Instructional Quality and Learning Design of Massive Open Online Courses

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Abstract

This chapter analyzes the instructional quality and learning design of different categories of online courses and their history, with a special focus on massive open online courses (MOOCs). Online courses have a long tradition that has gained public attention, broad interest, and huge numbers of participants thanks to the introduction of free MOOCs accessible online for all interested learners worldwide. In this chapter, we first define MOOCs, their characteristics, and history. Afterward, theoretical frameworks and practical instruments and tools based on scientific research are presented. From the beginning, the quality of MOOCs (and of online courses in general) has been debated. That led to

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discussions about the learning design and outcomes of MOOCs, which we introduce in the next section. Key research findings and practical validated instruments for designing and evaluating MOOCs (and online courses in general) are presented. Then following, the key benefits of MOOCs and the main arguments and scenarios for their usage are summarized. Based on our analysis of the research results, practices, and standards, a framework for categories and types of (massive open) online courses is proposed, called the typologies of online courses (TOC) framework. As part of the global community for open educational resources (OER) and in combination with the UNESCO recommendation on OER, MOOCs can play a significant role in achieving the SDG4 of the United Nations: inclusive and equitable quality education for all. This is true in particular during times of public lockdowns, such as during the ongoing COVID-19 pandemic.

Keywords

Digital learning and open education · Typologies of online courses framework · Educational impact and evaluation · Open educational resources (OER) · United Nations SDG4 (inclusive and equity quality education for all) · COVID-19 pandemic and new normal · Emergency remote education

Introduction

The world, educational systems, and all individual learners have globally experienced a dramatic interruption and changes due to the COVID-19 outbreak (Stracke et al., 2022a; WHO, 2020). The pandemic represented a threat to daily life and all communities and societies, which was caused in particular by lockdowns (UNESCO, 2020, 2021). The consequences for educational opportunities were severe, including for higher-education institutions without any digital expertise and infrastructure (OECD, 2021a, 2021b; UNESCO et al., 2020, 2021; United Nations, 2020; UNICEF & The World Bank, 2020, 2021). Currently, research has started to analyze this impact and offered solutions for different regions and countries (Stracke et al., 2021, 2022). From one day to another, digital learning became the "new normal" during the lockdowns, and educators, learners, parents, and policymakers have necessarily made unexpected adjustments and experienced new ways of teaching/learning, often for the first time.

Online courses can provide an answer in these difficult situations to continue the right of education for all. However, their learning design has to be carefully developed to be different from face-to-face education in order to achieve high instructional quality (Bozkurt & Stracke, 2022). This chapter analyzes the specific pedagogical and design requirements for massive open online courses (MOOCs) as a particular type of online course. In addition, we discuss these principles/requirements, online platforms, and the relevant standards in a broad way to be applicable

for online courses in general, as there are no specific platforms or standards for MOOCs.

After these discussions, we synthesize our findings into the typologies of online courses (TOC) framework and discuss identified benefits of MOOCs and the reasons for believing that MOOCs (and online courses in general) can strongly contribute to achieving the sustainable development goals (SDG) of the United Nations (2015) and in particular SDG4: "[e]nsure inclusive and equitable quality education and promote lifelong learning opportunities for all."

History and Characteristics of MOOCs

The term MOOCs originated in Canada and was first coined in 2008 by Dave Cormier and Bryan Alexander, describing an open online course "Connectivism and Connective Knowledge" at the University of Manitoba. This course was designed by Stephen Downes and George Siemens and was provided to 25 fee-paying students on campus and to 2300 other students from the general public free of charges (Daniel, 2012; deWaard, 2011; Siemens, 2013). The course content was provided through RSS feeds. The concept "all-at-onceness" was used to describe the complexity of MOOCs, implying the use of platforms and social networks, such as Moodle, Skype, Twitter, blogs, and chatrooms, for the distribution of knowledge and learning (Koutropoulos & Hogue, 2012; Levy, 2011).

MOOCs did not receive much attention between 2008 and 2011 (Stracke & Bozkurt, 2019), but this changed when the Stanford University course "Introduction to Artificial Intelligence" was provided. This course, taught by Sebastian Thrun and Peter Norvig, was considered the first successful MOOC, with more than 160,000 people around the world signing up to learn together through a learning management system. Students at the university and online thus had the same content and assessment materials, regardless of prior knowledge, collegiate experience, or socioeconomic status (Cheal, 2013).

After their success, Thrun and Norvig founded the company Udacity, which provides a platform that any university can use to offer MOOCs, stating the motivation behind this as "having done this, I can't teach at Stanford again. I feel like there's a red pill and a blue pill, and you can take the blue pill and go back to your classroom and lecture to your 20 students. But I've taken the red pill, and I've seen Wonderland." Later, on May 2, 2012, MIT and Harvard University announced a joint project called EdX that aims to provide free courses online.

