MOOCs as granular systems: design patterns to foster participant activity

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MOOCs often suffer from high drop-out and low completion rates. At the beginning of the course, the audience is indeed "massive"; thousands of people wait for the course to begin, but in the end only a low number of participants stay active and complete the course. This paper answers the research question "Is there a specific point during an xMOOC where learners decide to drop out of the course or to become lurkers?" by identifying MOOCs as a challenging learning setting with a "drop-out problem" and a decrease in participant activity after the fourth to fifth course week. These are the first results of a Learning Analytics view on participant activity within three Austrian MOOCs. This "drop-out point" led the paper to introduce a design pattern or strategy to overcome the "drop-out point": "Think granular!" can be seen as an instructional design claim for MOOCs in order to keep participant activity and motivation high, and that results in three design patterns: four-week MOOCs, granular certificates and suspense peak narratives.

Tags

Instructional Design, Drop-out Point, Granularity, MOOC, Learning Analytics

1. MOOCs: a challenging learning setting with a drop-out problem?

The MOOC phenomenon was born in Canada in 2008 and has since then become a worldwide movement (Hay-Jew 2015, 614; Hollands & Tirthali 2014, 25f.; Jasnani 2013). MOOCs can be seen as an expression for a modern orientation towards learning as learning can no longer be seen as a formal act that depends only on universities, schools and other institutions within a formal education system. Learning has to be seen as a lifelong process that has become flexible and seamless, as Wong (2012) and Hay-Jew (2015) resume. It encompasses formal and informal learning and physical and digital (learning) worlds (Wong & Looi 2011; Wong 2012). MOOCs – in our short research study, mainly xMOOCs – are open (Rodriguez 2013) and conducted online, with only an internet connection and registration on an xMOOC platform. The American providers Coursera (www.coursera.org), edX (www.edx.org), the German platforms iversity (www.iversity.org) and MOOIN (www.mooin.oncampus.de) or the Austrian iMooX (www.imoox.at), for example, are necessary for attending courses from different fields. Therefore, the audience is very heterogeneous and cannot be predicted in advance, as it can be for traditional learning settings. It can nevertheless be stated that "the majority of MOOC participants are already well-educated with at least a B.A. degree" (Hollands & Tirthali 2014, 42). They have a certain experience within the learning or the educational context (Gaebel 2014, 25). There are almost no limitations regarding location, age, sex and education, to name a few variables. Thus, MOOC design has to respect this unpredictable heterogeneity, which results in a balancing act between multicity and unity regarding, for example, resources and prior knowledge or further information. As a consequence, MOOCs need to have a special instructional design (Jasnani 2013; Kopp & Lackner 2014) that focuses on different framework conditions.

Jasnani (2013, 7) thus mentions a "lack of professional instructional design for MOOCs" which can be cited as one of the reasons for the low completion rates MOOCs suffer from. If we assume "an average 50,000 enrollments in MOOCs, with the typical completion rate of below 10%, approximately 7.5%, that amounts to 3,700 completions per 50,000 enrollments" (Ibid., 6) or even less: "Completion rates for courses offered by our interviewees ranged from around 3% to 15% of all enrollees." (Hollands & Tirthali 2014, 42) Several investigations (Khalil & Ebner 2014) have already been conducted to identify reasons for these high drop-out rates that lead to low completion rates such as Khalil and Ebner (2013a,b), who worked out the importance of interaction for guaranteeing participant satisfaction with MOOCs and increasing the probability of course completion. Colman (2013) conducted a web-survey and asked for reasons why participants would drop out of a MOOC; amongst others, the following six were given:

Reason	Classification
"Takes too much time"	personal/internal
"You're just shopping around"	
"You're there to learn, not for the credential at the end"	
"Assumes too much knowledge"	imposed/external
"Lecture fatigue"	
"Poor course design"	

Table 1. Reasons for dropping out of a MOOC

The reasons for dropping out of a MOOC can thus be classified within two categories: personal or internal, and imposed or external. With regard to the second category, it can be observed that some MOOCs "are headlined by prominent professors in their respective fields" (Hay-Jew 2015, 614). It is then the university's or the professor's prestige that leads to high registration rates; but it is neither the institution's nor the professor's name that helps to engage and activate the participants over a longer time period. As Hattie (2009, 108) states, "not all teachers are experts, and not all teachers have powerful effects on students"; it is ultimately the course design and the course content that influence participants' motivation to stay active within a course (Hay-Jew 2015). As mentioned above, an inappropriate course design or the lack of a clear course structure can be identified as main reasons for dropping out.

