

# Design Thinking Education: A Comparison of Massive Open Online Courses

**Abstract** The popularity of design thinking is soaring, both as an approach to innovation and as a tool for non-designers seeking to gain a strategic edge over the competition. As more and more people take advantage of Massive Open Online Courses (MOOCs) to bolster their skill sets, it comes as no surprise that design thinking courses have cropped up across various disciplines worldwide, in formal and informal educational settings. In this article, we report on our research into design thinking courses available to anyone online. Our study explored and categorized the different types of design thinking MOOCs available in June 2017. It reveals the what (content), how (pedagogy and assessment), and why of online design thinking courses. The findings we discuss here can support design thinking education not only via the web, but also more generally.

## Keywords

Design thinking  
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Design innovation

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## Introduction

In today's complex, connected digital age, individuals and organizations alike need new tools and skills – entrepreneurial, business, management, leadership, creativity, design, and cross-cultural capacities<sup>1</sup> – that will enable them to strategize and innovate sustainably. To meet the growing demand for such training, higher education providers have begun to make specialized online courses available to wider global audiences. Due to their flexibility, accessibility, and the breadth of subjects available, the popularity of these Massive Open Online Courses (MOOCs) has grown significantly over the last decade.<sup>2</sup> MOOCs are adding to the emergence of micro-credentialing, and enabling learners to supplement their degrees and professional practices with the skills that help them and their employers remain competitive in today's shifting international markets and societies.<sup>3</sup>

Creativity, design, cross-cultural sensitivity, and particularly design thinking are learned by tertiary students in the sciences, arts, business, and medicine alike.<sup>4</sup> Beyond this emphasis in higher education, employers are also focusing on proficiency in these areas among their employees. Organizations from the public and private sectors alike are increasingly turning to design thinking<sup>5</sup> to address wicked problems.<sup>6</sup> Recently, the notion of design thinking has shifted from design as a science<sup>7</sup> to design as a mindset and professional tool for non-designers to develop as a skill.

We need new learning approaches if we are to cultivate design thinking capability – and other twenty-first-century skills – in individuals whose expertise spans multiple disciplines and practices. New technologies have led to new platforms and outlets for online education of all kinds, including design.<sup>8</sup> In addition to face-to-face design thinking courses offered by higher education institutions, MOOCs are providing such content to a wider audience online.<sup>9</sup>

In this article, we will explore how educators are teaching design thinking online to a general and diverse audience. We found a broad range of design thinking MOOC applications. Seven key themes emerged, whose content and pedagogical approaches we will discuss and assess.

## Design Thinking Education

Design thinking has gained notoriety across various disciplines because its tools and methods are often associated with innovation.<sup>10</sup> Universities are increasingly incorporating design thinking into their curricula as a result.<sup>11</sup> Long-established components of any design discipline curriculum, design thinking courses are becoming common in business and management education.<sup>12</sup> Design thinking courses often ask cohorts of students from a variety of disciplines – engineering, social sciences, medicine, and education, for example – to solve real, complex problems using a human-centered design approach.<sup>13</sup> In addition to promoting transdisciplinary creative thinking and collaboration, enabling cross-disciplinarity among students can bridge specific gaps in knowledge.<sup>14</sup>

Cara Wrigley and Karla Straker's<sup>15</sup> study of undergraduate design thinking courses forms the foundation for their Educational Design Ladder, a scaffold for the design and progression of design thinking courses within a multidisciplinary context (Figure 1). The ladder reveals that, for design thinking to be successfully taught within higher education contexts across multiple disciplines, "design projects should involve authentic, hands-on tasks; possess clearly defined outcomes that allow for multiple solutions; promote student-centered, collaborative work and higher order thinking" as well as enable multiple design iterations.<sup>16</sup>

The undergraduate Educational Design Ladder demonstrates that the content and pedagogical stages of design thinking must progressively increase in

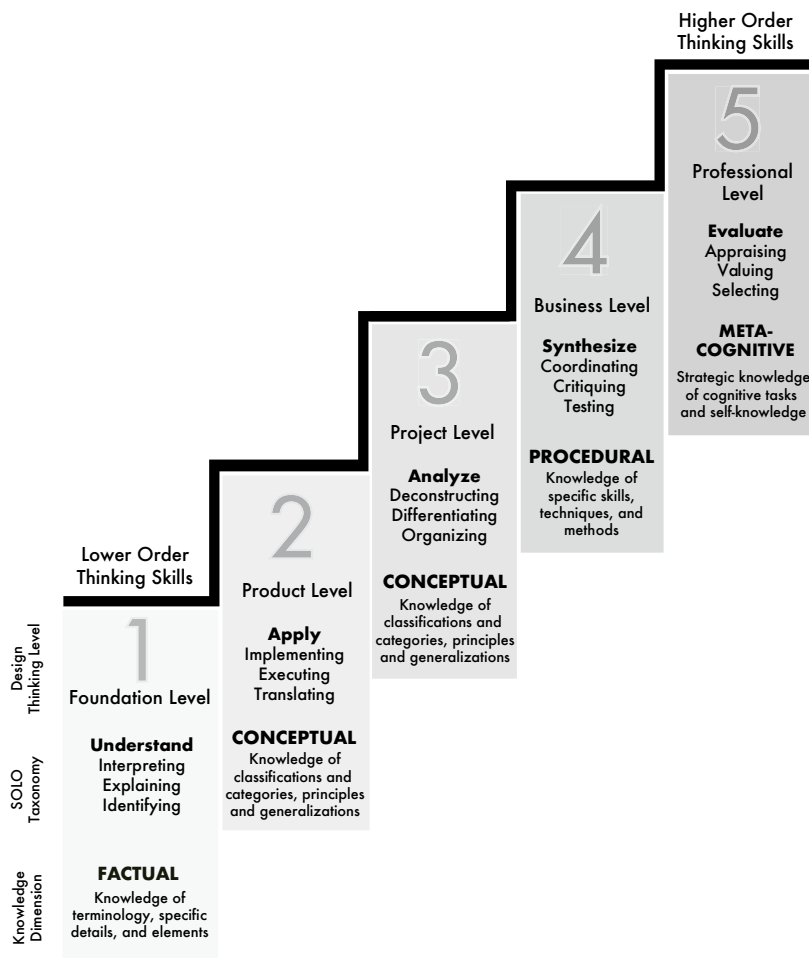


Figure 1 The Educational Design Ladder. Adapted from Wrigley and Straker, “Design Thinking Pedagogy,” 381. Copyright © 2017 Cara Wrigley and Karla Straker.

complexity – from lower order to higher order thinking skills, and from a foundational level of application to a professional one – for students’ notional understanding of design thinking and their practical skills to develop apace. Material begins with the basic product level and gradually moves through the project, business, and professional levels – with activities, subjects, learning modes, and assessment developing across each step. They state that pedagogy moves from lectures and tutorials, through to collaborative design projects, workshops, and studio classes on industry projects and work integrated learning.<sup>17</sup>

Design is predominantly taught through studio-based practice, which raises the question of how design thinking can be taught online and from a distance. Virtual design studios (VDS) emerged in the early 1990s, primarily for architectural design education.<sup>18</sup> A VDS is a networked design studio that allows students in various locations to “generate, communicate, and implement design ideas.”<sup>19</sup> In his study of VDS, Thomas Kvan<sup>20</sup> notes that teaching design online creates numerous opportunities to reconsider teaching methods traditionally employed in face-to-face settings, and allows instructors, teachers, and facilitators to develop and adapt to new ways of teaching and learning.

