Impact of feedback in students' engagement: The case of MOOCs

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"Education is an admirable thing but is well to remember from time to time that nothing that is worth knowing can be taught"

Oscar Wilde

Keywords

Feedback, Assessment, Student engagement, MOOCs, Online courses, e-Learning

Abstract

Over the last decade, Massive Open Online Courses (MOOCS) have received significant attention from the media, the educational sector and the business community. In principle, MOOCs provide free access to cutting-edge courses that could drive down the cost of university-level education and potentially disrupt the existing models of higher education. Considering also that recently COVID-19 has forced an unprecedented shift to online teaching at universities and other educational institutes around the world, students and universities are looking with renewed interest at the online delivery format. Nevertheless, despite their increasing popularity, MOOCs suffer from several limitations and several studies have reported a high drop-out rate as high as to 95%. Understanding the reasons behind dropout rates in MOOCs and identifying areas in which these can be improved is an important goal for MOOC development. In this respect, there is already some research activity on identifying the factors that influence student engagement which can be grouped into two broad categories, 1) didactic ones such as course structure and content, self-paced or not, workload and duration, course topic, type of exams, type of assessments and feedback, and interaction with students and instructors, etc.) and, 2) the non-didactic ones (students' and instructors' profiles, their demographics, reputation of institutions and of responsible professors and instructors, certification options, fee options, course popularity, etc.).

However, as it was shown in the literature review in this PhD thesis, there is lack of sufficient research into how specifically various feedback practices can affect student engagement with MOOCs. Therefore, the key purpose of this PhD research is to understand which feedback practices influence positively or negatively student engagement in MOOCs and to suggest related practices for improving it.

The data used for analysis was collected from the MOOCKnowledge project. This four-year project (2014-2018) aimed to build a database to provide insights into the profile, experiences and behaviour of participants of (European) open online courses.

First, we found insights on how student engagement can be measured in MOOCs and also which feedback factors affected student engagement; such as, the existence and type of assessments; the actors responsible for assessing student's work or providing feedback; the feedback mode; feedback content; how the feedback is provided; the feedback focus when the feedback is provided; interaction type; number of peer reviews per assignment; how many times

the student read fully the provided feedback; assessment impact; and, the feedback length. Most of those factors affected positively and some negatively the student engagement in MOOCs.

Second, based on the previous analysis, we specified those good practices that supported student engagement and influence it positively.

Considering also the changes in education that COVID-19 caused such as the significant transition to online education due to lockdowns and isolations, my research findings are of paramount importance since they provide new knowledge on how to increase student engagement in MOOCs and to an extent in on-line education .

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List of Abbreviations

cMOOC: connectivist Massive Open Online Course
DG: Direction General
ICT: Information Communication Technologies
IPTS: Institute of Prospective Technological Studies
JRC: Joint Research Center
MOOC: Massive Open Online Course
UOC: Open University of Catalonia
OUNL: Open University of Netherlands
PCA: Principal Component Analysis
SDT: Self Determination Theory
US: University of Seville
UPM: Technical University of Madrid
xMOOC: eXtended Massive Open Online Course

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _________________________

Date: _________________________

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I am deeply thankful to the GO-GN network namely the Global OER Graduate Network (GO-GN) that is a network of PhD candidates around the world whose research projects include a focus on open education (i.e. OER, OEP, MOOC). This network allowed me to meet and share my work and efforts with other PhD researchers and professors and realise that I am not alone in this journey. Special thanks go to the late Prof. Fred Mulder from GO-GN network; I will always remember him as a role-model and as an inspiring academician.

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To all of my family, my two boys Stamatis and Konstantinos as well as to Zoe, my partner for many years, thank you for your sacrifices, I love you and my apologies that I wasn’t able to be with you as much as I wanted. I hope one day you will understand. Also, I would like to thank my mother-in-law, Mrs Anastasia Apostolopoulou that, as a teacher and researcher herself, gave me useful insights and guidance on where to start with my PhD research idea.

Lastly, I would like to thank my students all these years that had been the fuel and energy for me to begin this work, to continue it and finally to complete it. Without them, I would not have started my PhD research and, definitely, I would not have finished it.

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Chapter 1: Introduction

I have been a trainer on how to exploit European funds since 2009 and this started in parallel to my work as a consultant in the EU area, a key occupation I have had since 1997. However, it only took me a few months to realise how fulfilling and demanding it is to be a teacher and the last 10-years I have completely dedicated myself to delivering trainings and coaching sessions as a European funding expert. These years have been by far the best professional years of my life.

I have realized as a teacher that training should be a journey for students during which they should experience a transformation in a pleasant way. The smiles and brightness on the faces of my students during and after my trainings are the best rewards that any teacher could get and signal about the success of the training session. Within my training career, I was blessed to receive my students' appreciations and to experience their transformation from "caterpillars" to "butterflies" that sparkled an inner light inside me and made me confirm at a crystal clear level my mission and vision as a professional and inspire me on every choice I make today. Specifically, my mission is to make individuals better professionals and better people via training and my vision is to also make the world a better place through training. I understand that such a mission and vision may sound "cliché" for people outside the educational community but for me they have given me a real purpose and guidance in my professional life. After that revelation, everything was clearer to me and that all my actions and decisions should always support my mission and vision.

With my mission and vision as a compass, I am sitting in front of my PC. It is spring in the year 2013. I am 41-years a family man with two boys 7 and 9 years old hungry for attention by their father and I was more than happy to give it to them. I have already been a trainer on how to exploit European funds for 4-years and I am puzzled as to how to deliver engaging training sessions to a wider audience. I thought that online training could be a good solution for me fulfilling my vision and I started exploring the options that online training could provide. Therefore, I participated in some online courses including some MOOCs but I was disappointed since in most of the cases the focus of those online courses was to deliver content and information but not to teach. One morning, I opened my LinkedIn profile and saw a post from a university called UOC - Universitat Oberta de Catalunya (Open University of Catalonia) that was accepting applications for its distance-based Doctoral programme in Education and ICT (e-learning). I was thrilled and in seconds I realised that the best way to reach my vision was to conduct a PhD in MOOCs and student engagement. Fully motivated, a marathon started for me collecting all the administrative documents and applying just in time with a draft proposal research idea.

On 20th September 2013, I was accepted for admission on the Education and ICT (e-learning) doctoral programme at the UOC. It was one of the happiest days of my life. Since then it has been a long journey. It took me seven years to complete my PhD thesis with a lot of personal and professional sacrifices -- but the experience and knowledge I have gained are invaluable. I have reached my own Ithaca like Odysseus in a journey full of obstacles but also with a lot of excitements till my final destination. My hope is that this thesis will contribute to increased evidence on student engagement on MOOCs based on various feedback factors.

1.1 Background and study context

This PhD research addressed the low engagement of students and high dropout rates within fully online courses and specifically in MOOCs by suggesting adequate feedback models. As explained in the literature review section where we defined feedback, we considered feedback and formative assessment as one integral part in this PhD thesis and when we referred to feedback, we meant both feedback and also formative assessment. Many publications and surveys[1, 2] referred to the high dropout rate in MOOCs that was around 90% if we compared the number of students who registered to the number who finished. However, many external factors outside the quality of the training delivery could be the reason for that such as free or low course fees, no enforced prerequisites for participation, no recognized university credits, no penalty for exit, etc. Other factors as pointed out by Adamopoulos (2013) could motivate someone registering to a MOOC course such as curiosity; accessing extra training content about a subject they are interested in; doing something more productive in their free time; watching how specific faculties teach their subject; getting more knowledge on a specific topic that they are interested in; receiving a completion certificate; etc. Possibly the dropout rate should be examined with respect to the different motivational factor for each participant and there was already continuous research in this area (Breslow et al., 2013; Maya-Jariego, et al., 2020).

Nevertheless, before this PhD study there was no significant research that examined student engagement in MOOCs with respect to their assessment and feedback structure. More specifically, it remained unexplored the feedback provided to the students in MOOCS whether could affect the

[1] Retrieved from https://www.insidehighered.com/news/2013/03/08/researchers-explore-who-taking-moocs-and-why-so-many-drop-out, on 11/11/2014

[2] Retrieved from MOOCs on the move: How Coursera is Disrupting the Traditional Classroom (text and videos). Knowledge @Wharton. University of Pennsylvania 7 November 2012, on 12/11/2014

quality and impact (negatively or positively) their engagement in the MOOCs but also in virtual learning environments in general.

Therefore, based on the above, the purpose of this PhD research was to address at what level various assessments (and especially formative ones) as well as feedback methods impacted students' engagement in MOOCs and to an extent the fully online learning environment.

This PhD study aimed to specify new as well as enhance existing theories, methodologies and practices based on assessment and feedback methods that could be applied in MOOCs and to an extent in virtual learning environments with a significant number of participants but with limited human resources for delivering the course.

Since it was not possible to examine all of the assessment spectrum (including summative ones), we focused specifically on **feedback factors** that could be applied in MOOCs for enhancing student engagement. In this research, we defined formative feedback as information communicated to the student that is intended to modify his or her thinking or behaviour for the purpose of improving learning (Shute, 2008) and formative assessment as any appraisal (or judgement or evaluation) of a student's work or performance in order to shape and improve the student's competence (Sadler, 1989).

Therefore, this work was based mainly on empirical methods that typically involved original collection of data and their analysis based on quantitative research methods that led to recommendations about feedback factors that can be applied especially to MOOCs for advancing student engagement. According to Hew (2015), student engagement in MOOCs was defined as the level of a student's engagement in a learning activity. The more the student is active within a course, the more engaged they are with this course. Furthermore, Hew reviewed specific literature (Fredricks, Blumenfeld & Paris, 2004; Helme & Clarke, 1998) on student engagement and identified three main dimensions:

1. ***Behavioural engagement*** referring to the learning activities that students are doing within a course such as completing an assignment, watching videos, participating in forums, etc.
2. ***Affective engagement*** referring to the feelings that learning activities create for students towards other colleagues, tutors, the course itself or the institution that runs the course.
3. ***Cognitive engagement*** referring to the emerging thoughts that learning activities create for students, e.g., cognition activity for asking and answering questions, for giving clarifications, for reasoning, etc.

However, this study focused especially on behavioural engagement and specifically on students' activity level and type within a MOOC and recommended specific assessment and formative models that can be applied in MOOCs for advancing this type of student engagement.

More specifically, we identified and analysed related research in regards to student engagement and its relationship with feedback factors and examined whether and under which conditions similar recommendations or even new ones could be applied especially in MOOCs for enhancing student engagement.

There was an extensive research on conditions and principles about feedback that enhance quality of learning and student engagement. One of the most significant ones was from Nicol & Macfarlane-Dick (2006). They argued that there were three conditions as prerequisites for students to be familiar with in order to benefit from feedback in academic tasks. They also pointed to seven principles for good feedback that should be applied in traditional teaching environments in order to strengthen the students' capacity to self-regulate their own performance. Similarly, other research (Gibbs & Simpson, 2004) argued that assessment had positive influence on students' learning and engagement and proposed a set of conditions for this to happen in traditional teaching environments.

However, no empirical research was identified to recommend feedback factors that could enhance student activity and consequently engagement specifically in MOOCs.

1.2 Research Questions, objective and hypotheses

Based on the theoretical analysis, we identified three main questions that were to be answered through the proposed research:

1. Which feedback practices are currently present in fully online courses and especially in MOOCs?
2. What is the influence (positive or negative) of feedback in students' engagement?
3. Which feedback model(s) should be developed and applied in fully online courses and specifically in MOOCs for advancing student engagement?

The answers to these questions supported the research objective that was to specify new or enhance existing feedback factors, namely theories, methodologies and practices based on feedback methods that could be applied in MOOCs for enhancing student engagement. Research and educational community had been from the appearance of the first MOOCs struggling with their low engagement of participants. Therefore, the objective of this research was to explore feedback factors that were present in MOOCs and their level of influence on student engagement.

1.3 Methodology

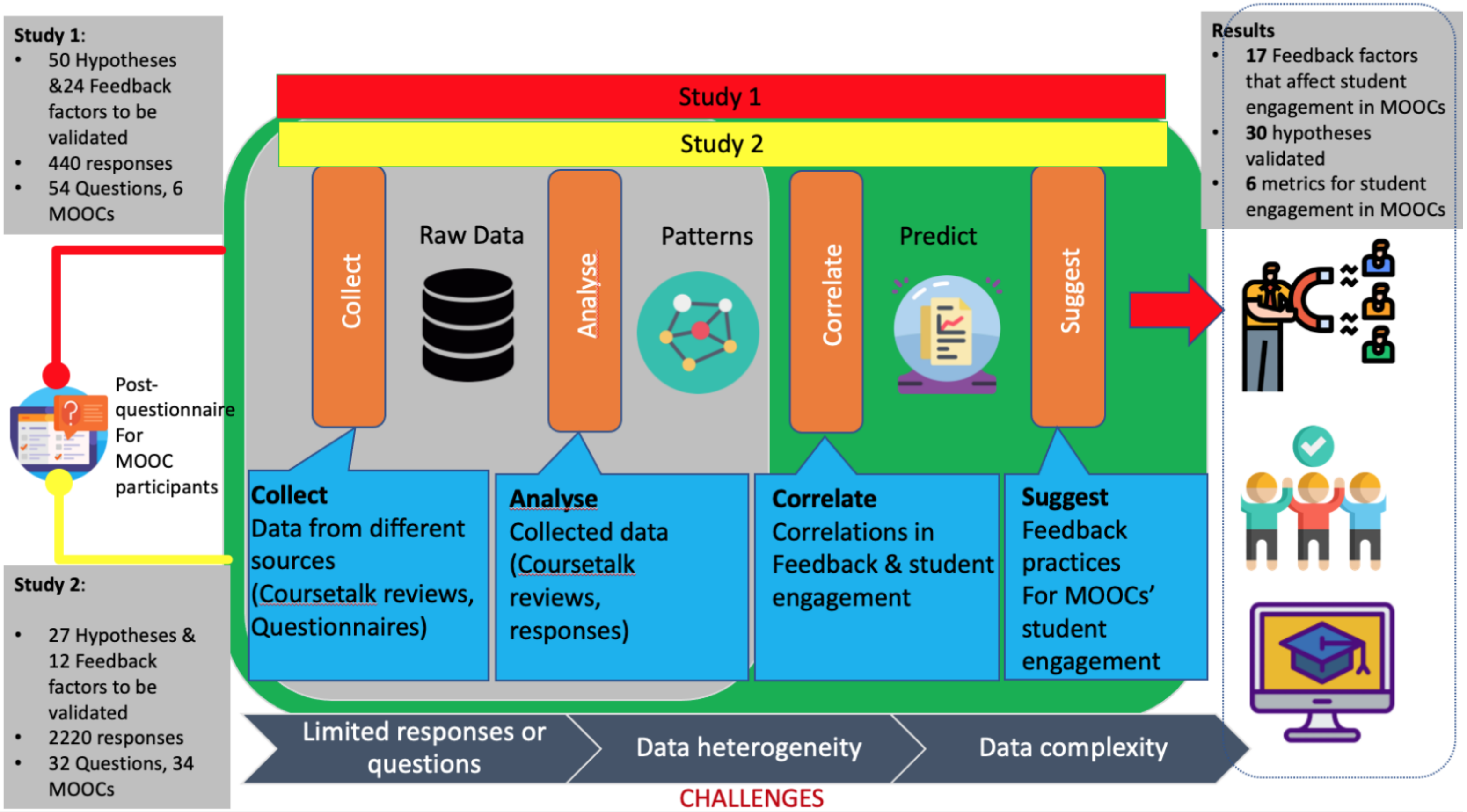
The approach involved two studies that both took place in the context of the MOOCknowledge project

- The first one involved the collection and analysis of primary data via a survey based on an extensive questionnaire that participants were invited to answer after their participation in the MOOC course . We considered this study as “**study 1**”
- Similar to study 1, the second study collected and analysed primary data via a survey based on questionnaire that participants were invited to answer after their participation in the MOOC course. The difference with study 1 is that now the questionnaire was much shorter and allowed the collection and analysis of more responses. We called this “**study 2**”.

Both studies 1 and 2 were based on empirical research where we analysed the collected data via statistical methods and we identified correlations between feedback and student engagement in MOOCs and finally we recommended feedback practices that can increase student engagement.

We show the overall concept and approach of this research in Figure 1 below.

Figure 1: Research concept and approach



In study 1, we formulated 50 hypotheses in regards to the relationship between student engagement and 24 feedback factors based mainly on the literature analysis. In order to analyse the validity of those 50 hypotheses, we formulated a post-questionnaire that included 54 questions related to those hypotheses and 440 responses were collected from students in 6 MOOCs. We analysed the relationship between student engagement and feedback factors using Principal Component Analysis, one-way ANOVA and Mann-Whitney. As a result, the study 1 findings found 27 hypotheses valid and in specific 14 feedback factors that affect student engagement.

Similarly, in the next and last stage of this approach that is **study 2**, we formulated 27 hypotheses based on 12 feedback factors. 10 out of the 14 feedback factors were also validated from study 1, plus two more based on scientific literature with high number of citations and impact. In order to check the validity of those 27 hypotheses between student engagement and feedback factors, we used a shorter questionnaire that included 32 questions related to those hypotheses and we managed to collect 2220 responses from 34 MOOCs. We applied in this study similar statistical methods as in study 1, namely Principal Component Analysis, ANOVA and independent t-samples for finding relationships between student engagement and the 12 feedback factors. We found 8 hypotheses and in specific 7 feedback factors that affect student engagement. Also, based on findings from both study 1 and study 2, we provided simple summaries on the feedback practices that were applied overall in the examined MOOCs.

Overall, we validated jointly from both studies 1 and 2, 30 hypotheses out of the initial 50 and 17 feedback factors out of the initial 24. We used these validated findings (i.e. 30 hypotheses and 17 feedback factors) as the model in order to suggest feedback practices for increasing student engagement in MOOCs. We also faced two main challenges in this PhD research namely limited number of responses or missing values as well as data heterogeneity and complexity between studies 1 and 2 that we addressed with proper statistical techniques.

Nevertheless, the key achievement of this PhD study was that we identified specific feedback factors that influenced positively MOOCs student engagement and six student engagement metrics in MOOCs, namely the completion rate of assignments, the access rate to learning material, the attempt rate of activities and assignments, the communication level, the participation level to activities and assignments and the access level to the learning material. Moreover, we found that some feedback factors could influence positively one student activity and at the same time negatively another one, e.g. having the system automatically assess students' work affects positively completion rate of assignments but affects negatively the access rate to the MOOC learning material. Therefore, the PhD findings are very important since they provided a starting point for MOOC actors to explore specific feedback factors that impact not only student engagement in general but also specific student activities. We consider these findings as the stepping stone for increasing the level of engagement of MOOC students in various student activities and requirements.

Finally, during the whole development of the thesis, we gave special emphasis on disseminating results in related conferences and in scientific journals. Even at the initial stage of this PhD study, we presented and published four research papers with summaries of the findings and recommendations. The conferences were the OpenEd14 Conference in Washington in November 2014; the Open Education Global 2015 Conference in Banff, Canada, in April 2015; the 9th Annual International Conference of Education, Research and Innovation in Seville, Spain, Nov 2016; and, the 9th International Conference on Education and New Learning Technologies, Barcelona, July 2017.

1.4 Thesis outline

This PhD study was presented in 9 chapters. This first chapter outlined the basic principles under which this research was conducted.

Chapter 2 dealt with the literature review. It begun by introducing the theoretical approach and exploring various student engagement theories about online and off-line courses (Section 2.1). After this, we defined and analysed feedback outside and inside the formative assessment context, (Section 2.2). In section 2.3, we discussed what defines student engagement and how it is perceived. In section 2.4, we explored the relationship between feedback and student engagement and more specifically what feedback factors affect student engagement as a good starting point for the hypotheses to be examined in this PhD. In section 2.5, we explored the significance and importance of online courses and MOOCs and, more specifically, the evolvement of online courses and MOOCs; the impact of MOOCs in Education; the MOOC structures and teaching approaches with emphasis on feedback; and the MOOC challenges and limitations in relation to student engagement. We analysed also in this section various assessment methods in MOOCs, as well as student engagement factors in MOOCs. After this, in section 2.6, we examined feedback factors in MOOCs that could support student engagement and we concluded in 2.7 with those feedback factors that emerged from the literature analysis and formed the basis for the research hypotheses.

In chapter 3, we presented the research design and methodology that consists of empirical approaches based on quantitative research methods. In section 3.1, we introduce the whole research setting. After this, we presented the research questions and we outlined the approach

(Section 3.2). In section 3.3, we presented study 1 approach that was an empirical one based on a survey and the respective statistical analysis. Also, for this study, we described the questionnaire used and the datasets as well as the procedures for dealing with each research question. Similarly, in section 3.4, we did the same for the study 2. In section 3.5, we described the tools used for the data collection and in 3.6 the ethical issues that we considered.

In chapter 4, we presented the results from the two studies and we introduce them in section 4.1. In section 4.2, we presented the results from the study 1, namely the findings from the statistical analysis and those feedback practices that we identified being used in MOOCs from the study 1. We closed this section with those feedback practices that there were present in the six MOOCs from study 1. In section 4.3, we presented in a similar way, the results from study 2, namely the PCA results and the findings from the statistical analysis; We concluded this section with those feedback practices that were found based on the responses from the participants in 34 MOOCs. I could have eliminated some details from the Results section for facilitating reading comprehension but I decided not to in order to make it easier for anyone that is interested to follow up my research and extent it further based on my own datasets under the open access framework.

The discussion of the findings took place in four chapters for facilitating presentation and comprehension and aligning them with the three research questions. Chapter 5 discusses the findings related to Research Question 1, i.e. Feedback practices present in MOOCs. Chapters 6 and 7 were the core ones where we discussed Research Question 2, i.e. Feedback factors that affect student engagement in MOOCs based on study 1 and study 2 respectively. In those chapters, we discussed how the results related to the theory and methods discussed previously as well as identifying any gaps in the current literature. Chapter 8 discussed Research Question 3, i.e. Feedback factors that influenced positively student engagement in MOOCs that resulted from both studies 1 and 2.

Finally, in chapter 9, we summarised what we did, what we found and what the implications of this PhD study are. More specifically, we answered the three research questions and what is the significance and implications of the findings as well as the contributions that this PhD study made in the area of online education and specifically in MOOCs. Lastly, we presented what were the limitations of this research that formed the basis for further research in the area of student engagement in MOOCs and feedback factors.

Personally, being an educator myself, I was fascinated with all of the above results that I believed open a new era in education and especially in online education that teacher interaction was quite limited such as in MOOCs.

Chapter 2: Literature Review

2.1 Introduction

For years the research community had been attempting to understand the feedback practices that influenced student engagement in the traditional class context with the teachers delivering their course to students present in the same room. However, since the emergence of digital tools and networks in education, remote training in synchronous (real-time) and asynchronous time had been facilitated that led to the development of online courses and more specifically of MOOCs (Massive Online Open Courses) in the last decade. The traditional class model was not applicable anymore in distance learning and digital learning providers. Instructional designers and educational and research communities had been introducing new teaching models including formative and feedback and assessment practices for increasing student engagement. This section analysed the theoretical basis of this research: that was, the relationship between feedback factors; student engagement; and online courses specifically MOOCs. More specifically, in this chapter, we identified and defined student engagement as well as feedback factors, their relation among them, as well as their link with online courses and specifically with MOOCs.

In section *2.2 Feedback definition*, we began by reviewing different feedback definitions and processes according to the literature as well as the relation between feedback and the impact of feedback on learning.

In section *2.3 Student Engagement definition,* we summarised different dimensions on student engagement according to their education level and the current trends in the research about student engagement as well as how student engagement could be identified and, if possible, measured. We examined engagement concepts in any teaching context (online or offline) and the various factors that had been identified so far from the research community. The analysis in this section did not target specifically any links between student engagement and feedback practices but it allowed us to explore the various theories of student engagement and identify those that could be considered further in this PhD research.

In section *2.4 Feedback and its relation with engagement*, we identified from scientific literature various feedback factors that influenced student engagement. Such information was very important in order to direct this research approach in analysing how feedback factors were considered of high quality and were related to student engagement.

The analysis on feedback and how it could be effective and correlated with student engagement, should be linked with how it could fit within online courses and specifically within

MOOCs that we should understand them better. Therefore, in section *2.5 Significance of Online courses and MOOCS,* in order to understand the expectations, benefits, challenges and limitations of online courses and specifically of MOOCs, we introduced the evolvement of eLearning and online courses in general; the emergence of MOOCs; their impact in education; their structure and teaching approach with emphasis on formative and feedback assessment practices; and, their challenges and limitations especially related to student engagement as well as assessment methods applied in MOOCs. This information highlighted also the significance of this PhD research thesis and the importance of the expected research findings for the educational community that seems to be based heavily on online education and more specifically on MOOCs.

Finally, we completed the literature review with section *2.6 Feedback and engagement in MOOCs*, that we identified various student engagement practices applicable in MOOCs according to the scientific literature as well as those feedback factors in MOOCs already identified by the research community that supported student engagement. Such information was valuable for formulating the research hypothesis and forms the basis of this PhD research efforts.

In the last section, 2.7 *Summary*, we summarised the key findings from the literature review that supported the research endeavours in this PhD thesis.

2.2 Feedback definition

We saw that Nicol (2010) found that student surveys across the world highlighted students dissatisfaction with the feedback they received on their assignments and many institutions had been putting plans in place to address this issue. Also, as Scott (2014) pointed out, there was no widely agreed scholarly definition of ‘feedback’ since in much of the literature the definition of the term was implied from its context. Research and further development regarding feedback tended, however, to have lagged behind developments in other areas of research into higher education. However, Scott defined feedback as the means by which a student is able to observe at each stage of the course how he or she was going in terms of the knowledge, understanding, and skills that would determine his or her result in the course. This definition was quite relevant since it didn’t not require teachers to tell the students anything, although it certainly did not exclude the teacher from providing information. This student-centred definition of feedback basically explained why students never seemed to believe that they had enough feedback, when teachers believe they were giving plenty of useful feedback (Scott, 2014). This was relevant to this research here since most feedback definitions assumed that firstly feedback involved teachers giving students information about their performance via an assignment (Bevan, et al., 2008).

Teachers commonly complained that the students' sole or primary concern was in the obtained mark, rather than the comments provided (Carless, 2006) but Scott (2014) concluded that there were cases where students complained that most teachers are mainly interested in providing a numerical mark. But the importance of the numerical mark was not surprising, since this was possibly the single most efficient way by which the student could assess how they were doing in the course. It was also likely to be the most reliable measure since comments might sound positive or negative depending on their tone and style, even for two assignments receiving the same mark. This did not mean that most students were not also interested in receiving comments within feedback. On the contrary, feedback included in assignments was the most important factor on students' satisfaction with feedback but should not be the only one (Scott, 2014). According to Hattie & Timperley (2007) a critical conclusion was that teachers did need to seek and learn from feedback (such as from students' responses to tests) as much as do students, and only when assessment provided such learning it was of value to either.

Feedback was a key communication bridge between the trainer and the trainee, and the main focus was therefore on how to ensure that it was constructive rather than inhibitory towards learning (Yorke, 2003). Feedback was in general and in principle considered to be any information that teachers provide to students in order to support them in understanding the outcome they achieved and to improve their future performance. In an extension to that, Hattie & Timperley (2007) defined feedback as information provided by an agent (i.e., not necessarily only from just a teacher but also via other actors, e.g., peer, book, parent, experience, etc) regarding aspects of one's performance or comprehension level.

Shute (2008, p.154 defined another term related to feedback and that is 'formative feedback' or 'formative assessment" as "information communicated to the student that is intended to modify his or her thinking or behaviour for the purpose of improving learning" and she highlighted aspects of feedback that actually had positive impact on learning. She concluded with lists of tips like "things to do", "things to avoid", "timing issues" and "student characteristics". Hattie & Timperley (2007) also addressed feedback as the practice that influenced learning in a positive way and developed a model of "feedback to enhance learning". Both these significant articles had one common base: The focus was on the provision of feedback and characteristics of the feedback as information provided mainly to the student. If we consider Shute's (2008) definition, then we can assume that it was the feedback context that modified thinking and behaviour. She also emphasized that by focusing on timing as well as in student characteristics then the feedback provider should take into consideration that different students interpreted feedback information in different ways. We found the same pattern in Hattie & Timperley's (2007) model: They brought the feedback information or feedback message up-front. These perspectives were well grounded in research and brought forward useful information that was needed to understand how feedback enhanced learning. There was an assumption that for feedback to be formative (Shute, 2008) and feedback to enhance learning (Hattie & Timperley, 2007) the feedback needed to be formulated and delivered in such a way that it encouraged students' active engagement with the feedback.

Therefore, we saw that most feedback definitions assumed that feedback involved teachers giving students information about their performance via an assignment. However, we were experiencing a change in this definition, since the education community had acknowledged the need for two-way communication between the teacher and the student (Espasa, Guasch, Mayordomo, Martinez-Melo, Carless, 2018) and, as we saw, Scott (2014) attempted to re-define feedback from a student's perspective to deal with general student dissatisfaction and disengagement with the feedback they received as part of their assessment.

Not only feedback but also summative and formative assessments were an integral part of the learning process (Garrison & Ehringhaus, 2007). Summative assessments were defined as tests (e.g., End-of-unit or chapter tests, End-of-term or semester exams) that were taken periodically to determine at a particular time what students knew and did not know. But summative assessments occurred too late in the learning path and could not provide useful information to the students for revising their learning approach and allow the teacher to make instructional adjustments and interventions during the learning process. On the other hand, formative assessment included test and assessment activities where the mark given along with the provided feedback were important information for teachers and students assessing their teaching and learning approach respectively. In fact, the key component of engaging students in the assessment of their own learning was providing them with formative feedback as they learned.

Formative feedback was based on information provided to the student that was intended to modify the student's thinking or behaviour for the purpose of improving learning (Shute, 2008). Effective formative feedback should be specific, simple, descriptive, and focused on the task (Fluckiger, et al., 2010). In fact, research showed formative assessment to be the most important strategy to advance students in their learning since it should provide students with an understanding of what they were doing well, linking to classroom learning, and giving specific input about how to reach the next step in the learning process. In other words, formative assessment should not be limited, namely just a grade, a sticker, or labelling such as "good job!" A significant body of research considered that such limited feedback did not lead to improved student learning (Garrison & Ehringhaus, 2007). According to Havnes et al. (2012), feedback was considered to be a key component in formative assessment and one of the factors that had the strongest influence on learning (Black & Wiliam, 1998; Crooks, 1988; Hattie & Timperley, 2007; Carter, 2009). As we saw, feedback and specifically descriptive feedback was considered an integral part of formative assessment. This meant that we could not have proper formative assessment without this being accompanied by some feedback. In this research, we focused both on feedback that aimed to improve student's performance and achieved the learning objectives.

Therefore, since feedback was part of formative assessment, we considered that feedback and formative assessment went together in this PhD thesis and when we referred to feedback, we meant both feedback and formative assessment.

Another relevant issue was that the positive effect of feedback as part of formative assessment was not always the case and it was achieved under some conditions. Specifically, Kluger & DeNisi (1996) found that more than one-third of the effects indicated a negative impact of feedback on learning. Therefore, Sadler (2010) highlighted the need to consider in the analysis of formative assessment the students’ understanding of the feedback information and the active use of it in furthering learning. Earlier, Ramaprasad (1983) added the active use of feedback as a necessary condition only when the information provided to the student was used to alter the gap between the actual level of performance and the reference level (see also Sadler, 1987). Boud (2000) claimed that feedback is considered effective by the student or by those giving the feedback when students were able to use it to produce improved work, via, for example, re-doing the same assignment, and also there were many factors that should be considered. Such factors that could influence the effectiveness and usefulness were feedback content; to be on time; to be regular; to be sufficiently detailed; to be legible (if hand-written); to be comprehensible and consistent; and, pitched at an appropriate level (Carless, 2006; Nicol, 2010; Orsmond, Merry & Reiling, 2005). The same thoughts were expressed by Dawson and his team in their survey (Dawson et al., 2019). Also, Li & De Luca (2014) found that some of the features of feedback most desired by students was the feedback content and more specifically when it was personal, explicable, criteria-referenced, objective, usable and applicable to further improvement. Moreover, research emphasized the need for students to be active participants in the feedback for that process to become effective (Boud, 2007; Nicol, 2010; Sadler, 2010; Vardi, 2012).

Further factors related to feedback and student engagement were identified in Section 2.4: *Feedback and its relation with engagement section*. These factors formed the basis of the hypotheses in this research.

2.3 Student Engagement

According to Deng, Benckendorf & Gannway (2019) and Eccles & Wang (2012) student engagement could be defined in many different ways that also depended on the learning community it referred to (e.g., schools, colleges and universities, web-based learning, and business education settings) and there was a significant literature on that. Hew (2015) reviewed specific literature (Fredricks, Blumenfeld & Paris, 2004; Helme & Clarke, 1998) on student engagement and identified its three main dimensions:

1. Behavioural engagement referring to learning activities that students were doing within a course such as completing an assignment, watching videos, participating in forums, etc,
2. Affective engagement referring to the feelings that learning activities created in students towards other colleagues, teachers, the course itself, or the institution that run the course
3. Cognitive engagement referring to the emerging thoughts that learning activities created in students, e.g., cognition activity for asking and answering questions, for giving clarifications, for reasoning, etc.

Furthermore, Hew (2015) with the support of other literature (Reeve, 2012; Skinner et al., 2009) as well as Tai, Ajjawi & Bearman, Wiseman (2020) directly linked student engagement with motivation and more specifically with Self-Determination Theory [SDT] (Deci & Ryan, 1990; Deci & Ryan, 2000) and concluded that student engagement and more specifically:

a) behavioural engagement is driven from the need of autonomy (the need of students to sense they were not dependent on other peoples' actions),

b) affective engagement is driven from the need of relatedness (the need of students to connect with other people for a purpose that related with them as well as they accessed info that was related to their expectations) and,

c) cognitive engagement was driven from the need of competence (the need of students to master specific knowledge).

In brief, authors which analysed engagement, agreed that it was mainly categorized into cognitive, emotional and behavioural that confirmed its multidimensionality (Deng, Benckendorff & Gannaway, 2019). Namely, student engagement fitted closer either to behavioural and cognitive engagement or closer to affective engagement. For example, Macquarie University (2009) has defined student engagement as ‘the extent or quality with which students are committed and actively involved in their learning” (Macquarie University, p. 1) that suggested student ownership of their learning by emphasising the student’s active involvement with the learning process, rather than emphasising interactions with other students, with academics or with institutions. Such an approach was related to behavioural and cognitive engagements. However, other research initiatives, for example student engagement surveys from the American National Survey of Student Engagement (National Survey of Student Engagement, 2009) and the Australasian Survey of Student Engagement (Radloff & Coates, 2010) had an implicit definition of engagement embedded within their questionnaires. This implicit definition emphasised engagement with peers, with staff, with the institution, and with specific technologies or types of learning activities, thereby ensuring that responsibility for student engagement did not lie solely with the student. Such an approach was closer to affective engagement. Therefore, student engagement could fit under any or in all these three dimensions of student engagement (Behavioural, Affectional and Cognitive) but it was not clear whether these three dimensions of student engagement were applicable also in online environments and specifically in MOOCs. In general, most of the research as we saw next, highlighted this gap in the research.

The literature from Fredricks, Blumenfeld & Paris, (2004), Deci & Ryan (1990), Deci & Ryan (2000) that had been considered as the most significant ones in student engagement for years (with more than 39,000 scientific articles referencing them[3]), did not consider student engagement in the context of an online environment. As more university services went online, and many of the incoming students had grown up in the digital age, it was becoming increasingly important to understand the effects of online learning practices on student engagement (Krause & Coates, 2008). Online students were, in general, positive about their online study, particularly with regards to its convenience in terms of independence of location and time (Fleckhammer & Wise, 2011). However, mode of delivery had a significant impact on retention rates, in that online students were more likely to drop out than on-campus students (Patterson & McFadden, 2009). Although some online students dropped out of their courses for reasons specific to the individual student (e.g., work commitments, ill-health), Willging & Johnson (2004) reported that feelings of isolation, disconnectedness, and technological problems were common explanations for the high drop-out rates in online courses. In other words, many online students dropped out from their study due to a lack of engagement with the online learning environment. Furthermore, some researchers (LeBay & Comm, 2004; Li & Irby, 2008) argued that online students also had higher expectations regarding interaction with teaching staff than on-campus students, presumably because staff members tended to be more visible to them through the interface of the online course materials than their fellow students. Online study was, for the most part, a solitary pursuit, whereas on-campus students had greater opportunity to engage with their peers in the course of their daily

[3] Based on number of citations from google scholar

activities on campus than they did with the teaching staff. Online students, more so than on-campus students, needed to be able to engage with their learning in an independent style, but it may be that overall academic engagement could be facilitated for this group by developing a greater sense of social engagement. Also, concerns had been raised that the technology comprising a university's learning management system ended up driving, rather than supporting, pedagogy (Deneen, 2010; Lane, 2009). Although this possibility was often cast in a negative light, learning technologies can also had positive effects on teaching practices and student engagement (Coates, James & Baldwin, 2005). With careful educational design, online courses were able to facilitate a sense of being part of a learning community despite the fact that students and staff were separated both physically and temporally (Rovai, 2002). Online activities, multimedia tools and discussion forums could increase emotional engagement in the learning environment (Chih-Yan Sun & Rueda, 2011) and provided the necessary elements for a community of students. Students who participated in a learning community were more engaged with their learning, which in turn was positively related to student outcomes and satisfaction (Zhao & Kuh, 2004). Temporally synchronised chat sessions and asynchronous discussion forums were both important tools in student engagement (Chih-Yan Sun & Rueda, 2011; Wise & Cui, 2018). In section 2.5.3: *MOOCs and student engagement*, we discussed in more detail these concepts specifically in the context of MOOCs.

Finally, Pugh & Phillips (2011) argued that student engagement was related to how the students appreciate the course content, structure and way of delivery (e.g., let's name it "Content Structure Appreciation"). To support their claims, the authors utilized Brophy's (2008) model of "content appreciation" and related the content appreciation with student engagement. According to this model, the teachers needed to first rediscover the content worth teaching; second, frame the lessons properly in terms of the content's value in students' lives, which motivated them; and third, scaffold "appreciation" according to students' "motivational zone of proximal development" (Pugh & Phillips, 2011).

Taking into account these studies, we started to examine the context of feedback, how it relates to student engagement, and how it may be related to MOOCs. In the next section, we analysed in more detail, how feedback was related to student engagement.

2.4 Feedback and its relation with engagement

After the analysis of the most significant definitions and different dimensions of feedback and student engagement, we presented now the relationship between feedback and student engagement that was the key purpose of this section and more specifically what feedback factors affected student engagement. This analysis would give us a good starting point for the hypotheses.

Winstone & Boud (2020) had discussed six problems created by the entanglement of assessment and feedback, namely: 1) students' focus on grades; 2) comments justifying grades rather than supporting learning; 3) feedback too late to be useful; 4) feedback subordinated to all other processes in course design; 5) overemphasis on documentation of feedback; and 6) the downgrading of feedback created by requirements for anonymous marking. Also, another factor that affected the feedback value was its comprehensibility and elaboration level since according to Sutton & Gill (2010), when feedback could not be understood by students it consequently produced a loss of self-esteem. In fact, students who perceived that they did not perform adequately in an assessment but could not understand why or what to do about it, were significantly disempowered and lowered in their engagement. Students may be unable to understand the feedback. This was supported by studies of student comprehension of written feedback (Austen & Malone, 2018; Cavanaugh & Song, 2014; Chew, 2014; Nicol, 2010), which was probably the most common medium for delivering feedback in the social sciences. Lack of engagement with feedback was a serious problem because unless students engaged with it, feedback could not be effective, which meant that time spent by teachers preparing it was wasted. Another issue was that unless students understood the assessment criteria for their work, (i.e., the context for the feedback), they could not fully interpret and 'decode' the feedback. This limited feedback effectiveness as well as student engagement. Feedback was rarely intended as a new piece of content – as something which is comprehensible and usable in its own right. However, providing sufficient feedback for supporting student engagement especially in the context of mass higher education such as in MOOCs had been challenging. (Ferguson 2011; Hounsell, et al., 2008; Nicol, 2010). Even in cases where a large number of teachers spent significant hours providing feedback for students, students tended not to find the feedback as useful as the teachers initially assumed (Carless, 2006; Onah, Sinclair & Boyatt, 2014). Teachers were frustrated by the fact that students do not always seem to pay attention to the provided feedback, e.g., by not collecting their assignment (Gibbs & Simpson, 2004). However, those students who did read it often do not know how to interpret it or use it in their learning process. Furthermore, writing constructive feedback comments was a time-consuming process not only for the academic staffs in traditional classroom teaching context but also in online and MOOC courses where they may be less willing to invest the time and effort needed to provide personally tailored feedback to individual students which encouraged a deep approach to learning. Therefore, finding out what students understood by 'feedback' could be an important step towards increasing student satisfaction with the feedback academic staff or peers provide and increase students' engagement in the course (Carless, 2006).

Also, another feedback factor related to engagement was its applicability and relatedness. Some researchers (Handley & Williams, 2011) proposed that if interactions with students were to be pedagogically effective, students must engage with them. This was particularly the case with feedback which relied for its effectiveness to be applied at some point in the future. However, a key issue for many students was that they perceived much of their feedback to be irrelevant to future assignments and modules (lack of connectedness and relatedness). Students considered the feedback provided specific only to its related assignment and actually not applicable to other learning activities and assignments. Students may decide not to engage with feedback if they see no link from one module to the next. This behaviour may occur if students see modules as unique rather than progressive, and as a result, they perceive no value in processing and applying feedback to subsequent assignments. More specifically, Carless (2006) found that teaching staff believed students are too grade-oriented and not interested in learning from feedback comments or were only interested in feedback comments which provide them with 'correct' answers. Within this context, students may be driven solely by the extrinsic motivation of the mark and consequently they desire feedback which simply provides them with correct answers. Student perception of the 'irrelevance' of feedback may arise for a number of reasons (Boud & Molloy, 2013; Carless, 2015; Carless, 2016; Chanock, 2000; Dawson et al, 2019; Gibbs & Simpson, 2004; Handley & Williams, 2011; Winstone, et al., 2017 Nicol, 2008; Winstone & Carless, 2019). Instead, feedback was conventionally understood as a mechanism for helping students see and then close a performance 'gap' and develop their self-assessment skills. This gap was the difference between the student's own work and an idealised performance indicated by the assessment criteria and standards, for example in the form of a criteria grid. Also, Hattie & Timperley (2007) argued that effective feedback should answer the student three major questions: *Where am I going? How am I going? and Where to next?* The answers to these questions enhanced learning when there was a gap between what was understood and what was expected to be understood. Such feedback could increase effort, motivation, or engagement for reducing this gap.

Furthermore, feedback was more effective when it aided in building cues and information regarding erroneous hypothesis and ideas and then led to their rejection and consequently to the development of more effective and efficient strategies for processing and understanding the material. Furthermore, According to Hepplestone, Holden, Irwin, Parkin & Thorpe (2011) the use of technology to support and enhance student learning and assessment was well documented in the literature, and effective feedback practices were similarly well published. However, in regards to the use of technology to support and enhance feedback processes and practices (i.e. production, publication, delivery and students making use of feedback through technology), they found the literature to be limited. It would be relevant in this research to consider how students pay attention to the feedback provided and use it further with the use of MOOCs technology.