The definition of MOOCs has also evolved over time since it was first added as an entry in Wikipedia in 2011, where it was defined as:

> A Massive Open Online Course (MOOC) is a course where the participants are distributed and course materials also are dispersed across the web. This is possible only if the course is open, and works significantly better if the course is large. The course is not a gathering, but rather a way of connecting distributed instructors and learners across a common topic or field of discourse.

Now, after the rapid development of MOOCS and after 1400 edits on Wikipedia, the definition reads as:

> An online course aimed at unlimited participation and open access via the web. In addition to traditional course materials such as filmed lectures, readings, and problem sets, many MOOCs provide interactive user forums to support community interactions between students, professors, and teaching assistants (TAs). MOOCs are a recent development in distance education, which was first introduced in 2008 and emerged as a popular mode of learning in 2012.

Despite the fact that MOOCs are open in nature, there is a continuous debate over whether they are open educational resources (OERs) – a debate that persists in the literature. For instance, Stracke, Downes, Conole, Burgos, and Nascimbeni (2019) stated that OERs are published under an open license, which is not the case for most MOOCs. However, MOOCs could be composed of several OERs. In the same vein, Tlili et al. (2020) supported this idea, claiming that even sustainability models for OERs are different than those found in MOOCs.

Frameworks, Instruments, and Tools for MOOCs

Several theoretical frameworks and practical instruments and tools based on scientific research are developed and presented in this third section. Here, we will broaden our view for online courses in general, as most platforms providing MOOCs are not distinguishing between MOOCs and online courses. Furthermore, the standardization bodies for technology-enhanced learning have not (yet) developed any specific standards for MOOCs, so we discuss key standards relevant for online courses in general.

Online Courses: Their Platforms and Current Practices

Online courses and learning have become mainstream and significantly popular since the 2000s (Garrett et al., 2020). This has been particularly true for higher education, where online courses have become more popular and mainstream. However, according to Baldwin, Ching, and Friesen (2018), the designers of online courses typically follow the traditional face-to-face ADDIE model, which is considered a limitation to the effectiveness of online courses. The ADDIE model represents five stages of the design process: analyze, design, develop, implement, and evaluate. Online course designers are distinct from those who design face-to-face courses mainly due to their different priorities. Online course designers prioritize and promote more interactions among learners than in physical courses. However, online course designers focus on facilitating learners' interactions and fail to address special needs or offer self-assessment (Bolliger & Martin, 2021). While the popularity of online courses and learning has significantly increased over the years (Shah, 2020),

there is still a significant gap in broad and longitudinal studies that address online courses and learning. This chapter will therefore summarize the current practices of multiple platforms that offer online courses and claim to be leaders in the context of the number of learners, courses, and quality.

Class Central is an online course platform that claims to be "the #1 Search Engine for MOOCs." The platform contains more than 50,000 courses from several universities (Class Central, 2021). However, the courses in the platform can only be filtered by basic categories, such as collections (self-curated), providers, rankings, and subjects (Class Central, 2021).

Unlike Class Central, Udemy, another giant MOOC platform, offers more courses and better filters. Udemy provides more than 183,000 video-based online courses that users can search through and select by topic. However, within the single topic category, there are other categories, including price, language, levels, features, ratings, subtitles, and video duration (Udemy, 2021). The features category also offers other categories, including coding exercises, subtitles, practice tests, and quizzes.

Another online platform is edX, which follows a similar structure as Udemy but only offers 3000 online courses (edX, 2021). Like Udemy, one can only select one of the subjects listed on the landing page or select courses directly from the navigation bar. However, with edX, one can also select from several categories from search results, including the program, provider, subject, language, learning type, and availability.

Coursera offers about 5000 online courses and has a landing page where users can directly search for a course or select direct links to degrees, goals, providers, skills, certificates, subjects, and free courses (Coursera, 2021). Coursera allows users to choose from several categories in the search results, including the level, language, skills, duration, partners, subject, and learning products (Coursera, 2021).

Other online course platforms including the Khan Academy (2021) provide fewer categories and filter options for users. For instance, in its MOOC List, one can only search between subjects and formal conditions (MOOC List, 2021). FutureLearn also differentiates its courses by their sizes such that they only have categories for short courses, micro-credentials and programs, expert tracks, and online degrees (FutureLearn, 2021). Fordham University offers online learning and is distinguished as Google's highest-ranking, but its courses are only categorized into three types: synchronous online courses, asynchronous online courses, and hybrid/blended online courses (Fordham University, 2021). A comparison of the definitions and categorizations for online courses used by the mentioned online platforms is shown in Table 1 below: The first column "Categories" presents the clusters, while the other columns list the assigned selection criteria and terms used by the analyzed platforms.