Ji-Yong Park suggests that for design education to be effective through an online platform, it needs to have “an integrated framework of design learning, including an interactive communication structure and learning evaluation.”<sup>21</sup> Along these lines, The Open University course “U101 Design Thinking: creativity for the 21st century”<sup>22</sup> is delivered as an online learning module that includes a VDS. As Peter Lloyd observes, the course enables diverse groups of students to acquire design thinking skills that “can be directly applied to a business context” as well as

9 Mana Taheri and Christoph Meinel, “Pedagogical Evaluation of the Design Thinking MOOCs,” in *Proceedings of the 3rd International Conference for Design Education Researchers*, vol. 1, ed. Robin Vande Zande, Erik Bohemia, and Ingvild Digranes (Aalto: Aalto University School of Arts, Design, and Architecture, 2015): 469–81, available at <http://www.cumulusassociation.org/learnxdesign-proceedings-of-the-3rd-international-conference-for-design-education-researchers/>; Mana Taheri, Thomas Unterholzer, and Christoph Meinel, “Design Thinking at Scale: A Report on Best Practice of Online Courses,” in *Design Thinking Research: Understanding Innovation*, ed. Hasso Plattner, Christoph Meinel, and Larry Leifer (Cham: Springer International Publishing, 2016), 217–35, DOI: [https://doi.org/10.1007/978-3-319-40382-3\\_13](https://doi.org/10.1007/978-3-319-40382-3_13).

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11 Judy Matthews and Cara Wrigley, “Design and Design Thinking in Business and Management Higher Education,” *Journal of Learning Design* 10, no. 1 (2017): 41–54, DOI: <https://doi.org/10.5204/jld.v9i3.294>; Gavin Melles, Zaana Howard, and Scott Thompson-Whiteside, “Teaching Design Thinking: Expanding Horizons in Design Education,” *Procedia—Social and Behavioural Sciences* 31, (2012): 162–66, DOI: <https://doi.org/10.1016/j.sbspro.2011.12.035>; Wrigley and Straker, “Design Thinking Pedagogy,” 374–85; Andrew Withell and Neil Haigh, “Developing Design Thinking Expertise in Higher Education,” in *Proceedings of the 2nd International Conference for Design Education Researchers*, ed. Janne Reitan et al. (Oslo: ABM Media, 2013), 1–8, available at <https://www.hioa.no/eng/About-HiOA/Faculty-of-Technology-Art-and-Design/DRS-CU-MULUS-Oslo-2013/DRS-CUMULUS-Oslo-2013-Proceedings>.

12 Matthews and Wrigley, “Design and Design Thinking,” 41–54.

13 Wrigley and Straker, “Design Thinking Pedagogy,” 374–85.

14 Rim Razzouk and Valerie Shute, “What is Design Thinking and Why Is It Important?,” *Review*

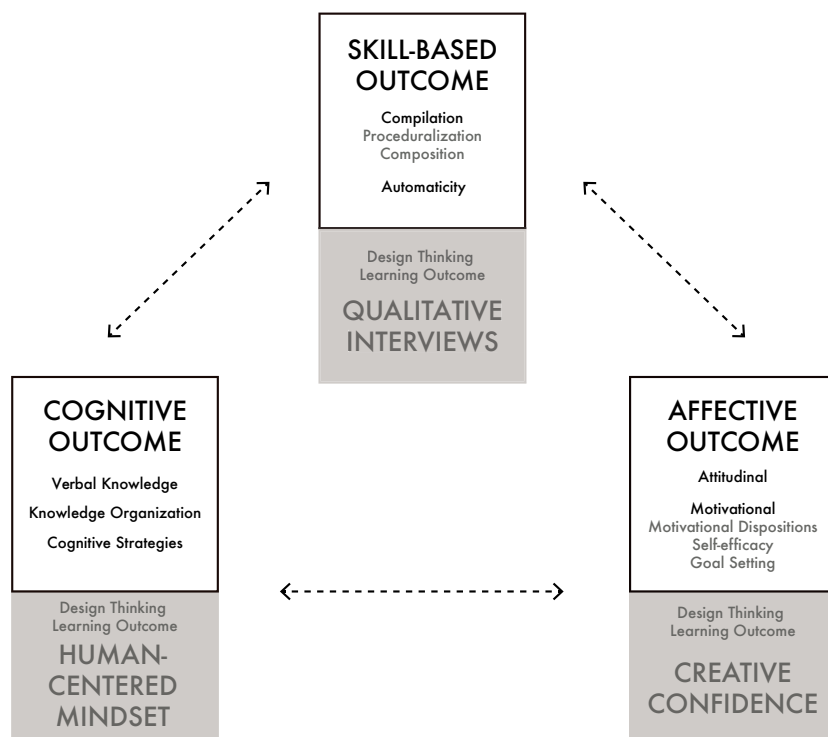
the wider world.<sup>23</sup> The potential benefit of teaching design thinking online, according to Lloyd, is that it facilitates interactivity and collaboration among a multi-disciplinary cohort.

Few scholars have explored the effectiveness of teaching design thinking in an online environment in depth. Mana Taheri and Christoph Meinel<sup>24</sup> chose four introductory-level design thinking MOOCs in their study of desirable learning objectives in design thinking education. Their aim was twofold: to evaluate how each course fulfilled an established pedagogical framework and to determine what specific educational and technological practices underpin best practice MOOCs.<sup>25</sup> To assess the four courses, Taheri and Meinel sought to determine whether each fulfilled Arthur Chickering and Zelda Gamson’s<sup>26</sup> seven principles for good practice in undergraduate education. These are 1) encourage contact between students and faculty; 2) foster cooperation between students; 3) promote active learning; 4) provide prompt feedback; 5) emphasize time on tasks; 6) communicate high expectations; and 7) respect and support diverse talents and ways of working. The scholars concluded that, although teaching design thinking online has its challenges, adhering to these seven principles will ensure that MOOCs will deliver a high standard of teaching and learning.

From this investigation, Mana Taheri and her colleagues developed a design thinking MOOC prototype to explore how design thinking can be taught online to a massive and diverse audience.<sup>27</sup> Applying Kurt Kraiger, Kevin Ford, and Eduardo Salas’s view on cognitive, skill-based affective learning outcomes<sup>28</sup> to specific design thinking outcomes such as creative confidence<sup>29</sup> or a design thinking mindset,<sup>30</sup> the scholars created a conceptual model for design thinking learning outcomes. They used this as the basis for their construction of a prototypical design thinking MOOC (Figure 2).

The prototype MOOC results revealed that incorporating exercises and peer-reviewed learning encouraged participants to transfer gained knowledge while also developing collaborative learning outcomes.<sup>31</sup> The results, however, do not explicitly state if MOOC participants achieved all three learning outcomes as highlighted in the conceptual model.

Figure 2 Conceptual Model of Design Thinking Outcomes. Adapted from Taheri et al., “The DT MOOC Prototype,” 220. Copyright © 2018 Cara Wrigley, Genevieve Mosely, and Martin Tomitsch.