Feedback at the self or personal level (usually praise) was rarely effective since praise is rarely directed at addressing the three questions and so is ineffective in enhancing learning. When feedback focused on praising, students tried to avoid the risks involved in tackling challenging assignments, minimize effort, and had a high fear of failure (Black & Wiliam, 1998). Hattie & Timperley(2007) claimed that although it was important for teachers to clarify the expected learning goals, learning practices did not necessarily begin by answering “What are the goals?” because these could be discovered (usually in more specific ways) as students undertook particular tasks. Goals could be many and sometimes competing, and thus may be constantly evolving, and the feedback about “How am I going?” and “Where to next?” could address these constantly evolving goals. Specifically, the answer to “Where to next?” needed to be more directed to the refinement and seeking of more challenging goals, because these had the highest likelihood of leading to greater achievement.

It should be clear that providing and receiving feedback required much effort by students and teachers. It was crucial for teachers to understand and appreciate that providing feedback was only a part of the equation. Learning could be enhanced to the degree that students shared the challenging goals of learning, adopted self-assessment and evaluation strategies, and developed error detection procedures and heightened self-efficacy to tackle more challenging tasks leading to mastery and understanding of lessons (Enríquez, L., & García, I. 2019; Hattie & Timperley, 2007) . Furthermore, in the article of Hattie & Timperley, it was confirmed one more time that for feedback to be effective, it needed to be clear, purposeful, meaningful, and compatible with students’ prior knowledge and to provide logical connections. It also needed to prompt active information processing on the part of students, had low task complexity, related to specific and clear goals, and provided little attention on praising. These conditions highlighted the importance of classroom environments that fostered peer review and self-assessment and allowed for learning from mistakes but as we saw already peer or self-assessment was generally not that much appreciated by the students.

In addition, feedback could be a decisive factor for advancing engaging learning environments as long as it follows a repetitive process. According to Lonka (Lonka, 2012; Lonka & Ketonen, 2012) feedback first should diagnose and activate, then foster learning and finally observe change. Specifically, feedback which activated and diagnosed the process involved coaching, setting context and goals, and initiating the learning. Feedback as fostering the learning process advanced reflective thinking and maintained interest by creating new knowledge and practices (f2f, P2P, virtually, etc.). Feedback as observing the change process should assess change by highlighting what new had been created and what should be developed further.

Also, the content and length of feedback did matter, especially as part of engaging instruction. Most current assessments especially in MOOCs as we analysed later, provided minimal feedback. But it was the feedback information and interpretations from assessments, not the numbers or grades, that mattered. In too many cases, testing was used as the measure to judge whether change had occurred rather than as a mechanism to further enhance and consolidate learning by teachers or students. Furthermore, when feedback was combined with effective instruction in classrooms, it could be very powerful in enhancing learning. It was important to note, however, that under particular circumstances, instruction was more effective than feedback.

Feedback could only build on something; it was of little use when there was no initial learning or surface information. Feedback was what happens second, was one of the most powerful influences on learning, too rarely occurred, and needed to be more fully researched by qualitatively and quantitatively investigating how feedback worked in the classroom and learning process (Hattie & Timberley, 2007). Feedback could not be the only determinant for advancing the student’s satisfaction within a course since it may not happen regularly and frequently especially if feedback was part of just a few key assignment items.

Further analysis showed also that the relationship between feedback and student engagement was not monolithic but multi-dimensional with various other factors to address. Scott (2014) considered as effective feedback the one in which the student assumed responsibility for their learning and compares their performance based on a number of sources of information, only one of which was the information given to students on their assignment performance. For example, something as simple and conventional as openly marking and discussing exemplars in class offered students valuable guidance as part of a wide feedback framework for students and was well-related to the notion of helping students to have a better understanding of what they were expected to achieve while they were doing it rather than finding out after they received the assignment. Also, Dawson (Dawson et al, 2019) who based their survey of students and educators on what was effective feedback, found that students said feedback was made effective either by repeated attempts at the same task, repeated attempts at similar tasks, tasks split into pieces and interspersed with feedback, or in-class feedback followed by feedback on an improved submission. Despite being mentioned by relatively few students, several of those students mentioned this as the only feature that made their specific instance of feedback effective. Similarly, for many of the staff who mentioned iterative or connected tasks as a feature of effective feedback in their classes, this was the only theme found in their data. Another research from Handley & Williams (2011) began by describing the problem of student (dis)engagement with feedback and argued that engagement could be enhanced by time-shifting feedback so that it comes before final assignments are submitted. One method of achieving this was to use exemplars annotated with feedback, and this method was investigated in a large undergraduate module in a business school, using WebCT to host the exemplars and provide a discussion forum (This was relevant since a similar structure and training approach could be applied in a MOOC context). Student responses to the exemplary facility suggested that most found it very useful, but not necessarily for the reasons expected: Their ability to see structure and layout was praised by half of the questionnaire respondents, and one-fifth added that the feedback was a useful guide to improving the quality of assignments. However, for these groups of students, the invitation to discuss the examples and feedback online was resisted: Students did not want to expose their questions to public online scrutiny. The more spontaneous and informal learning space of the classroom was preferred, suggesting that the main benefits of learning through examples resulted from class discussion. Indeed, the lack of a quantitative effect on students' marks suggested that more research was needed to investigate ways to develop and improve such facilities.

Although, exemplars seemed to increase the quality of feedback especially from peers and in self-assessment, Dawson et al (2019) argued that exemplars may not be viewed by educators and students as part of the feedback process. Other valuable practices could include self-review test questions, model answers and worked examples, as well as commentaries on past examination questions and opportunities for students to learn from and with one another as well as from the lecturer. Also, most students wanted to exploit feedback as a basis for improving their learning performance by receiving more feedback and more specific information on what they did well and what they didn't do well and needed improvement (Scott, 2014). In her research, when asked 'Would you have received higher results with more feedback?', 79% of students in the focus groups said that they would have done, and the remaining students answered 'maybe'.

The above analysis shows that feedback should be seen also in the context of the related assessment. If students were to exploit effectively a wider approach to feedback, they needed also to learn the skills of assessment, of how to clarify what good performance was and be facilitated to learn how to close the gap between current and expected performance (Nicol & Macfarlane-Dick 2006) and had tasks structured in such a way that they could demonstrate their improvement from one task to the next (Boud & Molloy, 2013). In addition, according to Nicol (2010), students generally preferred to be assessed by staff and not by peers. As we saw, the application of peer-based feedback processes were more productive than individualised, actionable feedback which is a labour-intensive task. And, although students were often happy to do peer-reviews and self-assessments, they preferred the staff instead of themselves to grade their assignments. Students often considered feedback by peers as of low value since they may assume that peers may not know much more than them and consequently, they were not convinced that they could assess adequately the current performance of other students (Nicol, 2010).

In addition, not only older research (Falchikov & Goldfinch, 2000; Gibbs & Simpson, 2004) but also more recent research (Dawson et al, 2019) argued that assessment had positive influence on students' learning and engagement and the main objectives of high-quality feedback in pointing out strengths and weaknesses as well as in motivating and make students feel good. Furthermore, feedback should: a) provide sufficient detail and often enough so that feedback information is available to students in time for them to undertake the next task; b) focus on students' performance, on their learning and on actions under the students' control, rather than on the students themselves and on their characteristics; c) be delivered in time for students so that it still matters for them; d) be aligned with the purpose of the related assignment; e) be well received by the student; and, f) advance future learning and use by the student. Additionally their research indicated that the qualities of good feedback (whether from teachers or students) that influenced student engagement should include a) adequate detail and frequency of comments; b) a focus on actions under the student's control; c) timeliness, enabling the student to apply the feedback when receiving it; d) adherence to the criteria of the assignment; e) appropriateness to the student's level of maturity and domain knowledge; f) sufficient "justification," including description of rationales and thinking). Especially, Dawson (Dawson et al., 2019) found that feedback needed to be detailed, specific or thorough. Many students mentioned that feedback content was the sole feature that made their instance of feedback effective. The feedback needed to be clear, focused, precise or direct and some students mentioned that their feedback experience was made effective by being personalised or individualized, namely when they felt the assessor had actually read their work and was making comments specifically about it – as opposed to receiving generic feedback information about the cohort's work. In contrast also in the survey of Dawson (2019), there was also a small set of students and staff who found generic feedback comments (the opposite of personalised feedback) effective. Also, a small number of students indicated that feedback was effective thanks to broadly affective features of the comments made about their work. Namely, the comments were nice, positive or constructive, or supportive, encouraging or motivating and for a substantial minority of students who discussed either of these themes it was the only theme mentioned; however, for most students these themes were mentioned alongside other features.

Furthermore, if students could not grasp the meaning of assessment criteria/ standards, feedback intended to guide them on achieving those standards may be incomprehensible and therefore ineffective. Further analysis to that was found in research by Nicol & Macfarlane-Dick (2006) but also more recently from Dawson et al. (2019). They argued that there were three conditions as prerequisites for students to be familiar with in order to benefit from feedback in academic tasks; i.e., Students should be familiar in advance with: a) what good performance is (i.e., the student must possess a concept of the goal or standard being aimed for); b) how current performance relates to good performance (for this, the student must be able to compare current and good performance); and c) how to act to close the gap between current and good performance. These three prerequisites imply that students in order to be able to compare an actual performance (of their own or of their peers) with a standard good one and take action to close the gap, then the whole training processes should dedicate much more effort to strengthening the skills of students' self-assessment for better learning experiences.

In this context, Nicol & Macfarlane-Dick (2006) identified seven principles for good feedback that should be applied in traditional teaching environments in order to strengthen the students' capacity to self-regulate their own performance. These seven principles, in brief, suggested that effective assessment and feedback practices should: a) help clarify what good performance is; b) facilitate the development of self-assessment (reflection) in learning; c) deliver high-quality information to students about their learning; d) encourage teacher and peer-dialogue around learning; e) encourage positive motivational beliefs and self-esteem; f) provide opportunities to close the gap between current and desired performance; and, g) provide information to teachers that can be used to structure the teaching approach.

Another feedback factor that impacted learning was "Time Factor", namely, when feedback should be provided and, as we saw, it had already been identified by many researchers (Boud 2000; Dawson et al., 2019; Falchikov & Goldfinch, 2000; Gibbs & Simpson, 2004; Handley & William, 2011; Scott, 2014). Also, Pokorny & Pickford (2010) in their research found that students wish that feedback happened every week to actually assist them with their learning. Additionally, the feedback must be linked with the remaining assessment towards their final result which meant that if a mark had already been specified, the interest of the average student may well be low. To be effective, feedback needed to reflect how the student was doing in terms of the knowledge, comprehension, and skills that would determine his or her result in the course (Scott, 2014).

Furthermore, digging deeper into this "Time Factor" of feedback, Frand (2000) specified some characteristics of the new generation of students that were accustomed to staying connected and communicating all the time virtually via their mobile phones that implied also the need to stay connected for interactivity and immediate response within their courses. Students of the new generation seemed to need immediate and ongoing confirmation that they were on the right track even before undertaking any tangible work in a course. Finally, the time factor in feedback had been the research focus for various researchers such as Li (Li & De Luca, 2014) and Dawson (Dawson et al, 2019) who argued that students are often regarded as wanting more timely feedback.

Feedback could be a diagnostic evaluation that fed information to the student in a continuous and supportive manner for acquiring new and useful knowledge. Such a feedback approach could be engaging and promote flow even for mass education. It was apparent that variously different feedback factors could affect student engagement. While there could be no universal formula for producing engaging feedback or any guarantee that it would be successfully fed forward, there was clearly the potential for feedback to become more engaging especially in MOOCs by examining different feedback factors and their relationship with student engagement.

2.5 Significance of Online courses and MOOCS

The analysis of the different approaches regarding feedback and student engagement and the relation between them had been presented in the previous section and here we focused on analysing the MOOC framework to see how feedback and student engagement could be related to within this context. Therefore, this section analysed the evolution of MOOCs and clarified various concepts around MOOCs by identifying specific definitions in relation to MOOCs and their different types. It outlined also what the educational community perceived as a MOOC as well as some facts and figures about MOOCs and MOOC platforms and their significance in changing the delivery of Higher Education by universities and the profile of university students and for education in general. We also examined the main teaching approaches applied in MOOCs including feedback practices. Finally, we analysed the high drop-out rate from MOOCs and any relation with effective personalised feedback practices.

This analysis on MOOCs along with the already analysed feedback and engagement literature, set up the foundation for concluding this chapter with section 2.6 *Feedback and engagement in MOOCs*.

2.5.1 Online courses and MOOC evolvement

The recent developments in ICT created the need of taking advantage of, integrating and promoting new forms of learning and opportunities open to all citizens (Baas& Schuwer, 2020; Gonzalez-Sanmamed, Sangra, Souto-Seijo, & Estevez Blanco, 2020) and an improvement of the quality on eLearning (Raffaghelli, J.E., & Cabrera N., 2020). One answer to these needs is the evolvement of MOOCs. In this section, we clarified all the different notions and concepts behind online courses and specifically MOOCs. Information Communications Technology (ICT), digital tools and networks became an essential element in today's education, both for accessing relevant course information and for facilitating collaboration and consequently lead to completely different models of education. In the last few years, new concepts emerged in the education community such as (Porter, 2015):

- **Technology-enhanced learning or e-learning**: any technology that was used to support a learning experience. This may or may not use the Internet, so electronic whiteboards and interactive polling systems are both forms of e-learning technologies, as well as learning systems such as virtual learning environments or learning management systems that rely upon Internet technologies to deliver content and connect students together.
- **Online learning**: learning that took place online using Internet technologies. It relied on Internet based e-learning systems
- **Open educational resources (OER)**: digital content that was licensed so that it could be used for educational purposes by others than the content owner. Licenses varied and may be broad and inclusive or more narrowly defined, for example, only allowing not-for-profit use of the resources. OER were also supported by an international movement that aimed to make increasing amounts of digital content available freely for public use.
- **MOOC**: a specific online course that was openly available to an unlimited number of participants, normally free of charge. It was also a form of online learning and MOOCs use educational technology to function. They may also use OER as their main source of content .

The major innovations with MOOCs were not about access to academic staff, peer interaction, wiki-style forums, and automated assessment; those could be found in many online courses offered by traditional universities over the last few years. Instead, they were a response to wider societal needs related to education and training (Bonk, Lee, Reeve, Reynolds, 2015). The disruptive effect of MOOCs was in shifting costs from students to institutions and future employers, by offering services such as matching students to jobs using the evidence of their performance in MOOC courses.

There was also significant momentum behind the concept of free and open access to high-quality university learning, and it was likely that content and courses would continue to be promoted resulting in more MOOCs and other types of open education approaches emerging. However, there was also a need to rethink current higher education structures and policies that obstruct innovation. Open courses based on new structures, ways or working and use of technology could make higher education more cost effective and accessible and may also contribute to balancing work, family and social life. Students had access to a variety of non-traditional learning models including access to courses and materials to self-direct their own learning beyond their classes and institutions. More flexible models and open approaches would encourage more mature students to participate in higher education and gain qualifications to advance their careers (Yuan & Powell, 2013).

Specifically, two categories of MOOC have been defined (Ross, et al., 2014; Welsh & Dragusin, 2013). The first category known as the cMOOC (or connectivist MOOC), focuses on emergent knowledge, broad student autonomy, and networking. Students participating in a cMOOC are expected to help shape the course and enrich its content through their participation. Instructors are seen more as facilitators than traditional teachers. The second MOOC category, the xMOOC or eXtended MOOC, provides a more traditional top-down type of instruction, with fixed content, centralized forums, and regular evaluation to assess content mastery but again there is minimal if any interaction between the instructors and the students. However, the latter structure prevails nowadays and in the Massive Open Online Course Market, xMOOC is expected to gain more momentum than cMOOC. The xMOOC platform positively impacts higher education owing to the quality of the content provided by leading universities, consistent financial support for development, and the existence of deadlines and grades which are expected to foster the global market in future as shown by many market studies (MarketsandMarkets, n.d.; Zion Market Research, n.d.)

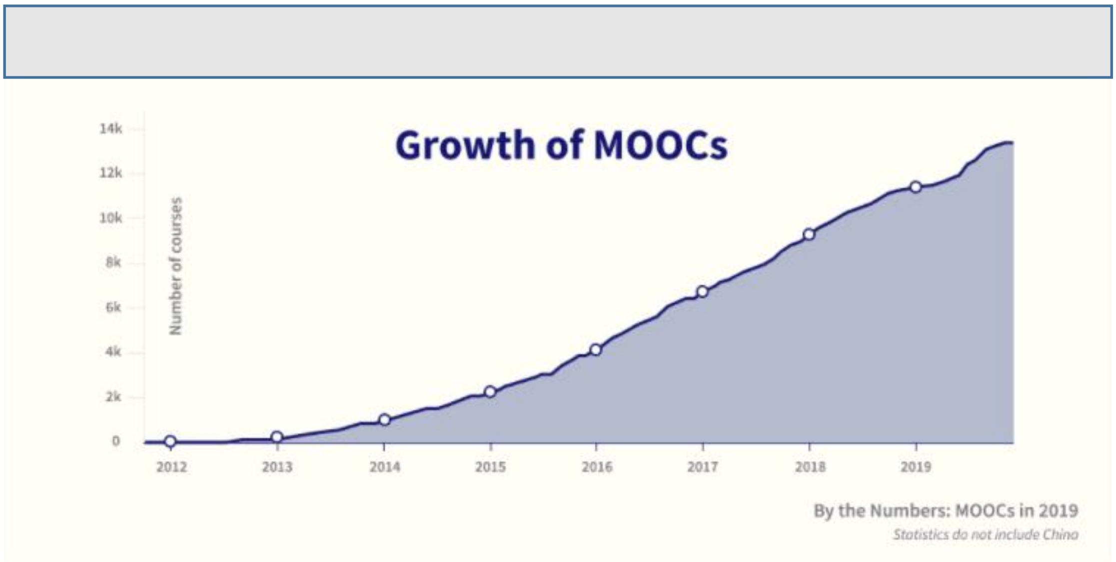
There are a few other MOOC platforms that are rather different in terms of their mission, strategy, and tactics. Mohamed & Hammond (2018) in their findings revealed that all courses surveyed corresponded to the idea of an xMOOC in that they were run on a model of instructional design. However, the course materials varied with respect to the media used, use of networking, discussion forums, and the degree of openness. Similarly, in terms of assessment, all analysed MOOCs used formative approaches (feedback based on forum discussions), all had automated responses, but only some had summative and peer assessment (Mohamed & Hammond, 2018).

According to Adamopoulos (2013), Massive Open Online Courses (MOOCs) was a recent development in the area of e-learning and distant education that has gained significant popularity among both students and educators. MOOCs are larger in scale than traditional online courses; have no restrictions on individual participation; they are globally distributed across a variety of networks; and, aimed at revolutionizing the way education happens.

Furthermore, and recently with the coronavirus (Covid-19) pandemic, universities began to mitigate against risks posed by the lockdown and social distancing limitations, with many applying a complete shut-down of face-to-face teaching and introducing instead online learning. It was apparent that online learning and especially MOOCs are coming into their own in higher education. One example that was characteristic to the interest that MOOCs have received is the web-traffic on a MOOC portal (classcentral.com) from 15 March to 15 April 2020, in the peak of the pandemic. More specifically, the total traffic just for those 30 days was almost twice the total traffic that the portal received for the whole of the year 2019 (Shah, 2020). Therefore, the aforementioned factors including the current pandemic conditions, together with the open nature of the courses and the lack of need for physical presence, attracted not only a huge number of students from a wide variety of backgrounds but in many cases made online learning as the main way for higher education to go forward. Interestingly, some prominent MOOCs, such as various classes from Stanford University, edX, Coursera, and Udacity, as we briefly examine further, have attracted tens of thousands of participants. According to the class central portal, the number of MOOC courses has increased exponentially since 2012 by reaching 13,000 courses in 2019 (Shah, 2020). This is shown in Figure 2 below.

Figure 2

Growth of MOOCs since 2012



Note: By the numbers: MOOCs in 2019. Statistics do not include China

According to the Class Central MOOC report (Shah, 2019), as of the year 2019, more than 110 million students from all over the world have enrolled in at least one course, with 45 million students on the Coursera MOOC platform; 24 million students participated in one or more edX (MITx or HarvardX) open online courses; Udacity with 11,5 million students; and Futurelearn with 10 million users. More specifically, we saw a remarkable growth in the number of courses provided and the number of MOOC students since large-scale MOOCs began in 2011. We cannot know exactly how many people signed up for MOOCs since these numbers are changing continuously but MOOCs experienced rapid expansion and received significant popularity among students and teachers. A few of the longer courses originally launched in 2012 and 2013 had also been split up into multiple courses and re-launched under a credential (microcredentials). Especially, online degrees offered via MOOC platforms from universities were emerging. In 2019, providers launched over 13,500 courses, 50 online MOOC based degrees, and 820 microcredentials (Shah, 2019). In specific, Coursera offers 16 online degrees & 420 microcredentials, edX 10 & 292, Futurelearn 23 & 49 and Udacity 1 online degree and 40 microcredentials respectively. Therefore, new courses continue to be created and launched as aggressively as ever.

Further to the current trends, MOOCs are about 15 years old (since 2008 that the first MOOC was released publicly available) though it was only in the last 11 years that they achieved a widespread, global profile. MOOCs had arisen from a long continuum of experimentation with educational technology and online learning, and with pedagogic approaches that were made possible through technology. And as with a small number of other technological innovations, the results had then been replicated many times since to create an established and well-understood model that was being used worldwide (Porter, 2015). The MOOC phenomenon was not isolated to the U.S. The Open University in the U.K., for example, an institution with a deep history in distance and online education, launched its own MOOC initiative called Futurelearn (Sandeen, 2013).

In regards to MOOC content, generally, MOOCs consisted of pre-recorded video lectures, online quizzes and forums for discussions between the students and sometimes between the students and the teachers and had the potential to reach significantly more students in ways that would not be possible with traditional classroom instruction. Such a structure facilitated open access and enrolments of as many students as possible that resulted in thousands of registrations with participants from all over the world (Reich & Ruipérez-Valiente, 2019) .

However, even though MOOCs had been broadly accepted, there was still plenty of room for improvement as far as the actual needs of students are concerned. This was evident if we took into consideration that the student retention rates were very low. Retention rates had not been improved according to recent research conducted by Reich & Ruipérez-Valiente (2019) who analysed all courses taught on edX by MIT and Harvard from 2012 to 2018 that covered 5.63 million students in 12.67 million course registrations. Among all MOOC participants, 3.13 percent completed their courses in 2017-18, down from about 4 percent the two previous years and nearly

6 percent in 2014-15. They argued that the trajectory of course completion rates was alarming despite six-years of investment in course development and learning research and they concluded that a strategy that depended on bringing new students into higher education could not succeed if educational institutions could not support students in converting their time and financial investment into completing a course to earn a credential with labour market value. Also, further to low retention rates another significant indicator that Reich & Ruipérez-Valiente (2019) pointed out was how decreasingly students sticked with MOOCs in general. Namely, while 1.1 million students took their first MOOC in 2015-16, only 12 percent took a MOOC in the 2016-17 academic year. And that proportion -- of first-time MOOC users who also enrolled in a MOOC the following year -- had fallen every year since 2012-13, from a high of 38 percent that year to 7 percent in 2016-17. Nevertheless, it was the duty of the academic community to shed light on the problems of MOOCs, trying to both understand their causes and provide actionable solutions, in order open education via MOOCs to achieve its potential and not fail.

Working toward this direction, we explored in this thesis one of the most important factors being feedback in MOOCs and its link with student engagement. Nowadays, an increasingly popular structure for technology-based classrooms is massive open online courses (MOOCs) that many researchers believed since 2015 that they may significantly alter education (Ashton & Davies, 2015). So we could see that although MOOCs seemed to have come from nowhere, MOOCs had their own short history, which built upon and was rooted in much longer-term research and developments in online learning, learning content, and trends such as open education, and investment by both public and private organizations in developing new online learning tools and courses. However, their increasing popularity on one hand and their decreasing commitment of students to MOOCs on the other, drove research to examine different factors that could increase student engagement in MOOCs and whether feedback and assessment practices applicable in MOOCs could increase student engagement.

In the next section, we will discuss the assessment and feedback practices currently applicable in MOOCs.

2.5.2 Assessment and Feedback practices in MOOCs

Starting with a literature review of assessment and feedback practices not specifically applied in MOOCs, we first saw that much of Nicol's (2010) work focused on improving the quality of written comments which was the main mode for providing feedback in MOOCs although that was not the focus of Nicol's research, but it was quite applicable in this case here. He argued that the many diverse expressions of dissatisfaction with written feedback, both from students and teachers, were all the result of ineffective dialogue. Mass higher education as in the case of MOOCs, was squeezing out dialogue with the result that written feedback, which was essentially one-way communication, often had to carry almost all the burden of teacher-student interaction. He suggested ways in which the nature and quality of the feedback dialogue could be enhanced when student numbers were large without necessarily increasing demands on academic staff. For example, written comments were more likely to be understandable and effective if there was a shared context for the assessment task and the comments were provided in response to a specific student request. And feedback was more likely to be timely and consequently effective if there were many cycles of feedback and if this feedback was available from many sources, peers as well as teachers, from online data banks as well as from face-to-face interactions.

Also, in addition to the need for improved written feedback, according to Sandeen (2013), one of the most relevant and promising aspects of MOOCs was the high level of experimentation and rapid prototyping of technology-based assessment that has occurred. This had very positive implications for assessment scholars and professionals. Because of the scale of MOOCs, it would be impossible to hire enough humans to conduct all the assessments required in a course. It was also challenging for most instructors to develop good quality multiple choice test items to measure high-level cognition such as applying, analysing, synthesizing, evaluating and creating (Krathwohl & Anderson, 2001). Furthermore, the mission of several MOOC providers was to improve student learning in foundational courses, especially among first generation, low-income students, using adaptive learning and feedback mechanisms. For these reasons, assessment methods could be hardwired into a MOOC. Standard assessment methods were applied within MOOCs, especially in subjects that could be assessed by commonly-used objective means. We also were witnessing developments in the areas of machine grading and peer grading that could be used to score writing-based assessments. The majority of MOOCs offered for credit were in STEM disciplines. However, it would be relevant to see new developments in large-scale online assessments for classes in the humanities and the arts where multiple choice examination questions were not always the most effective or accepted assessment method.

Furthermore, a relevant study conducted by Nunez, Caro & Gonzalez (2017) presented and analysed the process of transforming an online higher education course into a MOOC. In this study peer-assessments were introduced and ratings were based on rubrics. Peer ratings were compared with those of the professors and no significant differences were found between the two ratings, indicating that the evaluation by rubrics provides a good approximation.

In regards to the type of assessments that were applied in MOOCs, the majority of the assessments were based on automated system responses using pre-defined responses to closed questions or peer grading that shows a relatively high degree of acceptance. A survey on MOOC teachers conducted by the *Chronicle of Higher Education* (Kolowich, 2013) indicated that 74 % of respondents used automated grading; 67.1% found the technique to be “very reliable” and 30.1% found it to be “somewhat reliable.” Thirty-four percent of respondents used peer grading; 25.8% found the technique to be “very reliable” and 71% found it to be “somewhat reliable” (Kolowich, 2013).

Based also on Ashton and Davies (2015), the main barrier that challenged MOOCs was due to the open enrolment policies that could lead to incredibly large student-to-teacher ratios. More specifically, such imbalanced ratios make it unlikely that an individual teacher would be able to provide personalized feedback on student work and have a dialogue that Nicol (2010) considered as the key priority in feedback and assessment. Extending that further, one of the key challenges was how to escalate assessment and feedback mechanisms to global, large-scale MOOCs for creative, open-ended study.

In a traditional class, assessment materials and personalised feedback helped students gauge their current level of achievement and learn new skills. The time and effort required for instructors in a traditional classroom to read and review each writing sample could be overwhelming, even in a relatively small class that made it even more challenging to provide individuals with feedback in the MOOC context. Despite great potential benefits, MOOC education practices in general had issues that must be addressed, including feedback practices. Self and peer-to-peer feedback had been proposed as alternatives to teacher assessment of student performance, particularly in problem-based or on written assignments. However, the issue was whether self-assessment or peer assessment practices (two of the key assessment practices in addition to automated testing as we saw before) could substitute more traditional methods of evaluating student performance and be applied successfully in MOOCs. Indeed, some studies (Cho & MacArthur, 2010; De Wever, et al., 2000; De Wever, Van Keer, Schellens & Valcke, 2011) found peer feedback to be equally effective or in some cases more effective than comparable levels of teacher feedback and showed signs of high reliability and validity.

According to a comparative study on MOOC course development and approaches (Smith et al., 2017) but also generally, custom-built MOOC platforms (such as Futurelearn, Coursera, Udacity, etc) were designed for large audiences from the general public as students. They often had a single, prescribed pedagogic approach, i.e., generally a didactic approach with readings, video-based lectures and automatically-marked formative assessment tasks. There was generally some provision for student interaction through a forum or question/answer tracking system, but these were often limited in flexibility. Because they were designed for the delivery of a MOOC to a large general audience, the delivery platform was designed to make involvement in the course as smooth as possible for the participant. Many times, MOOC courses were structured to keep students within their learning environment as much as possible. Links to materials outside the course may be kept to a minimum and were placed normally in a "link" section on each module rather than being integrated within the text. This was a deliberate decision since linking to other sites risks students becoming lost in a maze of pages and unable to return to the courses. The MOOC courses were usually professionally edited by MOOC platform staff to ensure readability and accessibility for a diverse audience of non-specialist novice readers. Technical language was normally reduced to the minimum required and a comprehensive glossary of terms was provided for references. The course materials were adapted to several other contexts, including presentation in other countries. Assessments were based on multiple-choice quizzes automatically marked as the student took the test and incorrectly answered questions frequently directed the student back to the relevant part of the course materials. Usually, students were not required to pass, or even take, any of the assessment tasks but if they completed the majority of the learning steps and passed all the tests, students may have the option of buying a certificate of completion that had the name of the university offering the MOOC. Such certificates, however, were not considered a university qualification and did not carry any credit towards any university qualification. Self- and peer-reviewed assignments were mainly used to allow the students (including the peers) to understand better the training content.

More specifically, in regards to the assessments applied, according to Conache, Dima & Mutu, (2016) , for more theoretical classes, multiple choice machine-graded quizzes and text-input problems were available for all four platforms. Udacity and Udemy allowed the students to complete coding exercises in a proprietary coding editor for programming courses. Courses from Coursera and edX may require students to upload and submit their assignments before a deadline. Another feature of Coursera and edX was peer-grading and review, where fellow students anonymously graded up to 5 assignments. Also, Coursera, edX and Udacity, the platforms that offered a series of courses in a specific field, had the possibility of project submission and assessment for this type of course.

Further to the analysis above, we can see that within the MOOC world, irrespective of the type of assessment applied, feedback delivery was a central feature of design from the very beginning. In this new context, assessment was less about compliance than about supporting student learning outcomes and ultimately student success and attainment—directly in the centre as it was the main purpose of feedback So, techniques developed within MOOCs with no doubt could migrate into other formats and settings, including traditional online and classroom-based courses (Kolowich, 2013). Such techniques were expected to have feedback factors as cornerstones for advancing student engagement in MOOCs. Therefore, in the next section, we analysed the literature on student engagement specifically in MOOCs.

2.5.3 MOOCs and student engagement

According to Ashton & Davies (2015), universities and individuals acknowledged the cost savings potential of distance education via the MOOC format; the improved accessibility; the decreased student costs; the increased student flexibility; the increased curricular flexibility; the increased facilitation of informal learning; the higher expectations of student responsibility; the improved instructional quality; the decreased discrimination; the increased adaptation to technological change; the increased personalization; the added opportunities for instant feedback; and, the increased student collaboration. Despite this, it was clear that many of those who did wish to follow and complete a course were hindered by factors such as level of difficulty, timing and lack of digital and learning skills, and the lack of support via feedback. It was clear that such a disruption by MOOCs to a traditional classroom had benefits but also challenges but we needed to understand the different student engagement dimensions in a MOOC.

Most of the studies on student engagement in MOOCs identified in the literature review focused on the behavioural dimension because their behaviour could be easily identified whether it was just note-taking, video watching, browsing, participating in fora discussions, dropping the course, etc., but there was little consensus about how it was best conceptualized and measured. According to a study of Adamopoulos (2013) on 133 courses offered by 30 universities and 6 providers (platforms) Canvas Network, Codecademy, Coursera, edX, Udacity, and Venture Lab, the majority of enrolled students did not complete their courses. Within the "no credit context," course completions were estimated to be less than 10 percent. However, student motivations for enrolling in MOOCs varied and perhaps completion rates did not tell the whole story. Plus, in a course that enrolled 100,000 students, 10 percent completion was still a significant number of students. Given the high dropout rates, the level of educational impact and the pedagogical innovation, originally attributed to MOOCs, was still questionable (Maya-Jariego et al., 2020). Overall, in spite of the broad acceptance of MOOCs, there was still a long way to go in terms of satisfaction of students' needs, based on the extremely high drop-out rates that was one of the metrics for measuring student engagement as we had already seen. Specifically, despite their increasing popularity, MOOCs suffer from several limitations and several studies reported a high drop-out rate averaging to 95% (Hill, 2013). However, the dropout rates were very high according to Clow (2013) and Lewin (2013) and the research community should focus on addressing this issue by trying to understand the causes and suggest specific solutions so that open education could achieve its high potential and not fail. In this respect, there was already some research activity on identifying the factors that influenced student engagement which could be grouped into two broad categories: 1) didactic ones such as course structure and content, self-paced or not, workload and duration, course topic, type of exams, type of assessments and feedback, and interaction with students and instructors, etc) and, 2) the non-didactic ones (students' and instructors' profiles, their demographics, reputation of institutions and of responsible professors and instructors, certification options, fee options, course popularity, etc) (Adamopoulos, 2013).

Understanding the reasons behind dropout rates in MOOCs and identifying areas in which these could be improved was an important goal for MOOC development. Many widely quoted dropout rates were calculated from baseline numbers which included registrations by people who never engaged with the course or who engaged in their own way but without completing assessments. It seemed that there was no formal dropout definition for MOOCs since each scientific study used different definitions. Specifically, Sunar et al., (2017) had examined 15 research studies with almost each study considering a different drop-out definition such as "not completed the final week", "no activity during the most recent week", "no further activities in the following weeks", "no further assignment or assignment submission", and "absence for a period exceeding one month or viewing fewer than 50 percent of videos".

The penetration of MOOCs in higher education may in time lead to a transformation, but this transformation would likely depend on educators' ability to overcome some of the effectiveness and productivity challenges of this instructional format of which engaging feedback is a key element.

Therefore, in the next section, based on specific studies, we will examine some relation between student engagement and feedback in MOOCs

2.6 Feedback and engagement in MOOCs

We understood that MOOC literature tended to focus excessively on behavioural engagement and paid less attention to the other two broad engagement dimensions that we saw before such as affectionate/emotional and especially cognitive one since behavioural engagement could be easier identified (Deng, Benchekdorff & Gannaway, 2019) and consequently directly correlated with feedback practices that was the key focus in this research here. In this respect, we focused the analysis on literature as well as this PhD approach on behavioural engagement.

According to Hew (2015), student engagement in MOOCs was defined as the level of a student's engagement in a learning activity. The more the student was active within a course, the more engaged was with this course. This meant that the engagement level of a student was related to his/her participation level in the MOOC learning activities such as in browsing the content; downloading learning material; watching video lectures; doing the general quizzes/assignments; doing the end-of-module quiz/assignment; reading the forum discussions; actively participating in the (forum) discussions; studying the literature; doing the peer-review tasks; participating in related social media activities; and, communicating with the teacher or communicating with other students in the course.

Similarly, a research report from Scardamalia (Scardamalia, 2002) pointed out that the latest forms of education delivery such as MOOCs and flipped classrooms advanced behavioural engagement since they advanced autonomy. More specifically the students:

- deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers or managers
- instead of studying for isolated courses and credit units, they themselves select and engage in personally meaningful study projects
- enjoy self-regulated learning that is a valuable aspect of student engagement.

Such a perspective was useful and quite encouraging since MOOCs had a structure and a learning approach that could promote student engagement and supported the focus on identifying behavioural engagement in MOOCs and correlating it with feedback.

Also, research showed that drop-out rates could be decreased with peer-assessment practices compared with automated feedback implying that better ICT solutions for automatically providing feedback and evaluating the assignments of the students were still needed (Adamopoulos, 2013). In the same research, final exams and projects made the courses more engaging and had a positive effect but team projects that required the active collaboration with other students did not have the same effect. Various researchers such as Adamopoulos (2013), Smith et al., (2017), Brown, Chung & Ho (2016), Cabrera & Ferrer (2017) highlighted that the main assessment and feedback practices adopted by MOOCs and other online learning platforms were automated feedback as well as self- and peer- assessments but at the same time such assessment methods could be a key challenge for student engagement in MOOCs. Especially in training modules that required creativity and intellectual effort such as writing, it was challenging to provide effective assessment and useful feedback via online multiple-choice quizzes that was the common practice for many MOOCs that target more objective, learning areas, such as mathematics or science. A critical element for any effective peer assessment was a process that increased the likelihood that students' feedback was both valid and reliable. Such a support system would increase the probability that all students in a MOOC could give and receive useful feedback (Ashton & Davies, 2015).

As we saw, a specific feedback design feature that on one hand gained popularity in feedback literature over recent years and especially in MOOCs was peer feedback but on the other hand there was resistance to these approaches from students and educators (Liu & Carless, 2006; Tai, Canny, Haines, Molloy, 2016; Adachi, Tai & Dawson, 2018; Dawson et al, 2019). Therefore, in order to increase the likelihood of high-quality peer feedback, a variety of practices were proposed such as by Ashton & Davies (2015). More specifically, a number of researchers recommended providing guided instructional support systems to train students how to conduct general assessment and improve their peer feedback skills and in the proper use of rubrics, with clear yardsticks for the evaluation criteria (Li & De Luca, 2014; Poulos & Mahony 2008; Boud & Molloy, 2013; Nunez, Caro & Gonzalez, 2017). However, Dawson in his research study (Dawson et al., 2019) found that standards were not a feature of effective feedback experiences for many staff and students that participated in his survey. Most students mentioned comments that identified improvements, but few mentioned the reference point for those improvements. Furthermore, Ashton & Davies (2015) argued that support for peer feedback could be provided by teachers as well as by multiple peer assessors. A peer-assessment approach as part of feedback practices could be useful for student engagement if it included the following: a) supporting students understand not only how the peer feedback process works, but also its purpose (e.g., improve learning experience, to provide additional feedback, to better measure postings); b) systemising and providing paradigms of effective feedback prior to implementing the peer feedback process; c) clarifying guidelines regarding how to provide effective peer feedback, such as "always begin with positive feedback and then offer information on areas for improvement; d) following-up the process and providing feedback on the feedback, at least initially, to help the process run smoothly and to allow students to benefit from the peer-assessment practice; e) making sure that the feedback is anonymous so that peers can provide marks without feeling pressure from their colleagues; and, f) making sure that the peer-assessment is easy for students to apply so as not to overload them.

Also, various feedback delivery modalities (structured, automated or not, recorded, etc) could affect student engagement in MOOCs. More specifically, Dawson and his team (Dawson et al., 2019) in their research found that feedback design elements most desired by students were the forms in which feedback information was provided in rubrics that were noted as ‘accurate’ or ‘detailed’; digital recordings that were ‘easy to understand’ or face-to-face feedback that was personalised and thorough. The value of rubrics in peer-evaluations was also highlighted by Nunez, Caro & Gonzalez (2017). The lack of comments from students around automated sources (e.g., formative multiple-choice quizzes) was perhaps surprising. However, this did not imply these sources were ineffective, but it may implied they were not a part of the most effective recent feedback experience for these students (or, potentially, are not considered to be feedback as such).

Peer-to-peer feedback had the potential to reduce the need for teachers’ feedback and the potential to improve learning as students rate other students' work. However, research (Ashton & Davies, 2015) suggested that students may not be able to provide adequate feedback without training. There was certainly a perception that teachers’ feedback were better than students’ (i.e., peer) feedback. The usefulness of peer-to-peer feedback as an instructional strategy depended on the quality (i.e., reliability and validity) of the assessments students make (Admiraal, Huisman & Van de Ven, 2014; Staubitz et al., 2016; Suen, 2014).The goal of many attempts to use peer-to-peer feedback was to get students’ evaluations to align closely with teachers’ ratings. For peer-to-peer feedback in a MOOC course to be beneficial, students must be able to provide adequate assessments of other students’ work. This was supported also by Ashton & Davies (2015). Nunez, Caro & Gonzalez (2017) suggested that when peers were trained to use rating rubrics, the quality of their feedback should improve.

In addition to type of assessment and feedback (automated, peer-review), some research initiatives (as we outlined next) attempted to identify some further feedback and assessment practices in MOOCs that could create a better learning experience for the students. These were audio assessment feedback instead of written one (Chew, 2014), number of submissions for peer-assessment (Jiang et al., 2014), face-to-face study groups for direct feedback (Chen & Chen, 2015), anonymous peer assessment (Anderhoven et al., 2015), scaffolded rubrics for improving peer assessments (Ashton & Davies, 2015; Nunez, Caro & Gonzalez, 2017), gamification in assessment (Attali & Arieli-Attali, 2015), linking assessment with accreditation (Chauhan, 2014), providing video-based feedback (Van der Kleij et al., 2017).

The analysis in this section, gave us different views on feedback factors to consider in this PhD research. While there could be no universal formula for producing engaging feedback or any guarantee that it would be successfully fed forward, there was clearly the potential for various feedback practices to facilitate engagement in MOOCs and especially behavioural ones that could be identified and correlated more easily with the quality of the feedback provided.

2.7 Summary

In the literature review, we started by examining the different definitions of feedback and its significance on formative assessment as an integral part of it. We then analysed the multiple dimensions of student engagement based on literature as well as the relation between feedback and student engagement. We then examined literature on MOOCs and especially their types and structure, the different solution offerings and their impact in education. We then analysed feedback practices as well as assessment methods applied in MOOCs and how MOOCs could deal with student engagement. This structural approach led us to analyse literature on feedback practices and engagement specifically in MOOCs.

