Chapter 7
Learning Analytics in Massive Open Online Courses

7.1 Introduction to MOOCs

7.1.1 What Is MOOC?

MOOCs are Massive Open Online Courses (Fig. 7.1) built to accept an infinite number of registrations, facilitated fully online (Physiopedia, 2020).

Massive. since many participants often in thousands

Open. Since it takes place in a field that is open to all to read, reflect, and comment, it is accessible, and all people who take the course share material and work.

Online. Since the course is online.

Course. As it has course materials and facilitators, a start and finish date, and participants. This is an event about a subject that matters to people.

7.1.2 A Brief History of MOOCs

MOOC was coined in 2008 for an education entitled Connectivism and Connectivity Knowledge, created by Stephen Downes and George Siemens (McGill.CA, 2010). They wanted to make use of the possibility of interactions between many participants through online platforms to provide a richer learning experience than would be allowed by conventional tools. Twenty-five students attended a course by the University of Manitoba's campus, and an additional 2300 from around the world took part online. MOOCs based on interactions and connectivity is now known as cMOOCS.

In autumn 2011, Stanford offered three free online courses. Peter Norvig and Sebastien Thrun presented their Artificial Intelligence introduction for the initial

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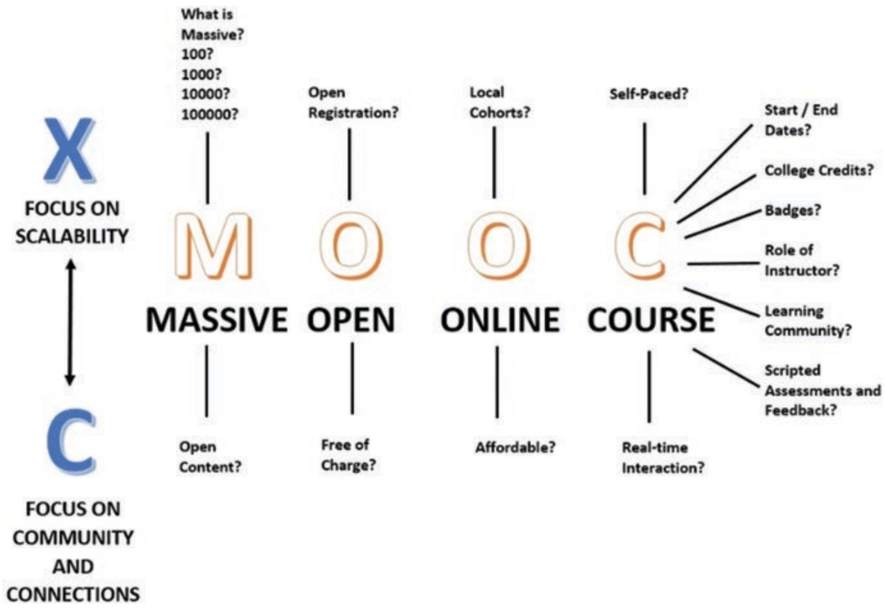

Fig. 7.1 Overview of MOOCs (Sidhartha, 2016)

registration of more than 160,000 students from around the world. More than 20,000 students completed the course. These xMOOCs concentrated less on student engagement and more on the possibility of reaching a broad audience.

In February 2012, Thrun founded a company known as Udacity (McGill.CA, 2010), which started creating and providing free MOOCs. In April 2012, the company named Coursera began with Andrew Ng and Daphne Koller, two other Stanford CS professors, who collaborated with universities in the planning and offering of MOOCs.

MIT developed MITx's MOOC platform, which was renamed edX when a partnership was formed with Harvard. There are currently over 30 university partners within the non-profit edX consortium that produces and provides MOOCs, including McGill. The project has made available an open-source platform that other organizations and individuals can use and create. The group also performs research on using emerging technology by evaluating the data it obtains from students. In reality, the consortium is the outcome of a previous MIT research project.

More than four million students have enrolled in Coursera MOOCs, and over a million students in their MOOCs have enrollment for Udacity and edX. Udacity collaborated with San Jose State to provide credit-free classes, which were low-cost and integrated MOOC resources with help from on-campus teachers and teaching assistants. Such success was indicated by Sebastian Thrun that there could be only ten institutions providing higher education in 50 years.

However, the experiment in San Jose State was less than successful, with the pass rates substantially lower in some courses than in conventional courses. Also, most

MOOCs have a high dropout rate of over 90%. Thrun reported in November 2013 that Udacity has a "lousy commodity" and would reconsider vocational education. In comparison, Anant Agarwal, president of the edX consortium, emphasizes that MOOCs' availability benefits students and universities.

7.1.3 How Are MOOCs Different from Online College Courses?

A MOOC and an online college course have certain resemblances, but not the same. MOOCs vary in the following ways from online college courses (Fieland, 2020):

Similarities.

1. MOOCs are offered online.
2. The same professors who teach online college classes also teach MOOCs.
3. MOOC course materials are also the same as those for college students who study online.
4. Often, MOOCs are delivered in cooperation with universities and colleges.
5. Often, a collection of MOOCs may be provided for academic credit. However, in these circumstances, a student must be formally enrolled at a college or university and must pay tuition fees to gain academic MOOC credits.
6. MOOCs provide self-study, enabling students to complete classes and take tests on their schedule.

There are variations.

1. MOOCs are free of charge.
2. The class size of the MOOCs is infinite.
3. Anyone can join in a MOOC course even though there are not "qualified" to take it.
4. Students can always start and stop the course without any formal consequences.
5. After completing the course, a student may not have a certificate, diploma, or transcript of completion, visible or officially acknowledged.

7.1.4 Features of MOOCs

The features shared by most MOOCs are (Physiopedia, 2020):

- Participants are expected to be spread worldwide.
- The contents of the course are not contained in any location, but available across the web.
- One of the locations where the interactions occur with online classrooms includes blogs or portfolios, websites, social networking platforms, and more.
- During the course, participants and teachers compile, mix, and repurpose their content.
- Courses have no specific requirements, but participants must keep up-to-date on rough schedules.
- Most MOOCs are free; if the participant works for accreditation, there may be a fee.