## Massive Open Online Courses

In 2016, MOOC platforms had fifty-eight million students, with over seven hundred partner universities offering 6,580 courses.<sup>32</sup> MOOCs serve large numbers of students and provide a combination of open online courses, short video lectures, automated assessments, quizzes, peer and self-assessment, and student collaboration through forum discussions.<sup>33</sup> The University of Manitoba was the first to describe an open online course experiment utilizing connectivism as a “MOOC.”<sup>34</sup> The acronym was similar to other online platforms emerging at the time, such as Multi-User Dimensions (MUDs), MUD object-oriented (MOOs), and Massively Multiplayer Online Role-Playing Games (MMORPGs).<sup>35</sup> MOOCs enable individuals to participate in education, professional development, and upskilling at the time, pace, and place of their choice. As Rolin Moe states, MOOCs were envisioned as opportunities for learners to engage in “a unique geospatial environment of content and connections, a marked departure from the formalized and accredited nature of traditional higher education.”<sup>36</sup> MOOCs can be delivered using centralized platforms (Coursera, edX; learning management systems) and decentralized networks (blogs, social media) and are designed to supplement university courses, professional development modules, and corporate training programs.<sup>37</sup>

MOOC learning design and pedagogical strategies vary significantly. There are two main types: cMOOCs and xMOOCs.<sup>38</sup> cMOOCs are based on connectivist learning theory – learning experiences are designed to be networked, open, and decentralized, and the learner determines their objectives, processes, and outcomes.<sup>39</sup> xMOOCs are based on cognitive-behaviorist theory – learning is centrally controlled and instructor directed, designed, and structured. The majority of today’s MOOCs are based on xMOOC principles, as their modes of delivery typically follow a more traditional structure: all students enrolled move through the course together, and content is taught by experts in that field. But in recent years the format of MOOCs has shifted towards greater accessibility. MOOCs – originally modeled on university courses – used to follow semester timetabling and have assignment deadlines. As course providers learned more about online student behaviors, MOOCs have become more student centered by offering self-paced courses with soft assignment deadlines.<sup>40</sup> This kind of personalized learning experience has drawn more students to online courses. However, because students learn in smaller cohorts and at their own pace, the collective learning experience happening in online discussion forums and through peer assessments, for example, is also being impacted.

Students use MOOCs to attend video lectures, read texts, participate in discussion forums, complete quizzes, and perform peer assessments. Discussion forums play an essential role in MOOCs, as tutors do not provide ongoing support. Students, therefore, need to collaborate and learn through peer-to-peer information exchange and assessment.<sup>41</sup> Sandra Mulligan and Patrick Griffin’s<sup>42</sup> investigation into how students learn in MOOCs, and the implications of this for MOOC design, revealed that learners can be classified on a continuum from novice to expert, and that learners at each stage will have personal attitudes, knowledge, skills, and beliefs about learning.

To better understand more specific approaches to design thinking MOOCs, our study looks at which aspects of design thinking they teach, and how they deliver design thinking curricula on English speaking learning platforms worldwide. We also compare design thinking MOOCs with existing design thinking education frameworks and models.

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15 Wrigley and Straker, “Design Thinking Pedagogy,” 374–85.

16 Wrigley and Straker, “Design Thinking Pedagogy,” 383.

17 Ibid.

18 Jeremy J. Ham and Mark Aurel Schnabel, “Web 2.0 Virtual Design Studio: Social Networking as Facilitator of Design Education,” *Architectural Science Review* 54, no. 2 (2011): 108–16, DOI: <https://doi.org/10.1080/00038628.2011.582369>; Thomas Kvan, “The Pedagogy of Virtual Design Studios,” *Automation in Construction* 10, no. 3 (2001): 345–53, DOI: [https://doi.org/10.1016/S0926-5805\(00\)00051-0](https://doi.org/10.1016/S0926-5805(00)00051-0).

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20 Kvan, “The Pedagogy of Virtual Design Studios,” 345–53.

21 Ji Yong Park, “Design Education Online: Learning Delivery and Evaluation,” *International Journal of Art & Design Education* 30, no. 2 (2011): 185, DOI: <https://doi.org/10.1111/j.1476-8070.2011.01689.x>.

22 For more information, see <http://www.openuniversity.edu/courses/modules/u101>.

23 Peter Lloyd, “Embedded Creativity: Teaching Design Thinking via Distance Education,” *International Journal of Technology and Design Education* 23, no. 3 (2013): 764, DOI: <https://doi.org/10.1007/s10798-012-9214-8>.

24 Taheri and Meinel, “Pedagogical Evaluation,” 469–81.

25 Taheri, Unterholzer, and Meinel, “Design Thinking at Scale,” 217–35.

26 Arthur W. Chickering and Zelda F. Gamson, “Seven Principles for Good Practice in Undergraduate Education,” *AAHE Bulletin* 3, (1987): 7, available at <https://www.aahea.org/articles/sevenprinciples1987.htm>.

27 Mana Taheri, Lena Mayer, Karen von Schmieden, and Christoph Meinel, “The DT MOOC Prototype: Towards Teaching

Design Thinking at Scale,” in *Design Thinking Research: Making Distinctions: Collaboration versus Cooperation*, ed. Hasso Plattner, Christoph Meinel, and Larry Leifer (Cham: Springer International Publishing, 2018), 217, DOI: <https://doi.org/10.1007/978-3-319-60967-6>.

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30 Shelly Goldman et al., “Assessing d.learning: Capturing the Journey of Becoming a Design Thinker,” in *Design Thinking Research: Measuring Performance in Context*, ed. Hasso Plattner, Christoph Meinel, and Larry Leifer (Berlin, Heidelberg: Springer, 2018), 15, DOI: [https://doi.org/10.1007/978-3-642-31991-4\\_2](https://doi.org/10.1007/978-3-642-31991-4_2).

31 Ibid., 235.

32 Dhawal Shah, “By the Numbers: MOOCs in 2016,” *Class Central*, December 26, 2016, <https://www.class-central.com/report/mooc-stats-2016/>.

33 David G. Glance, Martin Forsey, and Myles Riley, “The Pedagogical Foundations of Massive Open Online Courses,” *First Monday* 18, no. 5-6 (2013), available at <http://firstmonday.org/article/view/4350/3673>.

34 Tony Bates, “MOOCs: Getting to Know You Better,” *Distance Education* 35, no. 2 (2014): 145–48, DOI: <https://doi.org/10.1080/01587919.2014.926803>; Rolin Moe, “The Brief & Expansive History (and Future) of the MOOC: Why Two Divergent Models Share the Same Name,” *Current Issues in Emerging eLearning* 2, no. 1 (2015): article 2, available at <https://scholarworks.umb.edu/ciee/vol2/iss1/2/>.

## Research Method

In this article, we identify and examine the design thinking related MOOCs available to the general public in June 2017. We chose an inductive content analysis approach,<sup>43</sup> given that we derived our understanding of what constitutes a design thinking MOOC from the data rather than the limited literature available.<sup>44</sup> Content analysis is “a research method for making replicable and valid inferences from data to their context” with the goal of developing concepts or categories that describe the phenomenon.<sup>45</sup> To determine the content and delivery structure of MOOC design thinking curricula, we searched Google, studied the content provided by two large online learning platforms (edX and Coursera), and explored an online directory of MOOC providers.

We used the Google search engine to identify the scope and range of design thinking courses available. Because this initial, exploratory search returned over seven thousand results, we refined our search terms to include “MOOC,” which produced results that fit our criteria more specifically. We then systematically searched the directories of the two largest online learning providers using the terms “design thinking,” “design innovation,” “human-centered design,” and “entrepreneurship” to identify design thinking MOOCs.

Table 1. List of design thinking MOOCs.