In brief, we saw that MOOCs evolved significantly the last 10 years from just one experimental MOOC course initiated by two professors in 2008 to 13500 courses in 2019. Furthermore, we saw that although, initially, MOOCs were community driven and a point of sharing and commenting on educational content (i.e., cMOOC), what prevailed nowadays was the xMOOC where the training content was fixed, there were regular evaluations to assess content mastery by students but still there was minimal if any interaction between the instructors and students (Ross et al., 2014; Welsh & Dragusin, 2013). We saw also that the intention was to focus now not only on attracting as many as possible students to register in their courses but also finding ways to monetise this by (in most of the cases) examining certification options and collecting learning analytics and, in few cases, integrating a MOOC course into a campus-based course that could lead to university credits or attracting sponsorships from the companies and other sectors (Smith et al., 2017). It was likely that different business models would emerge for MOOCs in the future, and the opportunities and threats posed to established institutions were as yet unknown but potentially significant. We saw in brief the characteristics of the key MOOC platforms such as Coursera, edX, Udacity, and Futurelearn that universities used in order to build their MOOCs and there was limited differentiation since all of them applied a general didactic approach with video-based lectures accompanied by reading notes and slides. Students were interacting among themselves through forums and feedback mainly came from other peers or via automatically marked formative assessment tasks. Researchers believed that MOOCs and MOOC platforms would continue to change the way that higher education was delivered but they should understand the reasons behind the high dropout rates that were averaging to 95 percent (Hill, 2013). Although it seemed that there was no formal dropout definition for MOOCs since each scientific study used different definitions, research focused on how the student could be more engaged within a MOOC. However, the dropout rates were very high in the range of 90 percent or more and the research community should focus on addressing this issue by trying to understand the causes and suggest specific solutions so that open education could achieve its high potential and not fail (Clow, 2013; Lewin, 2013). In this respect, there was already some research activity (Adamopoulos, 2013) on identifying the factors that influenced student engagement in MOOCs by grouping them into didactic and non-didactic ones. Didactic ones included factors such as course structure and content, self-paced or not, workload and duration, course topic, type of exams, type of assessments and feedback, and interaction with students and instructors, etc). Non-didactic ones include for example students' and instructors' profiles, their demographics, reputation of institutions and of responsible professors and instructors, certification options, fee options, course popularity, etc. Various researchers highlighted that the main assessment and feedback practices adopted by MOOCs and other online learning platforms were automated feedback as well as self- and peer-assessments but at the same time such assessment methods could be a key challenge for the student engagement in MOOCs (Adamopoulos, 2013; Brown et al., 2016; Cabrera & Ferrer, 2017; Dawson et al., 2019; Hew, 2015; Smith et al., 2017). Especially in training modules that required creativity and intellectual effort such as writing, it was challenging to provide effective assessment and useful feedback via online multiple-choice quizzes that was the common practice for many MOOCs that targeted more objective, learning areas, such as mathematics or science and peer-assessment was extensively applied. A critical element for any effective peer assessment though was a process that increased the likelihood that students' feedback would be both valid and reliable. Such a support system would increase the probability that all students in a MOOC could give and receive useful feedback (Ashton & Davies, 2015; Carless, 2006; Onah, Sinclair & Boyat, 2014;). Also, some research (Adamopoulos, 2013) showed that drop-out rates could be decreased with peer-assessment practices compared to automated feedback implying that better ICT solutions for automatically providing feedback and evaluating the assignments of the students were still needed. In the same research, final exams and projects made the courses more engaging and had a positive effect but team projects that required the active collaboration with other students did not have the same effect.

Furthermore, some research initiatives attempted to identify some specific feedback and assessment practices in MOOCs that could create a better learning experience for the students: such as providing feedback on assessment via audio instead of written one (Chew, 2014); direct feedback via face-to-face study groups (Chen & Chen, 2015); anonymised peer assessments (Anderhoven et al., 2015); game-based assessments (Attali & Arieli-Attali, 2015); linking accreditation with assessment (Chauhan, 2014); providing video-based feedback that may be difficult to be applied due to limited resources or due to the course structure in a MOOC (Van der Kleij, Adie & Cumming., 2017).

In addition, we saw that there was already significant research into which feedback practices could be effective and promote student engagement in general, not necessarily within MOOC environments, and specific recommendations were identified from the literature such as from Boud & Molloy (2013), Carless (2015), Carless (2016), Chanock (2000), Dawson et al., (2019), Gibbs & Simpson (2004), Handley & Williams (2011), Nicol (2008); Winstone et al. (2017). Such factors were for example a) feedback content that orientated students to identify most important aspects or aligned with the purpose of the related assignment, or advance future learning or sufficient justification (Dawson et al., 2019; Gibbs & Simpson, 2004), b) when and where feedback was delivered (Boud, 2000; Dawson et al. 2019; Falchikov & Goldfinch, 2000; Fleckhammer & Wise, 2011; Frand, 2000; Gibbs & Simpson, 2004; Handley & Williams, 2011; Li & De Luca, 2014; Pokorny & Pickford, 2010; Scott, 2014), c) how feedback was delivered (Patterson & McFadden, 2009), d) by whom feedback was delivered, e) its detail level, f) whether it was legible, g) its frequency, h) and consistency, (Carless, 2006; Nicol, 2010), i) whether it supported interaction and advanced communication (Boud 2007; Dawson et al, 2019; Nicol, 2010; Sadler, 2010; Vardi, 2012), j) whether it was self-explained, k) whether it supported student to assess their performance and the performance of the other peers, and l) whether it increased self-esteem (Dawson et al., 2019; Nicol & Macfarlane-Dic, 2006; Sutton & Gill, 2010). However, most of them were examined by the research community outside the MOOC context and they were not considered as possible student engagement factors in MOOC environments either due to the lack of a proper structure or resources (Ashton & Davies, 2015). Furthermore, some research initiatives attempted to identify some feedback and assessment practices specifically to be applied to MOOCs in an attempt to create a better learning experience for the students such as audio assessment feedback instead of written ones (Chew, 2014); the number of submissions for peer-assessment (Jiang et al, 2014), the face-to-face study groups for direct feedback (Chen & Chen, 2015), the anonymous peer assessments (Anderhoven et al. 2015); Nunez, Caro & Gonzalez, 2017); scaffolded rubrics for improving peer assessments (Ashton & Davies, 2015; Boud & Molloy, 2013; Li & De Luca, 2014; Nunez, Caro & Gonzalez,2017; Poulos & Mahony, 2008); gamification in assessment (Attali & Arieli-Attali , 2015); linking assessment with accreditation (Chauhan, 2014); and, providing video-based feedback (Van der Kleij et al., 2017).

Therefore, based on the all the above, this literature review formed the foundation for the key research objective that was to specify new or enhance existing **feedback factors**, namely theories, methodologies and practices based on feedback methods that could be applied in MOOCs for enhancing student engagement.

This research thesis focused on identifying feedback practices present in MOOCs as well as by examining various specific feedback factors (considered or not considered already within MOOC environments). Furthermore, we examined at what level feedback impacted student engagement in MOOCs and prioritised those feedback factors that were applicable in MOOCs and were highly correlated with student engagement.

Chapter 3: Methodology

3.1 Introduction and Research Setting

The research was conducted mainly in the context of the MOOCKnowledge European project[4] initiated by the European Commission's Institute of Prospective Technological Studies (IPTS). The MOOCKnowledge project had the intention of building a database that can provide insights into the profile, experiences and behaviour of participants in (European) open online courses. MOOCKnowledge was a 4-year research project (2014-2018) aimed at understanding MOOCS from the student point of view. The study developed a series of surveys to collect longitudinal data (pre-course, post-course and follow-up after 1 or 2 years) on the students of MOOCs offered by European providers who were willing to collaborate with the study.

The aim of the study was to analyse students across different MOOCs and MOOC platforms so as to get scientific data on how MOOCs are affecting learning and skills development in Europe. The project collected data on the profile of European MOOC students, their digital competence, motivations, intentions (and its fulfilment), barriers to participation in MOOCs, and the relationship between MOOC-based education and labour market outcomes. The study was initiated and executed by the Institute for Prospective Technological Studies (IPTS) of the European Commission with support from DG Education and Culture, and in collaboration with external experts from the Open University of the Netherlands (OUNL), the Technical University of Madrid (UPM), the Open University of Catalonia (UOC), the PAU education, and the University of Seville (USA).

In the context of MOOCKnowledge project we conducted two empirical studies via an online post-questionnaire where we were interested in the views of the participants after their participation in the MOOC courses when we asked them to complete this online post-questionnaire. We were responsible for preparing the part of the questionnaire related to student activities during their participation in their MOOC course as well as for the part of the Assessment and Feedback, and after collecting their responses, we analysed the findings. We had collected and analysed from the MOOCKnowledge project two datasets. The first one was based on a lengthy questionnaire that resulted in 440 responses and the second with fewer questions overall that provided in total 2020 responses. In the following sections, we covered the overall approach that comprised these two consecutive studies.

[4] https://ec.europa.eu/jrc/en/moocknowledge

3.2 Research Questions and Approach

Based on the theoretical analysis, we settled on three research questions:

1. **Research Question 1:** Which feedback practices are currently present in MOOCs?
2. **Research Question 2:** What is the influence (positive or negative) of feedback in students' engagement with MOOCs?
3. **Research Question 3:** Which feedback model(s) should be developed and applied in fully online courses and specifically in MOOCs for enhancing student engagement?

The answers to these questions were used to support the research objective that was to specify new or enhance existing **feedback factors**, namely theories, methodologies and practices based on feedback methods that can be applied in MOOCs for improved student engagement.

The PhD approach is outlined in the next figure. First, we conducted a systematic literature review similar the one from Tai, Ajjawi, Bearman & Wiseman (2020). We identified and analysed 184 publications that were considered relevant to the research questions of this PhD. These publications were related mainly to feedback and formative assessment, student engagement, feedback in relation to student engagement, MOOC practices including student engagement and feedback practices.

From this analysis we identified 24 feedback factors that are either related to student engagement in classroom/traditional learning or they are currently present in MOOCs (e.g. interaction type, … no. of peer-assessments, etc).

Based on those feedback factors, we formulated 50 hypotheses and we conducted a study (study 1) based on a (post-)questionnaire that students were invited to complete in the context of MOOCknowledge project with total 162 questions but with just 54 related to the hypotheses of this PhD research.

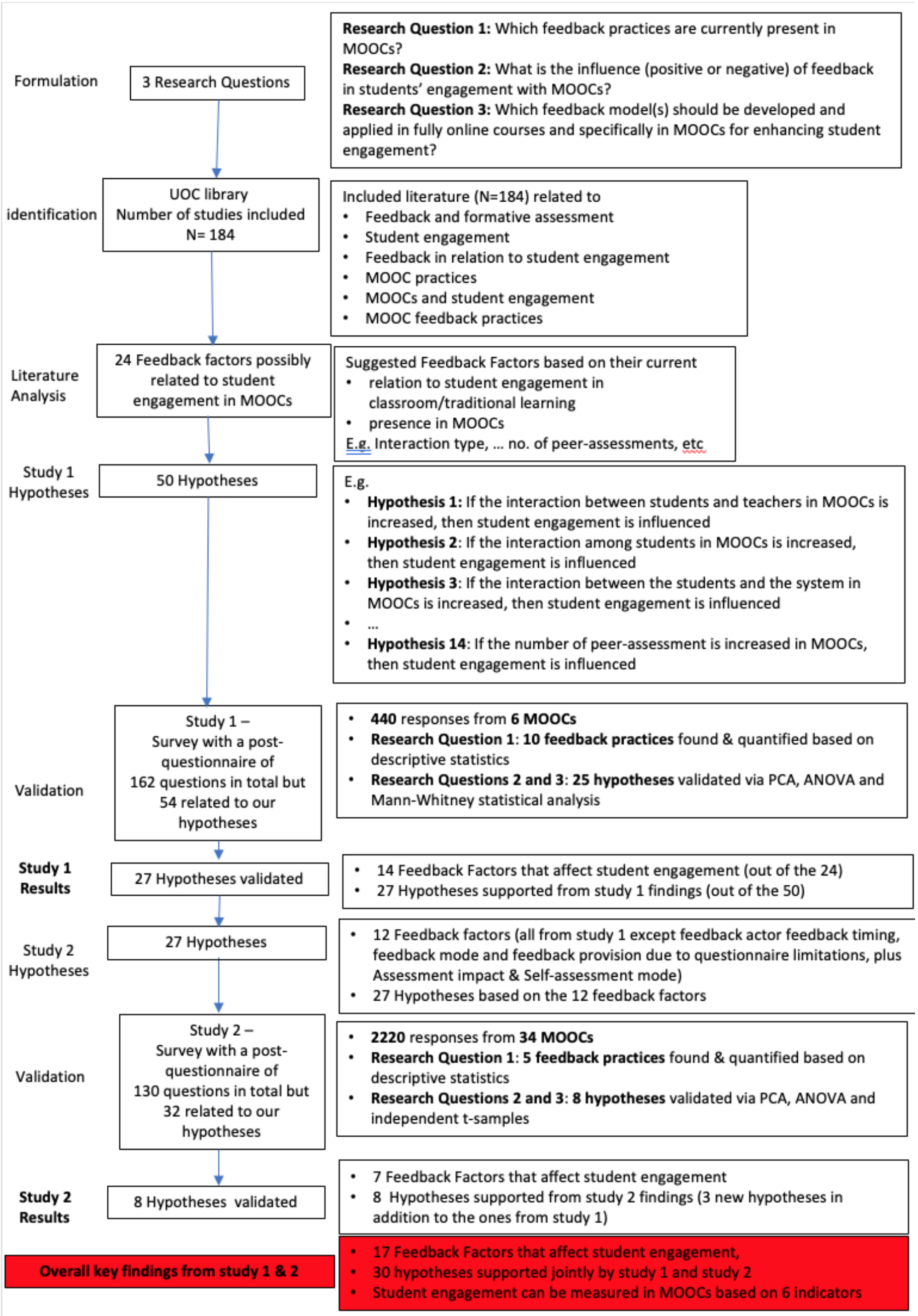
Overall, we received from the first study (**study 1**) 440 responses from 6 MOOCs and in regards to research question 1, 10 feedback practices were found and quantified based on descriptive statistics. For research questions 2 and 3, we validated 27 out of the 50 Hypotheses based on PCA, regression and correlation statistical analysis.

Further to the findings from study 1, we conducted a similar second study (**Study 2**) but with a shorter questionnaire again in the context of MOOCknowledge project (with 130 questions in total and 32 related to study 2) for validating 27 hypotheses. 25 out of 27 hypotheses were supported from the study 1 and the remaining 2 were supported from high impact publications.

From study 2, we collected 2220 responses from 34 MOOCs and for research question 1, 5 feedback practices were found and quantified based on descriptive statistics. Finally for research questions 2 and 3, we validated 8 out of the 27 hypotheses via PCA, regression and correlation statistical analysis.

Overall with this PhD approach we validated jointly via both studies 1 and 2, 17 feedback factors out of the initial 24 ones, 30 hypotheses out of the 50 initial ones and 6 student engagement metrics to be able to measure it and relate them with the validated 17 feedback factors.

Figure 2: PhD Approach



In more detail, in **study 1**, we formulated 50 working hypotheses so as to consider all those feedback factors that were identified already in the literature review and were related to student engagement. We examined their validity with specific statistical methods namely **Principal Component Analysis, one-way ANOVA and Mann-Whitney**. We firstly applied **Principal Component Analysis (PCA)** to investigate concepts of student engagement that were not easily measured directly by reducing a large set of student engagement variables to a small set of just three that still contained most of the information from the large set. The central idea of PCA was to reduce the dimensionality of a dataset consisting of a large number of interrelated variables on student engagement, while retaining as much as possible of the variation present in the dataset.

The different feedback factors were the independent variables that we considered they had an effect on the dependent variables, that was the student engagement and its components they were influenced by feedback factors.

Also, the independent variables (i.e., feedback factors) were nominal (variables where one category is no better than another e.g., true or false) and ordinal (i.e., there is some order to the categories e.g., 1st, 2nd, 3rd, etc.).

With ANOVA and Mann-Whitney we examined the validity of the 50 hypotheses in regards to feedback, formative assessment, student engagement along with its different components identified via the PCA. More specifically, with ANOVA regression analysis we explored the relationships between the two variables, i.e., *student engagement* that was the dependent variable and *feedback factors* that were the independent variables and were ordinal. Namely, we identified the relationship between a dependent variable that is student engagement and various independent ordinal variables on feedback factors. Also, with ANOVA we came out with some regression equations that could be used to predict the value of student engagement and whether it increases or decreases in relation to the increase, decrease or even existence of various feedback factors. Similarly, with Mann-Whitney analysis we identified those nominal independent variables that influence student engagement and its various components from the PCA.

Finally, based on this study, we provided some descriptive statistics and more specifically simple summaries about the feedback practices that were applied overall in MOOCs.

Similarly, further to the findings from study 1, we conducted **study 2** to validate specific factors and their hypotheses in relation to student engagement. We examined 12 feedback factors from the 24 that we had initially used in **study 1**. In the same manner, we had also 27 **hypotheses** from the 50 we had in **study 1** since we had to use a shorter questionnaire. Consequently, in **study 2** we managed to collect significantly more responses. The feedback factors to be further explored in study 2 were actually selected mainly because either they were already identified as important factors from **study 1** or they were based on publications with relevant high impact factor and/or significant number of citations of the specific article in google scholar. Those 12 feedback factors contained 10 from study 1 (i.e. all except feedback actor, feedback timing, feedback mode, and feedback provision) plus two that we considered also based on literature evidence (i.e. Assessment impact and self-assessment mode). Similarly, we applied in this study similar statistical methods as in **study 1**, namely PCA, ANOVA for ordinal independent variables and independent t-samples for nominal ones for finding relationships between student engagement and various feedback factors. Finally based on this last study we also provided simple summaries on the feedback practices that were applied overall in MOOCs.

In the next sections, we described for each of the two studies that we have just outlined, namely **study 1** and **study 2**, the type and source of data collected, and how it was analysed based on statistical methods used to analyse averages, frequencies, and correlations between variables. We also defined the variables and formulated hypotheses with the assumed relations between them and we described the appropriate statistical methods to test these hypotheses.

3.3 First Study – Study 1

3.3.1 Introduction

In **study 1**, based on a literature review, we considered 24 feedback factors that can affect student engagement as the independent variables in the analysis. Consequently, these 24 feedback factors led us to the formulation of 50 hypotheses in relation to feedback practices and student engagement.

For example one feedback factor was the interaction type and the three related hypotheses were

- **Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement is influenced
- **Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced
- **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced

In the table below (Table 1) we display the independent variables, namely feedback and assessment factors, and the related hypotheses. In annex G, we provided in a table also the literature source in addition to the feedback factors and the hypotheses .

Table 1:Study 1 – hypotheses linking independent variables (feedback factors) and dependent variable (student engagement)

	Feedback factors (Independent Variables for Research Question 2)	**Hypotheses**
1	Interaction type	**Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement is influenced **Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced
2	Existence of Assessment	**Hypothesis 4 :** If assessment exists in MOOCs then student engagement is influenced
3	Type of Assessments	**Hypothesis 5**: If participation level in forum discussions is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 6**: If the completion of an assignment individually is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 7**: If the completion of an assignment as a group is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 8**: If answering a quiz is part of assessment activities in MOOCs, then student engagement is influenced
4	Impact of Assessments Assessment activities that allow students to identify what they know and can do	**Hypothesis 9**: If assessment activities allowed the students in MOOCs to identify what they know and can do, then student engagement is increased
5	Impact of Assessments Assessment activities that allow students to identify their weaknesses	**Hypothesis 10**: If assessment activities allowed the students in MOOCs to identify their weaknesses, then student engagement is increased
6	Impact of Assessments Assessment activities that stimulate students to revisit earlier study and motivate them to engage in depth with the course topic	**Hypothesis 11**: If assessment activities supported the students in MOOCs to stimulate them to revisit earlier study and motivate them to engage in depth with course topic then student engagement is increased.
7	Impact of Assessments Assessment activities that allow students to understand the course content easier	**Hypothesis 12**: If assessment activities allowed students in MOOCs to understand the course content easier then student engagement is influenced.
8	Impact of no. of assessments	**Hypothesis 13:** If number of assessment activities is sufficient then student engagement is influenced
9	Number of submissions to be evaluated	**Hypothesis 14:** If the number of peer-assessment is increased in MOOCs, then student engagement is influenced
10	Existence of self-assessment	**Hypothesis 15:** If there is self-assessment in MOOCs, then student engagement is influenced
11	Self-Assessment Method	**Hypothesis 16:** If students had to evaluate their own work but after evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 17:** If students had to evaluate their own work but without the condition of evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 18:** If students had to evaluate their own work but with any other condition other than the ones above, then student engagement is influenced
12	Assessment Guidance	**Hypothesis 19:** If as guidance for self- or peer-assessment, a guide or matrix with model answers and clarifications on the assessment criteria and the related points/credits is provided, then student engagement is influenced **Hypothesis 20:** If as guidance for self- or peer-assessment, a group discussion on the assessment methods takes, then student engagement is influenced **Hypothesis 21:** If as guidance for self- or peer-assessment, a training session bases on a few practice assignments as exemplars, then student engagement is influenced

		Hypothesis 22: If as guidance for self- or peer-assessment, a training session bases on a few practice assignments as exemplars, then student engagement is influenced
13	Guidance on assessment that helps students to acquire the expected knowledge from the online course.	**Hypothesis 23**: If guidance received to assess the students' own work or the work of their classmates helped them to acquire the expected knowledge from the MOOC, then student engagement is influenced
14	Existence of feedback	**Hypothesis 24:** If there is feedback mechanism in MOOC, then student engagement is influenced
15	Actor responsible for feedback or assessing student's work	**Hypothesis 25:** If actor responsible for providing feedback or assessing student's work in MOOCs is the student himself/herself, then student engagement is influenced **Hypothesis 26:** If actor responsible for providing feedback or assessing student's work in MOOCs is the instructor/teacher, then student engagement is influenced **Hypothesis 27:** If actor responsible for providing feedback or assessing student's work in MOOCs is the peer, then student engagement is influenced **Hypothesis 28:** If actor responsible for providing feedback or assessing student's work in MOOCs is the system, then student engagement is influenced
16	Feedback Mode	**Hypothesis 29:** If written feedback is provided in MOOC, then student engagement is influenced **Hypothesis 30:** If audio feedback is provided in MOOC, then student engagement is influenced **Hypothesis 31:** If video feedback is provided in MOOC, then student engagement is influenced **Hypothesis 32:** If feedback via chat/skype is provided in MOOC, then student engagement is influenced
17	Feedback Content	**Hypothesis 33:** If the feedback content is general comments, then student engagement is influenced **Hypothesis 34:** If the feedback content is just a grade, then student engagement is influenced **Hypothesis 35:** If the feedback content is on solutions of the task/exercise but with no comments, then student engagement is influenced **Hypothesis 36:** If the feedback content is on solutions of the task/exercise but with comments, then student engagement is influenced **Hypothesis 37:** If the feedback content informs you about an incorrect response and allows you one or more attempts to answer it, then student engagement is influenced **Hypothesis 38:** If the feedback content suggests on how to improve further the submitted work, then student engagement is influenced
18	Feedback provision	**Hypothesis 39**: If the feedback was communicated via dialogue (trying to stimulate response), then student engagement is influenced. **Hypothesis 40**: If the feedback was communicated passively (one-way communication), then student engagement is influenced.
19	Feedback focus	**Hypothesis 41**: If the feedback focused on praising students' effort and on learning goals, then student engagement is influenced **Hypothesis 42**: If the feedback focused on praising the students' ability or intelligence, then student engagement is influenced **Hypothesis 43**: If the feedback focused on clarifying the learning content, then student engagement is influenced **Hypothesis 44**: If the feedback focused on comparing student's performance with other students, then student engagement is influenced **Hypothesis 45**: If the feedback focused on comparing student's performance with other measures of the individual's ability (e.g., creativity, critical thinking, etc), then student engagement is influenced
20	Feedback timing	**Hypothesis 46**: If the feedback timing changes, then student engagement is influenced
21	Feedback frequency	**Hypothesis 47**: If the frequency (how often) of the feedback changes, student engagement is influenced
22	Feedback length	**Hypothesis 48**: If the length of the feedback changes, then student engagement is influenced
23	Attention on feedback	**Hypothesis 49**: If students read frequently and the whole feedback provided, then student engagement is influenced

24	Feedback impact	**Hypothesis 50**: If feedback impacts positively student's learning objectives and motivation, then student engagement is influenced

Therefore, we considered these initially formulated 50 hypotheses in Table 1 related to feedback factors for increasing student engagement.

These 50 hypotheses were the basis for formulating the questionnaire in **study 1** for examining their validity. They emerged from the literature review where we identified various feedback factors that influenced student engagement. Such as

- feedback content (e.g., orientate students to identify the most important aspects or aligned with the purpose of the related assignment, or advance future learning or sufficient justification),
- comprehensibility,
- when it is delivered,
- how it is delivered,
- by whom it is delivered,
- its detail level,
- whether it is legible,
- its frequency and consistency,
- whether it supports interaction and advances communication,
- whether it is self-explained,
- whether it supports student to assess their performance and the performance of the other peers, and,
- whether it increases self-esteem.

However, most of them were considered as factors that advanced specifically in MOOCs student engagement and this research thesis here focused on investigating this deeper by assessing which specific feedback factors and at what level impact student engagement in MOOCs by formulating initially 50 related hypotheses in **study 1**.

Then we prepared a long questionnaire under MOOCKnowledge project for MOOC participants to primarily examine statistically with their responses the validity of the hypotheses and addressing research questions 2 and 3[5] and secondly dealing with the research question 1[6]. Consequently, we analysed statistically all the responses received from the MOOC students , i.e.,

[5] **Research Question 2**: What is the influence of feedback in students' engagement? And **Research Question 3**: Which feedback model(s) should be developed and applied in MOOCs for advancing student engagement?

[6] **Research Question 1**: Which feedback practices are currently present in MOOCs)

we analysed *nominal* responses (Yes/No*)* for dealing with **research question 1** and *Principal Component analysis (*PCA) for reducing the components of the dependent variable, *Mann Whitney test* for the nominal independent variables and ANOVA *Regression Analysis for Ordinal independent variables in order to address* **research questions 2 and 3**.

3.3.2 Data and Samples

In this study, we used a lengthy questionnaire of 162 questions in total but 54 related to the hypotheses of study 1 for the online survey since at this study we planned to address all three research questions and consider all the different feedback factors that we identified in the Literature Review chapter.

The questionnaire was developed in the context of the MOOCknowledge project as a goal to collect large-scale data about participants in (European) MOOCs. The questionnaire was completed after their participation in the MOOC and this was the reason that we referred to it as post-questionnaire.

In this thesis, the words “questionnaire” and “post-questionnaire” were the same and they were used interchangeably.

The whole questionnaire can be found in Annex A and in Annex B, we highlight the parts in which we were interested and used specifically for the statistical analysis, namely the ones related to student engagement, assessment and feedback. We also indicated whether the variables of each component were linked either with the dependent variable, i.e., student engagement or with the independent variables, i.e., feedback factors.

Based on the questionnaire part as indicated in Annex B, we statistically analysed the responses that we received from these specific questions in Annex B for identifying the relationship between the independent and dependent variables.

However, the long length of the questionnaire and the fact that all related questions were optional gave us a rather limited number of responses (i.e. 440) or missing values but as we showed later the sample was statistically adequate. We examined the six MOOC courses as shown in Table 2.

Table 2: Number of student samples responded to the study 1 survey per MOOC

MOOC number and code	Number of student samples
MOOC -1 HandsonICT	27
MiriadaBUIN	155
MiriadaXeape	55
CDDigitalpost	90
EduNarraMoocp	73
EmprenduMOOC	40

TOTAL	**440**

3.3.3 Approach

As discussed already, the first research question aimed to identify feedback practices that were currently present in fully online courses and especially in MOOCs.

For dealing with the research question 1, we used just descriptive statistics and analysed the responses from the questionnaire questions as indicated in the table 3 below

Table 3: Questions to identify feedback practices that are currently present in fully online courses

Feedback factors in MOOCs	**Related questions for descriptive analysis**
Interaction type	How much have the following interactions been facilitated within the MOOC? (Student – student interactions), (Student-teacher interaction, Student – content interaction)
Existence of any type of assessments	Which MOOC Course had any type of assessment activities and which not
Type of Assessment Activities	Which Assessment Activities were applied in each MOOC course (variable:Name_Mooc)
Person responsible to assess students' work	Who was responsible to assess students' work in each MOOC course (variable: Name_Mooc)
MOOC actor responsible for feedback	Who was responsible to provide you feedback in each MOOC course?
Feedback mode	Under which format, feedback was provided in each MOOC?
Feedback content	What was the content of the feedback?
Feedback provision	How was feedback provided in each MOOC?
Feedback focus	What was the focus of feedback provided?
Feedback timing	When was feedback of your work provided?

Therefore, in the Results section, we provided the analysis on which were the most popular interaction types in MOOCs; what was the percentage of the examined MOOCs that had assessment activities; which type of assessment activities were present in these MOOCs; who was responsible to assess student's work as well as who was responsible to provide feedback; in what format the feedback was provided; what was the content of the feedback; how the feedback was provided; what was the focus of the feedback; and, when feedback was provided.

For dealing with the research questions 2 and 3, we first had hypotheses formulated based on the literature review. In Table 1, we have already shown the hypotheses, linking independent (feedback) and dependent (student engagement) variables. As we mentioned, 440 respondents from six MOOC courses participated in the survey and they filled out the online questionnaire (See ANNEX A: First version of Post-Questionnaire (Used for study 1) after their participation in the MOOC course.

Then, we applied *Principal Component Analysis (PCA)* to reduce a complex data set on student engagement to a lower dimension and reveal a simplified structure on student engagement

Based now on the simplified structure of student engagement that emerged from PCA, we applied correlation and regression analysis for determining the strength of the association between student engagement including its different components and the feedback and assessment factors.

Principal Component Analysis on Student Engagement

We applied *Principal Component Analysis* in order to reduce a complex data set on student engagement with 16 dimensions (including two as other missing values) to a lower one and conclusively we revealed a simplified structure on student engagement based on 3 dimensions. Student engagement was specified in the questionnaire with 14 dimensions (plus 2 as missing values) and in specific as participation in the course activities and was measured with respect to the amount/level of:

1) lecture or videos watched,
2) quizzes completed,
3) assignments handed in,
4) final assessments completed,
5) MOOC content accessed,
6) specific activities participated,
7) selected lectures watched

as well as with respect to participation frequency and more specifically with respect on how often the student used …

8) video lectures,
9) academic material,
10) textbooks/Study books,
11) reference lists to external resources,
12) assignments,
13) tests, and
14) related social media activities.

In addition, we considered as missing values the responses on "other, please specify" for facilitating the statistical analysis. By applying the *Principal Component Analysis*, we reduced the dimensionality of large data sets (14 dimensions), by transforming a large set of variables into a smaller one that still contained most of the information in the large set. Specifically, we grouped the initial 14 student engagement components into 3 principal components for facilitating the statistical analysis as it was shown in the Results section.

The structure for "student engagement" was analysed based on a) *Pairwise deletion* for deleting any missing values and consequently, 425 total cases were used, and b) on using *Principal Component Analysis* based on correlation matrix (***R***), with *Varimax Rotation* and *25 iterations*.

Also the sample was adequate for running the Principal Component Analysis (PCA) according to Barlett's test. It showed that the sample was adequate in order to run PCA without any problem X2(15)=994,34, p<,05. The same was shown by *Kaiser-Meyer-Olkin Measure of Sampling Adequacy* that was close to 1 (,95). The six items that remained loaded in three principal components of "Student Engagement".

Furthermore, all variables had *communalities* with high values, i.e., above 0,94 and therefore were well represented.

Finding associations of components with student engagement

Initially, the "Student Engagement" variable consisted of 16 items (14 plus 2 as "other/please specify" that were considered as missing values) as we saw before and in order to facilitate the statistical analysis, we applied the *Principal Component Analysis (PCA)*. PCA was a useful tool for investigating variable relationships for complex concepts and allowed us to investigate the student engagement concept that is not easily measured directly by collapsing a large number of variables (in total 16) into three interpretable principal components.

More specifically, the *PCA* was run with *Variamax Rotation* and only six items /components remained that complied with the following criteria:

1. Factor loadings above or equal to 0,50,
2. no cross loadings,
3. no negative loadings, and
4. the meaning of items under the same extracted component must form a logical / theoretical structure too.

Furthermore, as we already indicated, loadings below 0,50 were rejected (not shown in results section). In the Results section we showed only the loadings of the related six dimensions that were above 0,80 and the numbers emerged on communalities, loadings and total variance explained validated this structure and the six dimensions could measure what they were expected to measure, i.e. student engagement.

Therefore, we used PCA as a dimension-reduction tool and we reduced a large set of 16 student engagement variables to a small set of three principal components that still contain most of the information from the large set.

The PCA in **study 1** as we show in the Results section, resulted in student engagement dimensions related to how often/frequency students are engaged with learning material and assignments (Access rate).

Finding relationship between student engagement including its three principal components and feedback factors

Many of the statistical procedures including *correlation, regression, t-tests, and ANOVA,* namely parametric tests, are based on the assumption that the data follows a normal distribution or a Gaussian distribution, it was assumed that the populations from which the samples were taken were normally distributed. Normality and other assumptions should be taken seriously, since when these assumptions did not hold, it would be impossible to draw accurate and reliable conclusions (Oztuna, Elhan & Tucar, 2006). Therefore, since the sample size was not significantly large (just 440 samples), we have checked the normality in order to ensure the use of the proper statistical methods for reliable and accurate results as shown in Table 4.

Apparently, normality test as well as Histograms with normal curve showed no normally distributed data for all scales of Student Engagement: $p>.05$. Therefore, non-parametric tests were run for nominal variables (i.e., Man-Whitney) and instead *one-way ANOVA method* was used that is applicable for parametric and non-parametric tests (McCrum-Gardner, 2008).

Table 4: Normality Test

		Completing Assignments	**Accessing learning material**	**Attempting assessment activities**	**Student engagement**
N		425	386	398	369
Normal Parameters	Mean	5,69	4,93	6,00	5,54
	Std. Deviation	1,84	1,68	1,30	1,19
Most Extreme Differences	Absolute	,32	,15	,23	,11
	Positive	,24	,11	,22	,11
	Negative	-,32	-,15	-,23	-,11
Kolmogorov-Smirnov Z		6,62	2,94	4,56	2,19
Asymp. Sig. (2-tailed)		,000	,000	,000	,000

After examining the literature (McCrum-Gardner, 2008; Statistics, 2015), we examined what statistical methods we could apply, and we finally used:

- *one way ANOVA analysis* for finding the relationship between student engagement including its three components and each one of the independent variables of feedback that are **ordinal**, and
- *Mann-Whitney test* for comparing **nominal** independent variables and which ones affect more student engagement including its three components.

In the following table (Table 5) we showed which of the 24 feedback factors/independent variables that possibly affect student engagement were ordinal and which ones were nominal.

Table 5: Study 1 – Feedback factors that possibly affect student engagement in MOOCs

No.	Feedback factors/Independent Variables	Variable type
1	Interaction type	Ordinal
2	Existence of Assessment	Nominal
3	Type of Assessments	Nominal
4	Impact of Assessments Assessment activities that allow students to identify what they know and can do	Ordinal
5	Impact of Assessments Assessment activities that allow students to identify their weaknesses	Ordinal
6	Impact of Assessments Assessment activities that stimulate students to revisit earlier study and motivate them to engage in depth with the course topic	Ordinal
7	Impact of Assessments Assessment activities that allow students to understand the course content easier	Ordinal
8	Impact of number of assessments	Ordinal
9	Number of submissions to be evaluated	Ordinal
10	Existence of self-assessment	Nominal
11	Self-Assessment Method	Nominal
12	Assessment Guidance	Ordinal
13	Guidance on assessment that helps students to acquire the expected knowledge from the online course.	Ordinal
14	Existence of feedback	Nominal
15	Actor responsible for feedback or assessing student's work	Nominal
16	Feedback Mode	Nominal
17	Feedback Content	Nominal
18	Feedback provision	Nominal
19	Feedback focus	Nominal
20	Feedback timing	Nominal
21	Feedback frequency	Ordinal
22	Feedback length	Ordinal
23	Attention on feedback	Ordinal
24	Feedback impact	Ordinal

In Chapter 4: Results, we show only those specific feedback factors out of the 24 that produced statistically significant results for influencing student engagement and omitted the rest.

3.4 Second Study – Study 2

3.4.1 Introduction

The fact that we received a lot of responses with missing values from **study 1** since we used an extensive questionnaire motivated us to proceed with one more study, i.e. **study 2** for validating the hypotheses but this time, we decided to introduce a reduced questionnaire with a limited number of questions compared to the one in the **study 1** which consequently resulted to the exploration of smaller number of hypotheses. More specifically, we had to reduce the number of feedback factors from 24 that were used in **study 1** to 12 with priority to those factors that indicated some statistical significance in **study 1**. Apparently, due to questionnaire size limitations, it was possible to examine the validity of up to 27 of hypotheses but, altogether, we managed to collect 2220 responses from 34 MOOC courses from the survey that were filled-in online after their participation in the MOOC course.

3.4.2 Data and samples

The whole questionnaire for **study 2** can be found in ANNEX C: Second version of Post-Questionnaire (used for **study 2**) and in Annex D, we show the questionnaire parts that we were interested in that they were related to the dependent variable (student engagement components) or the independent one (feedback factors). We statistically analysed the responses that we received and examined any relation between student engagement and the feedback factors.

The key findings were based on a statistical analysis conducted from 2220 total responses (plus seven complete blanks that gave in total 2227 responses) received from 34 MOOC courses provided by five MOOC platforms as shown in table 6 below.

Table 6: Number of samples per MOOC course and platform in study 2

MOOC platform/Course	**Sample**
MOOC platform: CARNET: https://mooc.carnet.hr/	
Moodle MOOC Designer	126
MOOC platform: EPP: www.coursera.org	
Aléatoire : une introduction aux probabilités - Partie 1 Coursera- Ecole polytechnique	8
Aléatoire : une introduction aux probabilités - Partie 2 Coursera- Ecole polytechnique	6
Étudier en France : cours de français intermédiaire B1-B2	145

Coursera- Ecole polytechnique	
Fundamentals fluid solid interactions Coursera- Ecole polytechnique	19
How to finance your venture? Coursera- Ecole polytechnique	2
How to write and publish a Scientific Paper Coursera- Ecole polytechnique	97
Optique non-linéaire Coursera- Ecole polytechnique	1
Recherche documentarie Coursera- Ecole polytechnique	23
Initiation à la théorie des distributions Coursera- Ecole polytechnique	8
MOOC platform: IEBS: https://www.iebschool.com/moocs/	
Gamificación para principiantes IEBS	15
Cómo implementar una estrategia de Growth Hacking IEBS	16
Aprende a crear tu primera newsletter con email marketing IEBS	15
Semana del Emprendedor en IEBS IEBS	5
Social Media para principiantes IEBS	34
MOOC platform: INTEF: http://mooc.educalab.es/	
ABP Ed. 3	116
Competencia Digital Ed4	33
Community Manager Ed1	118
Aprendizaje cooperativo Ed2	105
Credenciales Alternativas (1a ed)	32
Eduexpandida Ed2	39
Edu Narra MOOC Ed.3	24
Educar en igualdad	98
Inteligencias multiples	84
Realidad virtual	107
Open etwinning Ed2	97
Visual Thinking Ed 1	159
Origines Moléculaires de la Vie	30
MOOC platform: Paris Diderot: https://www.univ-paris-diderot.fr/tags/mooc-0	

Origines Moléculaires de la Vie	7
MOOC platform: UAB: www.coursera.org	
English for teaching purposes	6
MOOC platform: UANL: http://alere.uanl.mx/	
Desarrollo de Habilidades Académicas	65
Introducción a las Habilidades de Estudio	76
MOOC platform: UOC: Miriada X https://miriadax.net/web/general-navigation/cursos	
Introducción al Business Intelligence y al Big Data (3.ª edición) MiriadaX	318
MOOC platform: UPM: https://miriadax.net/web/general-navigation/cursos	
VERIFICADO POR BLOCKCHAIN *Iniciación al mundo de las aeronaves tripuladas en remoto (drones)*	193
TOTAL	**2220**[7]

Please note that all related questions in this research here were optional (not required to reply) which means that consequently we had to deal with a lot of missing values in the statistical analysis. For example, we provide in the table 7 below the number of valid and missing values for the student engagement variables/questions that we had to deal with in the Principal Component Analysis.

Table 7**: Number of valid and missing values for the student engagement variables/questions in Principal Component Analysis**

	Number of Samples	
Student Engagement variables	**Number of Valid values**	**Number of missing values**
pQ45 (learning activities frequency)	1660	567
pQ44 (learning activities level)	226	2001
pQ46_1 (Browsing content level)	1819	408
pQ46_2 (downloading learning material level)	1825	402
pQ46_3 (watching video lectures level)	1835	392
pQ46_4 (general quizzes/assignments activity level)	1842	385

7 In fact, 2227 students were surveyed but seven collected questionnaires were completely blank that gives a total number of 2220 student responses.

pQ46_5 (the end-of-module quizzes/assignments activity level)	1806	421
pQ46_6 (reading level of forum discussions)	1820	407
pQ46_7 (participating level in forum discussions)	1822	405
pQ46_8 (studying level of literature)	1803	424
pQ46_9 (Peer-review tasks activity level)	1824	403
pQ46_10 (Participation level in social media activities related to the course)	1816	411
pQ46_11 (Communication level with teacher/course facilitator)	1823	404
pQ46_12 (Communication level with other students in the course)	1819	408

However, overall as we will see further in this analysis, the results showed the adequacy of the sample and data suitability based on Barlett's test of sphericity and Kaiser-Meyer-Olkin (sig=0,000 and KMO=0,822>0,7).

The items of the questionnaire focused mainly on the research questions 2 and 3 and more specifically on examining what the influence (positive or negative) of feedback factors such as different types of interaction feedback length, time given, focus, with the different dimensions of student engagement.

3.4.3 Approach

For implementing the data analysis in **study 2**, we followed the same steps as we did for the **study 1**, namely:

1. **Step 1**: Formulation of the hypotheses based on the theoretical analysis and literature review. We considered in addition the findings from the statistical analysis in the **study 1** in order to identify feedback factors with the higher significance. The related hypotheses were shown in Table 8 below
2. **Step 2**: Use of Principal Component Analysis (PCA) in order to reduce a complex data set on student engagement to a lower dimension. This allowed us to reveal a simplified structure on student engagement.
3. **Step 3**: Based on the simplified structure revealed from step 2, we used, as previously explained, the ANOVA and Independent samples t-test statistical analysis. This

allowed us to determine the strength of the association between student engagement and various feedback factors.

Formulation of the hypotheses

Table 8 below provides the 27 hypotheses between the dependent variables on student engagement and the independent ones on feedback factors.

The hypotheses in **study 2** were a subset from the 50 initial hypotheses used in **study 1** and they were mainly the ones that were found to have some relationship between student engagement and feedback factors or they were based on publications with relevant high impact and/or significant number of citations in Google Scholar for the specific article, e.g., the article by Gibbs and Simpson (Gibbs & Simpson, 2004) has more than 2200 citations. 25 out of the 27 hypotheses were based on the findings from study 1 and 2 supported from high impact publications.