7.1.5 Benefits of MOOCs to Participants

MOOCs provide participants with the following benefits (Physiopedia, 2020; Srikanth, 2017):

- MOOCs are free!
- Allow access to training and experience to which you would not have access otherwise.
- Ability to globally connect, interact, and learn with peers and colleagues.
- Build networks and links which can be established after the course is finished.
- Learn digital skills.
- Commitment to your lifelong learning (continuing education and career)

7.1.6 Benefits to Organizations Running the MOOC

MOOCs give organizations the following benefits (Physiopedia, 2020):

- Builds awareness, expertise, and culture around a subject globally.
- Promote your activities, courses, products, services, and skills.
- Advanced preparation for your students and staff.
- Training peers for possible potential hires.
- Access to those involved in research, training, etc.
- Meets the standards of corporate social responsibility.

7.1.7 Business Models Associated with MOOCs

As stated in the last section, the key advantages of operating a MOOC are often not financial. This did not, however, deter organizations aimed at developing more traditional MOOC models. MOOC's fundamental aspect is that students are free to access educational experiences, and educational institutions and suppliers of MOOC platforms are finding several alternative ways to generate revenue from MOOCs.

Approaches under consideration include (Physiopedia, 2020):

- Optional examination and credential fees
- Optional tuition fees for access to supplementary resources
- Costs for MOOC production, hosting, and distribution
- Sale of student data (e.g., to potential recruiting organizations)

7.1.8 Various MOOC Types

7.1.8.1 The Following Are the Various Categories of MOOCs (Physiopedia, 2020)

- xMOOC-The most common form of MOOC structured around the core curriculum and the central professor of predefined study materials.
- cMOOC- "Connectivity-MOOCs" look like seminar courses; course materials form part of student conversations, focused on student-to-student experiences, which are the center of learning.
- DOCC-Distributed Online Collaborative Courses are courses where students in multiple institutions access the same material, but their exact administration can differ. Students may also communicate with each other via the online component of institutions.
- BOOC-Big Open Online courses are close to MOOCs and limited to fewer than 50 students.
- SMOC-Synchronous Massive Online Courses differ from xMOOCs because the lectures are broadcast live so that students can log in or listen to the lectures at certain times.
- SPOC – Small Private Online Courses are similar to BOOCs because the classes are small, but instructor interactions are comparable to typical classroom interactions. SPOCs in the "flipped classroom" model are similarly referenced.
- Corporate MOOCs – MOOCs are usually subsidized or specially certified by employers, intended for employees' training or further education.

7.1.9 Advantages of MOOCs

Traditional MOOCs are free online university courses offered by universities worldwide that do not normally qualify for credit. They can register up to 100,000 + students, and anyone can register around the world. Usually, after registration, students work to monitor informative lectures, lessons, and exercises.

MOOCs offer numerous advantages that are worth learning. These are the benefits of MOOCs (Goldy-Brown, 2018).

1. Offer a range of subjects. College schedules are tight, so you may not be able to take every course you want. Your school may not even offer a subject that is of interest. MOOCs can assist in this. Search for interesting classes on one of the MOOC providers' websites. The topics cover yoga, personal finance, engineering, IT, composition, etc. In some cases, you can pay a college credit for your hard work. Check the transfer policy of your school before payment.
2. Let you test out your major before committing. The major you choose mostly influences the college you attend and your future career journey. High school students can complete a MOOC course to see if it is right. This risk-free, cash-free method will help you figure out what is important to choose and save you money. Starting with college knowledge means that you do not have to spend time between majors and pay for useless classes.
3. Before you enroll, familiarize yourself with college-level learning. Wondering whether a college education is right for you? With a MOOC, you will understand how high school classes are before you pay for them. The tests you take and your assignments give you an insight into what might appear in the next 4 years. Try a course at a college you plan to attend if possible.
4. Prepare yourself academically for college. Feeling unprepared for university? You are not alone. Many MOOCs are designed to fight against this unpreparedness. Some MOOCs for high school students include mathematics, composition in the first year, and precalculus. Talk to your guide or teachers to see the areas in which they recommend you to focus.
5. Learn from the world's peers. Anyone who has internet access from any country can take a MOOC class. Participants can communicate with each other via social networking and discussion threads. Like in a real classroom, you will learn from your peers and perhaps also broaden your view of the world.
6. They are open to all. One of the advantages of MOOCs is that MOOC learning will not require any prerequisite. You can register for any class regardless of background or age. Just be ready to make an effort.
7. MOOCs are available in various. Your courses are not limited to where you live. Enjoy courses taught without hesitation in foreign countries, thanks to subtitles. Subtitles make these courses also friendly for people who are deaf or hard to hear.

8. Learn a language for FREE. Rosetta Stone is expensive, and language classes in person may move too fast for you. MOOCs are a free way to learn your language. Return to lectures as required and take your time to learn rather than grapple with exams.
9. Provide FREE AP examination preparation and courses. The edX MOOC platform of Harvard and MIT provides FREE AP exam preparation and courses. Outside your high school classroom, you can learn confusing material at your own pace. These additional courses help you achieve high AP scores, which in turn give you college credit.
10. Help your college and applications for scholarship stand out. Anything you can do to show future admission counselors that you are serious about learning will help your application in high school. Knowledge gained from MOOCs also helps with department applications and interviews or interest-specific research applications. Furthermore, taking these massive open online courses demonstrates initiative and intellectual curiosity. Both of these are features of a successful student.
11. Boost your applications and prospects for your career. Employers look to their future employees for severe soft skills. More than others, some degree programs help students develop these skills—free online classes such as MOOCs help bridge the gap between college graduates and employees. EdX offers several free "soft skills" courses covering topics from teamwork to the public. This MOOC platform also offers certified paid professional programs.

7.1.10 Disadvantages of MOOCs

MOOCs also have the following disadvantages (Sidhartha, 2016):

1. MOOC offers all video lectures and slides and all associated reading resources. This offers students the opportunity not to gradually study the lectures, but the whole lecture in an entire day that does not lead to a profound understanding of the concepts.
2. Real-time question-answering is also not possible during the lectures.
3. Courses that require physical hands-on exposure (e.g., civil, mechanical, electric, etc.) are quite difficult to provide with MOOCs.
4. Effective assessment methods such as Q&A in classrooms, surprise questionnaires, and presentations are not possible.
5. There are no proper evaluation methods, as automatic machine evaluations and assessments are not effective. Peer evaluation sometimes discourages students, leading them to quit the course.
6. MOOC style of education gradually kills teacher and student care, empathy, and respect in the physical school. Only the virtual social community is increased.

7.1.11 MOOCs Pedagogy

Minimum academic support is sufficient to run a MOOC. The pedagogies that are important for MOOCs have been available for years in distance education, but they are now applied to fulfill many people's needs for a free course (Baturay, 2015). Until implementation, cMOOCs were focused on peer and socio-learning models, but the subsequent paradigm of XMOOC was focused on online learning management, including video lectures, evaluation, and messaging.