	Course name	Platform	Institution	Faculty
1	Design Thinking for Innovation	Coursera	The University of Virginia	Business
2	Design Thinking	Open Learn	Open University	-
3	Design Thinking online course	Iversity	Macromedia (2014)	Media & Communication
4	Design Thinking Guide for Successful Professionals	Udemy	-	-
5	Cooper Crash Course: Design Thinking in 3 Steps	Udemy	-	-
6	The Beginners Guide to Design Thinking	Udemy	-	-
7	Designing the Future	Future Learn	RMIT University	Design
8	(K-12) Design Thinking Hero: Creating Innovative Learning Design Solutions	Canvas Network	University of North Texas Health Science Centre (2016)	Center for Innovative Learning
9	Design Thinking: The Beginners Guide	Interaction Design Foundation	Interaction Design Foundation	-
10	Design Thinking Action Lab	Novo Ed	Stanford (2014)	Design
11	Part 1: Innovation and Entrepreneurship – From Basics to Open Innovation	Coursera	EIT Digital	Business
12	Thinking and Acting Like an Entrepreneur	edX	RWTH Aachen University	Business & Management

(Continued on next page...)

**Table 1.** (Continued)

Course name	Platform	Institution	Faculty
13 Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship	Coursera	University of Maryland, College Park	Enterprise Institute
14 Innovative and Enterprise	Future Learn	Loughborough University	Enterprise Education
15 Invention and Innovation: An Introduction	Future Learn	Open University	-
16 Problem Solving and Critical Thinking Skills	edX	Fullbridge, Inc.	Business & Management
17 Leadership through Design Innovation	Coursera	Northwestern University	Design
18 Design Leadership and Innovation	edX	Delft University of Technology	Industrial Design
19 Strategic Innovation Toolkit for Working Professionals	Coursera	Vanderbilt University	Management
20 Excel in Competitive Strategy and Organization	Coursera	Ludwig-Maximilians-Universität München	Management
21 Storytelling for Influence	IDEO	IDEO	Design
22 Leading for Creativity	IDEO	IDEO	Design
23 Customer-Centric Innovation	edX	RWTH Aachen University	Business and Management
24 Design for Humanity: A New Perspective on User Experience	Udemy	-	-
25 Insights for Innovation	IDEO	IDEO	Design
26 Human-Centered Design 201: Prototyping	+ Acumen	IDEO	Design
27 Innovation and Design for Global Grand Challenged	Coursera	Duke University	Innovation & Entrepreneurship
28 Social Impact Strategy: Tools for Entrepreneurs and Innovations	Coursera	University of Pennsylvania	Social Policy & Practice
29 Design Kit: The Course for Human-Centered Design	+ Acumen	IDEO	Design
30 Design Thinking for Leading and Learning	edX	MIT/Microsoft	Digital Learning
31 Design in the Classroom with Cooper Hewitt, Smithsonian Design Museum	edX	The Smithsonian Design Museum	Design
32 From Ideas to Action	IDEO	IDEO	Design
33 Designing for Experimentation to Enhance Digital Innovation	edX	Boston University	Computer Science
34 How to Design a Successful Business Model	edX	Delft University of Technology	Technology, Policy & Management
35 Strategy in the Age of Digital Disruption	INSEAD	INSEAD	Business

35 Moe, "The Brief & Expansive History," 6.

36 Ibid., 7.

37 Abram Anders, "Theories and Applications of Massive Open Online Courses (MOOCs): The Case for Hybrid Design," *International Review of Research in Open and Distributed Learning* 16, no. 6 (2015): 39–61, available at <https://doi.org/10.19173/irrodl.v16i6.2185>.

38 Ibid.

39 Anders, "Theories and Applications of Massive Open Online Courses (MOOCs)"; Moe, "Brief & Expansive History," 1–23; C. Osvaldo Rodriguez, "MOOCs and the AI-Stanford Like Courses: Two Successful and Distinct Course Formats for Massive Open Online Courses," *The European Journal of Open, Distance and E-Learning* 2012, no. 1 (2012), available at <http://www.eurodl.org/index.php?p=archives&year=2013&halfyear=2&article=516>; Osvaldo Rodriguez, "The Concept of Openness behind C and X-MOOCs (Massive Open Online Courses)," *Open Praxis* 5, no. 1 (2013): 67–73, available at <https://www.learn-tech-lib.org/p/130655/>.

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41 Tobias Hecking, Irene A. Chounta, and H. Ulrich Hoppe, "Role Modelling in MOOC Discussion Forums," *Journal of Learning Analytics* 4, no. 1 (2017): 85–116, DOI: <https://doi.org/10.18608/jla.2017.41.6>.

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In total, our search revealed thirty-five design thinking online courses delivered across twelve online learning platforms (Table 1). We mapped course descriptions to a predesigned data sheet to ensure data consistency and validity. The data sheet breaks down MOOC course offerings by learning platform; educational institution; course date and overview; target audience; subject and syllabus; outcome and assessment; and pedagogy and learning experience.

We collected all data electronically from third-party resources such as websites, online learning platforms, and publications. The course information available to prospective students differed from platform to platform. Coursera and edX provided a comprehensive overview of their courses – learning outcomes, week-by-week course content, time required by participants, and content delivery mode. Other platforms offered a brief synopsis of the course and what participants could expect in terms of time and effort. To ensure reliability, we collected course data from official learning platform websites and related documents exclusively. We then conducted a thematic analysis of the data to identify similarities and differences in courses and to code them into common themes and corresponding categories.<sup>46</sup> Coding involved identifying similarities and differences across the dataset and grouping together courses that reflected similar objects of interest,<sup>47</sup> which we then classified into distinct typologies.

## Results

Seven key themes emerged through our analysis of *what* (content) and how design thinking was taught online across a broad range of disciplines: 1) Introductory; 2) Start-ups; 3) Leadership and Implementation; 4) Human-Centered Design (HCD); 5) Social Innovation; 6) Design Education; and 7) Business Strategy Design. We discuss each of these themes in detail below.

### Introductory

The Introductory theme, comprising ten courses, was the most common of the seven by far (Table 2). Each of these courses addresses design thinking as a skill across multiple disciplines, covers a wide range of content, and offers a general overview of the practice, rather than going into depth. Introductory courses aim to do what they say – introduce design thinking and its application to a broad range of problems and contexts. All of them explore the design thinking process – sometimes characterized as empathize, define, ideate, and prototype – along with an introduction to core tools and methods, such as research, to understand problems.

*Design Thinking for Innovation* from The University of Virginia uses video content and readings to provide students with an overview of design thinking. The course offers a model containing key questions and tools to help students understand design thinking as a problem-solving approach. Similarly, Microsoft’s *Introduction to Design Thinking* on edX separates its introduction into four core modules – discovery, synthesis, prototype, and iteration – each containing instructional content, videos, quizzes, and projects. Macromedia University bases its *Design Thinking Online Course* on the theoretical understanding that human needs and experiences should drive innovation. Their course teaches design thinking as a strategic approach to stimulate innovation through the implementation of creative and human-centered techniques. The three Udemy courses in this theme separately teach students how to apply design thinking to generate innovative ideas, conduct user interviews, and turn ideas into prototypes, while Interactive Design Foundation’s *Design Thinking: The Beginners Guide* builds on this knowledge by teaching ethnographic and analysis methods that help students employ design thinking methods effectively. Stanford’s *Design Thinking Action Lab* focuses on the practical application of design thinking



through rapid prototyping. Design thinking is used as the framework to support innovative product, service, and organizational development.