Table 8: Study 2 hypotheses

	Feedback factors (Independent Variables for Research Question 2)	**Related Hypotheses**	**Reason for selection in Study 2**
1	Interaction type	**Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement is influenced **Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced	Already an important factor from Study 1
2	Existence of Assessment	**Hypothesis 4:** If assessment exists in MOOCs then student engagement is influenced	Already an important factor from Study 1
3	Type of Assessments	**Hypothesis 5**: If participation level in forum discussions is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 6**: If the completion of an assignment individually is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 7**: If the completion of an assignment as a group is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 8**: If answering a quiz is part of assessment activities in MOOCs, then student engagement is influenced	Already an important factor from Study 1
4	Impact of Assessments Assessment activities that allow students to understand the course content easier	**Hypothesis 9**: If assessment activities allowed students in MOOCs to understand the course content easier then student engagement is influenced.	Based on publications with relevant high impact factor and/or significant number of citations of the specific article in google scholar Dawson et al. (2019), Falchikov & Goldfinch (2000), Gibbs & Simpson (2004), Hattie & Timberly (2007), Li & De Luca (2014)
5	Number of submissions to be evaluated	**Hypothesis 10:** If the number of peer-assessment is increased in MOOCs, then student engagement is influenced	Already an important factor from Study 1

6	Existence of self-assessment	**Hypothesis 11:** If there is self-assessment in MOOCs, then student engagement is influenced	Already an important factor from Study 1
7	Self-Assessment Method	**Hypothesis 12:** If students had to evaluate their own work but after evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 13:** If students had to evaluate their own work but without the condition of evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 14:** If students had to evaluate their own work but with any other condition other than the ones above, then student engagement is influenced	Based on publications with relevant high impact factor and/or significant number of citations of the specific article in google scholar Dawson et al. (2019), Falchikov & Goldfinch (2000), Gibbs & Simpson (2004), Hattie & Timberly (2007), Li & De Luca (2014)
8	Existence of feedback	**Hypothesis 15:** If there is feedback mechanism in MOOC, then student engagement is influenced	Already an important factor from Study 1
9	Actor responsible assessing student's work	**Hypothesis 16:** If actor responsible for providing assessing student's work in MOOCs is the student himself/herself, then student engagement is influenced **Hypothesis 17:** If actor responsible for providing assessing student's work in MOOCs is the teacher, then student engagement is influenced **Hypothesis 18:** If actor responsible for providing assessing student's work in MOOCs is the peer, then student engagement is influenced **Hypothesis 19:** If actor responsible for providing assessing student's work in MOOCs is the system, then student engagement is influenced	Already an important factor from Study 1
10	Feedback Content	**Hypothesis 20:** If the feedback content is general comments, then student engagement is influenced **Hypothesis 21:** If the feedback content is just a grade, then student engagement is influenced **Hypothesis 22:** If the feedback content is on solutions of the task/exercise but with no comments, then student engagement is influenced **Hypothesis 23:** If the feedback content is on solutions of the task/exercise but with comments, then student engagement is influenced **Hypothesis 24:** If the feedback content informs you about an incorrect response and allows you one or more attempts to answer it, then student engagement is influenced **Hypothesis 25:** If the feedback content suggests on how to improve further the submitted work, then student engagement is influenced	Already an important factor from Study 1
11	Feedback length	**Hypothesis 26**: If the length of the feedback changes, then student engagement is influenced	Already an important factor from Study 1
12	Attention on feedback	**Hypothesis 27**: If students read and use part or full of the feedback provided, then student engagement is influenced	Already an important factor from Study 1

Principal Component Analysis for Student Engagement Components

Similarly, as in the **study 1**, we had a big data set on student engagement with 16 variables (16 that were considered as well as one additional that was “other” and was taken as a missing value). These variables were conceptualized as the activities applied by the students and are related to student engagement. This was a rather long structure that didn’t facilitate the statistical analysis and we had to reduce it to a shorter one. As we already specified in the previous statistical analysis, we considered that student engagement is linked with student activity, i.e., the more active the MOOC students are, the more engaged they are.

Consequently, in this **study 2**, we asked the students which of the following 16 activities they had carried out and at what intensity level. Any values noted as “Non applicable” or “other” were considered as missing values in the statistical analysis. For the exact variable code in the questionnaire related to student engagement, please have a look at *ANNEX F: Relation in study 2 between the question code (dependent variable) in questionnaire and the different student engagement activities*.

Student engagement was defined in the questionnaire with 16 variables and measured with respect to:

1) Browsing the content and the learning material
2) Participating in MOOC modules
3) Doing the learning activities
4) Doing various activities such as browsing the content, downloading learning material, watching video lectures, doing the quizzes/assignments, doing the end-of-module quizzes/assignments, reading the forum discussions, actively participating in the forum discussions, studying the literature, doing the peer-review tasks, participating in related social media activities, communicating with the teacher or course assistant, communicating with other students in the course
5) Amount of content browsing
6) Amount of learning material downloaded
7) Amount of video lectures watched
8) Number of general quizzes/assignments made
9) Number of end-of-module quizzes/assignments made
10) Amount of (forum) discussions read
11) Amount of (forum) discussions participated
12) Amount of literature studied

13) Number of peer-review tasks done

14) Amount of related social media activities participated

15) Amount of communication with the teacher/course assistant

16) Amount of communication with other students in the course.

Consequently, the **next step** was to analyse the component structure for "Student engagement" based on the 16 different variables above. Similarly as in **study 1**, we have applied *Principal Component Analysis* and all related tests (e.g. *Reliability Test/Cronbach's Alpha, Kaiser-Meyer-Olkin Measure of Sampling Adequacy* for confirming variables in components, *Barlett's test of Sphericity* for ensuring statistically significant values, *Test of Homogeneity, Crosstabs, Varimax Rotation, Correlation Matrix,* etc.). As it was shown in the Results section, the total number of components extracted from PCA were three. Those three components explained 61,27% of the variance. In other words, this meant that the three components explained the 61,27% of the 16 student engagement variables and allowed us easier to find the association of feedback factors and student engagement and more specifically with three different student engagement components that emerged from PCA.

Associations of feedback factors with student engagement variables

In the **study 2**, we had a sample based on the responses of 2220 students and we can assume safely that the data followed a normal distribution since according to the literature:

- With large enough sample sizes, the violation of the normality assumption should not cause major problems (Pallant, 2007); this implies that we can use *parametric procedures* even when the data are not normally distributed and *true normality* is considered to be a myth (Elliot & Woodward, 2007).
- If we had hundreds of samples, we could ignore the distribution of the data (Altman & Bland, 1995),
- In large samples, the sampling distribution tends to be normal, regardless of the shape of the data (Field, 2009)

Therefore, for finding correlations between the dependent and independent variables, we used:

- *ANOVA* between student engagement including its three components and each one of the feedback variables that are ordinal and
- *Independent samples t-test* between student engagement including its three components and those feedback variables that are nominal.

In the Table 9, we show which of the independent variables were ordinal and which ones nominal:

Table 9: Study 2 – Type of independent variables

N.	Related Questions	Feedback factors (Independent variables)	Variable type
1	Students' interaction level between students, teacher and student and student and system content	Interaction type and level	Ordinal
2	Existence of assessment activities	Existence of Assessment	Nominal
3	The type of assessment activities such as their participation level in forum discussions, the completion of an assignment individually, or as a group, answering a quiz	Type of Assessments	Nominal
4	The impact of assessment activities in understanding the course content (Namely, the assessment activities applied in the course helped the student to understand the course content)	Impact of Assessments	Ordinal
5	The person (the student themself, the instructor/tutor, the peers/other students or system responsible to assess their work	Actor for assessments	Nominal
6	The number of submissions from their peers that they had to evaluate on average (i.e., How many submissions from your classmates did you have to evaluate for each course assignment on average?)	Number of submissions to be evaluated	Ordinal
7	Whether they had to assess their own work during the course (self-evaluation)	Existence of self-assessment	Nominal
8	Existence of feedback in the MOOC	Existence of Feedback	Nominal
9	The feedback content (i.e., General comments, Just a grade (correct/incorrect, overall percentage correct, Solutions of the task/exercise but with no comments, Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.), it informs you about an incorrect response and allows you one or more attempts to answer it, Suggestions on how to improve further the submitted work, Other)	Feedback Content	Nominal
10	The length of the provided feedback (i.e. Feedback was too long, Feedback was sufficient, Feedback was too short)	Feedback length	Ordinal
11	Attention given to the feedback provided by the participant (i.e., I gave special attention to all the	Feedback attention	Ordinal

	feedback provided, I gave special attention mainly to feedback on questions I was sure they were not correct, I gave special attention to feedback on questions I was sure they were correct, I didn't give special attention to any feedback provided, Non applicable, the feedback provided was general and not per question)		
12	Whether they had to evaluate their own work: a) but after evaluating the work of other classmates, b) without the condition to evaluate first the work of other classmates, c) with other condition	Self-assessment method	Nominal

As it is shown in the Results section, only a few specific feedback factors from the initial 12 (See Table 9) produced statistically significant but relevant results.

3.5 Software for data analysis

After reviewing several possible alternatives of survey systems we concluded that the IBM SPSS Data Collection System[8] for both main **studies 1 and 2** offered the most flexible system that allowed an international survey of this size. While comparable free products offer a fast design of standard survey items, special items could not be integrated in a reliable way and SPSS had a user friendly interface.

3.6 Ethical research considerations

According to the *Guidelines for Ethical Practices in Research* from the Open University of Catalonia[9] (UOC), the surveys were designed and distributed respecting the ethical considerations detailed below:

1. All participants were informed of the study and its purpose. They were guaranteed confidentiality in recruitment, and a welcome message with a complete explanation for MOOC participants (see Appendix A, Welcome message) was sent with the survey/post-questionnaire in both main **studies 1 and 2**.
2. All personal records and data as well as identification codes were maintained by the MOOC providers and they were not provided to us.

[8] http://www-01.ibm.com/software/analytics/spss/products/data-collection/

[9] https://www.uoc.edu/portal/en/universitat/responsabilitat-social/codi-etic/index.html

3. An alphanumeric identifier was assigned to MOOC participants to guarantee the confidentiality and anonymity of the subjects.
4. The research design did not involve any experimental treatment of the participants, either physically or mentally.

Chapter 4: Results

4.1 Introduction

`As we described in the Methodology section, the approach comprised two consecutive studies; namely **study 1** and **study 2**. First, we provided the findings from **study 1**, and more specifically the results from the statistical analysis of the survey of 440 students after their participation in a MOOC course. In total, we collected and analysed responses from six MOOCs and we examined which of the 24 feedback factors affect student engagement in MOOCs by formulating 50 hypotheses. First, we presented the findings from the PCA and more specifically, which are the three key components of student engagement that we identified and then we presented only those results that were statistically significant and affected student engagement for addressing research questions 2 and 3. We concluded the findings from **study 1** by providing those feedback practices that were most commonly found in the surveyed MOOCs based on the responses received from the participants for dealing with research question 1.

In the last section of this chapter, we presented the results from **study 2** similarly as in **study 1**. We presented the statistical analysis of the survey of students after they participated in a MOOC course. But this time, we used a shorter questionnaire for the survey, and we had 2220 responses to analyse. The statistical analysis from **study 2** led us to the last results from this thesis in regards to feedback factors that affect student engagement. We first presented those three specific components of student engagement that we identified via the PCA. Afterwards, we presented those seven feedback factors in MOOCs that affected student engagement and then we concluded with the most common feedback practices that were identified from the surveyed MOOCs based on the students' responses in **study 2**.

4.2 Study 1

4.2.1 Student engagement in MOOCs

As described in the methodology section, in order to identify those student engagement activities that are the most significant and representative ones in the MOOCs, we applied statistical methods such as the Principal Component Analysis method. In this way, we managed to group the student engagement criteria (dependent variables) into factors for facilitating the statistical analysis and from 16 components we reduced them into 3 components. This allowed us to group these 16 different student activities into three different components that still contain most of the information in the large set. The structure for "student engagement" was analysed based on a) *Pairwise* *deletion*, and b) on using *Principal Component Analysis* based on correlation matrix (***R***), with *Varimax Rotation* and *25 iterations*.

Also the sample was adequate for running the PCA analysis according to *Barlett's test*: $X^2(15)=994.34$, $p<.05$ and *Kaiser-Meyer-Olkin Measure of Sampling Adequacy* that was 0.95, i.e. close to 1.

More specifically, the PCA after the *Variamax Rotation* gave only six items from the 16 that complied with the following criteria:

1. Loadings above or equal to 0.50,
2. no cross loadings,
3. no negative loadings, and
4. the meaning of items under the same extracted component must form a logical / theoretical structure also.

Furthermore, as we already indicated, loadings below 0.50 were rejected (not shown) and Table 10 below showed the loadings of the related six components that were above 0.80 and the numbers emerged on communalities, loadings and total variance explained, validated this structure and the six components can measure what they are expected to measure, i.e., student engagement.

The following table 10 shows that the total scale explained 93.4 percent of the total variance and the total number of components extracted were four that explained the 93.4 percent of the 16 engagement items (including the two "Other" that were considered as missing ones and neglected). However, to facilitate the statistical analysis, we considered in this research the first three components that explained 87,8%, i.e. they explain the 87,8% which is already quite a high number of the 14 student engagement items (plus two that considered as missing ones).

Table 10: Study 1 – Total Variance explained for the PCA

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8,70	48,01	48,01	8,70	48,01	48,01	6,73
2	5,47	30,21	78,22	5,47	30,21	78,22	3,46
3	1,74	9,59	87,81	1,74	9,59	87,81	3,69
4	1,01	5,59	93,40	1,01	5,59	93,40	3,04
5	,67	3,69	97,09				
6	,53	2,91	100,00				

The following table (Table 11) showed the variables that comprise the three extracted student engagement components. Specifically, the Rotated Component Matrix values to be selected for each component were easily identifiable since they were significantly larger with respect to the other respective values in the other components.

Table 11: Study 1 – Related Component Matrix after PCA

Questionnaire code[10]	**Component**	Test completion (Component 1)	Frequency accessing (Access rate) Resources Material (Component 2)	Frequency of accessing (Attempt rate) Assessment Activities (Component 3)
pC2B2_pC2B2_3_GV1	**Handing in the assignments :**	**,69**		
pC2B2_pC2B2_4_GV1	**Completing the final assessment :**	**,92**		
pC2B3d_pC2B3_27_GV1	**How often using Textbooks/Study books :**		**0,7**	
pC2B3d_pC2B3_28_GV1	**How often using Reference lists to external resources :**		**,62**	
pC2B3d_pC2B3_29_GV1	**How often using Assignments :**			**,60**
pC2B3d_pC2B3_30_GV1	**How often using Tests :**			**,69**

Finally, reliability analysis assessed through Cronbach's alpha coefficient showed (See Table 12) adequate values of internal consistency in each subscale as well as in the total scale that was above 0,70 which is a standard threshold.

Consequently, the Principal Component Analysis gave the following components:

Component 1:

- pC2B2_pC2B2_3_GV1 handed in the assignments
- pC2B2_pC2B2_4_GV1 done the final assessment

Therefore, **Component 1** was labelled “**Completing the assignments**”

Component 2:

- pC2B3d_pC2B3_27_GV1 Frequency accessing Textbooks/Study books
- pC2B3d_pC2B3_28_GV1 Frequency accessing Reference lists/external resources

Hence, Component 2 was labelled “**Frequency accessing learning material**”

[10] See Annex A for the full questionnaire and use the code for the full question

Component 3:

- pC2B3d_pC2B3_29_GV1 Frequency using Assignments
- pC2B3d_pC2B3_30_GV1 Frequency using Tests

Consequently, **Component 3** was labelled "**Frequency attempting assessment activities**"

Table 12: Study 1 – Reliability analysis. Assess through Cronbach's alpha coefficient

Scale	Student engagement Components	Cronbach's Alpha	N of Items
1	Completion Rate: Frequency completing the Assignments	,89	2
2	Access Rate: Frequency accessing learning material	,82	2
3	Attempt Rate: Frequency attempting Assessment Activities	,81	2
	Total	,77	6

Furthermore, in order to ensure that the PCA model with the three components was acceptable and reject the H0 (Null Hypothesis), we conducted ANOVA analysis for each one of the three components (see Table 13) so that to mainly confirm that their statistical significance was less than 0,05 ($p < 0,05$). A small p-value (typically **≤ 0.05**) indicated strong evidence against the null hypothesis, so we could reject the null hypothesis.

Table 13: Study 1 – ANOVA analysis for student engagement and its components

		Sum of Squares	df	Mean Square	F	Sig.	Adj.R^2
Completion rate of assignments	Regression	28,48	3	9,49	3,00	,030	,01
	Residual	1252,28	396	3,16			
	Total	1280,76	399				
Access Rate: Frequency accessing learning material	Regression	142,74	3	47,58	18,93	,000	,13
	Residual	907,45	361	2,51			
	Total	1050,19	364				
Attempt Rate: Frequency attempting assessment activities	Regression	97,63	3	32,54	22,11	,000	,14
	Residual	546,11	371	1,47			
	Total	643,73	374				
Student engagement (in general)	Regression	82,07	3	27,36	22,98	,000	,16
	Residual	409,58	344	1,19			
	Total	491,64	347				

Therefore, we identified three components that could explain statistically sufficiently student engagement, and these are:

1. **Completion Rate: Completing the assignments**, which includes the frequency handing in assignments or the final assessment
2. **Access Rate: Frequency accessing learning material** which is related to the frequency (how often) of accessing textbooks/study books, external resources/reference lists
3. **Attempt Rate: Frequency attempting assessment activities** that is related to the frequency accessing assignments and tests.

Please note that the first student engagement component is different with respect to the third one since the first one is related to whether you are submitting the assignments or the final assessment whilst the third one is related on how often the student is accessing the assignments and tests. In the next section, we show which of the initial 50 hypotheses are valid and more specifically which of the 24 feedback factors (independent variables) affect student engagement overall but also each one of its three components (dependent variables). Next, we showed only those specific feedback factors that produced statistically significant results for influencing student engagement and hence validate 27 of the initial hypotheses and omitted the rest.

4.2.2 Feedback factors that their existence affect student engagement

We applied Mann-Whitney in order to identify which ones of the independent nominal variables in Table 13 above affected student engagement and were statistically significant, i.e. $p<0,05$.

The table below (Table 14) shows only those nominal variables that were statistically significant after applying the Mann-Whitney Analysis. We included the question code for easier reference in the questionnaire in Annex A, question on feedback related to the independent variable, the student engagement dimension, the values of No and Yes for selecting the higher one between the ones that were statistically significant (last column).

Table 14: Mann-Whitney results with statistical significance (p<0,05) for comparing the effect of independent nominal variables to student engagement including its three components

Code	Question Text	Student engagement dimension	No			Yes			M-W Sig.
			M	**Sd**	**N**	**M**	**Sd**	**N**	
pC3B1_1	**Existence of any type of assessment**								
	Did this MOOC include any type of assessment?	Completing Assignments	**4,05**	**1,89**	**29**	**5,89**	**1,75**	**384**	.000
		Student engagement	**4,97**	**1,27**	**22**	**5,6**	**1,18**	**336**	.009

pC3B1_2	**Assessment activities types**								
pC3B1_21	Participation level in forum discussion	Completing Assignments	**5,96**	**1,71**	**318**	**5,49**	**1,93**	**68**	.018
pC3B1_22	Completing a piece of work and submitting it								
		Frequency accessing learning material	**4,65**	**1,78**	**193**	**5,18**	**1,52**	**179**	.005
		Student engagement	**5,42**	**1,23**	**180**	**5,69**	**1,12**	**176**	.033
pC3B1_23	Answering quiz								
		Frequency accessing learning material	**5,44**	**1,58**	**97**	**4,72**	**1,68**	**275**	.000
		Frequency attempting assessment activities	**6,24**	**1,22**	**101**	**5,91**	**1,33**	**282**	.007
		Student engagement	**5,72**	**1,21**	**91**	**5,49**	**1,17**	**265**	.045
pC3B1_24	Completing an assignment as a group								
		Frequency accessing learning material	**4,84**	**1,69**	**342**	**5,62**	**1,5**	**30**	.008
pC3B2_1	**Actor responsible to assess students' work**								
pC3B2_12	The teacher	Completing Assignments	**5,87**	**1,73**	**344**	**5,06**	**2,05**	**63**	.001
		Frequency accessing learning material	**4,83**	**1,68**	**314**	**5,3**	**1,63**	**58**	.033
PC3B2_13	the peers/other students	Completing Assignments	**5,96**	**1,76**	**233**	**5,45**	**1,82**	**174**	.000
		Frequency accessing learning material	**4,64**	**1,77**	**215**	**5,27**	**1,49**	**157**	.001
pC3B2_14	the system automatically	Completing Assignments	**5,2**	**1,9**	**125**	**5,99**	**1,71**	**282**	.000
		Frequency accessing learning material	**5,43**	**1,45**	**113**	**4,68**	**1,73**	**259**	.000
pC3B2_3	**Existence of self-assessment**								
	Did you have to assess your own work during the course?	Completing Assignments	**4,94**	**1,81**	**64**	**5,93**	**1,67**	**124**	.001
		Frequency accessing learning material	**5,77**	**1,1**	**56**	**5,07**	**1,57**	**114**	.008
pC4B1_2	**Actor responsible to provide feedback**								
pC4B1_21	the student herself/himself (her/him own work)	Completing Assignments	**5,8**	**1,72**	**227**	**4,66**	**2,09**	**54**	.000
pC4B1_22	The (teacher) instructor/tutor								
pC4B1_23	the peers/other students	Completing Assignments	**5,74**	**1,83**	**163**	**5,36**	**1,87**	**118**	.020
pC4B1_24	the system automatically								
pC4B1_3	**Feedback Mode**								
pC4B1_31	Written	Completing Assignments	**4,89**	**1,95**	**55**	**5,75**	**1,79**	**226**	.003
		Frequency attempting assessment activities	**5,75**	**1,28**	**55**	**6,15**	**1,26**	**210**	.004
pC4B1_32	Audio	Completing Assignments	**5,7**	**1,83**	**251**	**4,58**	**1,77**	**30**	.001
		Frequency attempting assessment activities	**6,1**	**1,29**	**235**	**5,77**	**1,11**	**30**	.015
		Student engagement	**5,65**	**1,14**	**221**	**5,23**	**1,07**	**27**	.013
pC4B1_4	**Feedback Content**								
pC4B1_42	Just a grade (correct/incorrect, overall percentage correct)	Completing Assignments	**5,69**	**1,82**	**219**	**5,19**	**1,9**	**62**	.020
		Frequency accessing learning material	**5,2**	**1,56**	**205**	**4,8**	**1,46**	**56**	.034
		Student engagement	**5,69**	**1,13**	**196**	**5,3**	**1,12**	**52**	.009
pC4B1_44	Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.)	Completing Assignments	**5,38**	**1,88**	**185**	**5,96**	**1,75**	**96**	.003
		Frequency attempting assessment activities	**5,94**	**1,37**	**173**	**6,3**	**1,01**	**92**	.053
pC4B1_45	It informs you about an incorrect response and allows you one or more attempts to answer it	Completing Assignments	**5,4**	**1,87**	**210**	**6,11**	**1,68**	**71**	.004

		Student engagement	**5,52**	**1,16**	**185**	**5,86**	**1,03**	**63**	.034
pC4B1_46	Suggestions on how to improve further the submitted work								
		Frequency attempting assessment activities	**5,99**	**1,31**	**215**	**6,39**	**1,01**	**50**	.031
pC4B1_5	**Feedback provision**								
pC4B1_52	Through passive information transmission	Completing Assignments	**5,21**	**1,93**	**98**	**5,78**	**1,78**	**183**	.006
pC4B1_6	**Feedback focus**								
pC4B1_62	Praising ability or intelligence	Completing Assignments	**5,16**	**1,83**	**97**	**5,8**	**1,83**	**184**	.001
		Student engagement	**5,34**	**1,17**	**86**	**5,75**	**1,1**	**162**	.001
pC4B1_63	Clarifying the learning content	Completing Assignments	**5,68**	**1,84**	**231**	**5,12**	**1,83**	**50**	.013
		Frequency accessing learning material	**5,03**	**1,53**	**214**	**5,49**	**1,56**	**47**	.023
pC4B1_64	Comparing between your performance with other students	Completing Assignments	**5,63**	**1,85**	**260**	**4,95**	**1,8**	**21**	.025
pC4B2_1	**Feedback timing**								
pC4B2_11	Immediately after submission of my work								
		Frequency accessing learning material	**4,83**	**1,59**	**99**	**5,3**	**1,54**	**143**	.011
		Frequency attempting assessment activities	**5,88**	**1,43**	**100**	**6,27**	**1,13**	**144**	.044
		Student engagement	**5,49**	**1,27**	**92**	**5,82**	**1,01**	**137**	.059
pC4B2_12	Delayed								
		Frequency accessing learning material	**5,21**	**1,53**	**212**	**4,7**	**1,55**	**48**	.025
		Frequency attempting assessment activities	**6,13**	**1,27**	**215**	**5,79**	**1,25**	**49**	.012
		Student engagement	**5,68**	**1,14**	**201**	**5,27**	**1,1**	**46**	.008

Based on the above analysis, we concluded on the following feedback factors that their existence in MOOCs influenced student engagement. These results were discussed further in the Discussions chapter. We only showed those results in table 15 that they were statistically significant, $p<.05$.

Table 15**: Which factors of feedback and assessment if exist, influence student engagement in MOOCs**

Result No.	Result description	Result statistical analysis - Mean (M) of student engagement
Existence of assessment		
1	If any type of assessment exists, then the completion rate of the assignments is influenced positively	When any type of assessment exists in a MOOC, then completing the assignments (M=5,89) is bigger than when there isn't any assessment (M=4,05)
2	If any type of assessment exists, then student engagement in general is influenced positively	When any type of assessment exists in a MOOC, then student engagement in general (M=5,6) is bigger than when there isn't any assessment (M=4,97)

Type of assessment		
3	If the participation level in forum discussion is considered as one type of assessment, then completion rate of the assignments is influenced negatively	When the participation level in forum discussion is NOT applied, then completing assignments (M=5,96) is higher than when it is applied (M=5,49)
4	If it is required to complete a piece of work and submit it as one type of assessment, then access rate to the learning material as well as the student engagement overall are positively influenced	When completing a piece of work and submitting it, is applied, then frequency accessing learning material (M=5,18)and student engagement (M=5,69) are higher than when this assessment type is not applied (M=4,65), (M=5,42)
5	If it is required to answer a quiz as one type of assessment, then access rate to the learning material, and attempt rate of activities & assessments and student engagement overall are negatively influenced	When answering quiz is NOT applied, then frequency accessing learning material, frequency attempting assessment activities and student engagement in general are bigger (M=5,44), (M=6,24) (M=5,72) than when this assessment type is applied (M=4,72), (M=5,91), (M=5,49)
6	If it is required to complete an assignment as a group, then access rate to learning material is influenced positively	When completing an assignment as a group is applied then frequency accessing learning material is bigger (5,62) than when it is not applied (M=4,84)
Actor responsible to assess student's work		
7	If the (teacher) instructor/tutor is responsible to assess student's work, then completion rate of the assignments is negatively influenced and access rate to learning material is positively influenced	When actor responsible to assess student's work is NOT the teacher(instructor/tutor) (M=5,87) then completing the assignments is higher than when the teacher (instructor/tutor) assesses student's work (M=5,06) When the instructor/tutor is the one that assesses student's work (M=5,3) then frequency accessing learning material is higher than when he doesn't assess student's work (M=4,83)
8	If the other students/peers are responsible to assess student's work, then completion rate of assignments is negatively influenced and access rate to learning material is positively influenced	When the other students/peers are NOT the actors responsible to assess students' work (M=5,96), then completing assignments is higher than when they are (M=5,45) On the contrary, when the other students/peers are the actors responsible to assess students' work (M=5,27) then frequency accessing learning material is higher than when they are not (M=4,64)
9	If the system automatically assesses student's work, then completion rate of assignments is positively influenced	When the system automatically is the one that assesses students' work then completing

	and access rate to learning material is negatively influenced	assignments is higher (M=5,99) than when the system is not (M=5,2) On the contrary when the system automatically is not the actor to assess students' work then frequency accessing learning material is higher (M=5,43) than when it is (M=4,68)
	Existence of self-assessment	
10	If self-assessment exists, then completion rate of the assignments is positively influenced and access rate to learning material is negatively influenced	When self-assessment exists (M=5,93) then completing the assignments is higher than when it doesn't exist (M=4,94) On the contrary when there is NOT self-assessment (M=5,77) then frequency accessing learning material is higher than when there is (M=5,07)
	Actor responsible to provide feedback	
11	If the actor responsible to provide feedback is the student themself, then completion rate of the assignments is negatively influenced	When actor responsible to provide feedback is NOT the student herself (M=5,8)neither the other peers (M=5,74)then completing assignments is higher (M=5,8) than when they are (M=4,66) and (M=5,36) respectively
	Feedback Mode	
12	If the feedback provided is written, then completion rate of the assignments is positively biased	When feedback provided is written then completing assignment (M=5,75) and frequency attempting assessment activities (M=6,15) are higher than when it is not written (M=4,89) and (M=5,75)
13	If feedback is provided in audio, then completion rate of the assignments as well as student engagement in general are negatively biased	When feedback provided is NOT audio then completing assignments (M=5,7), frequency attempting assessment activities (M=6,1) and student engagement in general (M=5,65) are higher than when it is via audio (M=4,58, M=5,77 and M=5,65 respectively).
	Feedback content	
14	If feedback is just a grade (correct/incorrect, overall %), then completion rate of assignments, access rate to learning material and student engagement in general are positively influenced.	When feedback is just a grade (correct/incorrect, overall %) then completing assignments (M=5,19), frequency accessing learning material (M=4,8) and student engagement in general (M=5,3) are lower than then feedback is not just a grade (M=5,69, M=5,2, and M=5,69 respectively)
15	If feedback provides solution with comments (e.g. suggestions for improvements, common errors, etc), then	When feedback provides solution with comments (e.g. suggestions for improvements, common

	completion rate of assignments and attempt rate of assessment activities are positively influenced	errors, etc) then completing assignments (M=5,96) and frequency attempting assessment activities (M=6,3) is higher than when feedback is NOT provided as such (M=5,38 and M=5,94 respectively)
16	If feedback informs students about an incorrect response and allows them to attempt more for answering, then completion rate of assignments and student engagement in general are positively influenced	When feedback informs students about an incorrect response and allows them to attempt more for answering then completing assignments (M=6,11) and student engagement in general (M=5,86) are higher than when feedback is NOT provided as such (M=5,4 and M=5,52)
17	If feedback has suggestions on how to improve further the submitted work, then attempt rate of assessment activities is positively influenced	When feedback has suggestions on how to improve further the submitted work then frequency attempting assessment activities (M=6,39) is higher than when the feedback is not as such (M=5,99)
	Feedback Provision	
18	If feedback is transmitted via passive information (i.e. there is no dialogue with the student) then completion rate of assignments is positively influenced	When feedback is transmitted via passive information (i.e. there is no dialogue with the student) then completing assignments (M=5,78) is higher than when it is not transmitted in such a way (M=5,21)
	Feedback Focus	
19	If feedback focuses on praising ability or intelligence, then completion rate of assignments and student engagement in general are positively influenced	When feedback focuses on praising ability or intelligence then completing assignments (M=5,8) and student engagement in general (M=5,75) are higher than when feedback doesn't focus on that (M=5,16 and M=5,34 respectively)
20	If feedback focuses on clarifying the learning content, then completion rate of the assignments is negatively influenced and access rate to learning material is positively influenced	When feedback focuses on clarifying the learning content then completing the assignments is lower (M=5,12) and frequency accessing learning material is higher (M=5,49) than when it doesn't focus on that (M=5,68 and M=5,03)
21	If feedback focuses on comparing the student's performance with other students, then completion rate of the assignment is negatively biased	When feedback focuses on comparing the student's performance with other students then completing the assignment is lower (M=4,95) than when the feedback doesn't focus on that (M=5,63)
	Feedback timing	
22	If feedback is provided immediately after submission of student's work then access rate to learning material,	When feedback is provided immediately after submission of student's work then frequency accessing learning material (M=5,3), frequency

	attempt rate of assessment activities and student engagement in general are positively influenced	attempting assessment activities (M=6,27) and student engagement (M=5,82) are higher than when the feedback is not provided in that time instance (M=4,83, M=5,88, M=5,49 respectively)
23	If feedback is delayed then access rate to learning material, attempt rate of assessment activities and student engagement in general are negatively influenced	When feedback is NOT delayed then frequency accessing learning material (M=5,21), frequency attempting assessment activities (M=6,15) and student engagement in general (M=5,68) are higher than when feedback is delayed (M=4,7, M=5,79, M=5,27)

All the results in the above table (table 15) were very useful since they provided some feedback factors that could affect student engagement in MOOCS and we will discuss them further in Discussion chapters.

4.2.3 Intensity levels of feedback factors affecting student engagement

In this section, we presented the ordinal variables of feedback (independent variables) that we identified they had some relationship with *student engagement* and its three components, namely *Completion rate of the assignments*, *Access rate to learning material* and *Attempt rate of assessment activities* that all these were the dependent variables. We considered that these ordinal variables varied according to their intensity (order/scale) of student engagement. We first outlined the findings in the next table (Table 16) and then we elaborated each one in detail. The regression models were formulas with subtraction (-), addition (+) symbols as well as multiplication (*).

Table 16: Relationship between student engagement and ordinal feedback factors/variables

Dependent variable	**Related Independent variables**	**Regression Model**
Relationships between student engagement and interaction types		
Student engagement in general	Student to teacher interaction level, student to content interaction level	Student Engagement: = 3,67 + 0,11 *(Student to teacher interaction) +0,21 * (Student to content interaction)
Completion rate of the assignments	Student to content interaction level	Completion rate of the assignments = 4,8 + 0,13 *(Student to content interaction)
Access rate to learning material	Student to student interaction level, student to content interaction level	Access rate to learning material =2,64 +0,16*(Student to student interaction) + 0,22 * (student to content interaction)

Attempt rate of assessment activities	Student to student interaction level, student to teacher interaction level, student to content interaction level	Attempt rate of assessment activities =3,99 +0,09*(student to student interaction) + 0,09 * (student to teacher interaction)+0,23*(student to content interaction)
Relationships between student engagement and number of peer reviews, feedback attention and feedback length		
Completion rate of assignments	Number of peer reviews per assignment	Completing assignments = 3,97 + 0,44*number of peer reviews per submission
Access rate to learning material	Number of peer reviews per assignment, feedback attention (frequency of the total feedback read/paid attention to)	Access rate to learning material =3,83+0,29*number of peer reviews per submission +0,20*feedback attention (level of the feedback read)
Access rate to learning material	Feedback length, feedback attention (Frequency of total feedback read/paid attention)	Access rate to learning material =5,44 – 0,96 * feedback length + 0,29* feedback attention (level of the feedback read)
Student engagement in general	Feedback length, feedback attention (Frequency of total feedback read/paid attention)	Student engagement=5,84 - 0,75*feedback length + 0,29* feedback attention

Further to the outline above, in the next sections we elaborate on each one in detail. Again, we focus only on these results that were statistically significant ($p<0,05$).

Further to the details next, we see that the **R-square value** is **quite low** in most of the regression models. However, according to Neter (Neter et al. 1996) we can generate lots of data with low R-square, because we don't expect models (especially in social or behavioural sciences as in this case) to include all the relevant predictors to explain an outcome variable. We should note that R-square, even when small, can be significantly different from 0, indicating that the regression model has statistically significant explanatory power.

4.2.4 Influence level of interaction intensity to student engagement

Interaction type variables specify the level of interaction between the students, between the student and the teacher, and between the system and the student as shown in the following table 17:

Table 17: Independent variable values of Interaction type

Code	Variable	Value

How much have the following interactions been facilitated within the MOOC?		
C2B2_9	Student – student interactions	○ 1:1 Not at all ○ 2:2 Very little ○ 3:3 Little ○ 4:4 Somewhat ○ 5:5 To some extent ○ 6:6 To a great extent ○ 7:7 Completely
C2B2_10	Student – teacher interaction	
C2B2_11	Student – content interaction	

Based on the Table 17 above, the interaction type was an ordinal variable, therefore, we applied initially Multiple Regression Analysis between student engagement including its three factors, and the following **interaction type** variables:

- C2B2_9 Student – student interactions
- C2B2_10 Student – teacher interaction
- C2B2_11 Student – content interaction

The following relationships were the ones that we identified between the interaction type and the student engagement including its three components that were statistically significant.

- Relationship between student engagement in general, student to teacher interaction and student to content interaction
- Relationship between access rate to learning material, student to student and student to content interaction levels
- Relationship between attempt rate of assessment activities and student to student, student to teacher and student to content interaction levels.

The results and details of the Multiple Regression Analysis can be found in Table 18 below.

Table 18: ANOVA results between interaction type and student engagement including its three components

		Sum of Squares	df	Mean Square	F	Sig.	Adj.R^2
Completion rate of assignments	Regression	28,48	3	9,49	3,00	,030	,01
	Residual	1252,28	396	3,16			
	Total	1280,76	399				
Access rate to learning material	Regression	142,74	3	47,58	18,93	,000	,13

	Residual	907,45	361	2,51			
	Total	1050,19	364				
Attempt rate of assessment activities	Regression	97,63	3	32,54	22,11	,000	,14
	Residual	546,11	371	1,47			
	Total	643,73	374				
Student engagement (in general)	Regression	82,07	3	27,36	22,98	,000	,16
	Residual	409,58	344	1,19			
	Total	491,64	347				

Assessment Activities could be predicted by Student – student interactions, Student – content interaction, Student – teacher interaction: F(3,374)=22.11, p<.05 for all the three variables as shown in Table 19.

Table 19: Multiple Regression Findings (coefficients) between student engagement including its three components and interaction type

Student engagement incl. its three components		**UnStzd Coefficients**		**Stzd Coefficients**		
		B	Std. Error	Beta	t	Sig.
Completion rate of assignments (Component 1)	(Constant)	4,80	,41	,00	11,76	,000
	Student – student interactions :	-,04	,06	-,05	-,65	,518
	Student – teacher interaction :	,11	,06	,12	1,75	,081
	Student – content interaction	**,13**	,07	,10	1,96	**,051**
Access rate to learning material (Component 2)	(Constant)	2,64	,38	,00	6,92	,000
	Student – student interactions :	**,16**	,06	,20	2,90	**,004**
	Student – teacher interaction :	,09	,06	,11	1,61	,109
	Student – content interaction :	**,22**	,06	,17	3,43	**,001**
Attempt rate of assessment Activities (Component 3)	(Constant)	3,99	,29	,00	13,97	,000
	Student – student interaction	,09	,04	,13	1,98	**,048**
	Student – teacher interaction :	**,09**	,04	,14	2,10	,036
	Student – content interaction :	**,23**	,05	,24	4,86	**,000**
Student Engagement in general	(Constant)	3,67	,27	,00	13,61	,000
	Student – student interactions :	,06	,04	,11	1,63	,104
	Student – teacher interaction :	**,11**	,04	,19	2,76	**,006**

	Student – content interaction :	**,21**	,05	,24	4,71	**,000**

Based on the above tables 17, 18, 19, we had the following analysis:

Student engagement in general could be predicted by *Student – content interaction level* as well as by *student – teacher interaction level* since $F(3,347)=22.98$, $p<.05$

For both of these variables, the regression model predicts 16 percent of the variance of *student engagement* in general which is low, and it can be concluded that both "*Student to teacher interaction" and "Student to content interaction*" have both positive influence on *student engagement* in general. This means that the more we facilitate the interactions between the students and the teacher as well as with the training content, the more engaged the students become. Also the regression model is:

Student Engagement: = 3,67 + 0,11 *(Student to teacher interaction) +0,21 * (Student to content interaction)

The large positive value of the constant term meant that even if we didn't have any *student to teacher interaction* or *student to content interaction* (i.e. they are zero) then student engagement would still be significant. This implies that both *student to teacher interaction* and *student to content interaction* influence positively *student engagement* but not significantly since their coefficients were quite low.

Also, we could see that *Completion rate of assignments* could be predicted by *Student – content interaction level* since $F(3,396)=3$, $p<.05$ for this variable.

Based on the regression tables, the regression model predicted just 1 percent of the variance on completion rate of assignments that was very low[11] and also the statistical significance is slightly above the threshold p=0,051 which is the threshold to be considered as statistically significant. Anyway, we could conclude that "student to content interaction" had a positive influence on students completing the assignments. As we mentioned in the Discussion section, this meant that the more we facilitated the interaction between the student and the content, the more engaged the students become.

Also the regression model was:

Completion rate of the assignments= 4,8 + 0,13 *(Student to content interaction)

The large positive value of the constant term means that even if we didn't have any student to content interaction, completion rate of the assignments would be significant.

[11] In the Discussion chapter, this very low variance should be discussed further and elaborate on its significance

Therefore, student to content reaction influenced positively the completion of the assignments but not significantly since its coefficient was quite low.

Similarly, *access rate to the learning material* component could be predicted by *Student – student interaction level and Student – content interaction level* since $F(3,364)=18.93$, $p<.05$ for both these variables. Based on the tables 17,18,19 the regression model predicted 13 percent of the variance of using the learning material which was low. Nevertheless, it can be concluded that both *Student to student* and *student to content interaction levels* had both positive influence on *student engagement*. This meant that the more we facilitated the interactions between the students among themselves and with the content, the more the students used the learning material.

Also the regression model was:

Access rate to learning material=2,64 +0,16*(Student to student interaction) + 0,22 * (student to content interaction)

The positive value of the constant term meant that even if we didn't have any student-to-student interaction or student to content interaction (i.e. they are zero) then students still would be using the learning material. This implied that both student to student and student to content interactions influenced positively students accessing the learning material but not significantly since their coefficients were quite low.

Therefore, the more we facilitated students interacting among themselves as well as with the training content, the more engaged students became.

Furthermore, *Attempt rate of the Assessment Activities* could be predicted by the level of *Student – student interaction, Student – content interaction, Student – teacher interaction* since $F(3,374)=22.11$, $p<.05$ for all the three variables

According to the tables 17, 18 and 19 the regression model predicted 14 percent of the variance of attempt rate of assignments, and we concluded that all three variables of interaction type, "*student to student interaction" "student to teacher interaction"* and *"student to content interaction*" had positive influence on *student engagement*. Therefore, the more the interactions between the students among themselves as well as with the teachers and with the content, the more times the students attempted the assessment activities.

Also, the regression model was:

Attempt rate of assessment activities=3,99 +0,09*(student to student interaction) + 0,09 * (student to teacher interaction)+0,23*(student to content interaction)

The large positive value of the constant term meant that even if we didn't have any *student-to-student interaction*, or *student to teacher or student to content interaction* (i.e. they were zero), then still students would be *attempting the assessment activities*. This implied that all three interaction types influenced positively students attempting the assessment activities but not significantly since their coefficients were quite low especially for student-to-student interaction and student-to-teacher.

4.2.5 Influence level of the number of peer-reviews, feedback attention and feedback length to student engagement

In the same manner as we applied ANOVA for assessment type in the previous section, we did the same statistical analysis for all the other ordinal variables of feedback and in Tables 20 and 21 below, we provided only those results that had statistical significance. Namely:

- Relationship between completion rate of assignments and the number of peer reviews per assignment
- Relationship between access rate to learning material, number of peer reviews per assignment, feedback attention (frequency of the total feedback read/paid attention to)
- Relationship between attempt rate of assessment activities, feedback length, feedback attention
- Relationship between student engagement in general, feedback length and feedback attention.

