* demonstrates, there is an emphasis on objectives requiring the skill of applying and carrying out a procedure. This implies that the focus is mostly on teaching the process steps of the Design Thinking methodology. Thus assignments, tasks and activities need to be incorporated that encourage students to apply their learnings. Moreover, learning a new skill to a level of applying it requires time and commitment. Although loose schedules and less demanding assignments might be appealing to busy adult learners, but communicating low expectations might also hinder the potential learning that one could get from the course (Bali, 2014).

The evaluation further highlights good practices that tap into some of the unique potentials of MOOC model of education. The lack of student-faculty interaction for instance, can be mitigated to some extent by engaging former students in the supporting team, as seen in the course DK. Due to the large number of participants in each iteration, course designers can form a strong support team in collaboration with many former students.

Furthermore, the massive nature of the MOOCs offers a great opportunity for encouraging cooperation among students (Stewart, 2013). Considering the fact that students conventionally learn Design Thinking through interaction and collaboration in interdisciplinary teams, having students from different countries and disciplines offers a great opportunity to course designers to tap into the potential of diversity (Lloyd, 2013). A course that puts student interaction in the center of the learning experience will allow for participants from different backgrounds and expertise to be involved in the problem solving process and collaborate on a design challenge.

Finally, reaching a global audience in an effective way, requires awareness of existing challenges and limitations in different parts of the world. In another word, MOOC designers need to think beyond their own context (e.g. video lectures with high resolution pose a challenge to those with limited internet access). Furthermore using global examples and incorporating stories beyond ‘Western World’ in a given course, will help to resonate with a broader audience (Bali, 2014).

Discussion

This paper has provided a pedagogical assessment of the selected Design Thinking MOOCs using both Taxonomy Table (Krathwohl, 2002) and the Seven Principles of Good Practice in Undergraduate Education (Chickering & Gamson, 1987). The following remarks emerged as a result of this work:

Firstly, in classifying the learning objectives of a given Design Thinking course using the Taxonomy Table, the terminologies of the process steps of Design Thinking should be taken

into close consideration. In other words, classification solely based on the verb and noun phrase will be misleading in this case.

Secondly, as Brown (2005) and Lloyd (2013) point out, there is a division between learning *about* and learning *to be*. However some objectives claimed by the above-mentioned courses aim for outcomes towards learning *to be* a Design Thinker. Achieving such objectives requires course designers to take a more project-based teaching approach and communicate higher expectations with the participants.

Although we limited our review of MOOCs on Design Thinking to courses taught in English, interestingly this resulted in dismissing only one course which was taught in French. This indicates that teaching Design Thinking in a MOOC environment has been taken up mainly by English courses and offers a huge potential for international educators to design courses in other languages, and thus reaching a more diverse audience.

Moreover it is important to highlight that the results of the keyword search varied among the four aggregators, which implies that they are not covering all courses.

As a first step of a broader research project, our review has several limitations. In our attempt to extract learning objectives of the selected courses, our sole source of information was the welcoming page of each course. The presented objectives were those claimed by the course providers on their web page. In order to evaluate the impact of these objectives on students' learning experience and their development of Design Thinking attributes, survey and in-depth interviews with participants are required as a next step. Thus, there shall be further collaboration with the course providers in the future.

Moreover, the pedagogical evaluation using the above mentioned frameworks was completed by two reviewers separately, followed by a discussion. To avoid the risk of a subjective categorization it is recommended to involve more reviewers and to measure the inter-rater reliability.

Despite the limited number of accessible MOOCs on Design Thinking found in this study, the authors believe that this is a positive movement in demystifying and introducing the potential of Design Thinking methodology to a broader audience.

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