Regarding the first category, it has to be stated that when it comes to adult learning, "it is necessary to distinguish between learning for personal and for professional purposes" (CEDEFOP 2009, 44). Whereas professional purposes are often extrinsically motivated and "normally closely linked to enterprises and the labour market and can be more readily identified as further education or continuing vocational training" (Ibid.), it is more difficult to identify and validate the personal purposes as they are personal motivations. Sometimes MOOC participants just "shop around" and pick up different elements of a course but do not want to finish the course itself; sometimes it is not the

whole course that seems to be interesting but only parts of it that are new, innovative or simply appealing. It has already been stated that for informal learning settings willingness to learn and competences such as discipline, to cope with autonomous, self-directed, self-organised and self-paced learning processes and good time management, play an important role in achieving one's own learning goal. Thus, this learning goal can differ from the objectives or learning outcomes set up by the institution or the professors (Kyndt et al. 2009).

This paper aims to answer the research question "Is there a specific point during an xMOOC where learners decide to drop out of the course or to become lurkers?" and introduces strategies to overcome the "drop-out point" in order to keep course interaction high.

2. xMOOCs: their traditional instructional setting

There have been several researchers so far that have analysed different instructional settings for MOOCs. They have deduced MOOC design patterns or have formulated and presented tips and tricks to design MOOCs (Guàrdia et al. 2013; Jasnani 2013; Kopp & Lackner 2014; Richter 2013; Scagnoli 2012; Siemens 2012). In an xMOOC, some almost traditional components can be found: video lectures and readings, at least one discussion forum, and an assessment element, mostly a multiple-choice quiz or a peer-review assessment (Jasnani 2013: 11; Lackner et al. 2014; Wedekind 2013). These components can be used in different ways. The course forum posts can be compulsory for obtaining a certificate; the forum can be a platform to exchange ideas within the learning community, to talk about problems that arise within a course or to handle administrative and organisational issues. The quiz can be part of the video lectures, with integrated questions that stop the video and have to be answered for the lecture to continue, or it can be a stand-alone assessment with a flexible number of questions. Most MOOCs are set up as a four to eight-week course, with some MOOCs lasting twelve weeks (Jasnani 2013, 15; Richter 2013). Thus, Jasnani (2013: 15) highlights that "smaller, modular units of learning" should be the core of a MOOC, addressing different groups of people, i.e. taking the heterogenic audience into account. As Scagnoli (2012, 2) emphasises: "The only thing that all participants have in common is their interest for the topic of the course. This interest, however, is diverse as well and although all may be interested in the topic not all the participants enrolled have the same commitment or motivation for learning about that topic, and their interest has perspective." The course design should – not only in terms of the course structure but particularly in terms of content – cope with this heterogeneity: "The interest may go from learning more about a topic, to confirming concepts, to being curious, to finding a community to host discussion and concerns." (Ibid.) This diversity has led to a phenomenon called "MOOC Derivatives" (Hollands & Tirthali 2014, 48), that is to say the birth of different types of MOOCs such as the POOC (Personal Open Online Course), the Mini-MOOC, or the SPOC (Small Private Online Course). All these courses tend to cover different orientations or intentions towards the MOOC phenomenon. The question that remains is how to design an xMOOC that does not have the above-mentioned completion problem.