The latest courses are normally arranged weekly; students can access their sources. Some of these things include automated multi-choice quizzes, short videos, sharing of documents, and forums. Courses are based on a model of peer-learning, but the course is run by a professional. Besides asynchronous learning activities, there are synchronous learning opportunities (e.g., live seminars).

The first courses in the MOOCs contain recorded lectures, notes, and assignments that were previously released via the learning management system for campus students when the courses' layout is examined. These courses were developed over time in a video lecture format; more advanced videos with animations and simulations with their interactive characteristics are now published as MOOCs.

The majority of courses take the form of adult short learning courses, professional development, vocational students working with horses around the world, and mostly for places with no ready access to higher education institutions.

MOOCs focused on three fields of student engagement (Grainger, 2013):

- ***Video lectures:*** video lectures in MOOCs have different presentations, from speech heads to lecturers. Coursera provides subtitles (mainly English but other languages are introduced). The pace of the lecture videos is generally 5–10 minutes per video sample.
- ***Assessment:*** assignments are mainly assessed using: (a) automatically graded questions for multiple decisions or auto-graded assignments for programming, and (b) peer review assessments, where students evaluate themselves and grades based on a given rubric.
- ***Forums:*** forums where students answer questions posted by other students and are a significant tool for student interaction between course takers and instructors. Forums usually contain general conversation, topic-specific conversation, course input, and technical input.
- ***Readings:*** The majority of MOOCs do not require students to purchase books, and most readings are made available online or by trainers.
- ***Live video sessions:*** Live video sessions with a teacher are available as well as weekly seminars.
- ***Activities:*** There are several training exercises further to test their comprehension of the course's concepts.
- ***Additional video resources***: scripted videos to better explain the scenes.
- ***Social media:*** students are encouraged to continue their talks on various social media sites such as Facebook.

7.2 From MOOCs to Learning Analytics

MOOCs and data analytics seem current to be the two most prominent trends in education technology. While the so-called "big data," in education, or "learning analytics," as it is often referred to (Siemens, 2013), is often accompanied by referrals to "disruptive innovation," (Yuan & Powell, 2013) it is also cited in lists of imminent trends in education (NMC Horizon Report, 2017). In other respects, the two developments together claim to "reverse engineer the human brain" rather optimistically (Rscapin, 2013). MOOCs and data analytics seem well suited; more data on behavior and activities by students indicate greater precision in prediction and customization, and the large numbers of enrollment in MOOCs (see (Jordan, 2014) would then deliver such a promise.

However, the connection between these apparent trends is much more profound and lies at the center of technology's main thrust in education. Like the MOOC, learning analytics promises a technological solution to the long-standing educational problems. Instead of web technology that is supposed to remove economic and geographic barriers to the elite educational institution, computational routines promise to reveal unprecedented insights into the learning process. In both these ideas, the invisibility of technology itself is common, and the emphasis is placed on the result instead of how it is produced. In view of MOOCs and data analytics, this emphasis means that we tend to see what is made visible by technology, not necessarily every aspect of the technology itself.

7.2.1 The 'Materiality' of the Video

The MOOC platforms' major providers, Coursera, edX, and Udacity, concentrate on the video presentation, a system that seems to provide a prominent window to prestigious. However, with all its visibility and supposed discovery in online education of "real humans," the video shows a remarkable disguise of the technologies that produce it.

The underlying technology needed to have a Harvard or Yale lecturer appear worldwide is not meant to be part of the MOOC story. The vast amounts of Internet infrastructure containing the video lecture or Software Codes and algorithms that make transportation possible should not be seen, experienced, or engaged. Indeed, we believe that the promotional narrative is uniform, accessible to anyone, and free of regional inconsistencies or local difficulties. Our focus should be on the lecture itself, and studies have indeed described the development of intimate relationships between students and their video-professors (Adams, Yin, Vargas Madriz, & Mullen, 2014). While this may indeed be of advantage to the learning process in some ways, it distracts attention from the contingent processes which produced video, which in itself is "just the visible surface of a large realm of software, a complex amalgam of data structures, algorithms, packages, and protocols" (Dodge, Kitchin, & Zook, 2009). Instead of just watching the video lecture, I think that you could gain important educational insights from looking around the surface.

An evident example could be the algorithms required to reproduce the video image. Nothing new suggests that coding is necessary so that "users" of technology can understand the software underpinning their digitally infused lives or videos that appear during the MOOC experiences. In the UK, coding is firmly on the political agenda and decisively on the national curriculum, Australia may follow suit. However, as Williamson clearly shows, it is not just coding that is important; it is the ideological assumptions that are already part of our teaching (Williamson, 2014). Code For Australia, this "functionalist and technician" (Williamson, 2014) thinks perfectly in its three-step process: (1) problem, (2) idea, and (3) solution. Therefore, to learn about the algorithms that can compress and decompress a MOOC video is bound up in a strong "solutionist" discourse which largely regards the world as complex conundrums, which computing provides a step-by-step solution for (Morozov, 2013). Why do we teach coding that old social issues or educational problems can be eradicated by a few algorithms and a user-friendly interface? To explore the significant benefits of learning to code, we need to ask why the technology industry is largely within a particular location with increasing claims of discriminatory work practices (Wadhwa, 2014), ageism (Scheiber, 2014), and social inequality (Gumbel, 2014). They are examples of the very actual material conditions below the slick façade of technology, such as video streaming, but they appear not to be worthy of inclusion in our education technology. Large data centers' power consumption and their significant local pollution role are a further striking example (Glanz, 2012).

Although this is not solely or directly related to MOOCs, it is precisely that type of material and reality required for a renowned professor's image to be broadcast worldwide. Far from being a benign "cloud," servers needed for global education projects like the MOOC require real locations, physical store records, and huge amounts of power, but video technology does not "reveal" any of these materials. Besides providing free, online educational content, we must also consider the hardware infrastructures that support and enable such broadcasts; what kind of access they offer locally.

The vital point in this regard is, of course not that talk on "Modern and Contemporary American Poetry" should somehow address the environmental problems raised by data storage or, indeed, the morality of Silicon Valley, instead highlighting our cultural insights into technology and how it can limit our understanding of the complexity of education. Digital "tools" may be integral to many educational tasks, but how should the pedagogy focus on the instruments themselves as a way to foster curiosity and critical awareness? We want an educational system in which students use digital tools but did not think of how these tools were developed and produced or how they were influencing or limiting the kind of tasks they could perform? The content of a video lecture is important for both educators and students, but the complex factors comprising digital video itself, as a material object, are also worthy of consideration, not only the images on the screen.