Each of these introductory courses provides a general introduction to design thinking for those who may not have been exposed to it before and targets the general public (Table 2). Students are taught to use design thinking as a problem-solving approach, or as a means of uncovering innovative opportunities.

**Table 2. Introductory courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Design Thinking for Innovation</b> Coursera/Virginia	Beginner 4wks (5hrs)	Examine, understand, apply, use	Case studies, readings, videos, activities	Final assignment, reflection, peer reviews
<b>Design Thinking</b> Open Learn/Open University	Beginner 10hours	Investigate, initiate, develop, use, explain	Booklet (work through text and activities)	-
<b>Design Thinking Online Course</b> Iversity/Macromedia (2014)	Beginner 4wks (5hrs)	Apply, evaluate, explore	Video lectures, lesson units, slides, additional reading and tasks, case studies	-
<b>Design Thinking Guide for Successful Professionals</b> Udemy	Beginner 1.5hrs	Develop, demonstrate, break, experiment, foster, generate ideas	17 Lectures (1.5hrs), examples and stories	-
<b>Cooper Crash Course: Design Thinking in 3 Steps</b> Udemy	Beginner 2hrs	Apply, create, understand, guide, plan, make and use, identify, plan	55 lectures (2hrs), interactive coursework, real-life projects	-
<b>The Beginners Guide to Design Thinking</b> Udemy	Beginner 1.25hrs	Learn how, acquire	17 lectures (1.25hrs)	-
<b>Designing the Future</b> Future Learn/RMIT University (2014)	Beginner 5wks (2hrs)	Critically discuss, demonstrate, apply, reflect	-	-
<b>Design Thinking Hero: Creating Innovative Learning Design Solutions</b> Canvas Network (2014)	Beginner 4wks (4hrs)	Explore, examine, use	Instructor-led	-
<b>Design Thinking: The Beginners Guide</b> Interaction Design Foundation	Self-paced	Apply, make, initiate, employ, prototype	Case studies, videos, supporting material	-
<b>Design Thinking Action Lab</b> Novo Ed/Stanford (2014)	Beginner 4wks (1-5hrs)	Understand, define, generate, explore, apply, communicate	Google hangouts, short videos, activities	Weekly assignments

### **Start-ups**

Five courses had the Start-up theme, with a focus on entrepreneurship, innovation, and design thinking (Table 3). All Start-up themed courses were from business and management disciplines. Each MOOC teaches strategies for creating and bringing innovations to the market, demystifying the start-up process, and identifying and acting on innovative opportunities. In total, we placed seven courses in this group.

RWTH Aachen University's *Thinking and Acting like an Entrepreneur* seeks to develop an entrepreneurial mindset in students by teaching them how to identify and then exploit the commercial potential of novel business ideas. Through real-life case studies, online lectures, and tutorials, the course wants students to think like innovators by adopting design thinking methods. The University of Maryland's Coursera course, *Developing Innovative Ideas for New Companies* aims to assist aspiring

entrepreneurs to take new and innovative ideas and turn them into new companies through proven content, methods, and models for new venture opportunity assessment and analysis. UC Berkley Haas School of Business's two-part *Innovation and Entrepreneurship* course for Master's students focuses on design thinking, open innovation, and new business models. Through an interactive textbook that includes videos, quizzes, and projects, the courses aim to teach students to think like entrepreneurs with the help of dedicated models, tools, and frameworks. Both Loughborough University's *Innovation and Enterprise* and Open University's *Invention and Innovation: An Introduction* aim to create a model for innovation, help students understand why innovation is important, and offer practical applications, including ways to turn ideas into new products or services.

All of these courses explore and present design thinking as a problem-solving approach to innovation, invention, and entrepreneurship. Practical methods, targeted at audiences from professionals to beginners, are designed to help them recognize potential opportunities and implement innovative ideas.

**Table 3. Start-up courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Part 1: Innovation &amp; Entrepreneurship – From Basics to Open Innovation</b> Coursera/EIT Digital	Masters Level 6wks	Define, discuss, develop, analyze, understand	Web lectures, readings, discussion board	Assignments, weekly quizzes, exam
<b>Thinking &amp; Acting like an Entrepreneur</b> edX/RWTH Aachen University	Intermediate 6wks (6–8hrs)	Understand, explore, profile, gain insights, introduce	Online lectures, homework exercises, tutorials	-
<b>Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship</b> Coursera/University of Maryland, College Park	Beginner 4wks (3–5hrs)	Identify, enhance, build, improve, analyze, evaluate	Videos, readings, discussion board	Assignments, weekly quizzes
<b>Innovation and Enterprise</b> Future Learn/Loughborough University	Beginner 4wks (4hrs)	Look at	-	-
<b>Invention and Innovation: an introduction</b> Future Learn/Open University	Advanced 55hrs	Explain, define, identify, understand	Booklet (texts + activities)	Self-assessment questions

### **Leadership and Implementation**

The Leadership and Implementation theme included seven courses (Table 4). This theme suggests that professionals looking to upskill for leadership positions turn to MOOCs as they may not have the time for further postgraduate study. These courses aim to develop design thinking and innovation capacity as skills so that professionals can create value by implementing practical tools and methods. The four university-developed MOOCs target intermediate and advanced level students, whereas the three industry-based courses are for all levels. Delft University of Technology's *Leadership through Design Innovation* focuses specifically on developing the necessary skills for strategic designers to take a leadership role in their companies and move beyond product and service design. The course aims to increase the student's ability to become an innovative leader who creates impact beyond the core design work behind new products within their organization. Coursework focuses on tools and processes that demonstrate how design practices can be used

to have a more comprehensive operational impact within an organization. Northwestern's *Leadership through Design Innovation* was created for professionals working in a variety of industries. Students learn to apply human-centered design approaches to real-world problems, which improves their ability to drive innovation inside their organizations. Similarly, Fullbridge's edX *Problem Solving and Critical Thinking Skills* course, which forms part of their career development series, aims to cultivate design thinking skills, teaches problem solving techniques, and offers practice in effective research methods, all of which serve to enhance leadership skills and contribute to professional development. Vanderbilt University's *Strategic Innovation Toolkit for Working Professionals* teaches students to better harness creative ideas by identifying organizational barriers to innovation, and overcoming potential individual, organizational, industrial, societal, and technological constraints. The two industry-based courses from IDEO, *Storytelling for Influence* and *Leading for Creativity*, are designed for professionals to build skills to help create impact within their organization. Both courses focus on the real-world implementation of skills.