One can identify that the online platforms use varying terminologies as well as the types and number of categories. Most of the platforms distinguish the courses by their content and target audience, meaning they categorize their courses depending on the topics or subjects being taught, the duration or size of the content, and which levels or languages are addressed for the given audience. It is surprising to discover that most of the online platforms do not categorize their courses according to the

Table 1 A comparison of categories for searching and differentiating online courses in popular online/MOOC platforms

Categories	class central	Udemy	edX	Coursera	Khan Academy	MOOC List	FutureLearn	Fordham University
Objectives				Goals				
Target group		Levels Languages (foreign) subtitles	Program Level Language	Skills Language Level	Levels Languages (foreign) subtitles	Formal conditions		
Pedagogies			Learning type					Modes
Content	Subjects Collections (self-curated)	Topics Duration Price	Subject Availability	Certificates Degrees Subjects Duration Learning products	Topics Duration	Subjects	Sizes	
Assessment		Quizzes Coding exercises Practice tests			Quizzes Coding exercises Practice tests			
Context	Providers	Price	Providers/ partners	Free courses Providers/ partners	Price			
Evaluation	Rankings	Ratings			Ratings			

design or technologies used. Additionally, categorization based on objectives and pedagogies is rarely used, with the two appearing only once and twice, respectively, in the evaluated platforms. While scientific research and articles suggest that didactics and educational dimensions are critical for online platforms, the data from the online platforms indicates this is not a focus for MOOC providers.

The subsequent section introduces and analyzes current norms and standards relevant for online courses and learning to broaden the comparison with the collected data.

Standards and Norms for Online Learning, Courses, and MOOCs

There is a wide range of terminologies related to norms, guidelines, and standards. This chapter distinguishes between norms created by the two de-jure standardization bodies – the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) – legitimated by the national governments and supranational institutions (such as the EU), with guidelines created by institutions or individuals and standards created by authorities. Multiple national and regional standards have been published and made available, such as the International Association for K–12 Online Learning (2011). This name is highly misleading since one may assume that they are developed by an international group or association when, in fact, they are merely a replica of the national United States Standards developed by American authors only (International Association for K–12 Online Learning, 2011).

The Institute of Electrical and Electronics Engineers (IEEE) was the first international body to develop international standards that were relevant for online courses. IEEE developed the IEEE Std 1484.1 standard, which specified all the elements of a learning technology system architecture (LTSA) (IEEE, 2003). The architecture also highlighted the relationships between the components in an entirely technology-independent description. Such a technology-independent description is the biggest advantage of this standard (and many others): It allows the standard to be valid for a longer period of time. Through this technology independence, IEEE 1484.1 is still surprisingly useful and adequate currently, despite the fact that it was developed 18 years ago and several technological advances have been made since that time. It presents and defines the components of an online course or a digital environment and their relationships as shown in Fig. 1.

Another international standard developed in 2003, the same year as IEEE 1484.1, was the IMS Learning Design (LD), developed by the IMS Global Learning Consortium Inc., founded on the educational modeling language (EML) as shown in Fig. 2: It presents all elements relevant for the learning design of online or digital courses. It follows the narrative of a stage play and related terms. The IMS LD was extended by Publicly Available Specification (PAS) 1032-2, including three more components: experience, context, and metadata (PAS 1032-2, 2004).

However, there is only one legal, de-jure standard for online courses and digital learning that is approved internationally and is implemented broadly as a norm: It

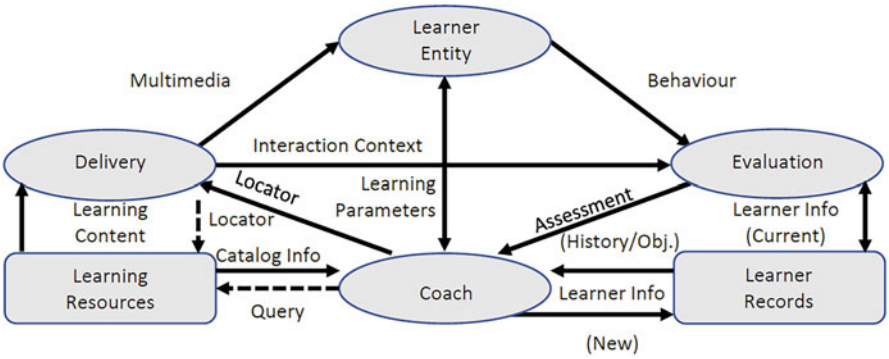

Fig. 1 IEEE 1484.1: The LTSA system components (IEEE, 2003)