7.2.2 *What Does that Have to Do with Learning Analytics?*

The video lecture's analogy is significant since it points to the propensity to concentrate on the surface's image and ignore its processes. Here, the concentration on visualization is an aspect of the data analytics process that seems important to the emerging field. Like the MOOC video, "visualizations, diagrams, charts, tables, infographics and other forms of representation …make education intelligible to a wide variety of audiences" (Williamson, 2014). In reality, learning analytics continues with the visual metaphor, which is considered "essential for penetrating the fog that has settled over much of higher education" (Long & Siemens, 2014). However, this tendency to interpret educational data and the presumed validity of "seeing" user behavior must be treated carefully. The explanation is that a graphical representation not only distracts attention from algorithms that have gathered data and analyzed it often tends to obscure its condition as a designed artifact generated by data collection, categorization, and arrangement processes. In other words, visualization does not get us closer to the "true" status of the data; it offers a layer of analysis and understanding more accurately. "The capacity to mobilize data graphically as visualizations and representations, or 'database aesthetics,' amplifies the rhetorical, argumentative and persuasive function of data" (Williamson, 2014). In short, visualization is produced to tell the story that analysts want to hear, not expose reality.

Coursera and edX's emergent research is consistent with the visualization trend in analytics and generates customary "heat maps" of global MOOC participation (Breslow et al., 2013; Perna et al., 2014; University Edinburgh, 2013). Different nations are colored here according to the IP address locations registration numbers, which effectively indicate "where" MOOC students are located. However, as we look at the nuanced IP address location methods, we begin to understand the multi-layered processes involved in data collection and analysis and the inconsistencies in global internet infrastructure. There is a reason why the African continent is mostly left vacant in these world views, but a graphic depiction of the statistics on the register would not really clarify anything or even give any hint about what you should do about it. Rather, the story tends to be one of global expansion, highlighting regions of corporate influence and recognizing key areas. This seems to be an excellent example of how "powerful visualizations are now being deployed to envision and diagrammatize the educational landscape 'out there,' and to make it amenable to having things done to it" (Williamson, 2014).

As if visualization is not enough, we are encouraged to consider the field of learning analytics using the now de rigueur "infographic," which, of course, provides much wider use than the humble MOOC. The importance in general on-campus programs of the maps of competence or the structures of "traffic light," as shown by Course Signals, shows the attraction for data analytics and the elegant visual layers from which we see them. We should concentrate on the graph shape or color of the show with these devices, not think about the workings below. However, who determines the most important data points, and who selects the graphic form and color, and for what reason?

It is necessary not to doubt the accuracy or the precision of the algorithmic processes at work or the successful work of these projects. Rather, the goal is to demonstrate how visualization deflects focus from process and system issues and renders the surface picture uncontroversial. This is precisely the point of visualizing the data; we do not have to look at the data itself, only the much more intuitive graph. Data scientists in wider fields are starting to challenge the blind acceptance by the mass media and the public of their visualizations (Warden, 2013). Burn-Murdoch strongly positions the problem in the visualization layer, not necessarily the underlying data science. Our belief in visualization is furthermore specifically defined in educational practices: "While the text is frequently presented to students for critique, diagrams and data visualizations are overwhelmingly used simply as a medium of displaying final results" (Burn-murdoch, 2013). Graphs, diagrams, and charts are rooted in us as the unquestionable fact of the data, and, if so, how do we transcend this and establish a more meaningful engagement?

Ferguson proposes two approaches for student analytics, including incorporating learners' viewpoints and specific guidance on ethics (Ferguson, 2012). These two directions require transparency and clarity, not in the shape of more surface visuals, but as co-development activities. This means identifying simulation processes and procedures and the motivation for educational groups to take an active part in shaping them. That requires learning analytics technology that is not invisible, but "transparent, enabling learners to respond with feedback that can be used to refine the analytics, and enabling them to see how their data are being used" (Ferguson, 2012). From this viewpoint, engaging in learning analytics becomes educational in itself as students actively participate in data production and are aware of how information is produced. This may be a way to step past fixation with the picture as an unquestionable reflection of fact and into an active practice through which we consider imagery mutability and participation.

7.3 Integrating Learning Analytics with MOOCs

Since MOOCs have been built upon the global education market (Semenova, Vilkova, & Shcheglova, 2018), online learning innovations have spread over informal education and the past decade in higher education and continued professional development (The 2019 *OpenupEd t rend report on MOOCs*, 2019). Universities and vocational schools have been able to extend educational choices through the use of MOOCs in education programs (Roshchina, Roshchin, & Rudakov, 2018) and to build conditions for virtual mobility between students (Sancho & de Vries, 2013), improve access to education, and minimize university costs (Larionova, Brown, Bystrova, & Sinitsyn, 2018). Using MOOCs, universities face the problem of choosing quality courses and evaluating the productivity of online learning. To establish specific decision-making principles, the techniques for selecting online courses and the methods for determining their efficacy must be evaluated in-depth. Learning analytics in MOOCs is a key instrument for improving education quality (Lee

O'Farrell, 2017). In addition to the evaluation of learning analytics and the study of learner interaction, it also offers quantitative details on the efficacy of online methods and techniques of learning (Bystrova, Larionova, Sinitsyn, & Tolmachev, 2018). Moreover, learning analytics is a key predictor of and actively utilized to boost MOOC efficiency (Bystrova et al., 2018).

Learning analytics is based on the study of big data on MOOC learning conduct (Keshavamurthy & Guruprasad, 2014). It can provide much knowledge about the causes of success and failure in learning and predict possible learning habits. Findings are used to improve and adapt learning experiences to new environments (Lee O'Farrell, 2017).

The key goals of learning analytics are as follows (Bystrova et al., 2018):

- Collect, measure, and present user behaviour data;
- Analyse student success during the entire course;
- Analyse behavioural patterns using big data;
- Create relationships of cause-and-effect between performance measures and learning;
- Detect errors and methodological problems in MOOCs;
- Create guidelines for the revision of course content;
- Predict the success or failure of the student.

Learning analytics covers different approaches, ranging from descriptive statistics to data mining. Additional information sources and streaming data on user activity obtained through MOOC platforms can include educational institutions' administrative databases, learner and teacher surveys, pre-tested performance, etc.