3. Learning Analytics: a way to understand the logic of xMOOCs

Due to the huge amount of data that arises when thousands of learners attend an xMOOC, new techniques and automated processes are necessary. Nowadays, in business, automated data processing is simply called Big Data; in education, the term Learning Analytics (LA) has been used for several years now. Learning Analytics can be summarised as an interaction analysis of educational data to understand and finally to improve learning behaviour (Greller et al. 2014; Retalis et al. 2006). In terms of MOOCs, LA is done behind the scenes by gathering data from different sources, from simple log files to tracking how often videos are watched or written posts are read. In our research study, we implemented a comprehensive automatic tracking system for user activities within each single course. The data was then thoroughly processed and interpreted.

3.1 First results

Within the Austrian MOOC platform iMooX, we scrutinised three different MOOCs focusing on student activity and completion rates: Gratis Online Lernen ('Free Online Learning'), Lernen im Netz ('Learning Online') and Soziale Medien & Schule ('Social Media & School'). All three courses were held in German, were delivered on iMooX and were each eight weeks' long. The workload was defined before the beginning of the course: Gratis Online Lernen (2 hrs/week), Lernen im Netz (5 hrs/week) and Soziale Medien & Schule (3 hrs/week). All three courses were

structured in a similar way and consisted of video lectures, readings, a discussion forum and a final multiple-choice quiz. Participants who passed every quiz with at least 75% could obtain a certificate at the end of the course. However, Lernen im Netz was a special course as it was not only a MOOC but also a university lecture at the University of Graz. Students of the University of Graz could attend the MOOC as a free course worth 4 ECTS but had to pass a supplementary electronic exam at the end of the semester.

Regarding the course participants, differentiation has to be made between those who have registered, those who are active students, those who have just completed the course, and those who are certified, as figure 1 shows:

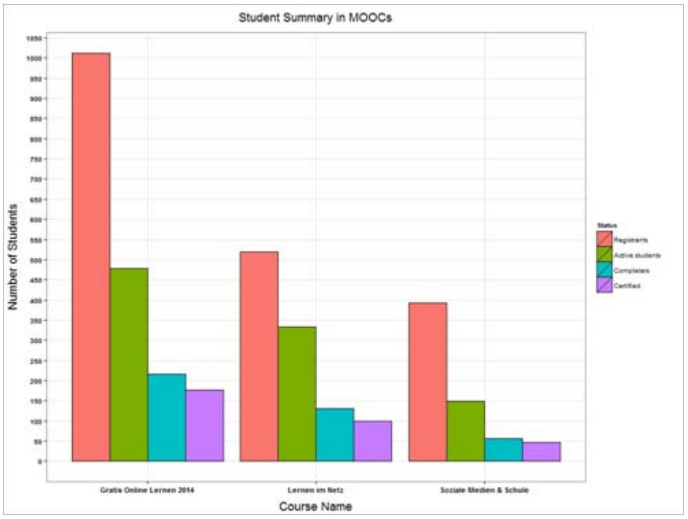

Figure 1: Different types of participants

As figure 1 illustrates, an obvious gap between registered and active students can be observed in all three courses. Active students are those who wrote at least one forum post or did at least one quiz. In Gratis Online Lernen, 1,012 students registered, but only half of them, 479 students, were active (47.33%). Lernen im Netz shows a higher percentage concerning the correlation between registered and active students (64.16%); Soziale Medien & Schule, a lower percentage (37.9%). As in "traditional" lectures at brick-and-mortar universities, the number of interested people who "pass by" and do not start a course is high. Whether they register without planning to do the course, want to get to know the teacher or the course or are interested in just one unit or aspect of the course, they can be compared to tourists that "shop around", as Colman (2013) showed in his web-survey. Calculating the completion rates on the basis of these registration rates, Gratis Online Lernen had a completion rate of 21.44% and a certification rate of 17.49%, 25.24% completed Lernen im Netz and 19% certified, whereas Soziale Medien & Schule had a completion rate of 14.2%, and 11.95% certified. If we calculate the completion rates on the basis of active participants, the numbers increase:

Course	Active & completed	Active & certified
Gratis Online Lernen	45.30%	36.95%
Lernen im Netz	39.33%	29.72%
Soziale Medien & Schule	37.58%	31.54%

Table 2. Active participants who completed or certified

Table 2 illustrates that the completion rates are on a level that is comparable to our experienced traditional university lectures. It shows nevertheless that more than half or two thirds of the active participants at a certain point of the MOOC lose interest, start lurking or become passive consumers. To identify this point, the participants' activity should be taken into account. For the three Austrian MOOCs, the quiz trials, the reading of forum posts and the writing of forum posts can be investigated.