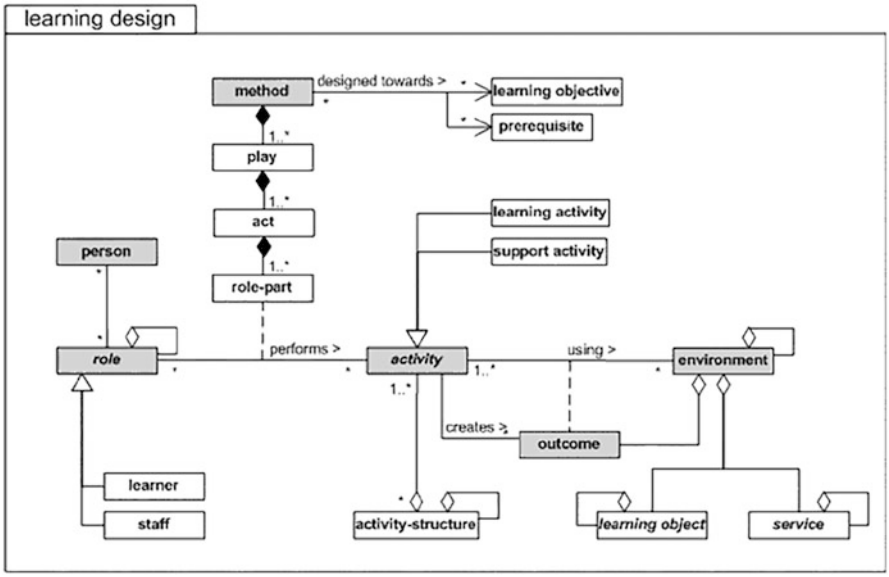

Fig. 2 IMS Learning Designs (IMS, 2003)

is the peculiar international quality norm ISO/IEC 40180 (2017), which was developed and approved by all national delegations from the International Standardization Organization (ISO) and the International Electrotechnical Commission (IEC). In the following, we briefly introduce it due to its unique importance as a global norm and its adoption as a national norm in more than 60 countries worldwide.

ISO/IEC 40180 was developed as a regular revision of the prior ISO/IEC 19796-1 (2005) that had been published as the first e-learning norm by IEC and ISO. The norm was developed in the international standardization committee SC36 by IEC

and ISO, managed by Convenor Christian M. Stracke, and approved by all national delegations from about 60 nations in consensus.

ISO/IEC 40180 defines a quality reference framework (QRF) for e-learning. It is important to distinguish this QRF developed by SC36 from the specific QRF for MOOCs developed by MOOQ and described in the following section of this book chapter: MOOQ decided to use the same abbreviation (QRF) for its quality reference framework for MOOCs (Stracke et al., 2018a) since it is based on the QRF by SC36 contained in ISO/IEC 40180 (ISO, 2017).

The QRF of ISO/IEC 40180 contains two core models: the QRF descriptive model, and the QRF quality model.

Figure 3 presents the QRF Quality Model with its seven dimensions (called process categories, in dark gray) and related 38 processes (in light gray). The QRF quality model covers and integrates all dimensions and processes that are relevant for online courses and learning. It is most important to understand that the QRF quality model presents them only as potential options and that, for all processes, it must be decided whether they are relevant for the given situation, target group, and institutional and learning objectives.

If a process is selected as relevant, then it has to be defined according the QRF descriptive model that is shown in Fig. 4. The QRF descriptive model is a master template for describing and defining all selected processes that are relevant in a given task and situation, such as designing an online course.

Figure 5 presents an illustrative example for the usage of the QRF descriptive model: It is a definition of the process "Concept of the contents" (CD.2) from the process category "Conception/Design."

Since ISO/IEC 40180 provides a complete view of all the possible dimensions and processes using its 7 dimensions and 38 processes, it is used as the foundation of categorizing online courses. Overall, the main benefit of ISO/IEC 40180 is the introduction of a common terminology and structure for online courses and technology-enhanced learning. It allows all involved stakeholders to discuss the requirements and achievements for the needs analysis, conception, realization, and evaluation of any online course and technology-enhanced learning opportunity.

As stated above, the QRF by SC36 should not be confused with the QRF by MOOQ, which is based on the QRF by SC36 and is described in the following section.

Quality, Learning Design, and Outcomes of MOOCs

In the previous section, we discussed the wide variety in how MOOC and online course providers have recently sought to categorize their courses. In contrast, researchers have differentiated and analyzed the difference in MOOCs from the very beginning (Stracke & Bozkurt, 2019).