If such requirements have been met, learning analytics will theoretically play an important role in online learning and MOOCs (Brouns & Firssova, 2016).

7.3.1 Learning Analytics Parameters in MOOC

Due to the abundance of data collected through MOOCs, learning analytics is an important guide for defining instructional design parameters in MOOCs that can enhance the students' learning experiences (Shukor & Abdullah, 2019). In several MOOC-related studies, parameters including the number of views, time spent viewing content, or the number of comments are used to determine the retention and participation of students in MOOCs (Jiang, Williams, Schenke, Warschauer, & Dowd, 2014). These parameters are often used to estimate the completion rate of students at the end of the course. However, little is known about how these criteria will enable educational designers and instructors to develop and update their MOOC instructional system. In this way, the instructional design will be more suited to their learners, since this design is focused on learner behavior during the course, which was called a study in "from the field" from the learner's perspective (Guàrdia Ortiz, Sangrà Morer, & Maina, 2013).

The engagement of students with course content can be calculated by evaluating the number of views. The number of students watching online learning materials in one class was collected in a study by Murray et al. (Murray, Pérez, Geist, & Hedrick, 2012), and a clear link was found between research and course materials.

Indeed, the more tools a student communicates with, the higher the probability of success in the course (Murray et al., 2012). Furthermore, the estimation of the highest average time spent among learners on the learning content is a significant measure of the learner's learning material quality. Wong (Wong, 2013) said students who spend more time on such materials give us an idea of the learning material's value.

A good online course should allow interaction between students and students and interaction between students and teachers. In every online course, features such as online discussion boards or chatting become mandatory. Online training lecturers can learn statistics about the number of comments about the overall concept of student engagement in the course. De Lange et al. (2003) found that online discussion

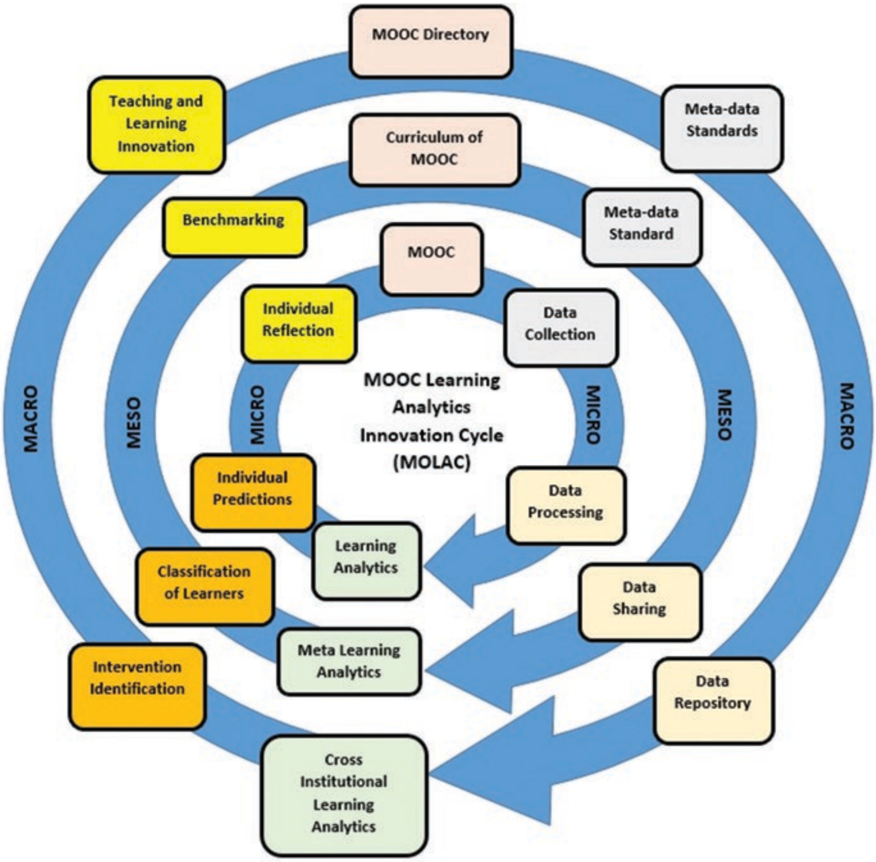

Fig. 7.2 The MOOC Learning Analytics Innovation Cycle – MOLAC (Drachsler & Kalz, 2016)

features significantly affect students' satisfaction with the course. MOOC is like many other online courses, but students' diversity has left very little room for personalized learning. Via learning analytics, trainers can learn more about their MOOC students and create an instructional design plan to suit their needs.

7.3.2 The MOOC Learning Analytics Innovation Cycle (MOLAC)

The MOOC Learning Analytics Innovation Cycle (MOLAC) (Fig. 7.2) has been developed to integrate the various domains, objectives, levels of analysis, and processes for learning analytics and MOOCs into a single picture (Drachsler & Greller, 2016). The cycle works on three levels. Data are gathered from a single course at the micro-level to promote predictions and reflection for individual students or teachers. On the meso level, educational institutions combine several MOOCs and allow data to be shared and analyzed via standard metadata beyond a single course. The combined data from different MOOCs can be used to classify learners and contributes to a more informed, data-driven approach towards the much-discussed concept of learning types and styles.

At the macro level, analysis is performed by MOOC providers, and curricula and data are shared among providers through a data repository. This type of cross-institutional learning analytics aims to identify interventions that help innovate learning and education for each institution and a wider group of stakeholders, such as the learning science community.

In this regard, the combination of MOOCs and learning analytics creates an innovative environment for educational institutions that enables initiatives and new ideas to be evaluated beyond the institution's current education structure. The majority of initiatives start with the micro-level but can ideally generalize research interest at a higher level through cross-institutional initiatives.

The European MOOCKnowledge initiative is an example of cross-institutional cooperation aimed at informing institutions about the strategic importance of the current open education strategies and providing (European) policymakers with information on the socio-economic impact of the open education sector but also obstacles to making the European higher learning system more accessible to the institutions.

7.3.3 MOOC Features for Learning Analytics

Learning analytics in MOOC tracks the behavior of a learner in a course. During the learning process, learners are tracked from the registration process, engaging in courses (video, discussions) to evaluation. Learners can view some tracking data in progress, results, completion of courses, and course statistics. etc., both for one course and all courses enrolled. Often, students are provided with additional details that alert them on top activities throughout the course.