Figure 2 shows the number of quiz trials within the three courses as quiz completion is crucial for obtaining a certificate:

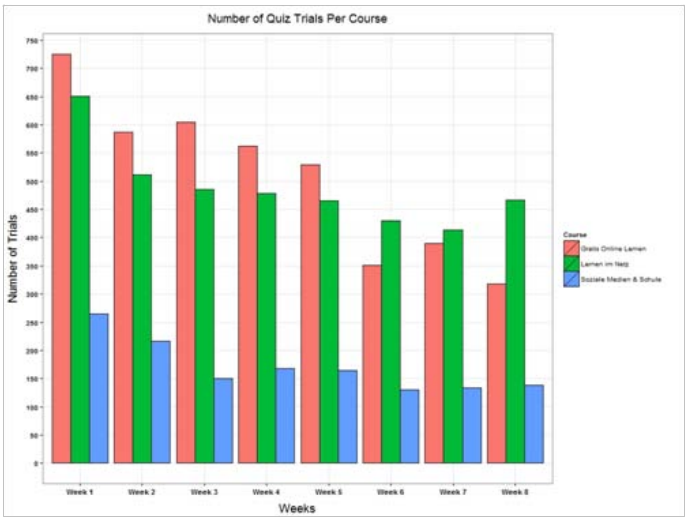

Figure 2: Quiz trials per week

The participants' quiz activity shows a tendency for the "drop-out point" to be between weeks 4 and 5. Week 8 in Lernen im Netz has to be seen as an outlier. The topic of the final week of this course was MOOCs, and it can therefore be presumed that the participants were highly interested in this topic or that the

quiz was very difficult, so more trials were needed. This split in the middle of the course can also be found within the forum reads and the forum posts, as figures 3 and 4 show, using Gratis Online Lernen as an example:

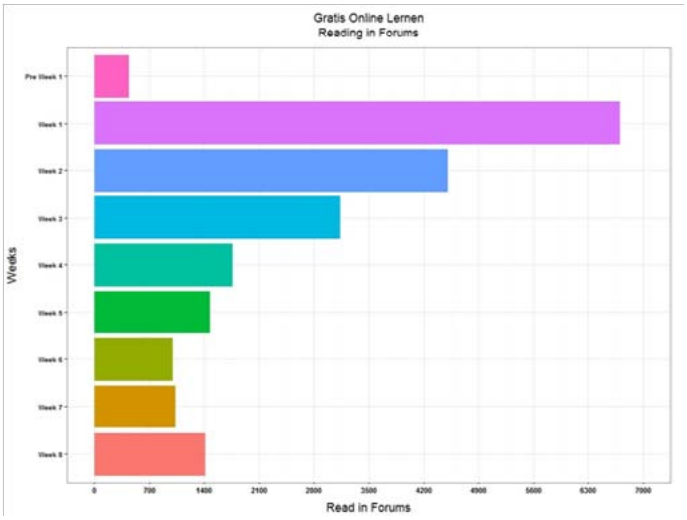

Figure 3: Forum reading: Gratis Online Lernen

The participants read the forum postings, but the frequency diminishes after the third week. Whereas in the first week there are 6,706 reads, in week 4 there are only 1,760. Lernen im Netz has 1,714 reads in week 1 and 465 in week 4 as the course offered a "pre-week" for the participants (Salmon 2007) to become familiar with the platform and to get to know one another; the readings in this pre-week are extremely high (2,970 reads). Soziale Medien & Schule has 186 reads in the first week and 153 in the fourth week; weeks 2 and 8 can be seen as outliers as the forum reads are significantly higher than in the other weeks (e.g. 299 in the final week).