Table 20: ANOVA results between other factors and student engagement including its three components

		Sum of Squares	df	Mean Square	F	Sig.	Adj.R^2
Completion rate of tests (Component 1)	Regression	163,86	6	27,31	10,58	,000	,22
	Residual	498,34	193	2,58			
	Total	662,20	199				
Access rate to learning material (Component 2)	Regression	53,97	4	13,49	7,63	,000	,17
	Residual	229,84	130	1,77			
	Total	283,80	134				
Attempt rate of assessment activities (Component 3)	Regression	48,15	5	9,63	9,92	,000	,48
	Residual	41,73	43	,97			
	Total	89,89	48				
Student engagement in general	Regression	40,51	4	10,13	12,50	,000	,44
	Residual	44,55	55	,81			
	Total	85,06	59				

Student Engagement component	Feedback factor	UnStzd Coefficients		Stzd Coefficients	t	Sig.
		B	Error Typ.	Beta		
Completion rate of Assignments (Component 1)	(Constant)	3,97	,75	,00	5,28	,000
	How many submissions from your classmates did you have to evaluate for each course assignment on average?	,44	,10	,37	4,55	,000
Access rate to learning material (Component 2)	(Constant)	3,83	,64	,00	6,03	,000
	How many submissions from your classmates did you have to evaluate for each course assignment on average?	,29	,09	,32	3,36	,001
	I gave special attention to feedback on questions I was sure they were correct	,20	,07	,25	3,02	,003
Attempt rate of assessment activities (Component 3)	(Constant)	5,44	1,21	,00	4,50	,000
	Please indicate the length of feedback provided in general?	-,96	,43	-,25	-2,24	,030
	I gave special attention to all the feedback provided	,29	,13	,27	2,20	,033
Student engagement in general	(Constant)	5,84	,76	,00	7,68	,000
	Please indicate the length of feedback provided in general?	-,75	,34	-,22	-2,23	,030
	I gave special attention to all the feedback provided :	,29	,07	,50	4,42	,000

In many MOOCs, it was common practice as part of their learning process for each student to conduct a specific number of peer assessments for each assignment. For example, there were cases that each student would have to assess the submissions from say three other students for the same assignment. In the survey, we wanted to check whether the number of peer assessments that each student conducted could affect their engagement and we considered a wide range of number of submissions from 0 to more than 5 peer-assessments per assignment

As we can see from the two tables 24 and 25, the *number of peer-reviews per submission*, the *feedback attention* (namely how often the student gave special attention to all the feedback provided to him/her*)* and the *feedback length* are related with **student engagement** including its **three components**. More specifically, we had the following regression models:

- *Completion rate of assignments = 3,97 + 0,44*number of peer reviews per submission* This regression model showed that even if zero the number of peer reviews per submission, completing assignments would always be positive. Also the more the number of peer reviews per submission the higher the completion of the assignments. The regression model predicted 22 percent of the variance which was satisfactory.
- *Access rate to learning material =3,83+0,29*number of peer reviews per submission +0,20*feedback attention (i.e., How often I gave special attention to feedback on questions*

*I was sure they were correct)***.** Even if the number of peer reviews per submission was zero as well as the number of times the student gave special attention to feedback on questions, he/she was sure they were correct), still just using the learning material will always be positive. Also the higher the number of the peer reviews per submission or the attention on feedback (*i.e., How often I gave special attention to feedback on questions I was sure they were correct*), the higher was the use of the learning material. The regression model predicts 17 percent of the variance which again was satisfactory.

- *Attempt rate of assessment activities=5,44 – 0,96 * feedback length + 0,29* feedback attention (i.e., How often I gave special attention to all the feedback provided).* The negative coefficient on the feedback length implied that the longer the feedback, the lower was the completion times for the assessment activities. On the contrary, the higher the attention on feedback (i.e., the more often the student gave special attention to all the feedback provided) the higher the doing of the assessment activities. The regression model predicted 48 percent of the variance that was a very good percentage as we commented also in the Discussion section.
- *Student engagement=5,84 -0,75*feedback length + 0,29* feedback attention (i.e., the more often the student gives special attention to all the feedback provided.* Again, the negative coefficient on the feedback length meant that the longer the feedback, the lower was the student engagement in general. On the other hand, the higher the attention to feedback (i.e., the more often the student gave special attention to all the feedback provided), the higher the student engagement in general. The regression model predicted 44 percent of the variance of student engagement that as we commented in the Discussion section was a very good percentage for this research field (social and behavioural science).

The above results will be discussed further in the Discussion chapters. Next, we described some descriptive statistics on the feedback practices and more specifically which formative and feedback assessment practices were found in **study 1**.

4.2.6 Feedback practices present in MOOCs

In this chapter we aim to give a picture on feedback practices that applied in MOOCs based on the responses we received from **study 1**. For this we examined the totals of the number of responses and their percentage for the questions from the questionnaire that are outlined in Table 21 below.

Table 21: Questions for identifying feedback practices based on study 1

No.	Descriptive Analysis to be made based on the following questions	Variables for Research Question 1
1	Were there any types of assessment in the MOOC courses?	Existence of any type of assessments
2	Which Assessment Activities were applied in the MOOC courses (Multiple choices) ● Participation level in forum discussion ● Completing a piece of work and submitting it ● Answering quiz ● Completing an assignment as a group ● Other	Type of Assessment Activities
3	Who was/is responsible to assess students' work? (Multiple choice) ● The student herself (her own work) ● the instructor/tutor ● the peers/other students ● the system automatically	Subject responsible to assess student's work
4	Did you have to assess your own work during the course? • no • yes	Existence of Self-Assessment
5	Who was/is responsible to provide you feedback (Multiple choice) ● The student herself (feedback to her own work) ● The instructor/trainer/tutor ● The peers/other students ● The system automatically	MOOC actor responsible for feedback
6	How was the feedback given? (Multiple choice) ● Written ● Audio ● Video ● Chat or Skype ● Other	Feedback Mode
7	What was the content of the feedback? (Multiple choice) ● General comments ● Just a grade (correct/incorrect, overall percentage correct)	Feedback Content

	• Solutions of the task/exercise but with no comments • Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.) • it informs you about an incorrect response and allows you one or more attempts to answer it • Suggestions on how to improve further the submitted work • Other	
8	How was the feedback provided to you? (Multiple Choice) • Through dialogue (tried to stimulate response and continuing dialogue) • Through passive information transmission • Other	Feedback Provision
9	What was the focus of the feedback provided? (Multiple choice) • praising effort and focusing students on learning goals • praising ability or intelligence • Clarifying the learning content • Comparing between your performance with other students • Comparing performance with other measures of the individual's ability • Other (Specify)	Feedback focus
10	When was feedback of your work provided? (Multiple Choice) • Immediately after submission of my work • Delayed • Mixed	Feedback timing

For each of the above practices, we provided the total number of counts and their percentage as answers to the related questions Table 22 below.

Table 22: Feedback practices from study 2

Variable	**N**	**N**	**N%**	**N%**
	No	**Yes**	**No**	**Yes**
C3B1_1– Existence of Assessment Activities				

Assessment Included	29	384	7,02%	92,98%
C3B1_2 – Type of Assessment Activities				
Participation level in forum discussion	318	68	82,38%	17,62%
Completing a piece of work and submitting it	212	195	52,09%	47,91%
Answering quiz	108	299	26,54%	73,46%
Completing an assignment as a group	377	30	92,63%	7,37%
Other, please specify.	336	71	82,56%	17,44%
C3B2_1 – Subject Responsible to assess student's work				
the student herself/himself (her/him own work)	124	64	65,96%	34,04%
the instructor/tutor	326	59	84,68%	15,32%
the peers/other students	344	63	84,52%	15,48%
the system automatically	233	174	57,25%	42,75%
C3B2_3 Self-Assessment or Not			#DIV/0!	#DIV/0!
Assess your own work during the course?	125	282	30,71%	69,29%
C4B1_2 – MOOC Actor responsible for feedback				
the student herself/himself (her/him own work)	227	54	80,78%	19,22%
the instructor/tutor	147	134	52,31%	47,69%
the peers/other students	163	118	58,01%	41,99%
the system automatically	149	132	53,02%	46,98%
C4B1_3 – Feedback Mode				
Written	55	226	19,57%	80,43%
Audio	251	30	89,32%	10,68%
Video	246	35	87,54%	12,46%
Chat or Skype	259	22	92,17%	7,83%
Other Type	256	25	91,10%	8,90%
C4B1_4 – Feedback Content				
General comments	103	157	39,62%	60,38%
Just a grade	219	62	77,94%	22,06%
Solutions without comments	262	19	93,24%	6,76%
Solutions with comments	185	96	65,84%	34,16%

More attempts on incorrect answers?	210	71	74,73%	25,27%
Suggestions for improvements	225	56	80,07%	19,93%
Something else?	262	19	93,24%	6,76%
C4B1_5 – Feedback Provision				
Through dialogue	187	73	71,92%	28,08%
Through passive information transmission	98	183	34,88%	65,12%
Other type	246	35	87,54%	12,46%
C4B1_6 – Feedback Focus				
Praising effort and focusing students on learning goals	208	52	80,00%	20,00%
Praising ability or intelligence	97	184	34,52%	65,48%
Clarifying the learning content	231	50	82,21%	17,79%
Comparing between your performance with other students	260	21	92,53%	7,47%
Comparing performance with other measures of the individual's ability	261	20	92,88%	7,12%
C4B2_1 Feedback Time				
Immediately after submission of my work	108	152	41,54%	58,46%
Delayed	228	52	81,43%	18,57%
Mixed	204	76	72,86%	27,14%

Based on Table 22 above, we explained briefly each one of the findings, namely:

- Whether and what type of assessments were found (Existence and type of assessment)
- Who is responsible to assess student’s work (Actor to assess)
- Whether self-assessment exists (existence of self-assessment)
- Who is responsible to provide feedback (Feedback actor)
- How the feedback was given (e.g. written, via audio, video, etc) (Feedback mode)
- What was the content of the feedback (Feedback content)
- Whether the feedback was provided via a dialogue or just passive (Feedback provision)
- What was the focus of the feedback (feedback focus)
- When feedback was normally given (Feedback timing)

Existence and type of assessment

As was expected, the majority of the responses (92,8%) answered that there were assessment activities in their MOOC and in this case the most popular type of assessment activities was to answer a quiz (73,46%). The next most popular with 47,9% was to complete a piece of work and submit it and then the participation level in forum discussion. The least popular one (7,37%) was to complete an assignment as a group.

Subject responsible to assess student's work

In the majority of the cases, the subject responsible to assess a student's work was the system automatically (42,75%) and second most popular (34%) was the student herself/himself for their own work. The least popular ones were to have other peers assess their work (15,5%) or the course instructor/tutor (15,3%).

Existence of self-assessment

The above result is in line with the next tendency that 69,2% answered that they had to assess their own work during the course.

Actor responsible for feedback

In most cases, the instructor/tutor (47,7%) and the system automatically (46,98%) were the key actors responsible for feedback to the students and third most popular was the other students. The least popular was the students themselves to give feedback on their own work (19,22%).

Feedback mode

By far, the most popular way/mode to give feedback was the written one (80,43%) with all the other modes (video, audio, chat or skype) close to 10 percent.

Feedback content

The content of the feedback in most of the cases was general one (60,38%) and the next most popular ones were solutions with comments (34,16%) or specifying which answers were wrong and allowing them more attempts (25,3%). Then the next most popular were to provide just a grade (22,06%) or suggestions for improvements (19,9%). The least popular one was to provide solutions without comments (6,76%).

Feedback provision

In most cases (65,12%) there was one-way feedback and, in some cases, (28,08%) there was some discussion via dialogue.

Feedback focus

Most of the feedback (65,48%) was focusing on praising the ability or intelligence of the student and then the next most popular (20%) was to praise effort and focus students on learning goals as well as clarifying the learning content (17,79%). The least popular ones (7,47%) were to compare performance with respect to other students as well as comparing performance with other measures of the individual's ability (7,12%). The two least popular feedback focuses with around 7 percent each were to either compare performance with other measures of the individuals' ability or compare the performance with other students.

Feedback timing

In most cases (58,46%) feedback was provided right after submission of students' work. In some cases it was mixed, i.e., immediately provided after the submission or sometime after (27,14%) and the least popular one (18,57%) was to only provide it after some time (Delayed).

All the above results will be discussed further in Chapter 5 – Discussion on Research Question 1.

4.3 Study 2

4.3.1 Student engagement in MOOCs

As we already saw in the methodology section, in the **study 2**, the use of a shorter questionnaire allowed us to collect 2220 filled-in questionnaires from 34 MOOC courses that were provided from 5 MOOC platforms. The first task was to ensure that we were able to group different student activities that were related to their engagement since student engagement was a multivariate variable that, as we saw, involved a substantial number of correlated variables that were 16 in this case. Therefore, we conducted Principal Component Analysis (PCA) as dimension-reduction tool that was used to reduce this large set of variables to a smaller set (actually 3) that still contained most of the information in the large set. Further to the application of the PCA, we found that student engagement consisted of **three** main components:

1. **Component 1**: **Communication level of students** that included how much they participated in forum discussions or at least read the forum posts; communicate with

other students in course or with the teacher if applicable; and participate in social media activities related to the MOOC course

2. **Component 2: Participation level to activities and assignments** that is related to how many course modules and learning activities they are participating, how many assignments and peer-review tasks they have done
3. **Component 3**: **Access level to the learning material** (that is related to how much content they browse, how many videos they watch and how much learning material they download).

As we saw in study 1, the PCA resulted in student engagement components related to how often/frequency students are engaged with learning material and assignments. However, in **study 2**, the PCA resulted in student engagement components related to the **amount/number** of (**how much/how many**) activities, learning material and assignments students are engaged with. This approach allowed us to examine also the intensity aspect of the student engagement activities via study 2 in addition to their frequency that we explored in study 1.

In the PCA analysis, we were confident of the *sampling adequacy* and data suitability based on *Barlett's test of sphericity and Kaiser-Meyer-Olkin (KMO)* (sig=0,000 and KMO=0,822>0,7).

KMO and *Bartlett's Tests* were based on the correlation between the variables and analysed if this correlation was enough to merge the variables in components.

In principle, *KMO* values closer to 1.0 are better, and any value larger than 0,70 is considered adequate. Since we obtained a *KMO* value of 0.822, it indicated that the samples were adequate for running the PCA.

In regards to *Bartlett's Test of Sphericity*, we wanted a statistically significant value for rejecting the null hypothesis due to lack of sufficient correlation between the variables and the value of sig. equal to 0,000 confirmed as shown in table 23 below.

Table 23: KMO and Bartlett Test for PCA in study 2

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,822
Bartlett's Test of Sphericity	Approx. Chi-Square	1009,743
	df	78
	Sig.	0,000

The total number of components extracted from PCA were **three** as shown in table 24 below. Those three components explain 61,27% of the variance. In other words, this meant that the three components explain 61,27% of the 13 student engagement variables (plus two as "other" that were neglected). We had also to omit from the PCA, one variable, namely PQ46_8: Studying level of literacy for facilitating the conduction of the PCA grouping into three components as well as the regression analysis that followed.

Table 24: Extraction Method: Principal Component Analysis

Total Variance Explained

Component	**Initial Eigen Values**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**[a]
	Total	**% of variance**	**% Cumulative**	**Total**	**% of variance**	**Cumulative %**	**Total**
1	4,732	36,398	36,398	4,732	36,398	36,398	3,960
2	2,077	15,974	52,372	2,077	15,974	52,372	3,000
3	1,158	8,904	61,275	1,158	8,904	61,275	2,425
4	,892	6,861	68,137				
5	,839	6,454	74,590				
6	,655	5,037	79,628				
7	,568	4,373	84,000				
8	,520	4,001	88,002				
9	,488	3,756	91,757				
10	,347	2,672	94,430				
11	,313	2,406	96,835				
12	,231	1,776	98,612				
13	,180	1,388	100,000				

The following table (Table 25) shows the variables that comprise the three extracted student engagement components. Specifically, the *Rotated Component Matrix* values to be selected for each component were easily identifiable since they had significant differences with respect to other respective values in the other components.

Table 25: Related Component Matrix after PCA

Related Component Matrix			
	Components		
	1	2	3
pQ46_7	**,860**	,156	,256
pQ46_12	**,857**	,245	,085

pQ46_11	**,837**	,303	,122
pQ46_6	**,822**	,176	,229
pQ46_10	**,695**	,417	,194
pQ45	,277	**,713**	,093
pQ46_4	,327	**,709**	,497
pQ46_5	,296	**,697**	,383
pQ46_9	,470	**,671**	,207
pQ44	-,063	**,628**	,289
pQ46_1	,120	,316	**,799**
pQ46_3	,049	,399	**,735**
pQ46_2	,339	,138	**,734**
Extraction Method: Principal Component Analysis Rotation Method: Oblimin with Kaiser Normalisation. Number of Iterations: 25			

Specifically:

Component 1:

- pQ46_7 (Active Participation in the (forum) discussions,
- pQ46_12 (Communication with other students in the course),
- pQ46_11 (Communication with the teacher/assistant)
- pQ46_6 (Read the (forum) discussions)
- pQ46_10 (Participation in social media activities related to course).

Therefore**,** **Component 1** was labelled "**Students Communicating Activities/Communication level**".

Component 2:

- pQ45 (Amount of learning activities)
- pQ46_4 (Doing general quizzes/assignments)
- pQ46_5 (Doing end-of-module quizzes/assignments)
- pQ46_9 (Doing the peer-review tasks)
- pQ44 (Participating in course modules)

Therefore, **Component 2** was labelled "**Students attempting Activities and Assignments/Participation level to activities and assignments**"

Component 3:

- pQ46_1 (Browsing the content)

- pQ46_3 (Watching video lectures)
- pQ46_2 (Downloading learning material)

Therefore, **Component 3** was labelled "**Students accessing the learning material/Access level to learning material**"

Furthermore, in order to ensure that the PCA model with the three emerged components was acceptable and reject the H_0 (Null Hypothesis), we conducted *ANOVA analysis for Regression* for each one of the three components so to confirm:

- the "*Adjusted R squared*" value was as close as possible to the "R squared" value and also it was as close to 1 as possible since it indicates the percentage of variation explained by the regression[12].
- confirm that their statistical significance was less than 0,05 ($p< 0,05$). A small p-value (typically **≤ 0.05**) indicated strong evidence against the null hypothesis, so we could reject the null hypothesis.
- confirm the statistical significance (when $p<0,05$) for each variable under each component.

In the following tables 26, 27 and 28, we highlighted with bold and darker background the values that we confirmed above.

Table 26: ANOVA Analysis Tables for Component 1: Communication level

Model Summary				
Model	R	R squared	Adj. R^2	Typ. Estimation Error
1	,991[a]	**,982**	**,982**	,13523889
a. (X) Independent Variables: (Constants), pQ46_12, pQ46_10, pQ46_6, pQ46_7, pQ46_11				
b.(Y) Variable dependent/Dependent Variables: REGR component score 1 (Component 1)				

ANOVA[a]						
Model		Sum of Squares	df	Root Mean Square	F	**Sig.**
1	Regression	181,708	5	36,342	1987,012	**,000[b]**
	Residual	3,292	180	,018		
	Total	185,000	185			
a. (Y) Dependent Variables: REGR component score 1 (Component 1)						

[12] R is the correlation between the predicted values (ARE THE 3 FACTORS) and the observed values of Y (FACTOR 1, I.E. COMMUNICATING). R square is the square of this coefficient and indicates the percentage of variation explained by the regression line out of the total variation. This value tends to increase as you include additional predictors in the model. Thus, one can artificially get a higher R square by increasing the number of Xs in the model. To penalize this effect, adjusted R square is used.

b. (X) Independent Variables): (FACTORS/CONSTANTS), pQ46_12, pQ46_10, pQ46_6, pQ46_7, pQ46_11						
Coefficients						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error typ.	Beta		
1	(Constant)	-2,386	,029		-82,453	**,000**
	pQ46_6	,229	,015	,239	14,961	**,000**
	pQ46_7	,238	,015	,277	16,182	**,000**
	pQ46_10	,161	,010	,199	16,117	**,000**
	pQ46_11	,184	,015	,216	12,576	**,000**
	pQ46_12	,225	,015	,266	15,200	**,000**
a. (Y) dependent Variables: REGR component score 1						

Table 27: ANOVA Analysis Tables for Component 2: Participation level to activities and assignments

Model Summary[b]				
Model	R	R Squared	Adj. R^2	Typ. Estimation Error
1	,979[a]	**,959**	**,958**	,20424582
a.(X) Independent variables: (Constants), pQ46_9, pQ44, pQ45, pQ46_5, pQ46_4				
b. (Y) dependent variables: REGR component score 2 (Component 2)				

ANOVA[a]						
Model		Sum of Squares	df	Root Mean Square	F	Sig.
1	Regression	177,491	5	35,498	850,942	**,000[b]**
	Residual	7,509	180	,042		
	Total	185,000	185			
a. (Y) Variable dependiente/dependent variables: REGR component score 2 (Component 2)						
b. (X) Variables predictors: (Constants), pQ46_9, pQ44, pQ45, pQ46_5, pQ46_4						

Coefficients [a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error typ.	Beta		
1	(Constant)	-4,814	,079		-61,118	**,000**
	pQ44	,273	,014	,329	20,217	**,000**
	pQ45	,467	,025	,328	18,799	**,000**
	pQ46_4	,249	,024	,211	10,248	**,000**
	pQ46_5	,298	,023	,254	12,763	**,000**
	pQ46_9	,233	,014	,287	16,624	**,000**
a. Variable dependiente: REGR component score 2 for analysis 4						

Table 28: ANOVA analysis tables for Component 3: Access level to learning material

Model Summary[b]				
Model	R	R squared	Adj. R^2	Typ. Estimation Error
1	,980[a]	**,960**	**,959**	,20175628
a. Variables predictors: (Constante), pQ46_3, pQ46_2, pQ46_1				
b. Variable dependiente: REGR component score 3 for analysis 4				

ANOVA[a]						
Model		Sum of Squares	df	Root Mean Square	F	Sig.
1	Regression	177,592	3	59,197	1454,276	**,000[b]**
	Residual	7,408	182	,041		
	Total	185,000	185			
a. (Y) Dependent Variables:: REGR component score 3						
b. (X) Independent Variables: (Constants), pQ46_3, pQ46_2, pQ46_1						

Coefficients						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error typ.	Beta		
1	(Constant)	-5,988	,097		-61,605	**,000**
	pQ46_1	,706	,027	,452	25,970	**,000**
	pQ46_2	,410	,016	,414	24,934	**,000**
	pQ46_3	,565	,024	,401	23,953	**,000**
a. Variable dependiente: REGR component score 3 for analysis 4						

4.3.2 Feedback factors in MOOCs

We statistically examined whether already identified feedback factors (independent variables) were related with the dependent variables: a) student engagement in general b) students' communication level, c) Participation level to activities and assignments (i.e. How often students were participating in activities and assignments) and d) Access level to learning material (i.e. How much of the learning material students were accessing). For identifying any relationships with the dependent variables, we have conducted *ANOVA regression analysis* for those feedback factors that were continuous/ordinal. For comparing the influence between student engagement and nominal variables for feedback we applied *independent samples t-test analysis*.

As shown in the following sections, only a few specific feedback factors from the ones above produced statistically significant results for influencing student engagement. In the sections that follow, we first presented those feedback factors that were nominal, namely we examine whether their existence or not affected student engagement. Then we presented those feedback factors that were based on ordinal variables which meant that their intensity level affected student engagement.

4.3.3 Feedback factors that their existence affects student engagement

As we already explained, for the independent nominal variables, we applied *independent samples t-test analysis* and the analysis below showed only those nominal variables that were statistically significant, namely:

- the subject responsible to assess students work
- the self-assessment method
- the existence of feedback.

Influence of the subject responsible to assess students work on student engagement

Subject responsible to assess students' work as it can be seen in the table 29 below was nominal variable:

Table 29: Independent variable values of subject responsible to assess students work

Code	Variable	Categories
Who was/is responsible to assess students' work? (multiple answers possible)		
pQ111a	The student herself (her own work)	(False:0, True:1)
pQ111b	The instructor/tutor	(False:0, True:1)
pQ111c	The peers/other students	(False:0, True:1)
pQ111d	The system automatically	(False:0, True:1)

We used the independent Samples t-test statistical analysis for finding their mean value and their significance (p-value) as shown in table 30 below.

Table 30: Independent samples t-test results for student engagement and subject responsible to do the assessment

Variables	Categories	Mean of student engagement	p-value
pQ111a The student herself (her own work)	True	3.07	.595
	False	2.94	
pQ111b The instructor/tutor	True	3.12	.096
	False	2.43	
pQ111c The peers/other students	True	3.05	.905
	False	3.09	
pQ111d The system automatically	True	2.72	.052
	False	3.93	

As we can see from the table (Table 30) above, sig (p) value is larger than 0,05 in all cases which means that there is no statistical significance between the subject that is responsible to assess student’s work and student engagement.

However, we can consider the case where the system is responsible automatically to do the assessment (pQ111d) and the sig. p value is equal to 0,052 that is very close to 0,05 which is the threshold, and we could say there is statistical significance between student engagement and when the system automatically assesses student’s work.

Result: For this particular case where the system is responsible automatically to do the assessment (pQ111d, we considered that there was statistical significance. Therefore, when the system does not automatically assess students' work, then student engagement is higher (False value of mean of student engagement is higher than the True one).

Influence of self-assessment method on student engagement and its components

The self-assessment method variable as we can see in Table 31 below was nominal one

Table 31: Independent variable values on self-assessment method

Code	Variables	Categories
pQ113	How did you have to evaluate your own work?	
	1.: We had to evaluate our own work, but after evaluating the work of other classmates	(False:0, True:1)
	2.: We had to evaluate our own work but without the condition to evaluate first the work of other classmates	(False:0, True:1)
	3.: We had to evaluate our own work but with other condition	(False:0, True:1)
	4.: Other (pQ113_2)	We considered this as missing value

Therefore, we used the Independent Samples t-test statistical analysis for finding mainly their mean value and their statistical significance (p-value) as shown in table 32 below.

Table 32: Independent samples t-test results for student engagement and self-assessment method

		N	Mean	Std. Deviation	p-value
Student engagement	1	13	3.4423	.49044	
	2	5	2.7875	.29514	
	3	4	2.9219	.39979	.013

	4	2	2.5000	.61872	
	Total	24	3.1406	.54836	
Component 1 – Communication level	1	13	.7708334	.86145733	
	2	5	-.1903237	.77839538	
	3	4	.0014945	.50512271	.067
	4	2	-.2946274	.26276555	
	Total	24	.3535808	.86582602	
Component 2 – Participation level to activities and assignments	1	13	.4082963	.82730820	
	2	5	-.2645361	.78431699	
	3	4	-1.1353365	.82438828	.007
	4	2	-1.2545952	.06533792	
	Total	24	-.1277235	1.00318024	
Component 3- Access level to learning material	1	13	.2724625	.61281743	
	2	5	.1226695	1.17068608	
	3	4	.9330569	.63684999	.437
	4	2	-.2681397	2.40660055	
	Total	24	.3063045	.91868929	

Table 32 above showed that self-assessment methods presented differences in the levels of student engagement ($p < 0.05$) with higher levels of engagement to be presented for students that had to evaluate their own work, but after they evaluate the work of other classmates (M= 3.44).

Additionally, statistically significant differences were found for component 2 (Participation level to activities and assignments) where higher levels similarly were presented for students that had to evaluate their own work, but after they evaluated the work of other classmates (M= 0.408).

Result: In cases that students had to evaluate their own work but after evaluating the work of other classmates, then we had an increase in student engagement in general. Similarly, we had an increase in students communication level in the MOOC (i.e., participating in forum discussions or reading posts, communicating with other students in the course or with the tutor, or participating in social media activities related to the course).

Influence of existence of feedback on student engagement

The existence of feedback (pQ114) as we can see from Table 33 below was a nominal variable (0: No, 1: Yes) and the task here was to conduct another analysis to find any relationship between the existence of feedback and student engagement including also its three components.

Table 33: Independent variable values for existence of feedback

Code	**Variable**	**Categories**
Does this open online course include any type of feedback?		

pQ114	Existence of feedback	○ 0:No ○ 1:Yes

So, we used the Independent Samples t-test statistical analysis for finding mainly their mean value and their statistical significance (p-value) as shown in table 34 below.

Table 34: Independent samples t-test for existence of feedback and student engagement including its components

Group Statistics

	p114	N	Mean	Std. Deviation	p-value
Student engagement	No	25	2.5425	.60265	**.000**
	Yes	**54**	**3.0995**	.49085	
Component 1 – Communication level	No	25	-.4074149	.88320787	**.003**
	Yes	**54**	**.3000849**	.97487151	
Component 2 – Participation level in activities and assignments	No	25	-.0530409	1.15338309	.884
	Yes	54	-.0177679	.91122562	
Component 3 – Access level to assignments	No	25	-.3502582	1.05857673	**.030**
	Yes	**54**	**.1887206**	.81923139	

Table 34 above shows that there was statistical significance between the provision of feedback and a) student engagement in general, b) Component 1 (students communication level) and Component 3 (Access level to the learning material) since $p < 0.05$.

Result: Based on Table 34 above, we concluded that:

When feedback was provided (Variable=Yes), then we had an increase on

- student engagement in general (M: Mean is equal to 3.09),
- Communication level (M=0.3) and in
- Access level to learning material (M=0.18).

Based on the above analysis, we concluded that the following feedback factors in table 35 influenced student engagement in MOOCs. These results were discussed further in the Discussion chapters with the support also of the literature. We only showed those results that were statistically significant, $p<.05$.

Table 35: Which feedback factors if exist, influence student engagement in MOOCs

Result No.	Result description	Result statistical analysis -Mean (M) of student engagement

Subject responsible to assess students work		
1	If the system automatically assesses students work, then student engagement in general is influenced negatively	When the system automatically assesses students work then the student engagement in general is lower (M=2,72) than when the system doesn't automatically assess student's work (M=3,93)
Self-Assessment Method		
2	If students had to evaluate their own work, but after they evaluate the work of other classmates, then student engagement in general is influenced positively	When students had to evaluate their own work but after they evaluate the work of other classmates then student engagement in general is bigger (M=3,44) than when they had to evaluate their own work but without the condition to evaluate first the work of other classmates (M=2,78) or when they had to evaluate their own work but with any other condition (M=2,92)
3	If students had to evaluate their own work, but after they evaluate the work of other classmates then their communication level in the MOOC is positively influenced	When students had to evaluate their own work but after they evaluate the work of other classmates then their communication level in the MOOC is bigger (M=0,4) than when they had to evaluate their own work but without the condition to evaluate first the work of other classmates (M=-0,26) or when they had to evaluate their own work but with any other condition (M=-1,13)
Existence of Feedback		
	If feedback is provided to students, then student engagement in general is influenced positively	When feedback is provided to students then the student engagement in general is higher (M=3,09) than when feedback is not provided (2,54)
	If feedback is provided to students, then their communication level in the MOOC is positively influenced	When feedback is provided to students then their communication level in the MOOC is higher (M=-0,3) than when feedback is not provided (-0,4)
	If feedback is provided to students, then their access level to the learning material is influenced positively	When feedback is provided to students then their access level to the learning material is higher (M= -0,18) than when feedback is not provided (M= -0,35)

4.3.4 The intensity of feedback factors that affect student engagement

In the same way as in study 1, we presented the ordinal variables of feedback (independent variables) that we identified they had some relationship with *student engagement* in general and with its three components, namely *Communication level*, *Participation level to activities and* *assignments* and *Access level to learning material* that all these three were the dependent variables. We first outlined the findings in the next table (Table 36) and then we elaborated each one in detail. Again, we focused only on these results that were statistically significant (p<0,05).

Table 36: Feedback factors that their intensity level affects student engagement

Dependent variable	**Related Independent variables**	**Regression Model**
Relationships between student engagement and interaction types		
Student engagement in general	Student to content interaction level	Student engagement=-3,082 +0,439* (Student to Content Interaction)
Communication level	Student to student interaction level	Communication level = -0,810+0,128 *(Student to Student Interaction)
Participation level to activities and assignments	Student to content interaction level	Participation level to activities and assignments = 1,067 +0,162*(Student to Content interaction)
Access level to learning material	Student to content interaction level	Access level to learning material = -1,205 +0,243*(Student to Content Interaction)
Relationships between student engagement and assessment impact (Namely, the assessment activities allowed the student to understand the course content easier)		
Student engagement in general	Assessment Impact	Student engagement=-2,516 +0,477*Assessment Impact
Communication level	Assessment impact	Communication level = -0,702 +0,138*Assessment Impact
Participation level to activities and assignments	Assessment impact	Participation level to activities and assignments =-0,894 + 0,172*Assessment Impact
Access level to learning material	Assessment impact	Access level to learning material =-0,919+0,168*Assessment Impact
Relationship between student engagement and number of peer-assessments (i.e. The number of peers-assessments that each student as peer has to assess per assignment)		
Participation level to activities and assignments	Number of peer-assessments per assignment	Participation level to activities and assignments =-0,374 +0,137*(number of peer-assessments)
Relationship between student engagement and feedback attention (i.e. how often the student gave special attention to all the feedback provided to him/her or in other words the frequency of giving special attention to the provided feedback)		
Student engagement in general	Feedback Attention	Student engagement=-1,674+0,388* (Feedback Attention)

Participation level to activities and assignments	Feedback Attention	Participation level to activities and assignments =-0,577+0,145 *(feedback attention)
Access level to learning material	Feedback Attention	Access level to learning material =-0,577+0,145 *(feedback attention)

Further to the outline above, in the next sections we elaborated on each one in detail. Again, we focused only on these results that were statistically significant ($p<0,05$). Further to the details next, we saw that the **R-square value** was **quite low** in most of the regression models. However, according to Neter (Neter et al. 1996) we could generate lots of data with low R-square, because we didn't expect models (especially in social or behavioural sciences as in this case) to include all the relevant predictors to explain an outcome variable. We should note that R-square, even when small, could be significantly different from 0, indicating that the regression model had statistically significant explanatory power.

4.3.5 Influence of interaction type on student engagement

Interaction type variables are specified with pQ59, pQ60 and pQ61 as follows in table 37:

Table 37**: Independent variable values of Interaction type**

<table>
<tr><th>Code</th><th>Variable</th><th>Value</th></tr>
<tr><td colspan="3">How much have the following interactions been facilitated within the MOOC?</td></tr>
<tr><td>pQ59</td><td>Student – student interactions</td><td rowspan="3">○ 1:1 Not at all
○ 2:2 Very little
○ 3:3 Little
○ 4:4 Somewhat
○ 5:5 To some extent
○ 6:6 To a great extent
○ 7:7 Completely</td></tr>
<tr><td>pQ60</td><td>Student – teacher interaction</td></tr>
<tr><td>pQ61</td><td>Student – content interaction</td></tr>
</table>

Based on the table (Table 37) above, the interaction type is an ordinal variable, therefore, we applied initially Multiple Regression Analysis between student engagement in general including also its three components, and the following **interaction type** variables:

- pQ59 Student – student interactions
- pQ60 Student – teacher interaction
- pQ61 Student – content interaction

We applied multiple regression analysis and we identified the following relationships between interaction type and student engagement including its three components, that were statistically significant.

- Influence of interaction type on student engagement in general
- Influence of interaction type specifically on students communicating
- Influence of interaction type specifically on students attempting requested activities and assignments
- Influence of interaction type on students accessing the learning material

Next, we provide in detail the findings of the above relationships.

Influence of interaction type on student engagement in general

We applied firstly multiple regression analysis for exploring any statistical relationship between the number of peer-assessment per submission and student engagement in general and we confirmed that their relationship was statistically significant. The results of the Multiple Regression Analysis could be found in Table 38 below. We highlighted the derived values that in brief show that

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- only pQ61 – Student to Content interaction was statistically significant (Sig. = 0,000) p<,05 and it could influence student engagement.

Table 38: Multiple regression findings between student engagement and interaction type**:**

Model Summary				
Model	R	**R squared**	**Adj. R^2**	Typ. Estimation Error
1	,366[a]	**,134**	**,118**	*1,94766*
a. (X) Independent Variables: (Constants), pQ61, pQ60, pQ59				

ANOVA[a]						
Model		Sum of Squares	df	Root Mean Square	F	**Sig.**
1	Regression	99,473	3	33,158	8,741	**,000[b]**
	Residual	644,874	170	3,793		
	Total	744,347	173			
a. Dependent Variables: totalOBlimint						
b. Independent (predictors) Variables: (Constant), pQ61, pQ60, pQ59						

Coefficients [a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	Sig.
		B	Error typ.	Beta		
1	(Constant)	**-3,082**	,649		-4,748	,000
	pQ59	,156	,128	,137	1,214	,227
	pQ60	,040	,120	,037	,332	,740
	pQ61	**,439**	**,122**	**,274**	**3,598**	**,000**
a. Dependent Variables: totalOBlimint						

Result: Based on the above table, the regression model predicts 11,8% of the variance of student engagement and it could be concluded that a) the variable "Student to Content Interaction[13]" had a significant positive influence on student engagement. This meant that the more we facilitated the interaction between the students and the training content, the more engaged the students become.

Also the regression model was:

Student engagement=-3,082 +0,439* (Student to Content Interaction)

i.e., the large negative value of the constant implied that interaction between the student and the training content should be quite significant (very frequent) in order to actually facilitate student engagement. Furthermore, referring to the constant term that it was negative (-3,082), it meant that if the independent variable was zero (i.e. Student to Content Interaction), the dependent variable (i.e. Student engagement) would be equal to that negative value.

Finally, we didn't have any statistical evidence on whether student engagement could be influenced by "student to student interaction" or "student to tutor" interaction.

Influence of interaction type specifically on students communication level

We applied also regression analysis between interaction type and the students communication level (Component 1) and we identified also a statistical relationship between them as shown in table 39. We highlighted below the derived values that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- only pQ59 - Student to Student interaction was statistically significant (Sig. = 0,000) p<,05 and it could influence students communication level.

[13] Here we have a relevant study that confirms the results and will be discussed further in the Discussion chapter http://www.irrodl.org/index.php/irrodl/article/view/1302/2294

Table 39: Multiple Regression Findings between students communication level and interaction type

Model Summary				
Model	R	**R squared**	**Adj. R2**	Typ. Estimation Error
1	,313[a]	**,098**	**,082**	,93423294
a. Variables predictors: (Constant), pQ61, pQ60, pQ59				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regresión	16,062	3	5,354	6,134	**,001[b]**
	Residual	148,375	170	,873		
	Total	164,436	173			
a. Dependent Variables:: REGR component score 1 for analysis 4						
b. Independent (predictors) Variables: (Constant), pQ61, pQ60, pQ59						

Coeficientes[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error typ.	Beta		
1	(Constante)	**-,810**	,311		-2,600	,010
	pQ59	,128	,061	,239	2,083	**,039**
	pQ60	,035	,057	,068	,603	,547
	pQ61	,034	,059	,045	,581	,562
a. Dependent Variables: REGR component score 1 for analysis 4						

Result: The model predicted 8,2% of the variance of "communication level" and it could be concluded that a) the variable "Student to Student Interaction" had positive significant influence on student engagement. This meant that the more we facilitated interaction between the students, the more active they were in communicating such as participating in the (forum) discussions, communicating with other students in the course, communicating if possible with the teacher/assistant), reading the (forum) discussions or participating in social media activities related to the course.

The regression model was

Communication level= -0,810+0,128 *(Student to Student Interaction)

This implied that in order to engage students to communicate more, we needed to facilitate significantly the interaction among them.

Also based on the above analysis there was no statistical dependence between student's communication level and b) "student to teacher interaction" or "student to content" interaction.

Influence of interaction type specifically on students participating in activities and assignments

Similarly, we applied multiple regression analysis in order to explore whether there was any statistical significance between interaction type and students' attempting requested activities and assignments (Component 2). We have highlighted the derived values in the Table 40 below that in brief show that:

- The R squared values and Adj. R Squared values were very close to each other. However, they are not that close to 1
- only pQ61 - Student to Student interaction was statistically significant (Sig. = 0,007) p<,05 and it could influence students attempting the required activities and assignments.

Table 40: Multiple Regression Findings between participation level to activities and assignments and interaction type

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,272[a]	**,074**	**,058**	,94908067
a. Independent Variables: (Constants), pQ61, pQ60, pQ59				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regresión	12,276	3	4,092	4,543	**,004[b]**
	Residual	153,128	170	,901		
	Total	165,405	173			
a. Dependent Variable: REGR component score 2 for analysis 4						
b. Independent Variables predictors: (Constants), pQ61, pQ60, pQ59						

Coeficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Error typ.	Beta		
1	(Constante)	**-1,067**	,316		-3,374	,001
	pQ59	-,019	,062	-,035	-,304	,761
	pQ60	,077	,058	,151	1,323	,188
	pQ61	,162	,059	,214	2,720	**,007**
a. Dependent Variables: REGR component score 2 for analysis 4						

Result: The model predicted 5,8% of the variance 'Participation level to activities and assignments'.

Now, facilitating the interaction between the students and the content, we increased their engagement with activities and assignments such as participating in learning activities, attempting general quizzes/assignments, attempting end-of-module quizzes/assignments, attempting the peer-review tasks, or participating in course modules in general.

The regression model was:

Participation level to activities and assignments=-1,067 +0,162*(Student to Content interaction)

Considering the large negative constant and the relatively low coefficient, we concluded that basically, we needed always to facilitate student to content interaction for achieving some increase in participation level to the activities and assignments.

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Influence of interaction type on access level to learning material

Similarly we applied Multiple Regression Analysis between interaction type and access level to learning material (Component 3). We have highlighted the emerged values in table 41 that in brief show that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- only pQ61 - Student to Content interaction was statistically significant (Sig. = 0,000) p<,05 and it could influence access level to learning material.

Table 41: Multiple Regression Findings between access level to learning material and interaction type

Model Summary				
Model	R	**R squared**	**Adj. R Squared**	Typ. Estimation Error
1	,322[a]	**,104**	**,088**	,94461453
a. Independent Variables predictors: (Constant), pQ61, pQ60, pQ59				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regresión	17,542	3	5,847	6,553	**,000[b]**
	Residual	151,690	170	,892		
	Total	169,233	173			
a. Dependent Variable REGR component score 3 for analysis 4						
b. Independent Variables predictors: (Constant), pQ61, pQ60, pQ59						

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	**Sig.**
		B	Error typ.	Beta		
1	(Constant)	**-1,205**	,315		-3,828	,000
	pQ59	,047	,062	,086	,748	,455

	pQ60	-,072	,058	-,139	-1,241	,216
	pQ61	,243	,059	,318	4,110	**,000**
a. Dependent Variable: REGR component score 3 for analysis 4						

Result: The model predicted 8,8% of the variance "Access level to learning material".
Now, it can be concluded that when the course facilitated and achieved higher interaction between the student and the training content then the access level to learning material such as browsing the content, watching video lectures or downloading learning material was increased.

Furthermore, the regression model was as follows:

Access level to learning material=-1,205+0,243*(Student to Content Interaction)

Based on this model, in order to increase the engagement of the student with the learning material, we needed at least to facilitate the interaction between the student and the training content.

There was no statistical evidence that facilitating interaction between the student and the other peers or with the course teacher could influence the interaction with the learning material.