Since the first MOOCs, the quality of learning within MOOCs was discussed by learners, designers, and researchers along with questions about their educational impact and achievements (Liyanagunawardena, Adams, & Williams, 2013; Stracke,

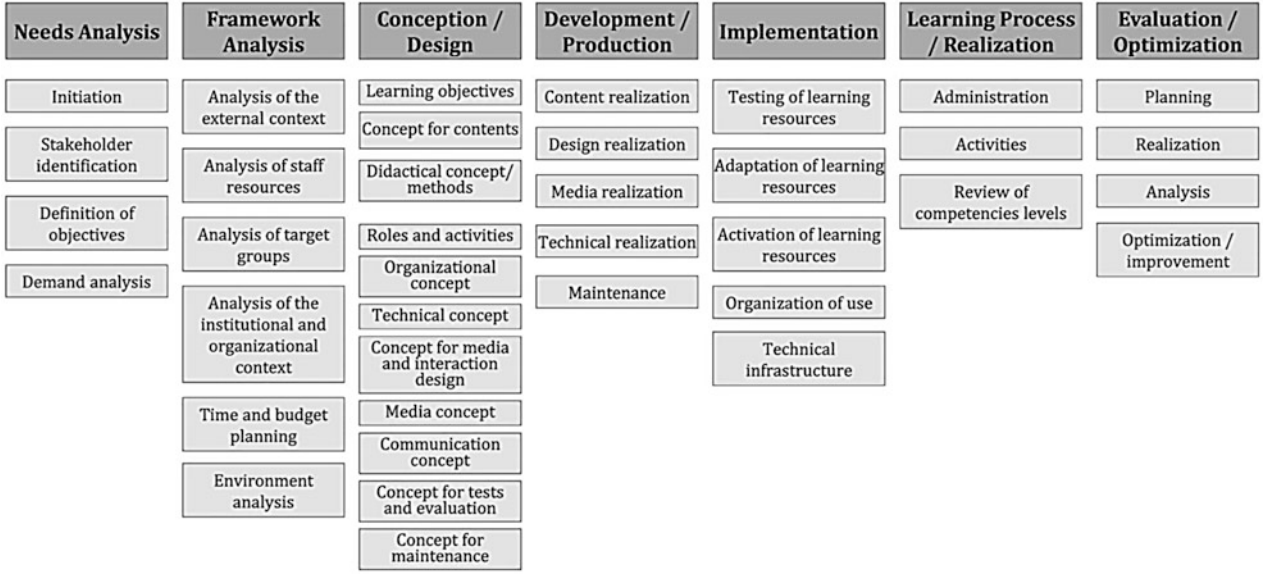

Fig. 3 ISO/IEC 40180: QRF Quality Model (ISO, 2017)

ID	Category	Process	Description	Relation
Sub-processes/ Sub-aspects				
Objective				
Method				
Result				
Actors				
Metrics/Criteria				
Standards				
Annotation/Example				

Fig. 4 ISO/IEC 40180: QRF Descriptive Model (ISO, 2017)

ID	Category	Process Name	Description	Relations
CD.2	Conception/Design	Concept of the contents	Concept of learning and teaching contents	*NA.4 Demand analysis* *FA.2 Qualifications*
Sub-processes/ Sub-aspects		Content selection Content Design		
Objective		1 Learner Demand: The goal is to provide content adapted to the needs and demand of the learner. 2 Adaptation: Each course shall provide different content presentation formats and entry points based on the user experience.		
Method		A prototype of the content shall be provided to a group of learners' representatives. In a consensus process, the contents shall be prioritized and agreed on. For each course, classify groups of learners according to their learning type. Adapt presentation format and methods according to these learning types.		
Result		1 Documentation of planned and agreed contents 2 Periodically, evaluate learning performance of different learners (test groups).		
Actors		Curriculum designer, didactic experts, institution accreditation authority, teacher, learners' representatives		
Metrics/Criteria		The content are measured based on their relevance, importance, exemplarity, ...		
Standards		Higher Education Standards		
Annotation/Example				

Fig. 5 ISO/IEC 40180: Example of a defined process CD.2 (ISO, 2017)

2019; Stracke & Trisolini, 2021; Veletsianos & Shepherdson, 2016; Zawacki-Richter, Bozkurt, Alturki, & Aldraiweesh, 2018). A repeated criticism was the high dropout rate of MOOCs, but it could be clarified that these relatively high figures are not always caused by low quality but by an inaccurate comparison to face-to-face (offline) courses: The dropout rate, for example, is not a valid measurement metric for MOOCs due to their different target groups and the various learning objectives for different students, many of whom only want to get an overview and not finish and pass a complete course (Stracke, 2017a).