An analysis of features offered to students across various MOOC platforms is performed (Chauhan & Goel, 2018). The analysis performed is summarized here (Chauhan & Goel, 2018).

The authors consider the features offered for a single student and all students enrolled in a course and all students of a course. They listed the characteristics for

- Single Learner Single Course (SLSC);
- Single Learner All Courses (SLAC) and
- All Learners Single Course (ALSC).

SLSC describes features to auto-reflect the learning of a person from a single course. SLAC provides information about all classes in which a student is enrolled. ALSC offers features that provide a community of students with learning, actions, and academic performance.

Also, the list of characteristics is formulated in conjunction with the learning process. Also, each feature often has a collection of parameters given to the learner as control or option. The features and parameters for various categories are shown in Table 7.1. Table 7.2 summarizes various styles for presenting the features.

The authors made a few primary findings from the review mentioned below.

- Some features are available on various channels, such as enrollment tracking, course content, forum contribution and response, specific reporting of trending, recently accessed units, the top/lowest scorer, etc.
- *Course activity* in MOOC is not so popular.
- *Assessment* information in open-source is more popular than proprietary systems.
- *Most platforms usually support • Status of progress and lesson unit*.
- The *completion status* in the proprietary platform is popular
- *Learning competency* is not a popular feature, but are supported by open-source platforms.
- *Recent activities* are a common feature of specific reporting, which is prominent among open-source platforms.
- Everybody receives the *Course information*.

Authors have also made several recommendations for learning analytics to platform providers from comparative analyses of the MOOC platforms. Features for "assessment," including quiz, assignments, and submitted assessments for the SLSC, can be included in Open edX. For all categories, the "specific reporting" feature can be implemented. Open edX also supports the ALSC group. It is also recommended that MOOC platforms have single access points for various artifacts that are visible and usable for learning analytics. For example, if a student wants to see the status of their quiz: to go where they left the last quiz, remaining to be completed, and completed all, they have to check each lesson unit and search. Controls are distributed across the system.

Table 7.1 The features and parameters for different categories

Category	Learning steps	Features	Parameters
SLSC (Single Learner Single Course)	Enrollment	Tracking	Total enrollment
	Course activity	Lesson unit	The score, Score details (Mean/High/Low/Score), Total, Comment, Remaining action, Deadline passed/Not released, Weight (%), Total weight (%)
		Course content	Number of videos watched/Watching, Number of slide downloads
		Forum contribution	Number of topics created, Number of comments posted, Title of topic/Post contributed to
		Forum response	Number of submissions and comments received
	Assessment	Quiz	Number of points, Grade (%), Total, Comments, Status (Completed, Overdue, Try again)
		Assignment	Grade/Score, Total, Comments, Number of assignments passed & Total, Status (Evaluation required/Not, Submitted/Not
		Assessments (Submitted)	Statistics, Recorded score, Feedback, Individual score, Time taken, Submission time
		Grades	Excursuses score, Total (%), Range, Percentage, Pass status
	Status	Progress	Completion (%), Participation threshold, Statis (Completed, Action remaining, Deadline passed/Not released
		Lesson unit	Time left, View/Completion (%), Resource status (Visited, Non-visited), Status (Completed, Action remaining, Deadline passed/Not released, Score (Subsection & problem, Total), Completed units, Release status (Lock, Unlock), Completed activities (Check, Uncheck)
		Course completion	Status (In progress, Completed), Requirement (View, Mark, Complete), Completed (Yes, No), Completion date
		Competency	Final score, Total points
	Specific reporting	Enrolment tracking	Recent learner enrolment in course
		Recent activity	Activities name (List), Update date
		Trending	Posts, Submissions
		Recent accessed unit	Lesson unit completion (%)
		Top/Lowest score	Three highest & two lowest grades (Students, Grade (%))

(continued)

Table 7.1 (continued)

Category	Learning steps	Features	Parameters
SLAC (Single Learner All Courses)	Course activity	Course	Title
		Lesson unit	Completion (%)
	Assessment	Assignment	Title, Due date
		Grades	Final grade (%), Grade required for certificate
	Status	Progress	Completion (%) or Lesson unit viewed (%)
		Completion	Completion (%)
	Specific reporting	Course	Last active/Inactive/Completed, Past/Planned/ Withdrawn
		Recent accessed course	Title, Status with lesson unit (Due assignments, Ended/Not)
ALSC (All Learners Single Course)	Enrolment	Tracking	Recent enrollment in course
		Participant	Name of participants in group
	Specific reporting	Recent activity	Activities name (List), Update date
		Trending	Posts & submissions, Active learners/Teams (Today)
		Top/Lowest scorer	Three highest & lowest grades (Students, Grade (%))

7.4 Benefits of Applying Learning Analytics in MOOCs

Learning Analytics is also studying student data on online platforms to uncover secret trends and discover practices paradigms. To improve learning and quantify learning environments, the needs for Learning Analytics arose. (Khalil, Taraghi, & Ebner, 2016) conducted a comprehensive analysis of the use of Learning Analytics on MOOC platforms. Their research also indicates that, between 2013 and 2015, the combination of Learning Analytics and MOOCs resulted in the largest number of citations from Google Scholar (http://scholar.google.com).

Online distance learning platforms such as MOOCs provide a rich source of potential for knowledge mining. Learning Analytics researchers can create enormous data logs using mouse clicks, forums, quiz results, login frequency, time spent on tasks, and monitoring videos interactivity. When properly viewed, this knowledge database will help scientists from different fields of computer science, pedagogy, statistics, machine learning, etc., directly participate in the pursuit of student success. Learning analytics benefits in MOOCs are infinite.