4.3.6 Influence of assessment impact on student engagement

With assessment impact we meant how often the assessment activities allowed the student to understand the course content easier and its variable was pQ108. The values are shown below in Table 42:

Table 42: Independent variable values of Assessment impact

Code	**Variable**	**Value**
The assessment activities allowed me to understand the course content easier		
pQ108	Assessment Impact	• 1:1 Never • 2:2 Rarely • 3:3 Sometimes • 4:4 Regularly • 5:5 Often • 6:6 Very often • 7:7 Always

The assessment impact was an ordinal variable and we applied Multiple Regression Analysis between the dependent variables student engagement including its components and the assessment impact (pQ108).

We presented only those relationships that were statistically significant, namely:

- Influence of assessment impact on student engagement
- Influence of assessment impact specifically on students' communication level in a MOOC

- Influence of assessment impact specifically on participation level to activities and assignments in a MOOC
- Influence of assessment impact specifically on the access level to learning material in a MOOC.

Next, we provided the findings in detail for each one of the above relationships.

Influence of assessment impact on student engagement

We applied multiple regression analysis between the assessment impact and the student engagement in general and we confirmed that there was a relationship that was statistically significant. The results of this statistical analysis and the student engagement in general could be found in Table 43 below. We highlighted the emerged values in table 49 that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ108 – Assessment Impact was statistically significant (Sig. = 0,000) p<,05 and it could influence student engagement.

Table 43: Multiple Regression Findings between student engagement and assessment impact

Model Summary				
Model	R	**R Squared**	**Adj. R squared**	Typ. Estimation Error
1	,325[a]	**,106**	**,100**	2,01932
a. Independent Variables predictors: (Constant), pQ108				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	75,104	1	75,104	18,418	**,000[b]**
	Residual	636,112	156	4,078		
	Total	711,216	157			
a. Dependent Variable: totalOBlimint						
b. Independent Variables: Predictors (Constant), pQ108						

Coefficients[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constant)	**-2,516**	,631		-3,989	,000
	pQ108	**,477**	,111	,325	4,292	,000
a. Dependent Variable: totalOBlimint						

Result: The model predicted 10 percent of the variance “student engagement”.

Now, it can be concluded that the more often assessment activities allowed the student to understand the course content easier, the higher was his/her student engagement in the course.

The regression model was as follows:

Student engagement=-2,516 +0,477*Assessment Impact

The high negative value of the constant implies that assessment activities should **often** ease the student to understand the course content for starting to have some student engagement.

Influence of assessment impact specifically on communication level in a MOOC

Similarly, we applied regression analysis between assessment impact and specifically students' communication level (Component 1), and we confirmed that their relationship was statistically significant. We highlighted the derived values in table 44 that in brief show that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ108 – Assessment impact was statistically significant (Sig. = 0,015) p<,05 and it could influence students' communication level.

Table 44: Multiple regression analysis between assessment impact and students communication level

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,194[a]	**,037**	**,031**	1,01472438
a. Independent Variables predictors: (Constant)), pQ108				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	6,255	1	6,255	6,074	**,015[b]**
	Residual	160,628	156	1,030		
	Total	166,883	157			
a. Dependent Variable: REGR component score 1 for analysis 4						
b. Independent Variables predictors: (Constant), pQ108						

Coefficient[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constant)	**-,702**	,317		-2,216	,028
	pQ108	**,138**	,056	,194	2,465	**,015**
a. Dependant Variable: REGR component score 1 for analysis 4						

Result: The model predicted 3,1% of the variance "Communication level"

Now it can be concluded that when the assessment activities allowed the students to understand the course content easier, then the more active they were in communicating such as:

- participating in the (forum) discussions,
- communicating with other students in the course,
- communicating if possible with the teacher/assistant),
- reading the (forum) discussions or

- participating in social media activities related to the course.

The regression model is

Communication level = -0,702 +0,138*Assessment Impact

The above model implies that assessment activities should **very often** ease the student to understand the course content for students starting to be more active in communicating within the course.

Influence of assessment impact specifically on students participating to activities and assignments in a MOOC

Similarly, we applied multiple regression analysis in order to explore whether there was any statistical significance between assessment impact and students' participation level to activities and assignments (Component 2) and indeed we confirmed that there was. We highlighted the derived values in the table 45 below that in brief show that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ108 – Assessment impact was statistically significant (Sig. = 0,01) p<,05 and it could influence the participation level to activities and assignments.

Table 45: Multiple regression findings between participation level to activities and assignments and impact assessment

Model Summary				
Model	R	**R Squared**	**Adj. R. Squared**	Typ. Estimation Error
1	,258[a]	**,067**	**,061**	,93412323
a. Independent Variables predictors: (Constant), pQ108				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regresión	9,728	1	9,728	11,148	**,001[b]**
	Residual	136,123	156	,873		
	Total	145,851	157			
a. Dependent Variable: REGR component score 2 for analysis 4						
b. Independent Variables predictors: (Constant), pQ108						

Coefficients[a]				
Model	Unstandardised coefficients	Standardised Coefficients	t	**Sig.**

		B	Error típ.	Beta		
1	(Constant)	**-,894**	,292		-3,066	**,003**
	pQ108	**,172**	,051	,258	3,339	**,001**
a. Dependent Variable: REGR component score 2 for analysis 4						

Result: The model predicted 6,1% of the variance "Participation level to activities and assignments".

Now, it can be concluded that the assessment activities that allowed the student to understand the course content easier have a positive influence on students attempting the activities and the assignments, i.e. participating in learning activities; attempting general quizzes/assignments; attempting end-of-module quizzes/assignments; attempting the peer-review tasks; or participating in course modules in general.

The regression model was

Participation level to activities and assignments=-0,894 + 0,172*Assessment Impact

This model implied that assessment activities should very often ease the student in understanding the course content for students participating to the learning activities and assignments.

Influence of assessment impact specifically on access level to learning material in a MOOC

Similarly, we applied Multiple Regression Analysis between assessment impact and students accessing the learning material (Component 3) and indeed we confirmed that there was a relationship between them that was statistically significant. We highlighted the emerged values in table 46 below that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ108 – Impact assessment was statistically significant (Sig. = 0,002) and it could influence students access level to the learning material.

Table 46: Multiple regression findings between access level to learning material and assessment impact

Model Summary				
Model	R	**R Squared**	**Adj. R squared**	Typ. Estimation Error
1	,249[a]	**,062**	**,056**	,94847204
a. Independent Variables predictors: (Constant), pQ108				

ANOVA[a]					
Model	Sum of Squares	gl	Root Mean Square	F	**Sig.**

1	Regressión	9,281	1	9,281	10,316	**,002[b]**
	Residual	140,337	156	,900		
	Total	149,618	157			
a. Dependent Variable: REGR component score 3 for analysis 4						
b. Independent Variables predictors: (Constant), pQ108						

Coefficients[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constante)	-,919	,296		-3,104	**,002**
	pQ108	,168	,052	,249	3,212	**,002**
a. Dependent Variable: REGR component score 3 for analysis 4						

Result: The model predicted 5,6% of the variance "Access level to learning material". Now, it could be concluded that the assessment activities that allowed the student to understand the course content easier had a positive influence on students accessing the learning material, i.e., browsing the content; watching video lectures; or downloading learning material.

The regression model was:

Access level to learning material=-0,919+0,168*Assessment Impact

This model implied that in order to achieve some engagement of the student with the learning material, the assessment activities should **very often** ease the student to understand the course content.

4.3.7 Influence of number of peer-assessments conducted by a student per assignment in student engagement

As we saw already in study 1, also in **study 2**, in many MOOCs, it was common practice as part of their learning process for each student to conduct a specific number of peer assessments for each assignment. In the survey, we wanted to check whether the number of peer assessments that each student conducts can affect their engagement and we considered a wide range of submissions from 0 to more than 5 peer-assessments per assignment. The number of peer-assessments per submission variable has the following values as shown in Table 47 below:

Table 47: Independent variable values of number peer assessment per submission

Code	**Variable**	**Value**
How many submissions from your classmates did you have to evaluate on average?		
pQ111_2	No. of peer-assessments per submission	• 0:None (only my own work) • 1:1 • 2:2

		• 3:3 • 4:4 • 5:5 • 6:More than 5

The number of peer assessments per submission was an ordinal variable and we applied Multiple Regression Analysis between the student engagement, its components and the number of peer-assessments per assignment (ordinal value, pQ111_2).

We saw that there was no statistical significance between the number of peer assessment and student engagement in general, including students' communication level and their access to the learning material.

However, we applied also multiple regression analysis for exploring any statistical relationship between the **number of peer-assessments per submission and participation level to activities and assignments (Component 2).** In this case, there was statistical significance and we underlined the emerged values in table 48 below that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ111_2 – Number of peer-assessments per submission was statistically significant (Sig. = 0,02) p<,05 and it could influence students attempting the required activities and assignments.

Table 48: Multiple regression findings between participation level to activities and assignments and number of peer-reviews per submission

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,304[a]	**,093**	**,084**	,87558370
a. Independent Variable predictor: (Constant), pQ111_2				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	7,983	1	7,983	10,413	**,002[b]**
	Residual	78,198	102	,767		
	Total	86,181	103			
a. Dependent Variable: REGR component score 2 for analysis 4						
b. Independent Variable predictor: (Constant), pQ111_2						

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constant)	**-,374**	,191		-1,962	,052
	pQ111_2	**,137**	,042	,304	3,227	**,002**
a. Dependent Variable: REGR component score 2 for analysis 4						

Result: The model predicted 8,4% of the variance "participation level to activities and assignments".

Now it was concluded that the number of peer- evaluations to be conducted per submission had positive influence to MOOC students in attempting required activities and assignments such as participating in learning activities, attempting general quizzes/assignments, attempting end-of-module quizzes/assignments, attempting the peer-review tasks, or participating in course modules in general.

The regression model was as follows:

Participation level to activities and assignments=-0,374 +0,137*(number of peer-assessments)

The negative value of the constant in the regression model suggested that student engagement in activities and assignments would start increasing as soon as students had three or more on average submissions from their classmates to evaluate.

4.3.8 Influence of feedback attention on student engagement

With feedback attention mainly, we meant how often the student gave special attention to all the feedback provided to him/her. Feedback attention in the survey was variable pQ116_2 and it was an ordinal variable as shown in table 49 below:

Table 49: Independent variable values of feedback attention

Code	Variable	Value
In general, I gave special attention to all the feedback provided…		
pQ116_2	Feedback attention	• 1:1 Never true • 2:2 Rarely true • 3:3 Sometimes true • 4:4 Fairly often true • 5:5 Often true • 6:6 Very often true • 7:7 Always true

Therefore, we applied Multiple Regression Analysis between student engagement including also its components and the **feedback attention** variable (pQ116_2).

Apparently, there was no evidence that that frequency of students giving special attention to feedback received could influence them communicating in a MOOC course but next, we presented those relationships and the related results that were statistically significant, i.e.,

- Influence of feedback attention on student engagement in general
- Influence of feedback attention on participation level to activities and assignments
- Influence of feedback attention on access level to learning material.

Influence of feedback attention on student engagement in general

First, we applied multiple regression analysis between feedback attention and student engagement in general and we showed that their relationship was statistically significant. The results were shown in Table 50 below and we highlighted the emerged values that in brief show that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ116_2 – Feedback attention was statistically significant (Sig. = 0,000) p<,05 and it could influence student engagement.

Table 50: Multiple Regression findings between feedback attention and student engagement

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,321[a]	**,103**	**,095**	1,63521
a. Independent Variables predictors (Constant), pQ116_2				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	36,182	1	36,182	13,532	**,000[b]**
	Residual	315,523	118	2,674		
	Total	351,705	119			
a. Dependent Variable: totalOBlimint						
b. Independent Variables predictors: (Constant), pQ116_2						

Coefficient[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	Sig.
		B	Error típ.	Beta		
1	(Constant)	**-1,674**	,573		-2,920	,004
	pQ116_2	**,388**	,106	,321	3,679	**,000**
a. Dependant Variable: totalOBlimint						

Result: The model predicted 9,5% of the variance of “student engagement”

Now, it could be concluded that the frequency of students giving special attention to feedback received had significant positive influence on student engagement.

The regression model was

Student engagement in general=-1,674+0,388(frequency of giving special attention to all provided feedback)

The negative high value of the constant suggested that students should **often** give special attention to the whole feedback provided in order to see some increase in their engagement.

Influence of feedback attention on participation level to activities and assignments

Similarly, we applied multiple regression analysis in order to examine the statistical significance between feedback attention and participation level to activities and assignments (Component 2). We highlighted the emerged values in the table 51 below that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ116_2 – Feedback attention was statistically significant (Sig. = 0,008) p<,05 and it could influence participation level to activities and assignments.

Table 51: Multiple regression results between feedback attention and participation level to activities and assignments

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,240[a]	**,057**	**,050**	,83462519
a. Independent Variables predictors: (Constant), pQ116_2				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	5,015	1	5,015	7,199	**,008[b]**
	Residual	82,199	118	,697		
	Total	87,213	119			
a. Dependent Variable:: REGR component score 2 for analysis 4						
b. Independent Variables predictors: (Constant), pQ116_2						

Coefficient[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constant)	**-,577**	,292		-1,974	**,051**
	pQ116_2	**,145**	,054	,240	2,683	**,008**
a. Dependant Variable:REGR component score 2 for analysis 4						

Result: The model predicted 5 percent of the variance of “Participation level to activities and assignments”.

Now, it could be concluded that the frequency of students giving special attention to feedback received could have positive influence on their participation level to activities and assignments such as participating in learning activities, attempting general quizzes/assignments, attempting end-of-module quizzes/assignments, attempting the peer-review tasks, or participating in course modules in general.

Now the regression model was

Participation level to activities and assignments=-0,577+0,145 *(frequency of giving special attention to the provided feedback)

The negative constant value suggested that students should **often** give special attention to feedback provided in order to see some increase in their engagement with the course activities and assignments.

Influence of feedback attention on access rate to learning material

Finally, we applied Multiple Regression analysis between feedback attention and access level to learning material (Component 3). We highlighted the derived values in table 52 that in brief showed that:

- The R squared values and Adj. R Squared values were very close to each other. However, they were not that close to 1
- pQ116_2 – Feedback attention was statistically significant (Sig. = 0,005) and it could influence access rate to learning material.

Table 52: Multiple regression results between feedback attention and access rate to learning material

Model Summary				
Model	R	**R Squared**	**Adj. R Squared**	Typ. Estimation Error
1	,254[a]	**,064**	**,056**	,90598095
a. Independent Variables predictors: (Constant), pQ116_2				

ANOVA[a]						
Model		Sum of Squares	gl	Root Mean Square	F	**Sig.**
1	Regressión	6,659	1	6,659	8,113	**,005[b]**
	Residual	96,855	118	,821		
	Total	103,514	119			
a. Dependent Variable REGR component score 3 for analysis 4						
b. Independent Variables predictors:: (Constant), pQ116_2						

Coefficient[a]						
Model		Unstandardised coefficients		Standardised Coefficients	t	**Sig.**
		B	Error típ.	Beta		
1	(Constant)	**-,851**	,318		-2,679	,008
	pQ116_2	**,167**	,058	,254	2,848	**,005**
a. Dependant Variable: REGR component score 3 for analysis 4						

Result: The model predicted 5,6 % of the variance of “access rate to learning material” Now, it was concluded that the frequency of students giving special attention to feedback received could have a positive influence on the amount of learning activities they access such as browsing the content, watching video lectures or downloading learning material.

Furthermore, the regression model was as follows:

Access rate to the learning material=-0,577+0,145 *(frequency of giving special attention to all provided feedback)

The negative constant value suggested that students should **often** give special attention to feedback provided in order to see some increase in access to the learning material.

4.3.9 Feedback practices present in MOOCs

This section aimed to provide the results for the first research question based on the findings from the **study 2**, namely which feedback practices were applied in the participating MOOCs.

More specifically, we examined the totals of the number of responses and their percentage for the questions from the questionnaire that were outlined in Table 53:

Table 53: Questions for identifying feedback practices based on study 2

No.	Descriptive Analysis to be made based on the following questions	Variables for Research Question 1
1	Were there any types of assessments in the MOOC courses?	Existence of any type of assessments
2	Which Assessment Activities were applied in the MOOC courses pQ106a Participation level in forum discussion pQ106b Completing a piece of work and submitting it pQ106c Answering quiz pQ106d Completing an assignment as a group pQ106e Other	Type of Assessment Activities
3	Who was responsible to assess students' work in the MOOC courses: pQ111a The student herself (her own work) pQ111b The instructor/tutor pQ111c The peers/other students pQ111d The system automatically	Subject responsible to assess students' work (multiple answers possible)
4	How did students have to evaluate their own work in the MOOCs (pQ113) 1. We had to evaluate our own work, but after evaluating the work of other classmates 2. We had to evaluate our own work but without the condition to evaluate first the work of other classmates 3. We had to evaluate our own work but with other condition 4. Other (pQ113_2)	Self-Assessment Method
5	What was the content of the feedback in the MOOCs)? (multiple answers possible)	Feedback Content

	pQ115a General comments pQ115b Just a grade (correct/incorrect, overall percentage correct) pQ115c Solutions of the task/exercise but with no comments pQ115d Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.) pQ115e it informs you about an incorrect response and allows you one or more attempts to answer it pQ115f Suggestions on how to improve further the submitted work pQ115g Other (pQ115_2 Please specify)	

Next we provided in the following tables (tables 54, 55, 56, 57, 58 and 59) the number of counts and their percentage to the answers to the above questions and they are discussed briefly in the discussion section.

Table 54: MOOCs with assessment activities

Question 1: Were there any type of assessment activities applied in the MOOCs				
		p105		Total
		No	Yes	
Results	Count	122	1526	1648
	%	7.4%	92.6%	100.0%

Result: As it was expected from the above table, the majority of participants in MOOCs confirmed there were assessment activities in the MOOCs they participated.

Table 55: Type of assessment activities in MOOCs

Question 2: Which Assessment Activities were applied in the MOOC courses						
		p106a Participation level in forum discussion	p106b Completing a piece of work and submitting it	P106c Answering quiz	P106d Completing an assignment as a group	P106e Other
Result	Count	405	1105	679	193	141
	%	16%	44%	27%	8%	5%

Result: The vast majority of the respondents (44%) had to complete a piece of work and submit it and the second most popular (27%) was to answer a quiz and the 3rd most popular (16%) was their participation level in forums and the fourth one as the least popular (8%) was to complete an assignment as a group.

Table 56: Subject responsible to assess students' work

Question 3: was responsible to assess students' work in each MOOC course					
		P111a The student herself	P111b The instructor/tutor	P111c The peers/other students	P111d The system automatically
Result	Counts	600	342	1089	450
	%	24%	14%	44%	18%

Result: The first most popular assessment was made by other peers (44%), then the 2nd most popular was the student themself (24%) and then as 3rd most popular (18%) the system automatically. The least popular one (14%) was the instructor/tutor.

Table 57: Number of submissions from your classmates (number of peer-assessments) to be evaluated

Question 4: How many submissions from your classmates (peer=assessments) did you have to evaluate per assignment?					
No. of peer-assessments		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	48	2.2	4.3	4.3
	1	17	.8	1.5	5.9
	2	108	4.9	9.8	15.7
	3	367	16.5	33.2	48.9
	4	86	3.9	7.8	56.7
	5	33	1.5	3.0	59.6
	6	446	20.1	40.4	100.0
	Total	1105	49.8	100.0	
Missing	System	1115	50.2		
Total		2220	100.0		

In most of the cases the students had to evaluate 6 submissions/assignments from their classmates (40.4%), followed by three with 33.2%. On the contrary, only in 4.3% of the cases the respondents had to evaluate only themselves.

Table 58: Self-assessment method

Question 5: How did students have to evaluate their own work in the MOOCs

	pQ113	Total

		1:We had to evaluate our own work, but after evaluating the work of other classmates	2:We had to evaluate our own work but without the condition to evaluate first the work of other classmates	3:We had to evaluate our own work but with other condition	other	
Total	Count	209	200	96	80	585
	%	35.7%	34.2%	16.4%	13.7%	100.0%

Result: In the majority of the MOOC courses the students had to evaluate their own work, but after evaluating the work of other classmates (N: 35,7%), or they had to evaluate their own work but without the condition to evaluate first the work of other classmates (N:34,2%). Less frequently, the students had to evaluate their own work but with other conditions (16,4%) or use other methods (13,7%).

Table 59: Feedback content in MOOCs

		P115a General comments	P115b Just a grade (correct/incorrect, overall percentage correct)	P115c Solutions of the task/exercise but with no comments	P115d Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.)	P115e it informs you about an incorrect response and allows you one or more attempts to answer it	P115f Suggestions on how to improve further the submitted work	P115 g Other
Total	Count	706	156	72	401	162	379	34
	%	37%	8%	4%	20%	8%	20%	2%

In the majority of MOOCs the content of the feedback was “general comments”(N:706, 37%), “Suggestions on how to improve further the submitted work” (N:379, 20%), and “Solutions of the task/exercise with comments (e.g., suggestions for improvements, common errors etc.) (N:401, 20%)”. Not very popular practices were to provide either just a grade without any comments or inform the student about the incorrect response and allow additional attempts for answering. Finally, “solutions of the task/exercise but with no comments” was the one of the less common content of feedback (Just 4%, N:72).

Chapter 5: Discussion on Research Question 1: Feedback practices present in MOOCs

5.1 Introduction

The structure of this chapter focused on discussing Research Question 1. These findings were based on a limited number of 40 MOOCs that we overall surveyed and cannot form the basis for conclusions applicable for the whole MOOC community but they provided some general idea.

We need to highlight here that we analysed the responses received from the participants without personally being able to participate in each MOOC course since most of the MOOCs were closed when we were receiving the related datasets.

This means that the findings related to which feedback practices were currently present in MOOCs, could only be used to show some trends or indications on formative and feedback assessment practices applied and not any detailed or accurate insights for the whole or even for a larger set of MOOCs.

Nevertheless, something like that would have been impossible with the given resources and time restrictions. First of all, the used questionnaire was part of a larger one as part of the MOOCknowledge project and there were size limitations. Secondly and most importantly, due to the large number of MOOC courses any attempt for some deeper insights in regards to feedback practices present in MOOCs would have been impossible. For example, by the end of 2018, over 900 universities around the world had announced or launched 11400 MOOCs from the around 4000 in 2016[14], which means that any attempt to consider all the MOOCs offered, would require significant and continuous further research that was beyond the scope of this thesis. We also understood that MOOCs with a higher number of responses have a bias in the overall findings. Therefore, it was important to consider the analysis for research question 1 just as an attempt to give an indication of the feedback factors that were found in MOOCs and further research with significant resources were needed for mapping the feedback practices that were currently present in the whole MOOC community.

Nevertheless, from both studies 1 and 2 we found feedback practices related to 5 feedback factors, namely assessment existence, assessment types and actors responsible to assess including self-assessment and feedback content. In addition only from study 1 that we had a longer questionnaire, we identified some more practices present in MOOCS related to the actors

[14] https://www.classcentral.com/report/mooc-stats-2018/

responsible to provide feedback, feedback mode, feedback provision, feedback focus, and feedback timing.

5.2 Assessment existence & types, actors to assess and provide feedback in MOOCs

Both the results from **studies 1 and 2** confirmed the same finding which was that the vast majority of the participants considered that the MOOC they participated had some assessment method. This was expected, since according to Suen (2014) the teach-learn-assess cycle is essentially lost in a MOOC and various efforts had been or were being made to re-introduce some degree of feedback into the process to prevent it from becoming a one-way information transfer or a broadcasting show instead of a learning hub. This high percentage of assessment practices indicates their use in improving the learning experience in MOOCs.

Also in regards to assessment types, automatic based assessments were the most common in study 1 and quite popular in study 2. However, such type of assessment was appropriate only for certain types of course contents where abilities to recall or to differentiate concepts or to interpret or extract information from text or graphics related to the subject matter were the only important instructional objectives (Suen, 2014). It was also challenging to most instructors to develop good quality multiple choice test items to measure high-level cognition such as applying, analysing, synthesizing, evaluating and creating (Krathwohl, Anderson & Bloom, 2009). Therefore, such an approach in MOOCs would not be appropriate for courses in which the desired evidence of learning was to have students demonstrate an ability to generate ideas or produce a product, such as answer open-ended questions, write an essay, submit a report, design an artifact, engineer a process, or solve an ill-defined complex problem.

In regards to the subject responsible to assess student's work, in study 1, in the majority of the cases, the process to assess a student's work was the system automatically and second most popular was the student themself for their own work. The least popular ones were to have other peers assess their work or the course instructor/tutor. On the other hand, based on the **study 2**, the most popular assessment was made by other peers, then the second most popular was the student themself and then as third most popular was the system automatically. The least popular one was the instructor/tutor.

Of course these findings were not representative as we indicated already and some of them may had been biased from the larger number of responses received by a specific MOOC.

Nevertheless, there was agreement in the literature that the instructor/tutor was used in limited cases for assessing the students' work, but peer assessment was not that popular in **study 1** which was the most popular one in **study 2**. These findings may showed an evolving trend in the assessment methods applied to MOOCs and an increased popularity in peer-assessment in study 2 since this study was based on MOOCs developed around two-years after the ones from study 1. This was supported also by Suen (2014) who identified the single approach that was widely applicable to most, if not all, MOOCs, was to use peer assessment and peer discussion forums to provide formative feedback to students. In any case, as we discussed already, the findings for the first research question show just one trend and they should not be extrapolated as universal findings. Furthermore, in regards to the system as the actor responsible to assess, the use of multiple-choice quizzes or automatic essay scoring, were applicable to all contents and assignments. It was also the most economical approach that didn't require the need to hire a large pool of support or instructional tutors as in the case of blended learning models. This allows any MOOC to be a complete stand-alone educational tool without limiting it just as a multimedia interactive textbook. However, as Suen (2014) argued peer assessment in MOOCs needed to be limited so that each student was asked to rate no more than a handful of other students' assignments. Also Suen (2014) and Jordan (2015) concluded that peer-assessments might lack credibility or create frustrations since they were time consuming (minimum five peer-assessments per assignment) and increased the drop-out rate. Therefore, peers and their peer-assessments should be considered applicable mostly in feedback practices and not for summative assessments (associated with grading, certifications and accountability) (Gardner et al., 2010).

Furthermore, self-assessment was the second most popular method used in MOOCs for students assessing their own work. The student themself was a popular actor to assess their work as it was also confirmed from literature (Admiraal, Huisman & Pilli, 2015; Admiraal, Huisman & Van de Ven, 2014). In the same literature, they argued that self-assessment should be used *as assessment for learning* and not *as assessment of learning* as it was actually the case now in edX MOOC courses in which self-evaluation was required after the student had completed the peer-assessments, but it was not considered for the final grade (Ventista, 2018). This condition of self-assessment was supported also from one of the findings in the study 2 that in the majority of the MOOC courses the students had to evaluate their own work, but after evaluating the work of other classmates.

As previous research concluded (Admiraal et al., 2015; Admiraal et al., 2014; Jordan 2015; Ventista, 2018) self-assessments and peer assessments should be improved if they were to be used as summative indicators of student achievements (assessment of learning). Currently, MOOCs could only be used for self-reflection and peer feedback, emphasizing the formative function of assessment (assessment for learning). Due to the massive character of MOOCs, summative assessments (assessment of learning) mostly took the form of quizzes or other multiple-choice tests, which generated scores automatically as we saw mainly in study 1. However, such practices did not fit with the assessment of more open and more complex assignments. Therefore, other forms of assessment, such as self-assessment, peer assessment or assessment by outside experts, should be improved in order to be more effective.

5.3 Feedback content

From the results from both studies, we saw that the content of the feedback in the majority of the cases was general and the next most popular was providing solutions with some comments. These findings support also related research. More specifically, Yuan & Powell (2013) found that most of the feedback in MOOCs was through peers and it was quite general. Furthermore, Suen (2014) identified many methods as suitable for feedback in an open distance learning environment. These included: (a) automated tutors; (b) peer feedback; (c) autoscoring of assignments; (d) reflective networks; (e) written comments; (f) oral comments; (g) meta-verbal; (h) emoticons; (i) self-checks; and (j) ePortfolio. However, only a limited subset of these methods and technology were considered applicable for MOOCs such as online multiple-choice quizzes that were machine-scored as progress checks and feedback to students. At the end of each instructional module, a number of multiple-choice questions were posed to the student. These questions were intended to assess the student's familiarity with the concepts and other contents covered in that module. The scores on these tests indicated whether the student had sufficiently learned the material and the given scores were considered as feedback. Students who did not do well were encouraged to return to the previous module to review the materials before proceeding. Such feedback practice could be considered for increasing the student engagement in MOOCs since as we saw already info bout the incorrect response and allowing resubmissions influenced student engagement.

5.4 Feedback Mode

From **study 1**, we saw that, by far, the most popular way/mode to give feedback was the written one with all the other modes (video, audio, chat or Skype) taking a limited share. This was already supported by the research so far from Godwin-Jones (2014); Hew (2015); Suen (2014). Providing feedback to students on their essay represented perhaps the most important task of the feedback provider and also possibly the most time-consuming task. In MOOCs, this task became more challenging, as there were no opportunities for face-to-face conversations with students due the massive number of students attending a MOOC. Typically, online instructors or other peers provided comments to students in text form. The use of audio comments through MP3 or via video files became an alternative (Cavanaugh & Song, 2014; Suen, 2014). As we saw in the literature, it was considered that audio feedback had advantages over written feedback, due to a more personal experience, detailed and supportive feedback (Kirschner, van den Brink & Meester, 1991). However, the audio feedback in these studies had been provided by instructors, not by peers that was the common case in MOOCs. And, partly as a result of this, these studies focused on receiving peer feedback rather than providing peer feedback. It is important to note though, a recent study made by Filius (2019) who argued that audio peer feedback made students feel personally committed and as a consequence both students as feedback providers and feedback receivers were more committed in participating and learning. Similar findings but with video-based feedback had been supported by other researchers (Ventura, Barcena & Martin-Monje, 2013; Ventura, Bárcena & Martin-Monje, 2014; Sharma et al., 2016).

5.5 Feedback provision

As we saw from **study 1**, in most of the cases there was one way feedback and in some cases there was some discussion via dialogue. The fact, that we had in most of the cases one way feedback emerges from the normal practice especially in xMOOCs (Extended MOOCs) to have anonymous peer assessment or blind peer review for reducing any grading bias (Lu & Bol, 2007; Gamage, Whiting, Perera, Fernando, 2018). As we saw in the literature review, students participating in a cMOOC (Collaborative MOOC) were expected to help shape the course and enrich its content through their participation and collaboration. Instructors were seen more as facilitators than traditional teachers. The second MOOC category, the xMOOC or eXtended MOOC, provided a more traditional top-down type of instruction, with fixed content, centralized forums, and regular evaluation to assess content mastery but again there was minimal if at all any interaction between the instructors and the students. However, in cMOOCs, that feedback via dialogue was not only encouraged but it was required, it had led to high quality feedback (Mackness et al., 2013; Margaryan, Bianco & Littlejohn, 2015). Finally, it was important to point out that when feedback is provided via some discussion and dialogue from identifiable peers even in xMOOCs, its quality was increased (Gamage et al, 2018). The need of enabling dialogue via feedback had been highlighted also by Winstone and Carless (Winstone & Carless, 2019).

5.6 Feedback Focus

Feedback was considered one of the single most important factors influencing student learning and MOOC students often complained that, even with peer grading, they did not get useful feedback to their work by the other peers (Gamage et al, 2018). This was in agreement in study 1 as we saw, since most of the feedback was focusing on praising ability or intelligence of the student and then the next most popular ones were to praise effort and focus students on learning goals as well as clarifying the learning content.

Indeed, it is true that often the feedback field in peer-assessments was either left blank or was not helpful or not constructive and comments such as "Great work" that praised students' ability showed that the students as peers did not provide quality feedback in the MOOCs (Gamage et al, 2018) and as we saw this was the case in the majority of the findings. With much fewer responses focusing on learning goals and clarification on the learning content, students rapidly lost interest in either providing quality feedback or learn effectively in MOOCs.

5.7 Feedback timing

From the **study 1** we saw that in most of the cases, feedback was provided right after submission of students' work. This was the case when automated feedback was provided immediately based on assessment/task responses. Even if the feedback was automated though, it was still important for the student to receive it immediately, otherwise the students had the sense they were speaking into a vacuum (Hew & Cheung, 2014). Automated feedback could help students because it was provided right after submission of students' work. However, in order to be considered formative, it should not provide only any marks to the students that receive it but focus instead on indicating wrong answers and providing answers to the questions raised automatically.

We also saw that the least popular practice was to provide feedback only after some time (Delayed) which normally applied to feedback provided by peers or instructor/tutor assessments.

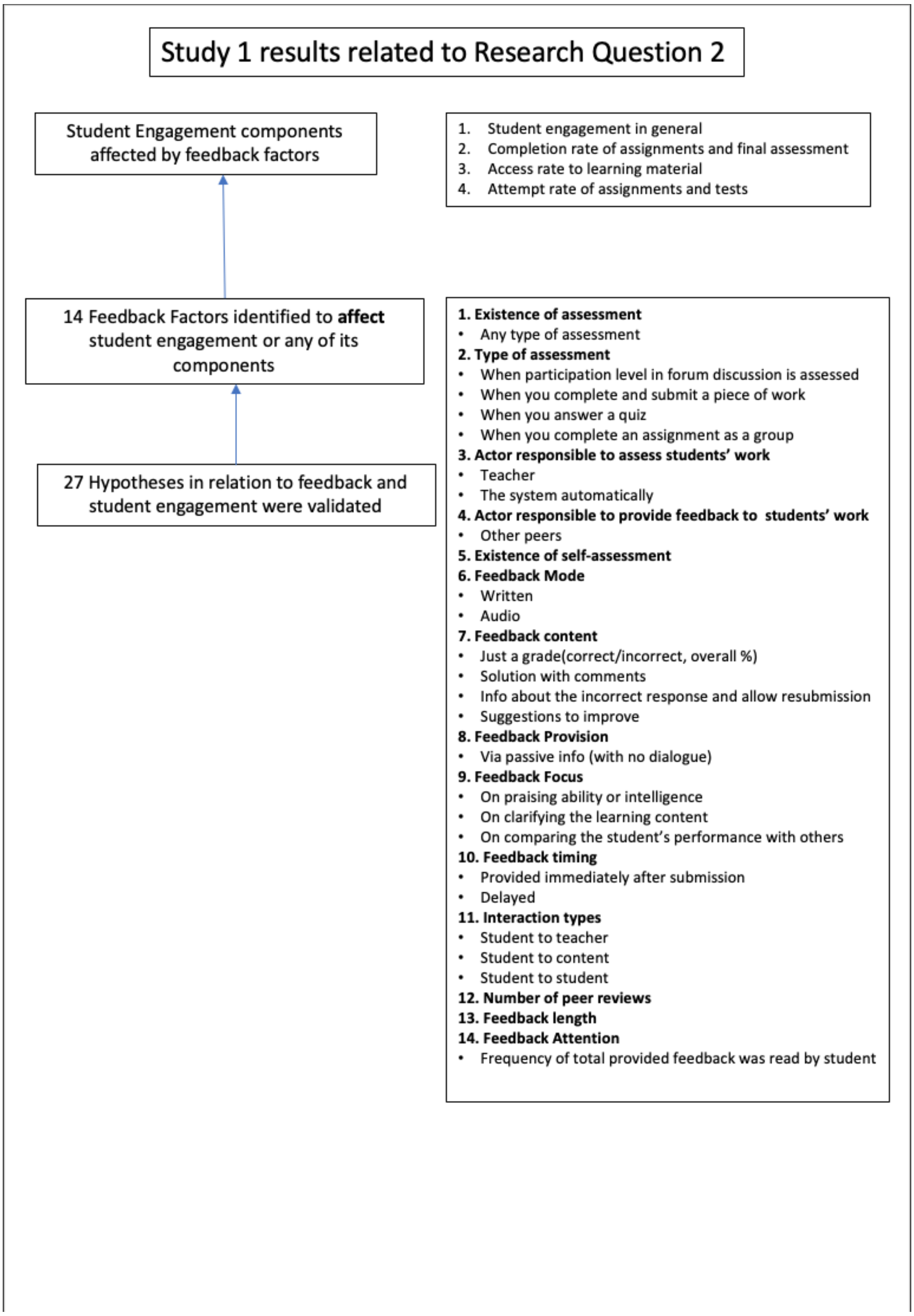
Chapter 6: Discussion on Research Question 2 based on Study 1 findings

6.1 Introduction

In this chapter, we discussed research question 2, namely relationships between feedback factors and student engagement that emerged from study 1. Specifically, we discussed whether and at what level the results supported the hypotheses and we contextualised the findings based on current research and theory. We then discussed a few unexpected results, and we evaluated their significance. Furthermore, we related the results with the scholarly work that we surveyed in the literature review.

In order to facilitate the discussion related to research question 2 and the findings from study 1, we provided below a figure that summarised the related key findings. Namely, 14 feedback factors were identified to affect (most of them positively but some negatively) the student engagement and its emerged three components. Furthermore 27 out of the initial 50 hypotheses in relation to feedback and student engagement were found to be valid. Both the validated hypotheses and the related feedback factors are discussed in the last section of this chapter.

Figure 3: Summary of findings from study 1 related to research question 2



Research question 2 was the core focus of this thesis since it opened new insights about feedback factors applied in MOOCs that advance student engagement and is the cornerstone for research question 3.

6.2 Student engagement components

We identified three components that could explain statistically sufficiently student engagement, and these were:

1. **Completion rate of the assignments**, which included the frequency of handing in assignments or attempting the final assessment
2. **Access rate to learning material** which was related to the frequency (how often) of accessing textbooks/study books, external resources/reference lists
3. **Attempt rate of assessment activities** that was related to the frequency attempting assignments and tests.

Please note that the first student engagement component was different with respect to the third one since the first one is related to whether you were submitting the assignments or the final assessment whilst the third one was related on how often the student is attempting the assignments and tests.

Based on the analysis in the literature review section as a reminder, we linked student engagement with student activity in MOOC courses (Hew, 2015) and the three student engagement components above were fully aligned with this argument. However, in general, an explicit consensus about what we actually meant by engagement was lacking from the literature although the most fundamental was the one related to the learning process; just getting students actively involved (Bowen, 2005) and this was the cornerstone of the findings on student engagement in MOOCs. However, being active in a course was still quite vague since students can do various activities in a MOOC course such as watching all lecture videos, completing all quizzes, handing in the assignments, doing the final assessment, accessing only a MOOC section, participating in specific activities, watching selected lectures, their interaction level between students, teacher and student and student and system content, as well as intensity of their activities, i.e., intensity/frequency on using various MOOC components such as video lectures, academic material, text/study books, reference lists to external resources, assignments, tests, and social media activities. In the **study 1** we considered specifically all these different activities and via the Principal Component Analysis we concluded that from the statistical point of view just three components could be considered for student engagement in MOOCs and these were the three above.

This was a very relevant result that gave for the first time some light on those specific student activities that were related to student engagement in MOOCs.

Nevertheless, there were some limitations on the research findings on the student engagement in MOOCs since the research addressed only the behavioural engagement referring to the learning activities of the students and it was driven by the need of autonomy (the need of students to sense they were not dependent on other peoples' actions) that was one of the three components of Self-Determination Theory (SDT) (Hew, 2015). But there were at least two more dimensions of student engagement (Hew 2015; Fredricks, Blumenfeld & Paris, 2004; Helme & Clarke, 1998) based on Self-Determination Theory (SDT) (Deci & Ryan, 1990; Deci & Ryan, 2000) as we saw also in the literature review that we didn't address in this research since they required a completely different approach that could be the subject of another research:

1) affective engagement referring on the feelings that learning activities created to students towards other colleagues, tutors, the course itself or the institution that run the course. Affective engagement was driven from the need of relatedness (the need of students to connect with other people) the second dimension of SDT and
2) cognitive engagement referring on the emerging thoughts that learning activities created to students, e.g. cognition activity for asking and answering questions, for giving clarifications, for reasoning, etc. Cognitive engagement is driven from the need of competence (the need of students to master specific knowledge) which is the third dimension of SDT.

Next, we discussed only those feedback factors from the **study 1** that were statistically significant and affect student engagement in general or any of its three components above. As seen from the figure above, we identified 14 feedback factors that were statistically significant and consequently when they existed, they affected either negatively or positively student engagement or some of its components.

In general, we identified that student engagement or some of its components were higher when in specific some feedback factors were applied and we discussed each one individually in the following section.

6.3 Presence of assessment activities

Any type of assessment activities influenced positively student engagement. In specific when there were assessments of any type in a MOOC, then there was an increase in student engagement in general as well as in the completion rate of the assignments**.**

In this research, we did not distinguish assessment activities between summative ones and formative ones since in many cases summative ones could be considered as formative ones for students that were interested in just acquiring further knowledge and did not wish to get a certificate or for completing the MOOC.

6.4 Type of assessments

Not only the existence of assessment activities but also specific type of assessment activities influenced student engagement that we discussed below.

When the participation level in forum discussions was not assessed then completion rate of assignments was higher. This was a relevant result if we considered also that only 3 to 5 percent of the students interacted in the user forum (Breslow, 2013; Rosé et al., 2014). Also, there was a clear relationship between the activity level in forum discussions and performance in assignments (academic tests, exercises and exams) and grades as He (He et al., 2018) argued. Therefore, it might be tempting to assess forum discussion participation as a motivation for students to participate more actively. However, the findings suggested that any assessment of the discussions exchanged in forums influenced negatively the completion rate of the assignments. This was a new finding that was not supported by any literature we explored and as we outlined in the Conclusions section, it could be investigated further by future research. This finding didn't suggest that forum discussions in general were a bad practice for student engagement in MOOCs but they should not be used as part of the student's assessment. Instead discussion forums should be present but they should be moderated and easy to access (Floratos, Guasch, Espasa, 2015). MOOC students appreciated such practice and considered them as a good way to receive support, sympathy and share ideas. As we saw, discussion forums were an essential part to foster interaction among teachers and students, as well as between students, in MOOCs. If interaction could be enhanced, this had a positive influence on motivation and finally also on drop-out rates. This notion of introducing moderators in discussion was not a new one since various research activities dealt with this (Lackner, Khali & Ebner, 2016; Salmon, 2012). In fact, they argued that moderation was crucial to establish a setting that offered individualized support for students, that fostered interaction and collaboration, hence the construction of knowledge, and that, finally, supported self-regulated learning. Therefore, moderators needed new skills that did not focus on the technical, but on the motivational and organizational field since the moderator's role was to encourage students to collaborate and communicate to maintain interactivity and to strengthen the motivation in moments of weakness.

In addition, when students had to complete a piece of work and submit it as an assignment then their access rate to the learning material was increased. This was actually the second most common type of assessment after answering a quiz as we saw. Therefore, it was not only common sense that such type of assignments forces students to access more frequently the learning material but it was also a common practice currently in MOOCs.

Also, when quizzes were not used for students' assessment then the students' engagement and their access rate to the learning material were higher. Again, this was a relevant finding, since answering quizzes was the most popular type of assignment in MOOCs that we had analysed. Then we showed that access rate to learning material was lower when students had to answer quizzes as part of their assessment that was in most of the cases. The findings here contradict some other research conducted by Hillman (2012) which argued that students appeared to benefit from the use of online quizzes as they became actively engaged in the course material. Her research was limited to one course with 61 students participating in the survey.