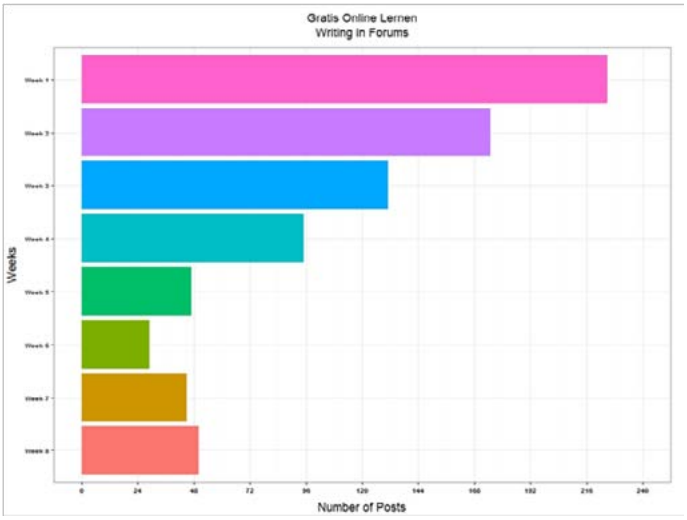

Figure 4: Forum posts: Gratis Online Lernen

If we consider active forum participation in terms of writing forum posts, the "drop-out point" in Gratis Online Lernen can be identified after the fourth week, with 95 posts, whereas week 1 had 251 posts. In the final week, 50 posts were added to the forum. In Lernen im Netz, the gap is even clearer: in the first week, the participants posted 169 entries, in the fourth week 20 and in the final week 9. Soziale Medien & Schule cannot be scrutinised in this context as the number of posts is too low: one post in the first week, five in week 2, two in week 4 and no more posts after the fifth week.

The role of forum activities for MOOCs have already been subject to research, providing a deeper understanding of the communication and collaboration processes within the courses and their participant community (Gillani et al. 2014; Khalil & Ebner 2013a). The quality of the forum activity as well as the quiz trials has to be further analysed for the above-mentioned courses. These first results, on a quantitative basis, help to identify a tendency within xMOOCs regarding the probable "drop-out point". All shown figures recall the so-called long-tail effect often discussed in terms of Web 2.0 (Bahls & Tochtermann 2012). Many learners begin a MOOC, but only few of them complete. On the basis of the data presented, the "drop-out point" for these three courses can be identified between the fourth and fifth week. At this point, participant activity decreases and stays more or less constant. This implies that participants who are still active in week 5 are more likely to complete the course.

4. Design Claim: Think granular!

As we saw in Table 1, there are two main categories of reasons why participants do not finish, or drop out of, a MOOC: internal and external forces influence their decision. The crucial point of decision whether to become passive or leave the course can be seen in course week 4. Indeed, course developers should react to this phenomenon and adjust the instructional design of their MOOCs: As a "pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice" (Alexander et al. 1977, X), an instructional design pattern is hence "[c]ombining a clear articulation of a design problem and a design solution, and offering a rationale which bridges between pedagogical philosophy, research based

evidence and experiential knowledge of design" (Goodyear 2005).

In the case of MOOCs and their completion rate, a design solution should be found in terms of a mental shift. The completion rate is not significant when it comes to measuring reached learning objectives. As the first results of the iMooX–MOOC analysis, in compliance with the results of Colman's (2013) web-survey show, the data basis has to be clear, and a difference between registration and activity has to be drawn. Virtual participants as well as traditional students often register for a course out of curiosity; they "shop around"; they want to see the professor for the first time. Yet, in the first lecture, they realise that the topic is not as interesting or appealing as they thought it would be or that they have registered for too many courses, so they have to drop out of some to manage their work–life balance. It might also be the case that only parts of a course, one or two topics/units, are interesting but the course as a whole isn't.