Here are the key advantages of using learning analytics in MOOCs from (Khalil et al., 2016):

- ***Prediction:*** one of the most common goals in both learning analytics and educational data mining. Techniques are used to determine when an online course is going to drop by a participant. This could be achieved by an analysis of student conduct, test results, and video skips. The monitoring of previous students'

Table 7.2 Various styles for presenting the features

Category	Learning steps	Features	Parameters
SLSC (Single Learner Single Course)	Course activity	Lesson unit	List, Table, Color variance
		Course content	Table
	Assessment	Quiz	Table, List
		Assignment	Table, List
		Assessments (Submitted)	Table, List
		Grades	Bar chart, List, Table
	Status	Progress in course	Bar chart, CheckBox, Progress bar, Doughnut chart, Check/Uncheck, List
		Lesson unit	List, CheckBox, Color variance, Bar chart, Doughnut chart, Progress bar, Check/Uncheck
		Course completion	Table, Vertical bar, Color variance, Horizontal bar, Doughnut chart, Check/Uncheck
		Competency	Text
	Specific reporting	Recent activity	List, Table, Text
SLAC (Single Learner All Courses)	Course activity	Course	List
		Lesson unit	Bar Chart
	Assessment	Grades	Text, Table, List
		Progress	Doughnut chart, Part viewed, Color variance
	Status	Completion	Percentage completed, Part viewed, Color variance
	Specific reporting	Course	List
ALSC (All Learners Single Course)	Specific reporting	Recent activity	List
		Trending	List
		Top/Lowest scorer	List

behaviors based on particular modules allows researchers to forecast potential actions, such as falling off a course or identifying at-risk students. Learning Analytics is also used to forecast success and motivation. Further projections on video consumption in a course and relative interest in forums for discussion can be studied.

- ***Recommendation:*** MOOC platform actions can be compromised for a recommendation. One example is when a MOOC provider advises students to use their previous registered courses for learning materials. Additionally, a student who addresses a particular question may be recommended in discussion forums.
- ***Visualization:*** The monitoring of previously described acts produces several records through learning analytics. Participants will obtain visualizations through dashboards that promote perception, reflection, and understanding. On the other

hand, analyzing data through the visualization of plots helps researchers identify patterns and eventually gives MOOC participants feedback and reflection.

- ***Entertainment:*** gamification makes learning more enjoyable in MOOCs, which gives students an increased incentive and completion rate. Such tools can be badges, reward marks, progress bars, or colorful measurements.
- ***Benchmarking:*** benchmarking is a learning process accessible by learning analytics, evaluating courses, videos, assignments, and MOOC platforms. Therefore, we can recognize learning disabilities and weak points in video lectures or online courses. Constructive feedback is then provided, resulting in an improved education system.
- ***Personalization:*** Learners will shape their personal MOOC experience. Developers may create a collection of customized products on the MOOC platform through various learning analytics techniques. A student can, for example, prefer a portion of a video or bookmark an article or text. Also, he can personalize alerts and add video annotations.
- ***Improving involvement:*** the interaction was an enticing subject for MOOCs. By data mining techniques such as clustering, we may put participants into a subset of students or identify experiences into videos, activities, and quizzes because of potential MOOC design initiatives or because we are researching the students' catalog needs.
- ***Communication information:*** Learning Analytics requires the gathering and analysis of data from sources. It is also used to submit information to various MOOC stakeholders in the form of statistical analysis. Like web analytics, students can track their activities and, for example, via dashboards and analyze general statistics. Teachers and policymakers may use descriptive statistics to create an analysis of MOOCs.
- ***Cost saving:*** Because Learning Analytics offers data analysis software, it opens the doors for a large inspection service that enables poor MOOCs to be identified. Decision-makers can then easily assign resources.

7.5 Major Concerns of Implementing Learning Analytics in MOOCs

While Learning Analytics has many advantages in terms of an education data stream, the constraints have been established recently (Khalil et al., 2016). Learning Analytics is powered by a broad data collection and process to resolve privacy and ethical concerns. A climate of insecurity among Learning Analytics practitioners as well as decision-makers is slowing down its steep growth (Hendrik Drachsler & Greller, 2016). Through our experience, we urge educational organizations, which stand for confidentiality, honesty, and availability, to follow the security model CIA.

We list the key concerns (Khalil et al., 2016) about the implementation of Learning Analytics in MOOC platforms in this section:

- ***Security:*** the preservation of student records in Learning Analytics application databases are central to their private information. Therefore, companies should not often bother maintaining database configuration. Infringements of confidential information may also occur.
- ***Privacy:*** Learning Analytics will disclose students' personal information. Sensitive information such as addresses, names, or emails may be used in the MOOC datasets. Privacy can be regarded as both a threat and a constraint in learning analytics.
- ***Ownership:*** "Who owns the analyzed MOOC data," questions can arise at any time. Participants tend to keep their details private while maintaining accountability, includes the consent policy. Also, MOOC providers are allowed to remove or de-identify their participants' personal information.
- ***Consent:*** Data ownership related. Not every MOOC provider makes the use of student data transparent. Policies with legislation frameworks should include personal information collection guidelines and information use definitions, such as research purposes or third-party sale of information.
- ***Transparency:*** Hidden procedures can mask biased decision-making when analytics on educational data sets are used. Similarly, providers must report their approach to gather, evaluate, and use participant data when Learning Analytics is used on MOOCs. Simultaneously, when the algorithms or methods for learning analytics are proprietary, a balance should be created.
- ***Storage:*** As long as MOOCs are available to the public, thousands of students can take a single course. Big data storage could be expensive, bloated, complicated, and difficult to handle. Personal data often no longer than required must be stored.

7.6 Limitation of Applying Learning Analytics in MOOCs

A crucial element in learning analytics is the quest for data consistency. However, Learning Analytics is adversely affected when data records have missing segments or corrupted information. Furthermore, providing a holistic analysis of students in online courses cannot be extracted solely from their left MOOC traces. Are there assurances of the outcomes of the Learning Analytics? What about precision?

This section summarizes some of the constraints that Learning Analytics can have through its use in MOOCs (Khalil et al., 2016).

- ***False Positives:*** decision-making based on small sub-sets of data by analysts or directors can lead to quick decisions, which could result in "false positives." The precision of any upcoming decision in a MOOC system would, therefore, be affected. Learning Analytics is also not always precise.
- ***Fallacy Analytics:*** Analytics can fail, and therefore, incorrect interventions or predictions will take place. Failures could occur during the main Learning Analytics cycle processes. Potential examples of faulty analysis are incorrect

behavior in collecting data from the MOOCs, flaws in processing or filtering, and misinterpretation of data. The findings via visualizations can also be displayed on the same page. Visualizations are a fantastic way to display details, but it may be difficult for the end-user to play with scales or to use 3D figures (student, instructor, decision-maker). Fallacy analysis can be unintentional and not deliberate, but it can be detrimental to various stakeholders and non-economic to the MOOC organization if analyzing data based on fallacy analytics. Fallacy analytics as a learning analytics tool by misusing statistics corrupt and pollutes the study records and wastes other researchers' time and resources.
- ***Bias:*** Learning Analytics can demonstrate important prediction and recommendation outcomes. It can also prove the relationship between behavior in forums and results, or watch videos and MOOCs. Collected data "could feed," but this goes back to the researcher or decision maker's deliberate desire. The bias against a certain hypothesis and the inner desire to prove the student theory contributes to biased learning analytics.
- ***Meaningful data:*** Learning Analytics uses quantitative analysis findings mainly. Qualitative approaches have not yet produced sufficient results. Learning analytics can be ineffective and effortless if meaningful information is difficult to extract.