Finally, when students were required to complete an assignment as a group then their access rate to learning material was higher. Although, as we saw such practice was not that popular for the surveyed MOOC students, still this finding was aligned with Self-Determination Theory (Deci & Ryan, 1990; Deci & Ryan, 2000) and more specifically with the need for relatedness (i.e., the need of students to connect with other people for a related purpose, namely in this case, to connect as a group and complete an assignment.

In any case, all type of assessments should be self-explanatory in advance from the MOOC course syllabus with clear deadlines per week/module and linked with related training content (Floratos, Guasch, Espasa, 2015). This comment also was aligned with other research on designing high quality MOOCs such as from Yousef and his team (Yousef, Chatti, Schroeder, Wosnitza, 2014) and it also supported research about good practices adopted from traditional learning environments (Ashton & Davies, 2015; Gibbs & Simpson, 2004). Furthermore, from the literature analysis, it was evident that assessment activities impacted student engagement but more specifically, assessments were recommended to be based on practical problems with clear expected output that give the sense of completeness to the students and were not that easy to address but challenging and relevant enough. This was supported from previous research on traditional learning environments such as with the Self-Determination Theory of Deci & Ryan, (1990; 2000), Nicol & Macfarlane-Dick (2006), Gibbs & Simpson (2004), and Scott (2014).

6.5 Actor responsible to assess student's work

In a MOOC as we saw, we had four types of actors responsible to assess student's work, namely the instructor/tutor, other peers, the system automatically as well as the student themself, and we provided next their influence on student engagement in general and on its three components

When the actor responsible for assessing a student's work was not the instructor or tutor then the completion rate of assignments by students was higher but the access rate to the learning material decreased. Such a finding is aligned with research from Carless (2006) and Onah, Sinclair & Boyatt (2014) where even in cases that a large number of teachers and tutors spent significant hours providing feedback for students, students tended not to find the feedback as useful as the teachers and tutors initially assumed. Also, teachers and tutors were frustrated by the fact that students did not always seem to pay attention to the provided feedback e.g., by not collecting their assignment (Gibbs & Simpson, 2004). Also, the education community had acknowledged the need for two-way communication between the teacher and the student as we saw from Scott (2014) and Espasa (2019). In addition, according to Nicol (2010), students generally preferred to be assessed by staff (teachers, tutors, etc.) and not by peers. As we saw, providing individualised, actionable feedback was a labour-intensive process that was not applicable in MOOCs and encouraged the application of peer-based feedback processes. And although students often were happy to do peer-reviews and self-assessments, they preferred the staff instead of themselves to grade their assignments or the mark should not be the main output from self-and peer assessments but instead to be more formative, i.e. generating feedback on performance and facilitate learning (Floratos, Guasch, Espasa, 2015). Furthermore, students often considered feedback by peers of low value since they may assume that peers might not know much more than them and consequently they were not convinced that they could assess adequately the current performance of other students (Nicol, 2010). The research finding showed that facilitation of interaction between teachers and students was not necessarily essential since it increased the completion level of assignments but decreased the access to the learning material. Perhaps MOOCs which are now in the majority of those that are focusing on selling certificates of successful completion to their students/participants, could consider introducing facilitators/tutors to interact with the students. This was even more significant now that according to classcentral portal[15], the total number of MOOC-based microcredentials such as courses offering certificates and specialization courses of shorter duration than a degree. These specialized short courses that may be found as micromasters, nanodegrees, mastertracks, had exceeded 800 and the total number of MOOC-based degrees has in 2018 grown to 50. In 2019, more than 170 new microcredentials of ten different types have been launched. In 2018, only 120 microcredentials were added.

Moreover, when students as peers were responsible to assess student's work then the access rate to learning material was increased but on the other hand the completion rate of the assignments

[15] https://www.classcentral.com/report/mooc-stats-2019/

is lower**.** Although in the analysis during the study 1, a small percentage of the respondents had to assess the work of others, in general, Suen (2014) had identified peer-assessment as the single approach that was widely applicable to most, if not all, MOOCs. Considering that peer-assessment was by now the most popular type of assessment, the findings from the **study 1** were quite significant. More specifically, most of the students in the MOOCs nowadays were more active in accessing the learning material but less active in completing their assignments. This was also aligned with other research such as from Dougherty (2012) who argued about the lack of challenging tasks in classrooms and the impact that deficiency had on student performance, and how, unfortunately, this pattern of weak tasks without content and clear purpose continued. According to Harvard researchers (City, Elmore, Fiarman, & Teitel, 2009) who studied classroom dynamics, they claimed that task predicted performance. More specifically, if assignments were not of high quality and were not relevant to the curriculum, then learning will also be of low quality and loosely connected to the curriculum, if at all. On the other hand, learning material was easier to be aligned with the curriculum and to the learning goals and most importantly access to learning material was more attractive for students rather than completing the assignments. Also in the case of peer-assessments, there should be clear instructions on how the assessment should be evaluated and, in complex cases, a scoring guide (rubric) to be used for the assessment (Ashton & Davies, 2015; Floratos, Guasch, Espasa, 2015; Nunez, Caro and Gonzalez, 2017) .

When the system automatically assessed students' work then the completion rate of their assignments was increased but their access rate to the learning material decreased. Specifically, with the use of multiple-choice quizzes or automatic essay scoring that could be applicable to all contents and assignments due to their lower cost, on one hand we had higher engagement of students completing their assignments but, on the other hand, their engagement level with the learning material was lower. We discussed further this finding in Chapter 7 in relation to related results from study 2.

6.6 Self-assessment Existence

As we saw from study 1, when there was self-assessment introduced in the MOOC course then the completion rate of the assignments by the students was increased but their access rate to the learning material decreased. The analysis of research question 1 showed that self-assessment was a popular type of assessment as it was also confirmed from literature (Admiraal, Huisman & Pilli, 2015; Admiraal, Huisman & Van de Ven, 2014). Also, this finding was quite relevant especially when we consider the research from Taylor (2014) who argued that self-assessment had become common practice for students to participate in some sort of self-assessment during their degree program. The self-assessment provided students with invaluable feedback about themselves and assisted them in their personal and professional development. However, although self-assessment tools supported students' learning, they predominantly treated also the self as an individual, thereby ignoring the relational and collective aspects of the self. Moreover, self-assessments that students made tend to be inflated, unreliable, and biased. So, in cases where self-assessment was inflated and biased then it may pass the wrong message to the students and make them feel overconfident and as a consequence encouraged them to avoid accessing more frequently the learning material. Similarly, access rate to the learning material may be decreased also in the case that the self-assessment was reliable and unbiased. One possible reason to explain this could be that self-assessment may signal to the students that they were ready to complete the course assignments without the need to access further the learning material and activities. In any case, as we indicated in the conclusion section, this could be the subject of further research.

6.7 Actor responsible to provide feedback

The finding showed that when the actor responsible for providing feedback was not the student themself or the other peers then the completion rate of the assignments was higher. It was important to point out that this finding did not discourage assessments made by other peers, but it just identified that when feedback was provided by peers, this discouraged students in completing their assignments. Furthermore, this finding didn't challenge the high value of peer-feedback from related research (Kasch, van Rosmalen, Löhr, Klemke, Antonaci, Kalz,2021; Nicol, Thomson, Breslin, 2014). Feedback provided by peers could be different from peer-assessment that might involve just marking the assessment. In the section 6.9 where we discuss the feedback content, we commented further on the quality of the feedback content and in relation to who provided it.

6.8 Feedback Mode

Study 1 here found that when feedback was written then the completion rate of assignments was higher. As we saw in the literature analysis from Nicol (2008), written feedback was one of the best ways to engage students in general, and in this research we managed to extend this to MOOCs. Specifically, we concluded that written feedback could increase the engagement of the students in MOOCs in completing their assignments. Of course, it was quite challenging to provide written feedback in a MOOC where thousands of students were participating. One way though that this could be achievable, was the automated feedback that was provided from the system in tests based on closed questions. In this way, depending on the answer that the student selected, the system could be configured so that it provided specific pre-defined written feedback to the student.

Also, as we discussed later in allowing re-submissions in MOOCs, we may be able to motivate also their peers that assess student's work to provide written and higher quality feedback and, at the same time, had the student to evaluate the quality of the received feedback and to be included in the evaluation rubrics in MOOCs. However, we did not identify such a practice in the literature or in the MOOCs we studied and as we outlined in the Conclusion section, this could be explored in further research.

Also when feedback was not provided via audio or video (that includes audio) then the completion and attempt rate of course assignments and assessment activities respectively, as well as the student engagement in general increased. A lot of researchers (Cavanaugh & Song, 2014; Filius, 2019; Kirschner et al., 1991; Nicol, 2010; Sharma et al., 2016; Ventura et al., 2013; Ventura et al., 2014;) had been arguing that feedback should be provided via audio and/or video. However, the research findings argued the opposite. More specifically, feedback via text increased the completion level of the assignments by the students. Any feedback via audio including video that had audio decreased a) the completion level of the assignments, b) the frequency students attempting assessment activities and, c) student engagement in general. Overall written feedback was more accessible than audio or video based ones. Specifically, for accessing feedback via text, you did not need to have specific equipment installed or to ensure that you were in a quiet environment so that you were able to listen to the audio-based feedback. Also feedback via audio required the student to listen to the whole file before deciding what would be needed while written feedback could be scanned very quickly by the student who then decided whether or what to read in more detail, something that it was not possible with the audio-based feedback. Also, with written feedback you normally did not need to take further notes other than highlighting what you believed was relevant, whilst, with audio feedback, you needed first to listen and then note down what you believed was important which could be quite challenging especially in MOOCs where the study time could be quite limited. Research from Dunne & Rodway-Dyer (2009) showed that students would be happy to receive audio feedback as long as they also received written comments. Furthermore, in the same research, average audio feedback had a duration of around 12-minutes that could be quite long for someone to go through and note down the important elements. Finally, we should not forget that in MOOCs other than from the system itself, normally feedback was provided by other peers or the student themself and creating audio-based feedback required significantly more time than text-based feedback. According to Ross-Fischer (2014) on average text-based feedback to a student generally took 5-15 minutes to prepare, audio-based feedback 15-30 minutes and video-based 25-50 minutes. Such longer preparation time for audio-based feedback may also made it less attractive for students to use for providing feedback either to themselves or to their peers.

6.9 Feedback content

In general, Carless (2006) investigated lecturers' perceptions of students' engagement with feedback and concluded that course staff believed the students were too grade-oriented and not interested in learning from feedback comments or were only interested in feedback comments which provided them with 'correct' answers. Also, writing constructive feedback comments was a time-consuming process not only for the academic staff in traditional classroom teaching context but also in online and MOOC courses that peers responsible for reviewing assignments of their colleagues, they may be less willing to invest the time and effort needed to provide personally tailored feedback to individual students which encouraged a deep approach to learning. Also, Pokorny & Pickford (2010) in their research had found that the feedback must be linked with the remaining assessment towards their final result which meant that if a mark had already been specified, the interest of the average student may well be low. This PhD research explored the feedback content deeper and we discussed below the relevant findings.

When feedback was not just a grade (e.g. correct/incorrect, overall percentage) then the completion and attempt rate of assignments and assessment activities respectively as well as student engagement in general were higher. This meant that any MOOC that facilitated feedback with just a grade, was not a good one since it affected negatively the completion as well as the attempt and the student engagement in general according to the findings. As Suen (2014) argued, scores on tests would indicate whether the student had sufficiently learned the material and the scores were given to the student as feedback. However, as we shall see later, such feedback did not support revision and resubmission, thus student engagement was impacted negatively.

We believe this finding was very relevant because it produced evidence that feedback based only on marks, did not contribute to engagement. Hence, feedback should be formative, i.e., it should tell the students what they had to improve and how they could do this. If this information was missed, then feedback could not promote engagement.

In addition, when feedback provided a solution with comments (e.g., suggestions for improvements, common errors, etc.) then completion and attempt rate of assignments and assessment activities respectively were positively influenced. We saw that Sadler's research (2010) supported that type of feedback but, in addition, in this research, we identified more specifically that such feedback practices increased the level of completing assignments and the frequency of attempting the assessment activities. We believed that this finding from the study was very relevant in the context of MOOCs. In a MOOC with thousands of students participating, one way that we saw this possible for students (i.e., to provide feedback with a solution accompanied with comments), was to provide them with an assessment guide outlining the common errors that students made in the assessment that they had to peer-review. As soon as the peers during their peer-assessment identified a common error according to the assessment guide, then they could indicate that in their feedback along with the solution. Also, another suggestion in the context of a solution with comments could be that peers should not only assess the quality of work of a student but vice versa, i.e., the student that whose work was peer-assessed to provide a mark to the peer-assessor based on the quality of the feedback he/she received from the peer-assessor. Such research analysis on the quality of peer-assessments was outside the scope of this research but as we outlined in the Conclusions section something like that could be the focus of other research endeavours so that the quality of the peer-assessments to be improved and contribute to student engagement.

When feedback informed students about an incorrect response and allowed them to make more attempts, then completion rate of the assignments and student engagement in general were higher. This finding aligned also with research by Floratos, Guasch, & Espasa (2015), Do, et al., (2013), Espasa et al. (2019), and Winstone & Carless (2019). i.e., they suggested allowing students to re-submit their assignments as soon as they had received some constructive feedback from the peer-reviewers. The last two research teams were not focusing on MOOCs but the first two conducted their research specifically for MOOCS. However, resubmission was found in automated quizzes but allowing resubmission also in other cases such as in peer-assessment should require additional effort from peers for the re-assessments that would make it quite challenging especially when peer-assessments mainly provide a mark and not that constructive comments. Carless (2006) investigated lecturers' perceptions of students' engagement with feedback. Within this context students may be driven solely by the extrinsic motivation of the mark and consequently they desired feedback which simply provided them with correct answers. It was understandable that once students received feedback if they didn't have the possibility to resubmit the assignment, then feedback didn't make sense because student might not know what to do with feedback received. Furthermore, writing constructive feedback comments as we already highlighted is a time-consuming process not only for the academic staffs in traditional classroom teaching context but also in online and MOOC courses that peers responsible for reviewing assignments of their colleagues, they may be less willing to invest the time and effort needed to provide personally tailored feedback to individual students. This was supported also by the fact that we didn't find any related research on MOOCs where resubmissions of assignments were allowed after the students received feedback from peer-assessors since this would create some delays in the completion of the MOOCs and require special provisions in the MOOC structures. Nevertheless, this PhD research found that student engagement in general but also the completion rate of their assignments were influenced positively in case resubmissions were allowed after feedback received. Obviously resubmissions were easier in automated quizzes but possibly could be explored also in the context of peer-assessments. For example, resubmissions to be peer-reviewed could be allowed only after the assignment had been assessed first by the student themself (self-assessment). In this way, the number of peer-assessments would remain the same, but the peer-assessments would take place only after the students assessed their own assignment and re-submitted their work for peer-reviewing. As we outlined in the Conclusion section such practice was a novel one that we didn’t identify in any of the MOOCs we investigated and it could be explored in depth by future research.

Finally, when feedback suggested how to improve further the submitted work then attempt rate of assessment activities was higher. Again, such feedback practices that supported student engagement were supported by the research community such as Nicol (2009) and Sadler (2010) but in this research, we were able to specify it further and argue that such feedback practice increased specifically the attempt rate of the assessment activities in MOOCs.

6.10 Feedback provision and focus

As we found from study 1, when feedback was provided passively (one-way as feedback provision) then completion rate of the assignments was higher. This time we had a conclusion different to the arguments made by researchers active in the field. More specifically, Nicol (2009), (2010), and Espasa et al. (2019) argued that when written feedback was conceptualised as a dialogue and a two-way process between the students, teachers and peers then it was more effective in mass education. It may still be the case but specifically in MOOCs, we saw in this research that one-way feedback as a monologue increased the engagement of students in completing their assignments. This could be possibly explained by assuming that when feedback was provided passively (i.e., by one way as a monologue) without any further interaction, it is less time-consuming and therefore more attractive to students. In any case, since this finding contradicted current research, we suggested in the Conclusion section this to be explored further in the context of future research.

Also when feedback focused (feedback focus) on praising the ability or intelligence of the student then student engagement in general and the completion rate of the assignments increased. Various researchers such as Nicol & Marfarlane-Dick (2006) and Haimovitz & Dweck (2017) argued that praising effort and strategic behaviours, lead to higher achievement than praising ability or intelligence. We understood that the latter could result in learned-helplessness, which meant that when we provided feedback to students by praising their ability and talent instead of process and effort, we ran the risk of creating segregation between students by sending the message that 'some people had it and others just didn't' and discouraging motivation to learn. Moreover, in a MOOC environment it was almost impossible to provide feedback that praised ability or talent since the students were not familiar with each other due to that large number of participants in one course. Therefore, as we indicated in the Conclusion section, this finding could be the subject of further research in the future since it contradicted related research so far and also it is challenging to be applied in a MOOC environment with thousands of students registered that were not familiar with each other.

Furthermore, when feedback focused on clarifying the learning content then access rate to learning material was higher but the completion rate of the assignments was lower. Nicol (2009) argued that feedback which clarified the learning content was effective. In this PhD research, we explored that in specific MOOCs and its effect on student engagement and its components. We found that such feedback focus increased access to the learning material specifically in MOOCs but on the other hand it decreased their engagement to complete the assignments. One possible reason for this could be that any feedback that clarified the learning content, made its comprehension easier and indirectly encouraged students to access it.

Also, when feedback did not focus on comparing the student's performance with other students then completion rate of the assignments was higher. Nicol (2009) supported this assertion by suggesting avoiding normative comparisons with other students and instead providing feedback that focused on learning goals by acknowledging the role that effort played in learning (an example of such feedback was analysing a case was complex and could be very demanding but all students who put in the time and effort got there eventually. This PhD research agreed also that the focus of feedback should avoid comparisons and, if so, then we had higher engagement in MOOCs by having students to complete their assignments.

6.11 Feedback timing

Based on the findings from study 1, we saw that when feedback was provided immediately after submissions of students' work or it was not delayed then student engagement in general, as well as access and attempt rate of the learning material and assignments respectively were higher. Again, Nicol (2009; 2010; 2014) showed that students received feedback too late to be helpful, since they were receiving it after the next assignment. He continued also to suggest that multistage assignments could address this time problem. If the assignment allowed the submission of a draft for getting feedback, students were more likely to see such feedback as timely and make good use of it. In another way, teachers might provide feedback on sub-components of an assignment (e.g., essay structure, introductions, etc) with the various tasks building to a more complex final assignment. Such practices were quite important since the research here extended them specifically for MOOCs. Namely, practices that allowed feedback to be provided timely increased student engagement in MOOCs and also their engagement with the learning material. This was also supported by research conducted by Floratos, Guasch and Espasa (2015).

6.12 Interaction Type

As we have seen already in MOOCs from research question 1, students interacted with the teacher, the system or the course content and with other peers. We understood that teachers could find it difficult to participate in discussion forums in MOOCs where thousands of students were participating at the same time and as Suen (2014) identified such challenge was partially addressed by MOOCs asking the students to vote for the most popular questions that they would like to be clarified further and, in this way, they could select some questions or points for explaining or clarifying further in the forum/discussion channel. Furthermore, we saw that although the common practice in MOOCs, specifically in xMOOCs, that was the key structure adopted by main MOOC platforms such as Coursera, edX and Udacity (Rodriguez, 2013), was to have anonymous peer assessments for decreasing grading bias (Lu & Bol, 2007; Nunez et al., 2017). On the other hand, as we already saw from a later research (Gamage et al., 2018), when instead of blind peer review, we had identifiable peers that provided feedback via some discussion and dialogue, the quality of feedback was increased, and students were more satisfied. The findings below gave some light on how student engagement was affected by the different interactions within a MOOC.

When the student interacted with the teacher or with course content then student engagement in general as well as access rate to the learning material were higher. It could be argued that both "Student to teacher interaction" and "Student to content interaction" had positive influence on student engagement. This meant that the more we facilitated the interactions between the students and the teacher as well as with the training content, the more engaged the students became. Therefore, the more we facilitated students interacting among themselves as well as with the training content, the more engaged they became. As an example, MOOCs already facilitated interaction between the students by allocating assignments in groups of students instead of each student to submit their own assignment. Group exercises forced students to interact among themselves quite significantly. Furthermore, another example for encouraging interaction between students and the training content was to introduce optional or non- optional short, automated quizzes within the learning content that facilitated interaction and provided formative feedback to the student on what kind of learning activities and content they needed to re-do or repeat.

Also when the student interacted with the course content, then the completion rate of the assignments was higher. In the previous paragraph we described an example of how this could be facilitated with optional or not optional automated quizzes.

Finally, when the student interacted with their other peers, or the course content or with the teacher then the attempt rate of the assessment activities was increased.

The above findings were supported as we saw already in the literature review. A lot of researchers (Handley & Williams, 2011; LeBay & Comm, 2004; Li & Irby, 2008; NSSE, 2009; Nicol, 2010; Radloff and Coates, 2010) have argued that interaction with students increased the engagement of students. In fact, Nicol (2010) argued specifically that interaction with peers as well as with teachers and with online databanks (automated) increased student activity and interaction. However, the research explored that further and also more specifically in MOOCs and we identified which type of interaction mostly affects student engagement and also which student component particularly. These findings were aligned with further research (Floratos, Guasch, Espasa, 2015; Nicol, 2010) and they could be quite useful for both categories of MOOCs (cMOOCs and xMOOCs). As a reminder, the cMOOC (or connectivist MOOC), focuses on emergent knowledge, broad student autonomy, and on networking between the student and the other peers, and has limited interaction with the teacher. The second MOOC category, the xMOOC or eXtended MOOC, provides a more traditional top-down type of instruction, with fixed content, centralized forums, and regular evaluation to assess content mastery but again there was minimal if any interaction between the instructors and the students but there was quite a lot with the system automatically or with the other peers.

6.13 Number of peer reviews per assignment

Based on findings from study 1, we showed that when the number of peer reviews per assignment was increased then the completion rate of the assignments as well as the access rate to learning material were higher. This was supported by various researchers (Nicol, Thomson & Breslin, 2014; Topping 1998; Cho & MacArthur, 2010; Cho, Cho & Hacker, 2010) who supported the idea that when the number of peers reviewing an assignment increased then the quality of the feedback overall improved. This consequently increased the student performance and engagement. In this research, not only did we confirmed that, but we also explored it further in the context of MOOCs. These findings were aligned with the literature (particularly, Carless, 2006; Dawson et al, 2019; Falchikov & Goldfinch, 2000; Gibbs & Simpson, 2004; Hattie & Timperley, 2007) where they stated that students learn not only from the feedback that they received but also when they gave feedback.

6.14 Feedback attention and feedback length

With feedback attention mainly, we meant how often the student read all the provided feedback. Such definition on attention was supported also by Commodari & Guarnera (2005). The findings were discussed below:

When we have an increase of the frequency students reading the provided feedback related to questions they were sure they were correct, then their engagement in general as well as their attempt of the assessment activities and their access rate to the learning material were increased. For example, such practice on feedback attention could be facilitated by first having the students to answer automated quizzes. As soon as the student attempted a quiz, then the MOOC platform could ask the students to note down those questions they were sure that were correct and then to provide the correct answers and ask them to compare them with the ones they believed they were correct. Again, this was a new practice that we did not see in any MOOCs and as we indicated in the Conclusion section, it be could explored further with future research.

When the length of the feedback provided was decreased then the attempt rate of the assessment activities as well as the student engagement in general were increased.

Regarding feedback attention, we saw in the analysis in the literature review that there were researches (Gibbs & Simpson, 2004) where teachers and tutors were frustrated by the fact that students did not always seem to pay attention to the provided feedback e.g., by not collecting their assignments. On the other hand, those students who did read it often did not know how to interpret it or use it in their learning process. Students considered the feedback provided as specific only to the related assignment and not actually applicable to learning activities and assignments in general (Carless, 2006). In this context, this research from study 1 confirmed this and even it went further. More specifically, when students paid more attention to, or read the whole feedback received, then their student engagement in general increased but also their attempt rate of the assessment activities and access rate to the learning material. We didn't find specific research on how to make students to pay more attention on feedback provided. This was aligned also with the research from Hepplestone, Holden, Irwin, Parkin and Thorpe (2011) that they reviewed literature on use of technology for providing feedback that advanced student engagement and they found that in terms of technology to support and enhance feedback processes and practices (production, publication, delivery and students paying attention and using the feedback through technology), they found the literature to be limited. In this context, Parkin, Hepplestone, Holden, Irwin and Thorpe (2012) conducted a research and found three practices that could be applicable in MOOCs and encouraged students to pay attention, read and use the feedback provided to them. Firstly, they found that the online publication of grades and feedback, through the university's virtual learning environment, enabled students to access their grades and feedback at a time and place of their choosing and actually the frequency of referring back to that feedback was more frequent in comparison to feedback provided as hard copy. Secondly, they saw that the adaptive release of grades namely, the process by which feedback was given to students for them to reflect upon prior to them receiving their grade forced them to read the provided feedback.

This could be achieved in a number of ways but the use of technology could facilitate the process and make it viable for a large cohort of students. Specifically, they used virtual learning environment functionality to allow tutors to release feedback but withholding the grade until the student had produced a reflective account on their feedback. Once this reflective account had been submitted, the grade was released without further intervention from the tutor. This automated practice could be easily introduced in the MOOC functionality. An extension to this could be having the students assessing or even rating the quality of the peer-feedback that they received, and that rate could be considered within the whole performance track of the peer student. We already suggested such a practice in the context of encouraging peers to provide written feedback of higher quality. However, since we didn't identify such practice in the MOOCs and since this was not part of this PhD study, this finding could be investigated further in the context of another research endeavour as we indicated in the Conclusion section. The third suggestion based on Parker and her team that encouraged students to read the provided feedback was to link the feedback provided by tutors to assessment criteria. One approach to achieve this was via feedback grids so that to enable students to clearly identify the links between what they were asked to do and the feedback that they were given on their work. For making it possible in a virtual learning environment they developed an electronic feedback tool called Feedback Wizard that allowed tutors to generate individualised feedback documents based on a template for an entire student group. Each such document contained a grid/matrix of assessment criteria and feedback comments, and other remarks specifically written for that student. This method could be easily introduced also and applied by peers in a MOOC in their peer assessments instead by the tutors as it was in their research.

In regards to feedback length, Austen & Malone (2018) had 28 university students to assess a sample of 95 pieces of written feedback and they found that the longer the feedback, the less preferred it was by the students. In this analysis not only did we confirmed this finding but we also explored it further and saw how it affected student engagement in MOOCs. Therefore, we found the longer the feedback was, the less was the student engagement in general and also the lower the access level to the assessment activities.

6.15 Hypotheses validated with study 1

Based on the discussion in this chapter, we concluded with the hypotheses that were validated from study 1. As we saw in the methodology section, we formulated 50 hypotheses and we saw that the results from study 1 supported 27 out of those 50 hypotheses that we listed them in the table 60 along with the related 14 feedback factors. The study 1 findings didn’t only validate these hypotheses but they elaborated them in more detail. In specific they identified two important points, first which feedback factors affected positively or negatively student engagement and second which student engagement components specifically i.e. completion rate of assignments, access rate to learning material and attempt rate of assessment activities, were affected positively or negatively by each of those 14 feedback factors,.

Table 60: The hypotheses supported by the Study 1 findings

Feedback factors	Initial hypotheses before Study 1 based on literature review	Hypotheses supported from Study 1 Results
Interaction type	**Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement is influenced **Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced	**Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement in general and access rate to learning material are positively influenced **Hypothesis 2**: If the interaction among students in MOOCs is increased, then attempt rate of assessment activities is positively influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement in general, completion rate of assignments, access rate to learning material and attempt rate of assessment activities are positively influenced
Existence of Assessment	**Hypothesis 4 :** If assessment exists in MOOCs then student engagement is influenced	**Hypothesis 4 :** If assessment exists in MOOCs then student engagement in general and completion rate of assignments are positively influenced
Type of Assessments	**Hypothesis 5**: If participation level in forum discussions is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 6**: If the completion of an assignment individually is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 7**: If the completion of an assignment as a group is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 8**: If answering a quiz is part of assessment activities in MOOCs, then student engagement is influenced	**Hypothesis 5**: If participation level in forum discussions is part of assessment activities in MOOCs, then completion rate of assignments is positively influenced **Hypothesis 6**: If the completion of an assignment individually is part of assessment activities in MOOCs, then access rate to learning material is positively influenced **Hypothesis 7**: If the completion of an assignment as a group is part of assessment activities in MOOCs, then access rate to learning material is positively influenced **Hypothesis 8**: If answering a quiz is part of assessment activities in MOOCs, then student engagement in general and access rate to learning material are positively influenced
Number of submissions to be evaluated	**Hypothesis 14:** If the number of peer-assessment is increased in MOOCs, then student engagement is influenced	**Hypothesis 14:** If the number of peer-assessment is increased in MOOCs, then completion rate of assignments and access rate to learning material as positively influenced
Existence of self-assessment	**Hypothesis 15:** If there is self-assessment in MOOCs, then student engagement is influenced	**Hypothesis 15:** If there is self-assessment in MOOCs, then completion rate of assignments is positively influenced and access rate to learning material is negatively influenced
Actor responsible for feedback or assessing student's work	**Hypothesis 25:** If actor responsible for providing feedback or assessing student's work in MOOCs is the student himself/herself, then student engagement is influenced **Hypothesis 26:** If actor responsible for providing feedback or assessing student's work in MOOCs is the	**Hypothesis 26:** If actor responsible for assessing student's work in MOOCs is the instructor/teacher, then completion rate of assignments is negatively influenced and access rate to learning material is positively influenced **Hypothesis 27:** If actor responsible for providing feedback in MOOCs is the peer, then completion rate of assignments is negatively influenced but access rate to the learning material is positively influenced

	instructor/teacher, then student engagement is influenced **Hypothesis 27:** If actor responsible for providing feedback or assessing student's work in MOOCs is the peer, then student engagement is influenced **Hypothesis 28:** If actor responsible for providing feedback or assessing student's work in MOOCs is the system, then student engagement is influenced	**Hypothesis 28:** If actor responsible for assessing student's work in MOOCs is the system, then completion rate of assignments is positively influenced and access rate to learning material to learning material is negatively influenced.
Feedback Mode	**Hypothesis 29:** If written feedback is provided in MOOC, then student engagement is influenced **Hypothesis 30:** If audio feedback is provided in MOOC, then student engagement is influenced	**Hypothesis 29:** If written feedback is provided in MOOC, then completion rate of assignments is positively influenced **Hypothesis 30:** If feedback is provided in MOOC via audio or via video with audio, then student engagement in general, completion rate of assignments and attempt rate of assessments and activities are negatively influenced
Feedback Content	**Hypothesis 34:** If the feedback content is just a grade, then student engagement is influenced **Hypothesis 36:** If the feedback content is on solutions of the task/exercise but with comments, then student engagement is influenced **Hypothesis 37:** If the feedback content informs you about an incorrect response and allows you one or more attempts to answer it, then student engagement is influenced **Hypothesis 38:** If the feedback content suggests on how to improve further the submitted work, then student engagement is influenced	**Hypothesis 34:** If the feedback content is just a grade, then student engagement in general, completion rate of assignments and attempt rate of assessments and activities are negatively influenced **Hypothesis 36:** If the feedback content is on solutions of the task/exercise but with comments (e.g. suggestions for improvements, common errors, etc) then completion rate of assignments and attempt rate of assessments and activities are positively influenced **Hypothesis 37:** If the feedback content informs you about an incorrect response and allows you one or more attempts to answer it, then student engagement in general and completion rate of assignments are positively influenced **Hypothesis 38:** If the feedback content suggests on how to improve further the submitted work, then attempt rate of assessments activities is positively influenced
Feedback provision	**Hypothesis 40**: If the feedback was communicated passively (one-way communication), then student engagement is influenced.	**Hypothesis 40**: If the feedback was communicated passively (one-way communication), then completion rate of assignments is positively influenced.
Feedback focus	**Hypothesis 42**: If the feedback focused on praising the students' ability or intelligence, then student engagement is influenced **Hypothesis 43**: If the feedback focused on clarifying the learning content, then student engagement is influenced **Hypothesis 44**: If the feedback focused on comparing student's performance with other students, then student engagement is influenced	**Hypothesis 42**: If the feedback focused on praising the students' ability or intelligence, then student engagement in general and completion rate of assignments are positively influenced **Hypothesis 43**: If the feedback focused on clarifying the learning content, then completion rate of assignments is negatively influenced and access rate to learning material is positively influenced. **Hypothesis 44**: If the feedback focused on comparing student's performance with other students, then completion rate of assignments is negatively influenced
Feedback timing	**Hypothesis 46**: If the feedback timing changes, then student engagement is influenced	**Hypothesis 46**: If the feedback is provided immediately after submissions of students' work or it is not delayed, then student engagement in general, access

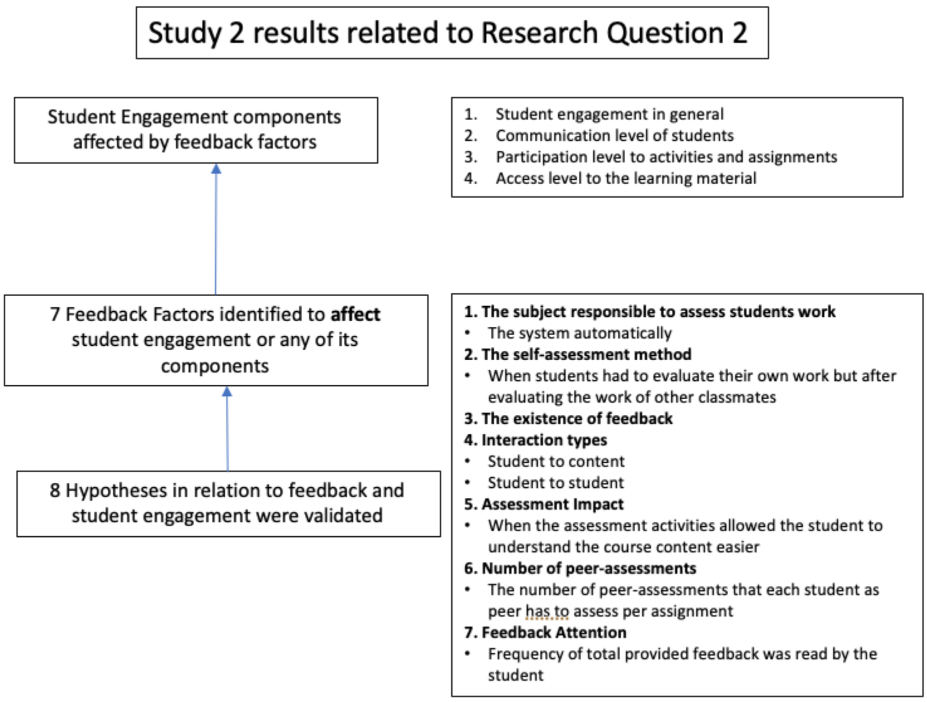
		rate to learning material and attempt rate of assessment activities are positively influenced
Feedback length	**Hypothesis 48**: If the length of the feedback changes, then student engagement is influenced	**Hypothesis 48**: If the length of the feedback decreases, then student engagement in general and attempt rate of assessment activities are positively influenced
Attention on feedback	**Hypothesis 49**: If students read frequently and the whole feedback provided, then student engagement is influenced	**Hypothesis 49a**: If students read frequently the feedback provided on questions they were sure they were correct, then access rate to learning material is positively influenced **Hypothesis 49b**: If students read frequently the whole feedback provided the student engagement in general and attempt rate of assessment activities are positively influenced.

Chapter 7: Discussion on Research Question 2 based on Study 2 findings

7.1 Introduction

Similarly in **study 2** we conducted one more survey but now on a larger number of MOOCs namely 34 and received 2220 responses based on a shorter post-questionnaire. Similarly as in chapter 6, we aimed in this chapter to show how the findings from study 2 fit with the existing knowledge, what new insights they contributed as well as their support to the research hypotheses & related feedback factors and what are the consequences in theory and practice. In order to facilitate the discussion related to research question 2 and the findings from study 2, we provided below a figure with the related main findings. In specific 7 feedback factors were identified to affect (most of them positively) the student engagement in MOOCs and its three derived components. Furthermore 8 out of the initial 27 hypotheses in relation to feedback and student engagement were found to be valid. Both the validated hypotheses and the related feedback factors were discussed in the last section of this chapter.

Figure 4: Summary of findings from study 2 related to research question 2



7.2 Student engagement components

In the same manner as in **study 1**, we conducted Principal Component Analysis (PCA) for grouping 16 different student activities into three components, namely:

1. **Communication level** that included their active participation in forum discussions or at least reading the forum posts; communication with other students in course or with the teacher/tutor if applicable; and participating in social media activities related to the MOOC course.
2. **Participation level to activities and assignments** that involved how many learning activities, course modules, quizzes/assignments and peer-review tasks the student participated.
3. **Access level to learning material** that included how many video lectures, learning material and content the student accessed.

The above three components are very relevant since they were three key activities of the students in a MOOC course: communicating, attempting assessments and required learning activities as well as accessing learning material based on the discussion for research question one. These components are supported by other research on student engagement in traditional learning environments such as by Bowen (2005), Fredricks, Blumenfeld & Paris (2004), Helme & Clarke (1998), Tai, Ajjawi, Bearman, Wiseman (2020) and the SDT of Deci & Ryan (1991; 2000).

Next, we discussed only those feedback factors from **study 2** that had statistical significance and consequently influenced student engagement or its three components above.

7.3 Interaction type

As we saw already in MOOCs from research question 1, students interacted with the teacher, the system or the course content and with other peers. In study 2, we found that student and content interaction as well as student to student interaction were related to student engagement.

When the interaction between the student and the content was facilitated then student engagement in general as well as the attempt rate of the activities and assignments and the access rate to the learning material were increased. According to (Miyazoe & Anderson, 2013) the interaction between student and content could be facilitated with the consideration in the instructional design of the MOOC of any interactive training content such as slide presentations that were annotated or videos by the instructor that were accessed on request by the student. Therefore, based on the above, in order to increase the access level to the learning material, we needed at least to facilitate the interaction between the student and the training content with similar practices.

When students interacted between them then their communication level with the MOOC was increased. This meant that the more we facilitated interaction between the students, the more active they were in communicating such as participating in the (forum) discussions, communicating with other students in the course, communicating if possible with the teacher/assistant), reading the (forum) discussions or participating in social media activities related to the course.

As we discussed also in study 1 and based on the literature review, a lot of researchers argued that interaction with students increased the engagement of students. However, the PhD research explored that further and we identified which type of interaction affected most student engagement and also which student activity in MOOCs. We discussed also how these findings could affect cMOOCs or xMOOCs accordingly.

7.4 Assessment Impact

Assessment impact along with the self-assessment method were the only additional feedback factors that were found from study 2 that influenced student engagement and they were not identified by study 1.

Specifically in regards to assessment impact, we found that when the assessment activities allowed the students to understand the course content easier, then their communication rate increased. This meant they were more active in communicating such as: a) participating in the (forum) discussions, b) communicating with other students in the course, c) communicating if possible with the teacher/assistant), d) reading the (forum) discussions, or e) participating in social media activities related to the course. This finding was aligned with the research from Wise & Cui (2018) that considered discussion forums as one of the best ways for students not only to communicate among themselves and possibly with the teachers/facilitators in MOOCs but also considering them as a formative way for understanding content and suggested that intensity of discussions taking place in MOOCs should be considered in the overall assessment of the participating students. Discussion forums were widely used in MOOCs to offer social interaction and learning support. However, the connections between forum participation, learning as well as assessment had not yet been well established. The study from Wise & Cui (2018) showed an overall relationship between contributing to forum discussions and passing the course, as well as a specific relationship between the quantity of content-related contributions and course grade. These findings indicated the critical importance of considering the content of forum discussions when examining their relationship to course assessments. Also, the research from Wise & Cui (2018) stated there was a need to reconceptualise conventional perspectives on what learning objectives were achieved via MOOC discussion forums and how they could be assessed.

When assessment activities allowed the student to understand the course content more easily, they had a positive influence on student engagement in general, on their participation to activities and assignments and on their access to learning material.

In short, when the assessment activities allowed the student to understand the content easier (Assessment Impact) then student engagement in general including all its components increased. This was a very relevant finding and there is already some research from Deshler (Deshler et al., 2001) on activities including assessment that could make the student understand the content better. These that could be applicable also in MOOCs were a) presenting the content in a way that involves students in the learning process, b) setting up multiple practice opportunities in the context of formative assessment for students to practice learning the content, c) assessing the students' mastery of the content and attainment of the standards and d) providing students with helpful feedback and further instruction, as needed, to advance comprehension. These ones and further activities as we indicated in the Conclusions section could be explored with future research since assessment impact was a significant factor for student engagement. Study 2 showed that assessment activities should ease the students in understanding the course content for students starting to be more engaged in general but also more active in their communication within the course, in their participation to activities & assignments as well as in their access to the learning material.

7.5 Actor responsible to assess student's work

As we saw, there were four types of actors responsible to assess student's work namely the instructor/tutor, other peers, the system automatically as well as the student themselves. In study 1, we found that all these actors affected student engagement and we discussed that extensively in Chapter 6. The results from study 2 supported the influence to student engagement only when assessment was conducted by the system automatically. In specific when the system assessed students' work automatically, then student engagement in general was lower. Therefore, although automatic assessment as we saw in the discussion for research question 1 was one of the three most common norms for assessing students' work in a MOOC, it still needed to be applied with caution since it negatively affected student engagement in general as well as the frequency students were accessing learning material. This was aligned also with research by Eckerdal (Eckerdal et al., 2014) who confirmed that automatic assessments had limited scope in MOOCs and called for new research in automatic assessment and feedback.

7.6 Number of peer reviews per assignment

Also in study 2, as in study 1, we found that when the number of peer-assessments per student was increased for each assignment, then their participation to MOOC activities and assignments was increased. As we discussed also in the context of the findings of study 1, these results were aligned with the literature where they highlighted how important was for students not only to receive feedback but also to give. Another relevant finding that emerged only from study 2 was the minimum no. of peer reviews needed for students to start being more active in MOOC activities and assignments. More specifically, the negative value of the constant in the regression model as we saw from the Results section suggested that student participation in activities and assignments would start increasing as soon as students had **three or more on average submissions** from their classmates to evaluate. We couldn't find any literature to explore about the minimum desired or optimum number of peer reviews for student engagement. Therefore this was a significant finding that as we indicated in the conclusion section it could be subject to further research.

7.7 Self-assessment and conditions for student engagement

We found from study 2 that when students had to evaluate their own work but after evaluating the work of other classmates, then we had an increase in student engagement in general as well as an increase in communication level. This was a very relevant and actually a new finding in relation to the study 1. The finding here showed that self-assessment of the student's work can affect student engagement positively on the condition that the student evaluated first the same work of other classmates. Also, this finding validated research from Nicol (2014) who highlighted that self-review after reviewing the works of others was quite important however, it did not establish what added value, if any, was realised by formally requesting from students to consolidate their reflections by writing them down (Self-assessment). As he specifically states "This issue warrants further research" (Nicol et al., 2014, p. 117).

Therefore, the limited research so far made the finding from study 2 even more significant, since it highlighted the value of the self-assessment and at the same time it specified a condition on when that should happen in MOOCs, i.e., after the peer reviews.