The same holds true for online courses, hence for MOOCs. When dealing with adult learners, who form the main MOOC audience, it is necessary to think in different patterns. Adult learners often do courses in their free time, struggle with self-organisation or time management or a lack of similar competences. They attend courses out of an intrinsic motivation, and the certificates do not influence their activity. As Scagnoli (2012, 2) points out, their interest or motivation differs "and although all may be interested in the topic not all the participants enrolled have the same commitment or motivation for learning about that topic, and their interest has perspective. The interest may go from learning more about a topic, to confirming concepts, to being curious, to finding a community to host discussion and concerns."

MOOCs can address this heterogeneity with a modular course design which can be understood under the main claim "Think granular" and results in three patterns that are displayed according to the structure used by Goodyear (2005). The main point of these three design patterns is their granularity. At the microscopic level, granularity has already been postulated regarding video content (Guo et al. 2014; Jasnani 2013, 14); at the macroscopic level, it should also be considered for the course itself.

4.1 Design Pattern: four-week MOOCs

Four-week MOOCs

This pattern deals with the overall structure of a MOOC on a macro level and describes the administrative structure of a MOOC.

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A granular structure addresses why the main drop-out point can be seen in the fourth course week. The choice of the course length is crucial in determining how likely participants are to finish a course.

As mentioned above, MOOCs tend to last four to eight or even twelve weeks. If participant activity decreases dramatically up until week four, course developers should consider planning and designing topic-related MOOC series (in analogy to podcast series) instead of longer courses, following a "concept of 'modularity'" (Hollands & Tirthali 2014, 92). An eight-week course could be split into two courses of four weeks, a step that could help developers as well as participants as "shorter courses are both easier to create and to complete" (Ibid.). As Jasnani (2013, 14) resumes, "granular courses are more digestible"; the learning process becomes a micro-learning process that seems to be less challenging in terms of the required competences (e.g. self-regulated learning, time management or self-organisation). The granular structure of a MOOC could address the identified motivation loss in longer courses.

- Three- to four-week-courses allow participants to see the "light at the end of the tunnel".
- Longer courses can be broken down into several courses focusing on different aspects of a topic, just as the BBC does for the general topic of World War 1 on the FutureLearn platform (https://www.futurelearn.com/organisations/bbc).
- It is easier to time shorter MOOCs around holiday periods.

Therefore:

Design MOOCs that last three to four weeks and that focus on a specific topic. Add a link word to these MOOCs to create a series of MOOCs that connect to one other in the way a podcast series, for example, does. Devise a marketing strategy for the courses that makes the link between the different short MOOCs of a series visible. Allow the MOOC to start in a way that respects longer holidays such as Christmas or Easter.

Patterns tied to this pattern include: Know your audiences[1] , Bring them along[2] , Induction[3] , Six-minute video[4].

4.2 Design Pattern: Granular certificates

Granular certificates

This pattern deals with the visibility of learning achievements.

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A granular certification process makes specific learning achievements visible. It answers participants' need to be able to select different topics and units that are important for their personal non-formal learning process.

In response to the different orientations and motivations towards any learning systems, a different certification process or attitude should be developed, e.g. by awarding badges (Schön et al, 2013). These badges can be seen as a way of making informal learning processes visible as they can be displayed in professional social networks, e.g. LinkedIn (www.linkedin.com). Within a longer MOOC, different badges – according to topics, projects or special achievements – can be acquired; the collecting process and the prospect of the next badge could increase or renew motivation. Participants decide whether they want to display these badges and if so, which badge should be visible according to their (digital) identity or needs. A further advantage of a badging system would be that participants are not forced to follow the mostly linear structure of MOOCs (Jasnani 2013, 15); instead, they determine the work order according to their prior knowledge and interests, i.e. to an individual framework. An example of a badging system can be seen in the German HanseMOOC (https://mooin.oncampus.de/mod/page/view.php?id=24), provided by MOOIN (https://mooin.oncampus.de).

Therefore:

Design MOOC certifications for different types of learners, e.g. active and passive learners, so that they can make their specific learning achievements visible. Keep in mind that the MOOC audience is very heterogeneous, which results in different learning goals. Provide granular certificates, e.g. badges or statements of accomplishment of different MOOC units, that can but not necessarily lead to the statement of accomplishment or certificate for the entire course. Help participants to make their learning visible.