**Table 4. Leadership and implementation courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Problem Solving and Critical Thinking Skills</b> edX/Fullbridge	Beginner 4wks (1-2hrs)	Demonstrate, develop, identify, use, plan, design, build	Videos, discussion board	Final assessment
<b>Leadership Through Design Innovation</b> Coursera/ Northwestern University	Intermediate 4wks (3-4hrs)	Engage, explore, identify, discuss	Videos, projects, quizzes	Design brief
<b>Design Leadership and Innovation</b> edX/Delft	Advanced 4wks (3-4hrs)	Learn how, practice, understand, identify, create, utilize	Short lectures, practical exercises, webinar, individualized feedback	-
<b>Strategic Innovation Toolkit for Working Professionals</b> Coursera/Vanderbilt University	Intermediate 4wks (3-4hrs)	Generate, assess, implement, build, lead, recognize, develop, manage	Videos, discussion board, readings, case studies, interactive exercises	Weekly quizzes, final assignment
<b>Excel in Competitive Strategy &amp; Organization</b> Coursera/Ludwig-Maximilians-Universität München (LMU)	Intermediate 4 courses of varying length and duration	Understand and analyze	Videos, readings, discussion board	Weekly quizzes, projects
<b>Storytelling for Influence</b> IDEO	Beginner 6wks (2-4hrs)	Develop, identify, build, explore, craft (create, design), practice, prototype	Videos, case studies, practical activities, discussion board	Final assignment - presentation
<b>Leading for Creativity</b> IDEO	Beginner 6wks (2-4hrs)	Practice, explore	Videos, case studies, practical exercises, discussion board	Lesson based assignments

### **Human-Centered Design**

Human-Centered Design courses focus on increasing innovation in businesses by focusing on understanding customer needs and user experiences (Table 5). These courses focus on gaining deep customer insights through interview techniques, concept testing, identifying opportunities, synthesizing user and market research, rapid experimentation, and testing prototypes with users. The courses also cover theories and models of innovation and the development of design process skills. These

courses are predominately targeted at beginners, with the exception of one university course offered by RWTH Aachen University, which is targeted to advanced level professionals. RWTH Aachen's edX course *Customer-Centric Innovation* focuses on the development of different approaches to market research and customer co-creation. This course is focused on creating innovative ideas through understanding real customer needs. Similarly, *Insights for Innovation* (IDEO) and *Design for Humanity* (Udemy) aim to build new design skills that generate insights and challenge previous ways of working through framework implementation and using toolkits. Both of these courses encourage students to meet face-to-face with other course participants (where physically possible) to discuss and debate course content. *Human-Centered Design 201: Prototyping* (+Acumen) builds on design skillsets and knowledge base by focusing on prototyping as the design process stage where ideas can be quickly developed and tested. These courses focus on helping students develop attitudes and dispositions towards design as a practice that can meet the real needs of users and challenge existing biases.

**Table 5. Human-Centered Design courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Customer-Centric Innovation</b> edX/ RWTH Aachen University	Advanced 6wks (6–8hrs)	Evaluate, experiment, explain, understand, identify, apply, review	Online lectures, individual and group exercises, real-life case studies and examples, discussions	Capstone exam
<b>Design for Humanity: A New Perspective on User Experience</b> Udemy	Beginner 4hrs	Understand, challenge, improve, stress test	37 lectures (4hours), practical exercises	-
<b>Insights for Innovation</b> IDEO	Beginner 6wks (1–4hrs)	Discover, conduct interviews, craft (create, design), practice	Interactive videos, interactive activities, project challenges, discussion board, feedback	-
<b>Human-Centered Design 201: Prototyping</b> +Acumen/IDEO	Beginner 4wks (5hrs)	Practice, experiment, demonstrate, prototype, test, build, plan	Project-based coursework, reading guides, workshop guides, videos, supplemental resources	Feedback

### **Social Innovation**

Design thinking online courses in the Social Innovation theme focus on social entrepreneurship and solving public and development problems (Table 6). Courses in this category may draw on methods from another category in the context of social challenges. The aim of each of these courses is to create innovative solutions to real-world problems through addressing conservation and development challenges by providing development ideas and tools that enable students to become change-makers and helping them develop the skills they need to create a business model and launch a social impact organization. Each of the three courses in this theme targets participants with a beginner level of experience. Duke University's *Innovation and Design for Global Challenges* aims to use design as a general framework for addressing global grand challenges by implementing new technologies, generating open source innovations, and developing entrepreneurial skills. *Design Kit: The Course for Human-Centered Design* introduces HCD as a problem-solving approach for social innovation. The course teaches four HCD process steps – inspiration, ideation, prototyping, and implementation – through reading, workshop guides, and videos. The University of Pennsylvania course entitled *Social Impact Strategy: Tools for*

*Entrepreneurship and Innovators* focuses on social entrepreneurship and using design thinking as a process to build empathy and identify valuable insights. In this particular course, design is taught as the second step in a four-phase approach to solving complex social problems.

**Table 6. Social Innovation courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Innovation and Design for Global Grand Challenges</b> Coursera/Duke University	Beginner 5wks (8–10hrs)	Review, examine, apply	Videos (lectures, interviews), readings, discussion board	Weekly quizzes, projects
<b>Social Impact Strategy: Tools for Entrepreneurs and Innovators</b> Coursera/University of Pennsylvania	Beginner 4wks (2–4hrs)	Develop, test, assess, apply, explore	Videos, readings, discussion board	Quiz
<b>Design Kit: The Course for Human-Centered Design</b> Acumen/IDEO	Beginner 9wks (4–5hrs)	Apply, build, synthesize, practice, learn how	Reading guides, workshop guides, videos, supplemental resources	Activity, discussion, reflection

### Design Education

Both courses in this theme are specific to the profession of teaching and using design thinking to transform classroom learning and school communities (Table 7). These courses address why design thinking is essential for the classroom and how it can be incorporated into lesson plans and used to drive change and develop strategies for improving schools and systems. These courses promote design thinking as a way to develop creative, innovative, problem-solving skills in K-12 students. The joint MIT/Microsoft course called *Design Thinking for Teaching and Learning* introduces design thinking to teachers and education leaders as a twenty-first-century skill for any student. Participants learn how to teach design thinking in ways that encourage creativity, problem solving, and communication skills in their students. This course gives its students – who are encouraged to meet in real life – hands-on design challenges that demonstrate the potential of design thinking in an educational setting in both the classroom and the wider school community. Similarly, The Smithsonian Institution’s *Design in the Classroom* aims to teach teachers how to use design thinking in the classroom and solve local community problems. The course focuses on developing an understanding of design thinking and why it is useful for the classroom, and then moves on to practical application and the development of a design process lesson plan.

**Table 7. Design Education courses: pedagogy and assessment.**

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>Design Thinking for Leading and Learning</b> edX/MIT Microsoft	Intermediate 6wks (2hrs)	Apply imagine, understand, explore, use, identify, plan, implement, reflect	Videos, assignments, forum interactions, readings, group work, real-world examples	Assignments, apply design thinking process to an everyday problem, create lesson plan and reflection, explore a challenge and imagine new solutions
<b>Design in the Classroom with Cooper Hewitt, Smithsonian Design Museum</b> edX/The Smithsonian Institution	Beginner 5wks (1–2hrs)	Define, identify, create, evaluate, assist, analyze, apply	Videos, text pages, discussion questions, case studies, readings, discussion board	Unit activity checklists, design solution challenge, prototyping and presenting solutions, create a design-based lesson plan

### Business Strategy Design

The four courses in this theme are highly specialized – the focus is on business innovation (Table 8). Delft University of Technology’s *How to Design a Successful Business Model* takes students through the key stages in the process of business model design. The course specifically focuses on design thinking and creating value for customers as the foundations for developing simple, complex, and multisided business models. INSEAD’s *Strategy in the Age of Digital Disruption* introduces strategic tools, concepts, and perspectives that enable individuals to respond to digital disruption and leverage it for future growth. Similarly, *Designing for Experimentation to Enhance Digital Business Innovation* (Boston University) focuses on design as enabling business model experimentation to enhance object and service oriented design. These courses aim to develop targeted understanding and skills related to design process implementation, technical infrastructure building, digital strategy creation, business model development, and customer value creation.