In the beginning, quality discussions followed the identified types of MOOCs that were distinguished by their designs, specific learning objectives, and pedagogical

approaches (Davidson, 2013; Stracke, 2017b). That led to two main schools of thought for MOOCs: the cMOOCs and xMOOCs.

On the one hand, cMOOCs were designed to promote collaborative learning processes and network building among all MOOC learners. It was labeled cMOOC due to the so-called "connectivism" that was promoted as a new theory from the very first MOOC "Connectivism and Connective Knowledge" (CCK08) (Bozkurt, Kilgore, & Crosslin, 2018). Today, it is evident that this MOOC type has not created a new pedagogical design theory but is following well-established learning designs from constructivism with a focus on social communication, collaborative exchange, and common learning processes (Stracke et al., 2019). On the other hand, xMOOCs transferred traditional classroom teaching to broad audiences online. It was labeled xMOOC, with "x" symbolizing an extension, as that is what Harvard University used to mark the online courses in its lectures catalogue. In addition, several other types of MOOCs were proposed, but the differentiations between these proposed types are always difficult to discern and are outweighed by the overlaps in MOOCs combining different design approaches (Stracke et al., 2019; Zawacki-Richter et al., 2018).

Another attempt to structure the quality discussion related to MOOCs was the focus on the four abbreviations of massive, open, online, and courses. However, all four criteria are often not realized, and each can be questioned as mandatory conditions for current online courses labeled as MOOCs (Stracke et al., 2019). Only the scalability with large amounts of online learners is unique for MOOCs, but this does not present a pedagogical innovation or new learning style but instead a potential condition that has to carefully be addressed in the learning design.

Thus, a categorization of MOOC types has attempted several times, but we argue such attempts can be discarded, as the diverse learning designs in online courses are not different from "normal" offline courses – the latest research on the quality of MOOCs reveals that there are no specific learning designs for MOOCs (Bozkurt et al., 2018; Stracke et al., 2018b; Stracke & Trisolini, 2021; Zawacki-Richter et al., 2018). However, MOOCs do have specific aspects and opportunities (such as scalability, interactions, and reproducibility) that demand more emphasis on the learning designs and outcomes of MOOCs. Therefore, multidimensional perspectives are required for the design and quality of MOOCs to cover all these important aspects.

The international initiative MOOQ (which stands for the quality of MOOCs) has analyzed the current MOOC offerings and provisions from four perspectives: the learners, designers, facilitators, and providers of MOOCs. The first major research result of MOOQs (Stracke et al., 2018b; Stracke & Tan, 2018) is the different appreciation and valuing of interactions between learners ($n = 146$) and designers ($n = 52$). In the comparative online surveys for MOOC learners and designers, MOOC learners recognized all four interaction types: (a) learners to resources, (b) learners to learners, (c) learners to facilitators, and (d) groups to groups – these were all found to be relevant for the learning outcome (all four relations are significant with $p < 0.05$, and three of the four are even very highly significant with $p < 0.001$), while the MOOC designers considered all four interaction types as unimportant (all with non-significant relations).

Based on the overall research, including additional interviews, literature analyses, and workshops in collaboration with more than 10,000 MOOC learners, designers, facilitators, and providers, the research initiative MOOQ (www.mooc-quality.eu) has developed and continuously improved the QRF for MOOCs (Stracke et al., 2018a).

	Analysis			
A-1	Initiation			R
A-2	Stakeholder identification	X		R
A-3	Definition of objectives	R	X	R
A-4	Needs and demand analysis	R		X
A-5	Analysis of the external context			R
A-6	Analysis of the organizational context	X		R
A-7	Time, resources and budget planning	X		R

	Design			
D-1	Learning objectives	R	X	X
D-2	Organizational concept and roles	X	X	R
D-3	Didactical concept and methods	R	X	X
D-4	Concept for contents	R	X	X
D-5	Concept for learning activities	R	X	
D-6	Technical concept	X	X	R
D-7	Media design	R	X	X
D-8	Communication concept	R	X	
D-9	Interaction concept	R	X	
D-10	Feedback concept	R	X	
D-11	Concept for tests and assessment	R	X	X

Fig. 6 (continued)

	Implementation			
I-1	Content realization	R	X	X
I-2	Design realization	R		X
I-3	Media realization	R		X
I-4	Technical realization	X		R
I-5	Organization of use	X	X	R
I-6	Testing and activation	R		X

	Realization			
R-1	Administration	X	X	R
R-2	Learning activities and related support	X	R	X
R-3	Review of competence levels	R	X	X

	Evaluation			
E-1	Evaluation planning	X	X	R
E-2	Evaluation realization	X	X	R
E-3	Evaluation review	R	X	X
E-4	Improvements and optimization	X	X	R

Fig. 6 The quality reference framework (QRF) (Stracke et al., 2018a, pp. 10–11)

The QRF for MOOCs is following and adapting the quality norm for digital learning and online courses ISO/IEC 40180 (also called QRF) that was described in the previous section on relevant international standards and norms.