7.7 Tools that Support Learning Analytics in MOOCs

In 2014, the Universidad Autónoma de Madrid (UAM) joined the edX Consortium (https://www.edx.org/school/uamx). Several 15 MOOCs have since been created and offered free, and various studies in the field of learning analytics based on the MOOCs in the UAM in edX are being created, and the following tools support learning analytics in MOOCs (Cobos, 2018):

- ***Open-DLAs:*** Open Dashboard for Learning Analytics, where descriptive-analytical methods were used to determine how learning takes place.
- ***edX-MAS+:*** edX MOOC Model Analyzer System, predictive analytical techniques were used to build predictive models and foresee what could happen.
- ***edX-WS:*** edX MOOC Warning System, where perspective analytical methods were used to identify learning-enhancing strategies.
- ***edX-CAS:*** edX MOOC Content Analyzer System, a Web-based framework used as a tool to evaluate textual content in MOOC courses.

7.8 Cast Study: Online Learners and their Persistence Within Online Courses Offered on the Coursera Platform

The case study is focused upon "What We Can Learn From Historic MOOC Data: Findings From Our Participation in the AIM Analytics Dropout Prediction Challenge." (Quintana, Schulz, & Tan, n.d.).

7.8.1 Motivation

Yuanru Tan, Learning Design and Accessibility Fellow, and the Learning Experience Designer Rebecca Quintana, decided to learn how data scientists solve learning analysis concerns, such as recognizing which students are in danger of not completing a course, to enhance the course design. Data scientist Kyle Schulz also signed up for the AIM (Academic Innovation at Michigan) Analytics challenge and aimed to translate his previous experience in predictive analytics into a new area (online courses) to learn more about the subject space and compete for prize money.

7.8.2 The Challenge

The challenge focused primarily on online students and their success in the online courses offered on the Coursera platform. The majority of these initiatives account for just a small percentage of students who remain involved in the course. For the competition, the first 4 weeks of learner data from a random subset of courses were presented, and each student in the courses was asked to predict the probability of persistence (described as showing some behavior during the last week of the course).

7.8.3 Goals

They began with two mutually beneficial goals in mind early in the competition:

7. To understand what can be learned from historic MOOC data about the evolution of course design and
8. To build a model to find out which learner habits have important effects on the course's success rates.

7.8.4 Process and Outcomes

They used log, clickstream, and demographic data from a University of Michigan MOOC on Social Network Analysis (SNA) and an unpublished MOOC course for their goals. To understand how courses were structured (and therefore how learner behavior could differ), they also studied the two SNA courses' design. One was Applied Social Network Analysis in Python, published on Coursera in 2017. Another course was Social Network Analysis, which employs the theory and computational tools for social network analysis to provide a meaningful overview of the Internet-fueled social and information networks.

7.8.5 Learning Design Approach and Outcomes

Yuanru and Rebecca used a method for the visualizing course structure (Quintana, Tan, & Korf, 2018; Seaton, 2016) to compare the historic SNA MOOC with the contemporary SNA MOOC.

1. ***Video production styles:*** Social network analysis tended to have longer, 15–25 minutes-length videos, whereas Applied social network analysis in Python tended to have much shorter, 7–12-minute videos. U-M has moved from a more informal style to a more standard mode in terms of formality, with an instructor lecturing from various campus locations, where the instructor is filmed in a studio setting.
2. ***The students' commitment:*** Social network analysis required students to acquire and use external software to the platform and use their personal information within assignments. Applied Social Network Analysis in Python offered platform-based data and software, thus reducing participatory barriers. The length of the MOOCs has also changed: the historical MOOC lasts 9 weeks, and the current version lasts only 4 weeks.

7.8.6 Learning Analytics Approach and Outcomes

Before embarking on the model's training task, they examined recent learning analytics research on student behaviors and their associations with MOOC results. Guided by literature and their preliminary analysis, they undertook a brainstorming activity that proposed additional elements that could complement the persistence factors already established.

They have introduced a gradient-boosting algorithm (XGBoost) with a new arsenal of feature vectors to allow them to analyze:

- the overall accuracy of their persistence prediction,

- the performance of their method of prediction relative to other models published;
- the relative importance in their final model for all the features.

The two most powerful predictors of the features they implemented were:

1. The timestamp of the last interaction between a learner and the platform (i.e., their last click) and
2. The timestamp of the last "in-video" quiz submission.

Although they did not discover new persistence factors, their final model was the first place in the competition!

7.9 Conclusion

In the past 15 years, educational technology has gained great importance. Currently, the framework of education technology includes numerous engaging online environments and fields. Learning analytics and Massive Open Online Courses (MOOCs) are two of the emerging topics that are most relevant in this field. Since they are open to everybody at no cost, MOOCs attract hundreds and hundreds of thousands of people. Experts from various disciplines demonstrated considerable interest in MOOCs as the phenomenon grew rapidly. Indeed, MOOCs have proved themselves to scale-up education in various fields. Their advantages are crystallized by improving educational performance, cutting costs, and expanding accessibility.

The large datasets of MOOC platforms require advanced tools and methodologies for further study because of their exceptional massiveness. This reflects the key importance of learning analytics. MOOCs offer various challenges and practices for learning analytics to address. Given this, this chapter combines both fields to investigate further steps in learning analytics capabilities in MOOCs. This chapter's main focus was to integrate learning analytics into MOOCs and look at the advantages and challenges afterward.

7.10 Review Questions

Reflect on the concepts of this chapter guided by the following questions.

1. Define MOOCs. List the features of MOOCs.
2. Describe the benefits that MOOCs provide to organizations and participants.
3. List and explain various types of MOOCs.
4. Write a short note on MOOCs Pedagogy.
5. What are the various Learning Analytics parameters used in MOOCs?
6. With the help of a diagram, explain the MOOC Learning Analytics Innovation Cycle – MOLAC.

7. What are the benefits of applying Learning Analytics in MOOCs?
8. List and explain the major concerns of implementing Learning Analytics in Cs.
9. Summarize the various limitations of applying Learning Analytics in MOOCs.
10. Describe the various tools that support Learning Analytics in MOOCs.

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