Table 8. Business Strategy courses: pedagogy and assessment.

Course	Level, duration, hours per week	Learning objectives	Learning modes	Assessment
<b>From Ideas to Action</b> IDEO	Beginner 6wks (2–4hrs)	Create, generate ideas, develop, apply	Live office hours, video lessons, interaction with global community, toolkits, feedback	Weekly activities and assignments, final project
<b>Designing for Experimentation to Enhance Digital Business Innovation</b> edX/Boston University	Advanced 6wks (3–5hrs)	Experiment, learn how, use	-	-
<b>How to Design a Successful Business Model</b> edX /Delft University of Technology	Self-paced	Design, present, reason, select, review	Videos, readings, discussion forum, activities	Quizzes, case study assignments, self-reflection
<b>Strategy in the Age of Digital Disruption</b> INSEAD	Beginner 5wks (2–4hr)	Understand, leverage, execute	Videos, examples, case studies	-

48 Wrigley and Straker, “Design Thinking Pedagogy,” 374–85.

### Discussion

The seven themes we present above offer you an overview of the various topics and teaching and learning practices used in design thinking MOOCs. These typologies demonstrate that, within general education, design thinking has an ever-growing range of applications and can be used to address small-scale, everyday, operational problems as well as complex social and global challenges.

While the plethora of design thinking MOOCs all attempt to contribute to the design literacy of the general public, there still exists the question of whether an online environment can provide the same quality of learning as a physical context. When we applied the results of our analysis to Wrigley and Straker’s Educational Design Ladder,<sup>48</sup> we found that the themes indicate a clear progression of design thinking content, moving from the foundational, introductory level through to the professional level (Figure 3). The Educational Design Ladder demonstrates that learners are better able to apply design thinking to a range of different contexts when they learn it *progressively*, through levels of increasingly mature concepts and applications. When we look at the current, publicly-available design thinking MOOCs, this progression appears to take place in five steps.

- Step one (foundation level): This step introduces students to design thinking. MOOCs define design and teach idea generation, design thinking process implementation, prototyping, and research methods.
- Step two (product level): The focus in this step is on human-centered design principles. The connection of theory and practice in these courses develops students' ability to synthesize user research; experiment; and implement processes, concepts, and methods to design products, services, interactions, and environments.
- Step three (project level): This step applies design thinking to complex social problems and the variety of factors that influence them.
- Step four (business level): Design thinking is applied to competitive strategy, organization design, business model development, and innovation strategy.
- Step five (professional level): Design thinking in this step is a professional skill set for use in business innovation and strategy development.

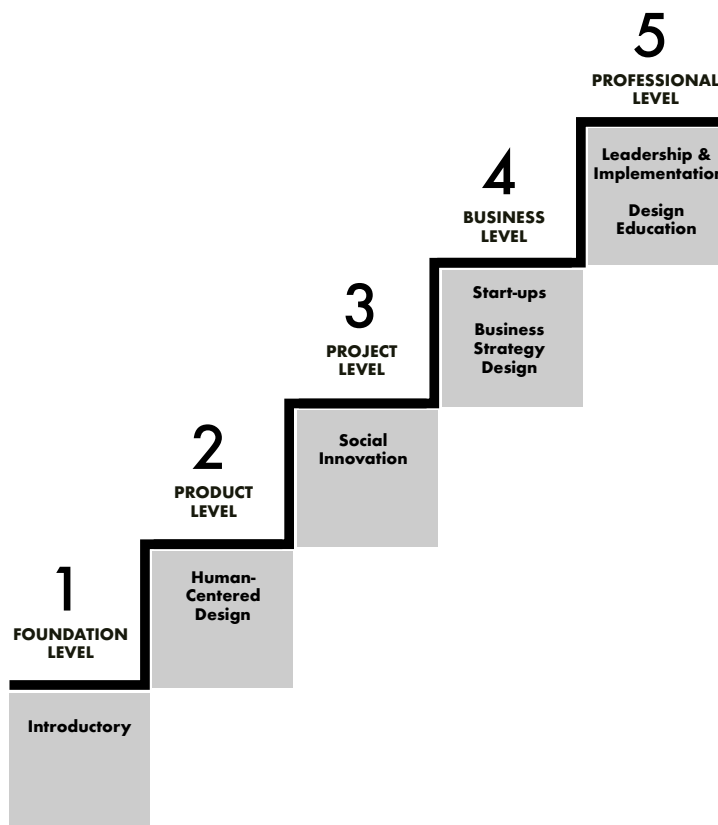


Figure 3 Design thinking MOOC themes mapped to the Educational Design Ladder. Adapted from Wrigley and Straker, "Design Thinking Pedagogy," 380. Copyright © 2018 Cara Wrigley, Genevieve Mosely, and Martin Tomitsch.

49 Wrigley and Straker, "Design Thinking Pedagogy," 374–85.

50 Taheri et al., "The DT MOOC Prototype," 236.

51 Mahmoud Reza Saghafi, Jill Franz, and Philip Crowther, "A Holistic Model for Blended Learning," *Journal of Interactive Learning Research* 25, no. 4 (2014): 531–49.

However, when we examined the pedagogical progression *within* each course, we found that they do not, in fact, move from teaching lower order thinking to higher order thinking skills. Each MOOC introduces students to design thinking and allows students to gain the knowledge and skills to apply design thinking to a range of different contexts and projects, yet MOOCs in all the themes cover some form of foundational knowledge and introduction to design thinking principles and practices. This raises the question of the effectiveness of design thinking MOOCs. If the content of the MOOC doesn't match the pedagogical approach, how useful is it for the student?

Table 9 highlights the apparent disparity between the level targeted by a course, time spent completing it, and the anticipated level of understanding gained during it.<sup>49</sup> A good example is the Introductory theme. *Copper's Crash Course: Design Thinking in 3 Steps* on Udemy, for example, is an entry-level content course with 1.5 hours of video content. But students are required to make, use, plan, and create during the course, which implies knowledge synthesis and skills acquisition that can be tested and critiqued. In the Start-ups theme, three courses – ranging from beginner, to intermediate and Master's level – all share the same level of pedagogical analysis. Our analysis revealed a mismatch between the MOOCs use of specific learning objectives when describing learning outcomes and assessment practices and their ability to teach design thinking to that level using the learning modes stated. Further analysis is needed to uncover and examine whether MOOCs at each level develop and test the skills they describe. Our study raises two critical questions: Can design thinking be effectively taught online? And, can MOOCs replace classroom environments? Our analysis led us to conclude that based on the limited amount of time that participants engage with the MOOC, they will only develop basic skills and understandings. The application of design thinking is not universal – it differs according to context. What are useful frameworks and processes for one context will not be applicable in another. As Taheri and her colleagues suggest, MOOCs can be used to bridge the gap between real life and online learning.<sup>50</sup> Design thinking MOOCs could be used as introductions to broader design thinking programs, by offering students fundamental tenets, tools, and case studies. However, for students to learn to apply that theory within a professional and practical context, they will likely need to be in a (design) studio classroom environment that has an expert facilitator and the possibility of peer support.