The QRF for MOOCs consists of three dimensions (phases, perspectives, and roles) and provides quality criteria and a quality checklist that is adaptable and has always been adjusted to the given situation, defined learning objectives, and selected target groups (Stracke et al., 2018b). Within the phase's dimension, the QRF distinguishes five processes (presented in Fig. 6): analysis, design, implementation, realization, and

evaluation. The difference to the five consecutive ADDIE stages is that the QRF defines process categories without any sequence but with a strong recommendation for parallel and iterative cycles (Stracke, 2019). They have to be selected and defined in the design, quality, and evaluation of MOOCs as required. Consequently, they are optional and present the full range of alternatives that have to be adapted to the given situation, target group, and learning objectives (Stracke et al., 2018a).

Within the QRF, the QRF quality checklist asks guiding questions to beginners in the design of MOOCs, and the QRF key quality criteria present the complete list of quality criteria for MOOCs that designers and experts in online education can benefit from.

Finally, a recent systematic literature review on the quality of MOOCs (Stracke & Trisolini, 2021) focused on the analyzed quality criteria and identified 103 studies (following the PRISMA protocol). The comparison and discussion of the results from the 103 studies through iterative validation cycles led to the establishment of a quality framework for MOOCs. This quality framework covers four dimensions (pedagogical, organizational, technical, and social) that are relevant for the quality of MOOCs and thus for their design. It can be used to guide design and evaluation of the learning design of MOOCs and future research related to their quality.

Thus, we can conclude that the research on MOOCs has revealed and addressed quality, learning design, and outcomes as key topics and led to initial instruments, such as the QRF for MOOCs that are currently evaluated in use and validation studies.

Benefits, Arguments, and Scenarios for Using MOOCs

Finally, the key benefits of MOOCs and the main arguments and scenarios for their usage are summarized in this section.

The key benefits of MOOCs can be identified as:

1. Time-independent: Learners can use MOOCs at any time they prefer as long as synchronous parts are not emphasized.
2. Location-independent: Learners can use MOOCs at any location they prefer as long as internet connectivity and an appropriate device are available.
3. Scalable: Educators can address large populations of learners with no limits except technical infrastructure and bandwidth.
4. Equitable: One MOOC is always offering the same conditions and quality for all learners independent from individual form on the day.
5. Inclusive: Different pathways and media channels can be combined in one single MOOC to cover all needs and preferences of learners.
6. Observable: The activities of learners and educators can be easily observed in digital environments as long as legal data protection is fulfilled.
7. Repeatable: One MOOC can be provided many times to allow for many cohorts and sequences.
8. Improvable: A MOOC can be easily reviewed and evaluated for continuous improvement cycles.

In addition, prior discussions on the usefulness and quality of MOOCs can be considered obsolete and outdated given that traditional in-person courses can suffer the same problems in the learning design as MOOCs (if not more) (Stracke, Burgos, et al., 2022; Stracke, Sharma, et al., 2022).

Categories and Types of (Massive Open) Online Courses

Previously, we discussed findings from the research literature that identified quality criteria for the design and evaluation of MOOCs. In this section, we compare and integrate the results from the previous sections to contrast ideas of quality and standards and create a new framework to guide MOOC design.

First, Table 2 shows a comparison of the various categorizations and dimensions used in online courses in comparison to the international norm ISO/IEC 40180 coupled with the international standards IMS LD and IEEE LTSA and with the QRF for MOOCs to generate the typologies of online courses (TOC) framework, as shown below in Table 2. The first column "Categories" presents the clusters, while the other columns list the assigned components and terms discussed in the previous sections.

Table 3 presents the main outcome from the discussion of the literature and the comparison of the platforms and standards. It highlights the eight dimensions that are most important for the categorization of online courses and in particular for the design of MOOCs.

This potential TOC framework can serve as a basis for a future framework on the typologies of online courses that can be derived from the comparison of their different categories as shown in Table 3 above. For achieving that, it requires testing and evaluation in future applications, as well as research and validation studies to gain broad acceptance and richness of detail.