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Patterns tied to this pattern include: Bend don't break[5] , Know your audiences[6] , Six-minute video[7] , Checkpoints[8] , Showcase of Learning (Bauer & Baumgartner, 2012).

4.3 Design Pattern: Suspense peak narratives

Suspense peak narratives

This pattern deals with the narrative structure of longer MOOCs.

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A granular narrative structure with several tension or suspense peaks can be essential in longer lasting MOOCs in order to keep motivation and activity high. If they don't know what is going to happen next, participants will be more curious and stay attentive.

Since the Middle Ages and its oral literary tradition, it has been known that the narrative structure of a text or a play is important for engaging the audience. If the writer or singer is able to create suspense and curiosity, the audience is more likely to come back to listen to the next episode (Bakker 1993). In modern soap operas or novels, this literary phenomenon is called cliffhanger: "Cliffhanger plot device ensures readers will buy the next installment in order to read and find out what happens." (Literary Device 2015: s.v.) Following a storytelling approach, the structure of a MOOC could be organised in granular portions using cliffhangers and moments of suspense to engage and motivate participants to stay active. These cliffhangers can be topic-related or interaction-related, for example in the form of supplementary or informal learning activities (Fidalgo-Blanco et al. 2014). An example of this pattern can be seen in Introduction to Forensic Science (https://www.futurelearn.com/courses/introduction-to-forensic-science), provided by FutureLearn (www.futurelearn.com), or the German HanseMOOC (https://mooin.oncampus.de/mod/page/view.php?id=24) or Mein Digitales Ich ("My Digital Me") (https://mooin.oncampus.de/mod/page/view.php?id=221), both provided by MOOIN.

1 http://ilde.upf.edu/moocs/v/b75.
2 http://ilde.upf.edu/moocs/v/b8a.
3 http://ilde.upf.edu/moocs/v/bxp.
4 http://ilde.upf.edu/moocs/v/bw8.
5 http://ilde.upf.edu/moocs/v/by7.
6 http://ilde.upf.edu/moocs/v/b75.
7 http://ilde.upf.edu/moocs/v/bw8.
8 http://ilde.upf.edu/moocs/v/bvv.

Therefore:

Design your MOOC using a consistent story. Plan different suspense peaks so participants become curious about what is going to happen next. Add questions or assignments at the end of the unit that will be answered in the next session. Add quizzes and deliver the answers in the following week's unit. Use a storyteller who tells a story and ties a narrative knot. Create different strands to treat parallel topics. Dissolve the narrative knots in different units. Don't use too many lines of action: participants could have difficulty in following.

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Patterns tied to this pattern include: Knowing the story[9] , Storytelling, Drumbeat[10] .

5. Conclusion

MOOC critics often use the low completion and high drop-out rates as a killer argument when disputing xMOOCs. As research has proven, at the beginning of a course the number and motivation of participants is higher than at the end. In using Learning Analytics to get a deeper understanding for the logic of xMOOCs, this paper has shown that the fourth and fifth week of an eight-week course are crucial in terms of participant motivation and orientation towards course completion. This so-called "drop-out point" adjudicates on whether participants continue, and most likely complete, or whether they drop out of the course. MOOCs, above all informal learning settings that are mostly for adult learners, have to take into account that participants' motivation to attend and complete a MOOC depends on personal and external reasons. To address these reasons and to foster activity throughout the course, the course design should be adapted: "Think granular!" is introduced as an instructional design claim for MOOCs, offering different approaches to engage participants to complete courses, or parts of them, and make their learning achievements visible. Three design patterns – four-week MOOCs, granular certificates and suspense peak narratives – can be deduced from the design claim, and have been presented in this paper. In this way, the granularity that has already been postulated regarding video content, e.g. in the design pattern Six-minute video, at the microscopic level (Guo et al. 2014; Jasnani 2013, 14) should be transferred to the macroscopic level – the course itself.

9 http://ilde.upf.edu/moocs/v/b7c.
10 http://ilde.upf.edu/moocs/v/byh.

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