Learning design thinking requires an understanding of its theoretical concepts and techniques *and* their practical application to real-world problems. Learning the theory takes time, and learning to apply the theory critically and creatively also takes time. Each of the courses we have included in this study provides a theoretical understanding of design thinking. But the quality of the learning experience they afford remains unclear, as does whether students' learning experiences match the stated learning outcomes. Moreover, even though all the MOOCs we analyzed list discussion boards as one of their learning platforms, students' ability to develop social connections and learn collaboratively from their peers in the online environment is limited, especially compared to face-to-face design studio settings.<sup>51</sup>

Despite this, design thinking MOOCs do provide access to and promote design to a broad audience. Even though they teach design thinking differently, they still manage to effectively introduce the concept, which then allows students to investigate design thinking further through face-to-face programs that enable them to develop a higher level of thinking.



**Table 9. Design thinking MOOCs: typologies/pedagogy content mapped to Educational Design Ladder.**

	1	2	3	4	5
	Foundation Level	Product Level	Project Level	Business Level	Professional Level
Typology	<i>Understand</i>	<i>Apply</i>	<i>Analyze</i>	<i>Synthesize</i>	<i>Evaluate</i>
	Interpreting	Implementing	Deconstructing	Coordinating	Appraising
	Explaining	Executing	Differentiating	Critiquing	Valuing
	Identifying	Translating	Organizing	Testing	Selecting
Introductory	x	x	x	x	
Human-Centered Design				x	x
Social Innovation		x	x		
Start-ups	x	x	x		
Business Strategy Design	x	x	x		x
Design Education				x	
Leadership & Implementation			x	x	

### Summary and Avenues for Future Research

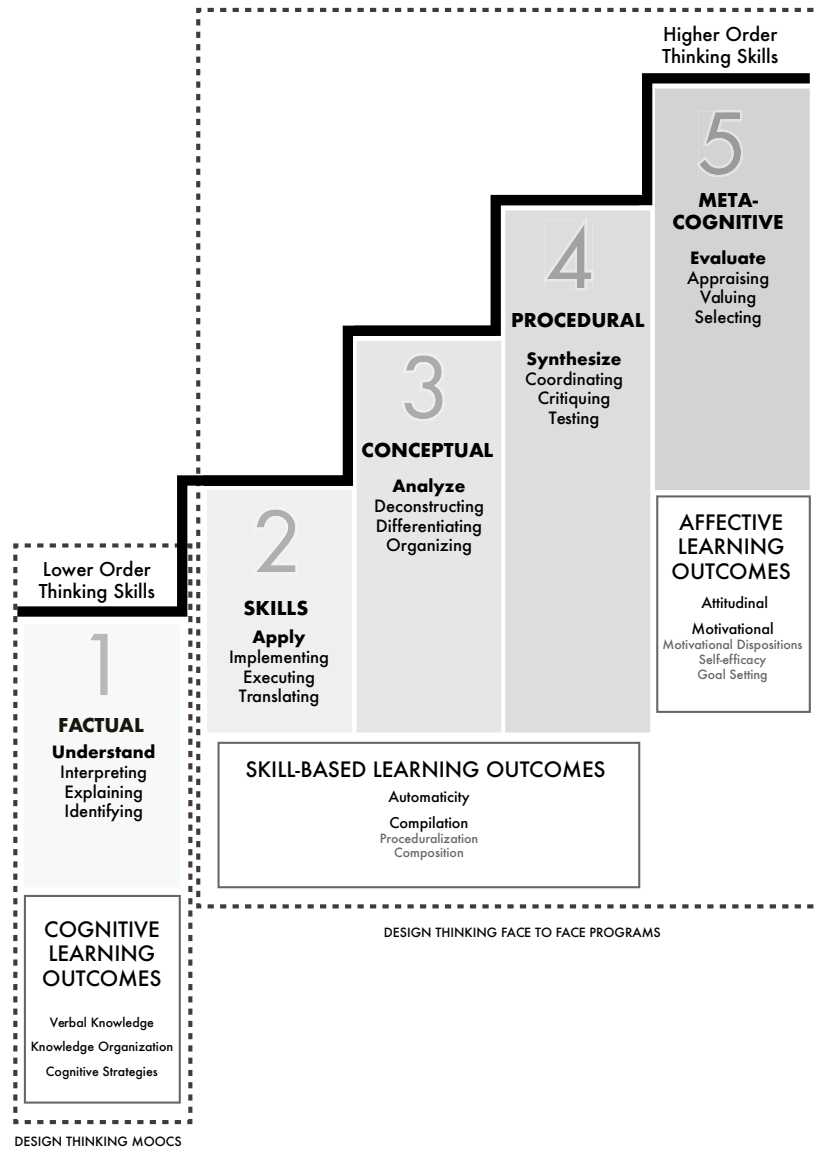
The Design Education Ladder model demonstrates that for a design program to educate students effectively – meaning that students learn theory and gain practical experience and insight – its content must progress in difficulty from lower order thinking and basic skills development to higher-order, independent practices and applications. Our research here shows that while the design thinking MOOCs available on the Internet today do offer content that progresses from lower to higher orders of design thinking application, the content they provide individually does not move students consistently from lower levels of understanding and knowledge application to higher ones. Not only do nearly all contain some elements of general theory, the outcomes that most promise to deliver are not supported by the educational material and practical experience they provide. On the whole, the knowledge that students might gain through one of these courses will probably not match the refined understanding of design thinking they would achieve during the course of an undergraduate or master’s degree program.

MOOCs seem to act as standalone courses – they introduce or supplement other forms of learning and practice. In terms of their usefulness – the *why* of their offerings – and given the number and variety of courses available, universities could assign existing MOOCs to students enrolled in higher education programs to establish fundamental or pre-requisite levels of knowledge. Another possibility is for universities to develop their own MOOCs that present and teach the basics of their degree programs to prospective and current students.

We argue that to effectively transmit design thinking theory and capability to students, content delivery, skills acquisition, and assessment should take place primarily face-to-face. The danger of relying solely on MOOCs to teach design thinking is that once a course is completed, students’ notion of design thinking (theory and practice) may stop evolving and will never reach the level of maturity they need to implement their ideas successfully.

Many of the MOOCs we analyzed in this study offered content that does not evolve from lower to higher orders of thinking and practice. MOOCs in other disciplines – computer science, for example – do offer introductory courses introducing key concepts and skills that students use in intermediate and advanced courses. Is

Figure 4 Design Thinking Educational Outcomes Ladder. Copyright © 2018 Cara Wrigley, Genevieve Mosely, and Martin Tomitsch.



52 Developed based on Wrigley & Straker “Design Thinking Pedagogy,” 381; and Taheri et al., “The DT MOOC Prototype,” 220.

this structure something that design thinking MOOCs should aim to address and follow? Would this kind of evolution in MOOC content complexity lead to more effective teaching and learning outcomes? Preliminary design thinking MOOCs could introduce students to design thinking concepts at a basic level, and face-to-face modules could assess how well students have integrated what they learned by offering practical skills application. To illustrate, Figure 4 shows a recalibrated Design Thinking Educational Ladder<sup>52</sup> that includes a MOOC stage and a progression of face-to-face practical phases.

One limitation of our study is that we used secondary data sources, and restricted our research to a short period of time. Further limitations were that we limited the scope of our research to English-language courses and only analyzed publicly-available MOOCs. While our study is able to provide a broad overview, there is potential for future research to uncover the relationship and use of MOOCs within various university courses, including their degrees of success. Researchers must also complete each MOOC within each typology along the ladder to determine whether it is possible to meet the outcome criteria. Furthermore, data related to enrollment, attendance, and retention rates, as well as student feedback, could assist researchers wishing to assess the quality of teaching and learning outcomes in design thinking MOOCs, including their success achieving their intended purpose.