Conclusion

MOOCs, as a special type of online course, offer numerous benefits, and, thus, it is not surprising that their numbers and learners are constantly increasing. The main use of MOOCs is in higher and adult education for professional and personal development, often as free courses to promote the providing universities or to sell certificates after successful completion. However, MOOCs could also be used in school and vocational education and in lifelong learning to enrich educational opportunities and systems through alternatives with high and stable quality and with innovative learning designs.

The presented eight dimensions for a typologies of online courses (TOC) framework provide support for achieving these objectives. Derived from our analysis of current MOOC practices, offers and related standards and guidelines worldwide, these dimensions are marking the necessary perspectives the quality of MOOCs. They offer guidance for the MOOC development and evaluation. They can be applied in all processes and phases during the learning design and implementation

Table 2 Categories of online courses differentiated in norm and standards

Categories	ISO/IEC 40180 (QRF by SC36)	IMS LD	IEEE LTSA	Quality reference framework (QRF by MOOQ)
Objectives	Definition of objectives Learning objectives	Learning objective		Definition of objectives Learning objectives
Target group	Demand analysis Analysis of target groups	Person Prerequisite	Learner entity	Needs and demand analysis
Pedagogies	Didactical concept/ methods Roles and activities Organizational concept Communication concept Organization of use Activities	Method Play Act Role-part Role Activity Activity structure Learning activity Support activity	Delivery Coach	Organizational concept and roles Didactical concept and methods Concept for learning activities Communication concept Interaction concept Feedback concept Organization of use Learning activities and related support
Content	Concept for contents Media concept Content realization Media realization Testing of learning resources Adaptation of learning resources	Learning object Service	Learning resources	Concept for contents Media design Content realization Media realization
Design	Concept for media and interaction design Design realization			Design realization
Technologies	Technical concept Concept for maintenance Technical realization Maintenance Activation of learning resources Technical infrastructure	Environment		Technical concept Technical realization Testing and activation
Assessment	Concept for tests and evaluation Review of competencies levels	Outcome	Evaluation Learner records	Concept for tests and assessment Review of competence levels
Context	Initiation Stakeholder identification Analysis of external context			Initiation Stakeholder identification Analysis of the external context

(continued)

Table 2 (continued)

Categories	ISO/IEC 40180 (QRF by SC36)	IMS LD	IEEE LTSA	Quality reference framework (QRF by MOOQ)
	Analysis of staff resources Analysis of institutional and organizational context Time and budget planning Environment analysis Administration			Analysis of the organizational context Time, resources, and budget planning Administration
Evaluation	Planning Realization Analysis Optimization/ improvement			Evaluation planning Evaluation realization Evaluation review Improvements and optimization

Table 3 Dimensions for a typologies of online courses (TOC) framework

Context	The given context is crucial for the design of an online course. Specific conditions and given limitations, such as available resources, have to be identified and considered. Therefore, the design should start with a needs analysis that also reflects requirements and demands of all involved stakeholders
Objectives	This dimension covers the organizational objectives related to the expected impact as well as learning objectives related to the planned learning outcomes
Pedagogy	The pedagogy dimension can be considered most important for overall success and requires close attention and many aspects to be addressed. In online courses, there are several unique opportunities that need to be exploited, such as digital competence building, and automatic self-assessment
Content	Content covers the resources and media that are combined and mixed in the online course
Interaction	Interactions in online courses are enriched by a fourth mode – —the interactions among different groups of learners, (next to the three traditional modes: (a) learners to resources, (b) learners to learners, (c) learners to facilitators as explained above). Online learners and online designers highly value this feature but with diverse expectations
Technologies	Technologies play a special role in online courses, as they have to work, and learners (and designers and facilitators) need the related digital competencies
Support	Support in online courses is crucial for introducing beginners to online learning, giving orientation, and providing feedback
Assessment	The assessment consists of measurement of the learning progress and outcomes achieved by the learners as well as the evaluation of the online course for future improvements

of MOOCs in collaboration among all stakeholders and can be used for the measurement and continuous improvement of the instructional quality of MOOCs as well as for their labeling and distinction by MOOC providers (for promotional purposes) and by MOOC learners (to select the best fitting MOOC).

In summary, we believe that the full potential of MOOCs for all educational systems worldwide has not yet been achieved. As part of the global community for open educational resources (OERs), and in combination with the UNESCO recommendation on OERs (UNESCO, 2019), MOOCs can play a significant role in achieving the United Nations' SDG4: inclusive and equitable quality education for all. This is true in particular in times of public lockdowns, such as in the ongoing COVID-19 pandemic. Further research on MOOCs is required, such as studies on licensing, sustainability and exploitation models, student dropout, teacher attrition, etc. Our long-term research objective is to identify all opportunities for their instructional quality and learning designs as well as for their uses for all learning objectives and target groups as well as in all educational fields.

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