7.8 Existence of feedback

Feedback was an important factor for student engagement in MOOCs. Specifically from study 2, we found that when feedback was provided then we had an increase in student engagement, in communication level, and in their access level to learning material. Many researchers such as Austen & Malone (2018); Carless (2006); Chew (2014); Ferguson (2011); Handley & Williamson (2011); Housell et al. (2008); Nicol & Marcfarlaine-Dick (2006); Nicol (2010); Nicol, Thomson & Breslin (2014); Pokorny & Pickford (2010); Poulos & Mahoney (2008); Sadler (2010); Scott (2014); Shute (2008); Sutton & Gill (2010); and Vardi (2012) highlighted the value of feedback. However, the research from study 2 went deeper since we found that feedback in MOOCs increased students' engagement in general but also the communication level of the students as well as their access level to the learning material.

7.9 Feedback attention

As we saw also in study 1, feedback attention may have different interpretations. In this PhD research, we have considered that the students pay attention to the provided feedback when they read it and make sure they understand it by asking for clarifications if needed. Such definition on attention is supported also by Commodari & Guarnera (2005). From study 2, we found specifically that when the frequency of students reading the provided feedback was increased then it affected positively the student engagement in general, their participation level to activities and assignments as well as their access level to learning material.

Overall in regards to feedback attention, we had discussed in detail the value for the students when they read the provided feedback with analysis of the current literature review in the study 1 and we saw that the more often we pay attention to the feedback provided, the higher is their engagement with the learning material, with the assessment activities and the student engagement in general. Similarly, in the study 2, we had a positive influence on student engagement in general as well as on participating in the activities and the assignments as well as in accessing the learning material. We discussed also in study 1 that the literature related to feedback practices that can make students read and most importantly use the feedback is limited. However, we discussed three practices that could be applied in MOOCs based on the research by Parkin and her team (Parkin, Hepplestone, Holden, Irwin, Thorpe, 201). We discussed also one further practice of increasing the frequency that students read and understand the feedback they receive (Feedback attention). This was to introduce as a practice that when students receive any feedback either automated, from the teacher or from other peers to be able to evaluate and reflect on its quality.

7.10 Hypotheses validated with study 2

After the discussion on the results, we concluded this chapter with the hypotheses that were supported by study 2. We saw already from the Methodology chapter that for study 2 we formulated 27 hypotheses (instead of 50 in study 1) and the results validated 8 hypotheses that we outlined them in the table 61 along with the related 7 feedback factors. Similarly as from study 1, the study 2 findings went deeper and they identified two important points, first which feedback factors affected positively or negatively student engagement in general and moreover which student engagement components specifically i.e. communication level of students, participation level to activities and assignments, access level to the learning material, were affected positively or negatively by each of those 7 feedback factors,.

Table 61: The hypotheses supported by the Study 2 findings

Feedback factors	**Initial hypotheses before study 2 based mainly on study 1 findings**	**Hypotheses supported from Study 2 findings**
Interaction type	**Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced	**Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement in general, their participation level to activities and assignments as well as access to learning material are positively influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then their communication level is positively influenced
Impact of Assessments Assessment activities that allow students to understand the course content easier	**Hypothesis 9**: If assessment activities allowed students in MOOCs to understand the course content easier then student engagement is influenced.	**Hypothesis 9**: If assessment activities allowed students in MOOCs to understand the course content easier then student engagement in general, their communication level, their participation level to activities and assignments as well as their access level to learning material are positively influenced.
Number of submissions to be evaluated	**Hypothesis 10:** If the number of peer-assessment is increased in MOOCs, then student engagement is influenced	**Hypothesis 10:** If the number of peer-assessment is increased in MOOCs, then participation level of students to activities and assignments is positively influenced
Self-Assessment Method	**Hypothesis 12:** If students had to evaluate their own work but after evaluating the work of other classmates in MOOCs, then student engagement is influenced	**Hypothesis 12:** If students had to evaluate their own work but after evaluating the work of other classmates in MOOCs, then student engagement in general as

		well as their communication level are positively influenced
Existence of feedback	**Hypothesis 15:** If there is feedback mechanism in MOOC, then student engagement is influenced	**Hypothesis 15:** If there is feedback mechanism in MOOC, then student engagement in general, their communication level as well as their access level to learning material are positively influenced
Actor responsible assessing student's work	**Hypothesis 19:** If actor responsible for providing assessing student's work in MOOCs is the system, then student engagement is influenced	**Hypothesis 19:** If actor responsible for providing assessing student's work in MOOCs is the system, then student engagement in general is negatively influenced
Attention on feedback	**Hypothesis 27**: If students read and use part or full of the feedback provided, then student engagement is influenced	**Hypothesis 27**: If students read and use part full of the feedback provided, then student engagement in general, their participation level to activities and assignments as well as their access level to learning material are positively influenced

Chapter 8: Discussion on Research Question 3 based on both Studies 1 & 2 findings

8.1 Introduction

As we saw already in the context of the discussion for research question 2, all the identified feedback practices were examined in relation to literature and other research and there was limited research that was applicable to MOOCs and these PhD findings reduced the knowledge gap on which feedback practices influenced student engagement. In this section, we used the results from both study 1 and study 2 in order to deal with research question three and discussed specific feedback practices that could increase student engagement in MOOCs in general and specifically in its 6 components as were identified from either study 1 or 2. Namely, i) completion rate of assignments and final assessment, ii) access rate to learning material, iii) attempt rate of assignments and tests, iv) communication level of students, v) participation level to activities and assignments and vi) access level to the learning material.

8.2 Feedback practices that affect positively student engagement in general

Based on studies 1 and 2, we found in total 15 feedback practices that **affected positively student engagement in general in MOOCs** as shown in table 62 below.

Table 62: Feedback suggestions that affect positively student engagement in general in MOOCs

Feedback practices that affect positively student engagement in general in MOOCs	
1.	Existence of assessment
2.	Avoid having as an assessment activity students answering quizzes
3.	Avoid having system automatically assessing students' work
4.	Apply assessment activities that allow the student to understand the content easier (Assessment Impact)
5.	Require students to evaluate their own work but after evaluating the work of other classmates
6.	Feedback existence
7.	Avoid providing feedback via audio
8.	Avoid feedback with just a grade (correct/incorrect, overall%)
9.	Provide feedback that informs student about an incorrect response and allows him/her to re-answer one or more times
10.	Provide feedback immediately after submissions of students' work or do not delay it

11.	Ensure that students read and understand (pay attention) on the feedback related to questions they were sure they were correct
12.	Ensure that students read and understand (pay attention) on the provided feedback
13.	Reduce the length of the provided feedback
14.	Facilitate interaction between the student and the teacher
15.	Facilitate interaction between the student and content/automatically from the system

From the table 62, it is clear that whenever, MOOC course included assessments (e.g. completing an assignment alone or in a group) the student engagement in general was increased. Also, the same happens when the system avoided assessing automatically the work of a student (e.g. automatically via a quiz). Also when the assessment helped the student to understand the training content (e.g. by providing students with helpful feedback and further instruction, as needed, to advance comprehension, as discussed in section 7.4), then student engagement was increased. Also self-assessment as a practice in a MOOC could increase student engagement as long as it required first the student to assess the work of other peers as discussed in section 7.7. Furthermore just the existence of feedback and when the MOOC avoided providing it via audio or only a grade then student engagement was enhanced as discussed in sections 6.8, 6.9 and 7.8, especially, when feedback informed students about an incorrect response and allowed resubmissions. Two more feedback practices that affected positively student engagement were the feedback timing (immediately or with no delay) and feedback length (the less the better) as discussed in 6.11 & 6.14. Also when the student paid attention to the provided feedback and especially to the ones related to questions they believed they were correct as discussed in sections 6.14 & 7.9 student engagement increased. Furthermore, when MOOC introduced provisions to facilitate interaction between the student and either the teacher/tutor or the content automatically then student engagement also increased as discussed in sections 6.12 & 7.3.

8.3 Feedback practices that affect positively the completion rate of assignments and final test

Similarly, in this PhD research we identified specific feedback practices that could improve the **frequency of students completing the assignments or the final assessment, namely the** completion rate. We provided them in Table 63 :

Table 63: Key research contribution 3: Feedback suggestions to affect positively students completing assignments in MOOCs

Feedback suggestions that affect positively students completing assignments in MOOCs	
1.	Avoid assessing participation level in forum discussion is not assessed (Explored in both studies)
2.	Avoid having the instructor or tutor to assess student’s work
3.	Avoid having students as peers to assess another student’s work
4.	Have the system automatically to assess students’ work
5.	Increase the number of peer reviews per assignment
6.	Apply self-assessment practices
7.	Avoid having the student or the other peers responsible for providing feedback
8.	Provide written feedback
9.	Avoid providing feedback via audio
10.	Avoid providing feedback with just a grade (correct/incorrect, overall%)
11.	Provide feedback based on solution with comments (e.g. suggestions for improvements, common errors, etc)
12.	Provide feedback that informs student about an incorrect response and allows him/her to re-answer one or more times
13.	Provide feedback passively (one-way)
14.	Provide feedback that focuses on praising ability or intelligence of the student
15.	Avoid feedback that focuses on clarifying the learning content
16.	Avoid feedback that focuses on comparing the student’s performance with other students
17.	Facilitate interaction between the student and content/automatically from the system

Based on the table 63, it was not a good practice to assess the participation level in MOOC forums and it was better to avoid such practice for increasing the completion rate of the assignments as discussed also in section 6.4. Similarly, MOOCs should avoid having the tutor or other peers to assess student’s work but should have more assessments conducted automatically by the MOOC platform as discussed in 6.5 for increasing the frequency that students complete the assignments and the final test. Furthermore, the higher the number of peer reviews per assignment as well as the interaction between the student and the MOOC content automatically the higher the completion rate of assignments as discussed in 6.12 and 6.13. When there were in MOOCS practices for the student to assess themself but not to provide feedback to their work or to have other peers to provide feedback then completion rate of assignments increased as discussed in sections 6.6 and 6.7. When feedback was provided via text (written) and not via audio then completion rate of assignments increased as discussed in 6.8. Only grade as feedback practice should be avoided but feedback that provided solution with comments or informed the student about the incorrect response and allowed resubmissions, then completion rate of assignments increased as discussed in 6.9. Similarly in MOOCs when feedback was provided passively (not via dialogue) or when feedback focused on praising ability or intelligence of the student or avoided either clarifying the learning content or comparing the student’s performance with other students then completion rate of assignments was increased as discussed in 6.10.

8.4 Feedback practices that affect positively the access rate to learning material in MOOCs

In the same manner, in this PhD research we identified specific practices that could **increase the frequency that students access (Access rate) learning material** such as textbooks/study books, external resources/reference lists as shown in the table 64 below:

Table 64: Feedback practices to affect positively access rate of students to learning material in MOOCs

Feedback practices to affect positively the frequency that students in MOOCs access (Access rate) learning material such as textbooks/study books, external resources/reference lists	
1.	Require from students for an assessment to complete a piece of work and submit it
2.	Avoid having students to answer quizzes as an assessment activity
3.	Students are required to complete an assignment as a group
4.	Apply assessment activities that allow students to understand the content easier (Assessment Impact)
5.	Have the actor responsible to assess student's work to be the instructor or tutor
6.	Have students as peers responsible to assess another student's work
7.	Avoid having the system automatically to assess students' work
8.	Higher number of submissions per assignment
9.	Avoid self-assessment
10.	Provide feedback that focuses on clarifying the learning content
11.	Ensure that feedback is provided immediately after submissions of students' work or it is not delayed
12.	Ensure that students read and understand (pay attention) on the feedback related to questions they were sure they were correct
13.	Facilitate interaction between the student and the teacher
14.	Facilitate interaction between the student and content/automatically from the system

Based on the table 64, when MOOC required from students to complete a piece of work and submit it either alone or as a group for an assessment or avoided having students to answer quizzes as an assessment then access rate to the learning material was increased as discussed in 6.4. Similarly the higher the number of submissions per assignment, the higher was the access rate to learning material as discussed in 6.13. When there was no self -assessment in MOOCs then access rate to learning material was influenced positively as discussed in 6.6. When feedback in MOOCs focused in clarifying the learning content or was provided immediately or with no delay then access rate to learning material was influenced positively as discussed in 6.10 & 6.11. When MOOC ensured that students read and understood the feedback provided or facilitated interaction between the student and the tutor or with the content automatically then access rate to learning material increased as discussed in 6.12 & 6.14.

8.5 Feedback practices that affect positively the attempt rate of assessment activities in MOOCs

Also, in this PhD research we have identified specific feedback suggestions to influence positively **the frequency of students attempting (Attempt rate) assignments and tests**. We provided in the table 65 below the related suggestions:

Table 65: Feedback practices to affect positively the frequency students attempt (Attempt rate) assessment activities in MOOCs

Feedback practices to affect positively the frequency students attempt (Attempt rate) assessment activities in MOOCs	
1.	Avoid providing feedback via audio
2.	Provide feedback that is not just a grade (correct/incorrect, overall%)
3.	Provide feedback based on solution with comments (e.g. suggestions for improvements, common errors, etc)
4.	Provide feedback that suggests on how to improve further the submitted work
5.	Ensure feedback is provided immediately after submissions of students' work or it is not delayed
6.	Ensure that students read and understand (pay attention) on the provided feedback
7.	Reduce the length of the provided feedback
8.	Ensure that there is interaction between the student and content/automatically from the system
9.	Ensure that there is interaction between the students with the other students

Based on the table 65, when feedback was not provided via audio or provided immediately or with no delay, then the attempt rate of assessment activities was positively influenced as discussed in 6.8 & 6.11. Similarly, this happened also when the feedback was not focusing on just a grade or provided the solution with further comments or suggested on how to improve the submitted work as discussed in 6.10. Furthermore, the lower the feedback length or higher the attention of the student to the provided feedback, then the higher was the attempt rate of the assessments as discussed in 6.14. In the same manner, the higher the interaction among the students or with the content automatically in MOOCs, then the higher was the attempt rate of the assessments as discussed in 6.12.

8.6 Feedback practices that affect positively the communication level in MOOCS

Also, in this PhD research we identified specific feedback suggestions that **advance students' communication within a MOOC**, namely the level of students actively participating in forum discussions or at least reading the forum posts, communicating with other students in the course or with the teacher/tutor (if applicable) or participating in social media activities related to the MOOC as shown in the table 66 below:

Table 66: Feedback practices to affect positively students' communication level in MOOCs

Feedback practices to affect positively students communication within the MOOCs	
1.	Assessment activities allowed the student to understand the content easier (Assessment impact)
2.	Students had to evaluate their own work but after evaluating the work of other classmates
3.	Feedback existence
4.	There is interaction between the students with the other students

Based on the table above, when assessment activities allowed the student to understand the content easier or when students had to evaluate their own work but after evaluating the work of other peers, then communication level in MOOCS was positively influenced as discussed in 7.4 & 7.7. Similarly, just the existence of feedback practices or the interaction among the students, then the higher was the communication level as discussed in 7.3 & 7.8.

8.7 Feedback practices that affect positively the participation level to activities and assignments in MOOCS

In addition, in this PhD research we identified specific feedback suggestions that could influence positively **the number of course modules and learning activities students were participating**, as well as how many end-of-module quizzes/assignments, general quizzes/assignments or peer-review tasks they did in a MOOC. We provided below in table 67 the related suggestions:

Table 67: Feedback suggestions to affect positively the number of activities and assignments students attempt in MOOCs

Feedback suggestions to affect positively the number of activities and assignments the students attempt in a MOOC	
1.	Increase number of peer reviews per assignment
2.	Ensure that assessment activities allow the student to understand the content easier (Assessment Impact)
3.	Ensure that students read and understand (pay attention) on the provided feedback
4.	Ensure that there is interaction between the student and content/automatically from the system

The higher the number of peer reviews per assignment or when the assessment activities allowed the student to understand the content easier, then the higher was the number of activities and assignments that students participated as discussed also in 7.4 & 7.6. Similarly when MOOC practices ensured that students read and understood the provided feedback or the higher the interaction was between the student and the MOOC content automatically, then the higher was the number of activities and assessments that students were participating as discussed in 7.3 & 7.9.

8.8 Feedback practices that affect positively the access level of students to learning material in MOOCs.

Finally, in this PhD research we identified specific feedback suggestions that could **increase the amount of learning material is accessed by students in MOOCs** such as course content, video lectures and other material that students accessed in a MOOC as shown in the table 68 below.

Table 68: Feedback practices to affect positively how much of the learning material (course content, lecture videos, other learning material) students access in MOOCs

Feedback practices to affect positively the access level of students to learning material in MOOCs	
1	Apply assessment activities that allow students to understand the content easier (Assessment Impact)
2	Provide feedback
3	Ensure that students read and understand (pay attention on) the feedback related to questions they were sure they were correct
4	Facilitate interaction between the student and content/automatically from the system

Based on the table above, when assessment activities allowed students to understand the content easier, then their access level to the learning material was increased as discussed in 7.4. Also just the existence of feedback or when MOOC practices ensured that students read and understood the feedback related to questions they were sure they were correct, then access level to learning material was positively influenced as discussed in 7.8 & 7.9. Similarly the higher the interaction between the student and the content automatically, the higher the access level to the learning material as discussed in 7.3.

8.9 Feedback practices in MOOCs and in online learning environments

It was important to highlight that the identified above practices could be applicable also in fully online courses with a significant number of students, as long as they were following similar teaching practices as MOOCs such as limited interaction with tutors, extensive use of peer-assessments and of automated quizzes as well as automatic interaction with learning content. Almost all of the suggested feedback practices, could be easily applied in a MOOC such as a higher number of peer-assessment, the feedback timing, who should be the actor providing feedback or assessing the work, etc.

In addition, we suggested some feedback factors that were not easy to consider how they could be applied in a MOOC. These were:

- Having feedback that provides a solution with comments (e.g., suggestions for improvements, common errors, etc)
- Having feedback that informs students about an incorrect response and allows them to attempt more times for answering and then completing the assignment
- Having assessment activities that ease the student to understand the course content (Assessment Impact)
- Having students to read and understand (Feedback attention) the feedback on questions, they were sure they were correct
- Having students to read and understand (Feedback attention) the provided feedback
- Having feedback focusing on clarifying the learning content

We suggested in the discussion chapters 6 & 7, some thoughts on how such practices could be introduced in MOOCs. However, we didn't find any literature to support them neither we found them in any of the MOOCs that we came across. Hence, we suggested in the Conclusion chapter, future research to explore those feedback practices further and in specific how they could be implemented successfully in a MOOC.

Chapter 9: Conclusions

In this final chapter we clearly stated the answers to the three research questions, summarise and reflect on this PhD research and on the new knowledge we have contributed, and make recommendations for future work on the topic.

9.1 Conclusions

Research and educational community had been for years struggling with the low engagement of participants in MOOCs. Therefore, the objective of this PhD research was to explore feedback factors and practices that were present in MOOCs and their level of influence on student engagement. The datasets were quite extensive since we statistically analysed in total questionnaire responses given by 2660 participants from 40 MOOCs (**Sum from both Studies 1 and 2**).

9.1.1 Conclusions on Research Questions 1

In particular, the first goal was to identify feedback practices present in MOOCs and we identified some present based on the MOOC participants surveyed. We needed to highlight here that we analysed responses received from the participants without personally being able to participate in each MOOC course when. Therefore, the purpose of the first research question was to identify just feedback practices present in MOOCs and not provide any statistics or indicators on that. This meant that the findings related to which feedback practices were currently present in MOOCs, could only be used to show some trends on formative and feedback assessment practices usually applied.

More specifically, we saw that popular actors to assess the students' work were the system automatically and the student themselves especially for MOOCs that it was important to recall or to differentiate concepts or to interpret or extract information from text or graphics. On the other hand, for MOOCs where it was required to generate ideas or produce a product as part of an assessment, such as answer open-ended questions, write an essay, submit a report, design an artifact, engineer a process or solve an ill-defined complex problem then the most popular actor to assess was another peer.

Also a popular actor to provide feedback was the system automatically and we had few cases that students were providing feedback to themselves. Self-assessment was used mainly for *assessment for learning* as well as for *assessment of learning* since there was not a big difference between the number of the students that had to evaluate their own work after evaluating the work of other classmates (*self-assessment of learning*) and the ones that such condition was not required (*self-assessment for learning*). Also, the most popular mode for providing feedback was in a written format.

Regarding the feedback content, in most of the cases, it was general but we also had many cases where the provided feedback specified which answers were wrong and allowed them more attempts. Also, in many cases, feedback was providing solutions with comments and there were just a few cases where feedback was providing solutions of the task/exercise but with no comments.

Feedback in most of the cases was provided passively (one way) instead of having further discussions via dialogue. Furthermore, in many cases feedback focused on praising the ability or intelligence of the student (e.g., with just statements such as “great work”). Also, frequently, feedback focused to praise effort (e.g. by giving comments such as “good effort”), and in fewer cases feedback focus was to clarify the learning content.

We also saw that in most of the cases, feedback was provided immediately after submission or it was not delayed even in cases that students had to peer assess the assigned tasks

9.1.2 Conclusions on Research Questions 2 and 3

The key goal was to identify feedback factors that influence student engagement (research question 2) and especially which ones advanced it positively for encouraging them as practices and which ones negatively for discouraging them within a MOOC (research question 3).

We considered based on previous research that student engagement was highly linked with their activity within the MOOC, i.e., on how active they were during their MOOC participation and the more active they were, the more engaged they were considered to be. In this respect, we identified that student engagement was not only generally linked with student activity, but as we already saw also it was linked with other components. Overall with this PhD, we identified six components of student engagement as metrics that could be used in order to measure student engagement in MOOCs. Those 6 student engagement components that can indicate how engaged a student is within a MOOC are shown in the table 69 below.

Table 69: Student Engagement components and metrics in MOOCs

Student Engagement Components	Student Engagement Metrics
Completion rate of the assignments	Frequency of (How often) students hand-in assignments or the final assessment
Access rate to learning material	Frequency of (How often) students access textbooks/study books, external resources/reference lists
Attempt rate of activities and assignments	Frequency of (How often) students attempt assignments and tests,
Communication level	How much (Level/intensity of)students actively participate in forum discussions or at least reading the forum posts, communicating with other students in the course or with the teacher/tutor (if applicable) or participating in social media activities related to the MOOC course
Participation level to learning activities and assignments	In how many course modules and learning activities, end-of-module quizzes/assignments, general quizzes/assignments or peer-review tasks students are participating.
Access rate to learning material	Students how much content browse, how many video lectures watch, how much learning material download

These student engagement metrics could be used in any MOOC in order to measure how much they were affected by various feedback factors. Moreover, this PhD thesis identified 17 different feedback factors that affect student engagement as outlined below:

1. **Interaction types**
    - Student to teacher
    - Student to content
    - Student to student
2. **Existence of assessment:** (Any type of assessment)
3. **Type of assessment:**
    - When participation level in forum discussion is assessed
    - When you complete and submit a piece of work
    - When you answer a quiz
    - When you complete an assignment as a group
4. **Actor responsible to assess students' work**
    - Teacher
    - The system automatically
5. **Existence of self-assessment**
6. **The Self-assessment method:** When students had to evaluate their own work but after evaluating the work of other classmates)

7. **Assessment Impact:** When the assessment activities allowed the student to understand the course content easier
8. **Number of peer reviews** (The number of peer-assessments that each student as peer has to do per assignment)
9. **Existence of Feedback**
10. **Actor responsible to provide feedback to students' work :** Other peers
11. **Feedback Mode:** Written or Audio
12. **Feedback content**
    - Just a grade(correct/incorrect, overall %)
    - Solution with comments
    - Info about the incorrect response and allow resubmission
    - Suggestions to improve
13. **Feedback Provision :** Via passive info (with no dialogue)
14. **Feedback Focus**
    - On praising ability or intelligence
    - On clarifying the learning content
    - On comparing the student's performance with others
15. **Feedback timing:** (Provided immediately after submission or Delayed)
16. **Feedback length**
17. **Feedback Attention:** Frequency of total provided feedback was read by student

These 17 feedback factors were the ones out of the initial 24 and the initial 50 hypotheses that were found in this PhD thesis to influence positively (most of them) and some of them negatively student engagement or its six components. These 17 feedback factors along with the 30 hypotheses that the results from studies 1 and 2 supported form the basis of those feedback practices that should be applied in MOOCs in order to support student engagement based on the following table 70 that was a summary of all those feedback practices that affected student engagement. The "+" symbol indicated that a specific feedback factor affected *positively* the related student engagement or its component and the "-" symbol *negatively*.

Table 70: Feedback practices that advance student engagement matrix

	Feedback practices that influence positively (+) or negatively (-) student engagement or its components	Student Engagement in general	Completion Rate of assignments	Access Rate to learning material	Attempt Rate of assessment activities	Student Engagement in general	Communication Level	Participation level to activities and assignments (Level/how many)	Access level to learning material (level/how much)
		Study 1				Study 2			
1	Existence of any type of assessment	+	+						
2	Participation level in forum discussion is not assessed		+						
3	Students for an assessment they have to complete a piece of work and submit it			+					
4	Answering quizzes is not used as assessment activity	+		+					
5	Students are required to complete an assignment as a group			+					
6	The actor responsible to assess student’s work is NOT the instructor or tutor		+	-					
7	Students as peers are responsible to assess another student’s work		-	+					
8	System automatically assesses students’ work		+	-		-			
9	Number of peer reviews per assignment is increased		+	+				+	
10	Assessment activities allowed the student to understand the content easier (Assessment Impact)					+	+	+	+
11	Existence of self-assessment		+	-					
12	Students had to evaluate their own work but after evaluating the work of other classmates					+	+		
13	Feedback existence					+	+		+
14	Actor responsible to provide feedback is not the student or the other peers		+						
15	Feedback is written		+						
16	Feedback is not provided via audio or via video with audio	+	+		+				
17	Feedback is not just a grade (correct/incorrect, overall%)	+	+		+				
18	Feedback provides solution with comments (e.g. suggestions for improvements, common errors, etc)		+		+				

	Feedback practices that influence positively (+) or negatively (-) student engagement or its components	Student Engagement in general	Completion Rate of assignments	Access Rate to learning material	Attempt Rate of assessment activities	Student Engagement in general	Communication Level	Participation level to activities and assignments (Level/how many)	Access level to learning material (level/how much)
19	Feedback informs student about an incorrect response and allows him/her to re-answer one or more times	+	+						
20	Feedback suggests on how to improve further the submitted work				+				
21	Feedback is provided passively (one-way)		+						
22	Feedback focuses on praising ability or intelligence of the student	+	+						
23	Feedback focuses on clarifying the learning content		-	+					
24	Feedback does not focus on comparing the student's performance with other students		+						
25	Feedback is provided immediately after submissions of students' work or it is not delayed	+		+	+				
26	The frequency students give special attention to feedback on questions they were sure they were correct.			+					
27	The frequency students give special attention to the whole provided feedback	+			+	+		+	+
28	Length of the feedback provided is decreased	+			+				
29	There is interaction between the student and the teacher	+		+					
30	There is interaction between the student and content/automatically from the system	+	+	+	+	+		+	+
31	There is interaction between the students with the other students				+		+		

The above matrix (Table 70) is a very useful instrument for concluding concisely on those feedback practices or models that influence positively student engagement and its six components. Anyone interested in increasing a specific student engagement metric out of the six or the student engagement in general could apply those feedback practices related to that student engagement metric as shown in table 70.

9.2 Limitations in my study and future research

Lastly, we presented below what were the limitations of this PhD research that formed the basis for further research in the area of student engagement in MOOCs via feedback factors.

First, in regards to feedback factors that existed in MOOCs, we identified some based on the responses that we received from 40 MOOCs and 2660 surveyed participants. The analysis was enough for identifying the key feedback practices present in MOOCs but this analysis was not exhaustive. By the end of 2018, over 900 universities around the world had announced or launched 11400 MOOCs from the around 4000 in 2016, which means that any attempt to consider all the MOOCs offered, would require significant and exclusive research that was beyond the scope of this PhD endeavour. Other research could select a representative sample (since due to the growing number of MOOCs any attempt to examine all would not be feasible) of the current MOOCs with respect to different selection criteria such as type, approach, topic, geographical origin etc and conduct such research for getting a representative view of the feedback factors that exist in MOOCs.

Second, this PhD research considered only the behavioural engagement of the student in a MOOC due to feedback factors. This behavioural engagement was driven from the need of autonomy (the need of students to sense they are not dependent on other peoples' actions) that is one of the three components of Self-Determination theory (SDT). Further research could focus on the effect of feedback on the other two dimensions of student engagement according to SDT. Namely, *affective engagement* referring to the feelings that feedback create to students towards other colleagues, tutors, the course itself or the institution that runs the course and *cognitive engagement* referring to the emerging thoughts that such factors create to students.

Third, this PhD research analysis on the two studies, namely 1 and 2, was based on surveys from MOOCs that agreed to participate in the MOOCKnowledge project. This project was of great help in order to collect many responses from different MOOCs and accumulate a significant number of responses that contributed to the high quality of results. On the other hand, though, we didn’t have the option to select MOOCs that were representative based on a representative sample based on different selection criteria such as type, approach, topic, geographical origin etc and conduct such research. Hence, other research could consider a representative sample based on a set of different selection criteria as the ones above or alternatively focus on MOOCs of a specific type (e.g., courses on a specific learning topic).

Fourth, the fact that my PhD was part of MOOCKnowledge was extremely helpful since I had the chance to discuss some issues with other experts as well as being financed to present my ideas and findings in conferences around the globe (Banff, Barcelona, Ljubljana, Seville, Washington) and share views and concerns with other scholars. However, it brought some limitations, as for example, that I had to synchronise my research with the project workplan as well as to limit the length of the questionnaire for study 2**.**

Fifth, the empirical research was based on an extensive survey conducted in the context of MOOCKnowledge project that was using a large questionnaire without addressing exclusively relations between student engagement and feedback but dealing with other areas irrelevant to this PhD research such as demographics, time availability of the participants, their competencies, language of the course, etc., that were of high interest to other researchers and organisations but not per se to this PhD research. This extensive survey required the preparation and use of a large questionnaire which consequently discouraged many participants from participating and they left many questions blank or unanswered. Although the datasets were statistically sufficient, further research could use a questionnaire exclusively addressing the key areas of this PhD research, i.e., student engagement, feedback. This can result in a higher number of participants in the survey and less null/missing answers in the collected responses.

Finally, the findings were based by focusing the PhD research specifically on MOOCs. We can assume that similar findings may be applicable in other online courses with a significant number of participants but with limited human resources for delivering the course (i.e. no tutors/trainers, automated content and assessments, peer and self-assessments, etc). However, further research could examine whether the recommended feedback factors were applicable in any online learning environment.

Future Research

This research opened the way for other researchers active in MOOCs, in student engagement and/or in feedback to explore further some of the findings and identify whether and how they could be applied in MOOCs for increasing student engagement.

As we saw, further investigation was required for building more evidence on the finding that when feedback focused on praising ability or intelligence of the student then student engagement in general and the completion rate of the assignments were higher. This was necessary for two reasons: a) it contradicts key research in the area such as from Nicol & Macfarlane-Dick (2006) and Haimovitz & Dweck (2017), and b) the large number of students registered in a MOOC makes it almost impossible to provide feedback by praising ability and talent since this required personal acquittance which is not present in MOOCs.

Furthermore, the findings showed that when feedback was provided via audio then the completion and attempt rate of course assignment and activities as well as the student engagement in general are negatively influenced. We didn't find any other research to support this and in addition this finding contradicted many researchers (Cavanaugh & Song, 2014; Filius, 2019; Kirschner et al., 1991; Nicol, 2010; Sharma et al., 2016; Ventura et al., 2013; Ventura et al., 2014;) who had been arguing that feedback should be provided via audio and/or video. Therefore, further research could explore that further in the context of MOOCs specifically.

Finally, in addition to the future research suggestions above, we suggested in the discussion section three new feedback practices as examples for increasing student engagement and its components. These are new practices that we didn't find them yet supported in the literature or in any MOOC that we came across and they could be explored further in future research.

The first suggested practice was to have the feedback received to be evaluated or rated by the student that received it. In this way, we believe that a) the feedback the students will be receiving will be of higher quality than without any rating which is the norm now and b) it will force the students to read and make sure they understand the received feedback (i.e., feedback attention).

The second suggestion was applicable in cases where questions and assignments had pre-fixed and specific answers (e.g., in automated tests). In those cases, we suggested the student to answer the test, say the automated quiz and then before receiving any results from the system itself, the platform could ask the students to note down the answers they were sure they were correct and afterwards to provide them the answers and ask them to self-assess how right they were.

The third suggestion involved the use of forum discussions: a) as part of the assessment activities, as well as b) the place at the same time for peers providing clarifications on questions raised by other students on the course content and this activity could be somehow considered in the assessment of the students.

Nevertheless, these suggestions although they were based on the PhD findings, they were quite novel and currently they were not supported by any significant literature or applied in MOOCs and we suggested to be explored further in future research.

Hence, some research suggestions that emerged from this PhD research follow below that could be explored further because either they contradict other research or they haven't been investigated sufficiently (e.g. they were explored only in study 1 and not in study 2 due to limitations on the questionnaire length) or up to now they were not yet a common practice in MOOCs. There were

- Further examination of the student activity in forum discussions as part of an assessment and whether this affects student engagement
- Further investigation on whether student engagement is affected, when students mark the quality of the peer-assessment they receive
- Further exploration on whether student engagement is affected when the MOOC permits students to resubmit assignments for peer-reviewing under specific conditions or no(e.g. resubmissions for peer-reviewing can be allowed only after the assignment has been assessed first by the student themselves – self assessment)
- Further research on which type of assessment activities to be applied in MOOCs so that to ease the student to understand the course content (Assessment Impact) and whether this affects student engagement
- Further investigation on which practices can make students to read and understand (Feedback attention) the provided feedback in MOOCs and whether this affects student engagement
- Further examination on how feedback practices in MOOCs can focus on clarifying the learning content or on comparing the student's performance with other students and whether this affects student engagement.
- Further exploration on whether the actor responsible to provide feedback (peers, system, tutor, student themself) affects student engagement
- Further research on whether feedback mode (Written, audio, video) affects student engagement
- Further investigation on when feedback is provided passively/via a monologue or via a dialogue/Interaction in MOOCs, it affects student engagement

- Further examination on whether student engagement is influenced when feedback is provided immediately or not delayed.

Future research activities could consider also the other two dimension of student engagement based on Self-Determination Theory, namely behavioural engagement, affective engagement and cognitive engagement and not just behavioural one.

Final comments

One of the most exciting and long journeys in my life has been completed with this PhD thesis. The trip took me more than seven years, but I was fortunate enough to have a great compass, that is my two PhD supervisors Dr. Teresa Guasch and Dr. Anna Espasa that every time I was getting lost, they were always putting me back on track and, most importantly, motivated me to continue. The feelings now that I have at the end of this journey are mixed.

On one hand, I am quite fulfilled and excited since I have managed to persevere with my PhD research, even when it was often quite difficult, and been able to contribute to the body of knowledge in this field. This knowledge that I created is very useful for me as an educator but most importantly I consider it very significant for the online (and also offline) international educational and research community. Specifically, due to the COVID-19 pandemic, it is now more essential than ever to engage with online courses supported with effective feedback practices. I believe I have set one of the cornerstones for doing so. My PhD research specified how student engagement can be foreseen in online education and more specifically in Massive Open Online Courses (MOOCs), and also identified feedback factors that MOOCs should consider in order to enhance their student engagement. This is an achievement of which I am personally very proud.

On the other hand, I still feel thirsty and hungry for new discoveries and I am looking forward to my next journey in this inspiring world of education and research.

I would like to conclude with one very relevant quote from the American biochemist John Jacob Abel (1857-1938) that will guide me in this new adventure: “Greater even than the greatest discovery is to keep open the way to future discovery”.

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ANNEX A: First version of Questionnaire (Study 1)

Introductory text on the welcome page

The MOOCKnowledge project is an initiative funded by the Institute for Prospective Technology Studies (Joint Research Centre of the European Commission) and executed by the Open University of the Netherlands in cooperation with the Open University of Catalunya (UOC) and the Technical University in Madrid. The goal of the MOOCKnowledge project is to assess the current perspective of students as participants of European MOOCs. We define MOOCs in a wide sense as open online courses that do not require payment for participation. The goal of the project is to collect a large-scale data basis about participants of (European) MOOCs with respect to their demographic background, lifelong-learning profile, ICT competences and motivation. These data will inform policy-making by the European Commission and can also inform MOOC providers to build open online education.

With this survey we would like to collect data about your experiences. It is very relevant to also collect experiences of participants who do not start. Therefore we would also like to invite specifically participants who have enrolled into the course but did not start.

With the click to the start page of the survey you declare that you had sufficient time to think about your participation and that your participation is voluntary. All data from this survey is collected anonymously and will be treated confidentially. In case of question, you can contact the research team anytime under moocknowledge@ou.nl.

The MOOCKnowledge research team

Chapter 1: Person related information

Block 1: Demographics

Code	Question type	Text	○ Answers	Comments
C1B1_1	single response (radio buttons)	What is your gender?	○ male ○ female	
C1B1_2	single response (numerical or drop-down)	What is your birth year?	○ 2000 ○ 1999 ○ … ○ 1936 ○ 1935	

Block 2: Nationality, country of residence and language proficiency

Code	Question type	Text	Answers	Comments
C1B2_1	multiple response (drop down)	What is your primary nationality?	Non-exhaustive list of nationalities Other, please specify	
C1B2_2	single response (drop down)	What is your country of residence?	Non-exhaustive list of countries Other, please specify	
C1B2_3	multiple responses (drop down)	Which foreign languages do you speak	Non-exhaustive list of languages Other, please specify	=> repeat for each language selected go to C1B2_5 until done; go to C1B3_1
C1B2_4	single response (drop down)	What is the proficiency level of your	○ beginner ○ elementary ○ intermediate	

	or alternatively 7-point likert	foreign language speaking	○ upper intermediate ○ advanced ○ mastery ○ mother tongue	

Block 3: Household composition

Code	Question type	Text	○ Answers	Comments
C1B3_1	single response (radio buttons)	What is the composition of your household?	○ living together with partner ○ living with roommates ○ living alone ○ living with my parents other, please specify	
C1B3_2	numeric field	What is the number of children in your household	$0 \leq$ answer $\leq$ N	

Block 4: socioeconomic status (education, occupation, income)

Code	Question type	Text	Answers	Comments
C1B4_1	single response (radio buttons)	What is the highest degree or level of school you have completed?	7 levels from ISCED 1998 in national format other, please specify	We use here the UNESCO International Standard Classification for Education from 1997 (see here for all countries)
C1B4_2	single response	Are you currently…?	○ employed for wages ○ self-employed	=> if employed or self-employed set

	(radio buttons)		○ out of work and looking for work ○ out of work but not currently looking for wages ○ a homemaker ○ a student ○ military ○ retired ○ unable to work ○ other, please specify	FLAG to EMPLOYED =>if out of work set FLAG to OUTOFWORK => if student set FLAG to STUDENT => if military set FLAG to MILITARY
C1B4_3	single response (drop down)	In which sector do you work?	○ A – Agriculture, forestry and fishing ○ B – Mining and quarrying ○ C – Manufacturing ○ D – Electricity, gas, steam and air conditioning supply ○ E – Water supply; sewerage, waste management and remediation activities ○ F – Construction ○ G – Wholesale and retail trade; repair of motor vehicles and motorcycles	Only if FLAG=EMPLOYED We use the list from the United Nations International Standard Industrial Classification of All Economic Activities (see here for full overview)

			○ H – Transportation and storage ○ I – Accommodation and food service activities ○ J – Information and communication ○ K – Financial and insurance activities ○ L – Real estate activities ○ M – Professional, scientific and technical activities ○ N – Administrative and support service activities ○ O – Public administration and defence; compulsory social security ○ P – Education ○ Q – Human health and social work activities ○ R – Arts, entertainment and recreation ○ S – Other service activities	

			○ T – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use ○ U – Activities of extraterritorial organizations and bodies	
C1B4_4	single response (drop down)	Please provide an estimate of your annual gross salary.	○ Under € 3000 ○ € 3.000≤ - ≤€ 6.000 ○ € 6.000≤- ≤€ 9.000 ○ … ○ € 78.000 - € 81.000 ○ more than € 81.000	Only if FLAG=EMPLOYED
C1B4_5	Single choice	What is your current job position level?	○ Fresh/Entry level ○ Non-Executive ○ Junior-Executive ○ Senior-Executive ○ Manager ○ Senior Manager ○ Other: Please specify	Only if FLAG=EMPLOYED

Chapter 2: Learning Experience

(12 items)

Code	Question type	Text	Answers	Comments
	text	In this particular block we ask you about your previous experience with MOOCs. With taking a MOOC we mean that you enrol in a MOOC so to get access to all the course materials and teachers if any. Completing a MOOC means that you have achieved your personal objectives. Personal objectives are, for example, finishing the complete MOOC or only those parts that you find relevant or need. Also, doing all the assignments, quizzes, and assessments may or may not be part of your personal objectives. However, you may not always succeed to achieve your personal objectives for a number of reasons. In the next items we try to uncover those reasons.		

Code	**Question type**	**Text**	○ **Answers**	**Comments**
C2B1_1	single response (radio buttons)	I have started the MOOC I was enrolled for	○ no ○ yes	=> If no skip to C7B2_1

C2B1_2	Single choice	Did you have enough time to participate in the MOOC?	○ Yes ○ Yes, but I decided to invest less time No, I had not, due to random unexpected situations: (for example unexpected family obligations, unexpected work obligations (e.g. sudden absence of a college), illness etc)	
C2B1_3	Open question	How much time (including online and offline activities) did you devote to MOOC related activities?		Open field with hours

C2B1_4	Likert-scale (7-point)	I achieved my personal learning goals by participating in this MOOC.	○ not at all ○ very little ○ little ○ somewhat ○ to some extent ○ to a great extent ○ completely	
C2B1_5	Likert-scale (7-point)	Did the open online course meet your expectations?		
C2B1_6	Likert-scale (7-point)	Were the course learning objectives clear to you?		
C2B1_7	Radiobox	When were the course learning objectives clear to you?	○ Before the start of the course ○ At the beginning of the course ○ During the Course ○ At the end of the course ○ Never	
C2B1_8	radio buttons	Were the course learning objectives aligned with your personal learning objectives?	○ not at all ○ very little ○ little ○ somewhat ○ to some extent ○ to a great extent ○ completely	
	Text	**In this MOOC I have…**		
C2B2_1		○ **watched all the lecture videos**	○ **never true** ○ **rarely true**	

C2B2_2	Likert-scale (7-point)	○ completed all quizzes	○ sometimes true ○ fairly often true ○ often true ○ very often true ○ always true	[Student engagement activity]
C2B2_3		○ handed in the assignments		
C2B2_4		○ done the final assessment		
C2B2_5		○ accessed only a specific part of the MOOC		
C2B2_6		○ participated in specific activities		
C1B2_7		○ watched selected lectures		
C2B2_8		○ other, please specify		

	Text	**How much have the following interactions been facilitated within the MOOC?**		
C2B2_9	**Likert -scale (7-point)**	○ **Student – student interactions**	○ **not at all** ○ **very little** ○ **little** ○ **somewhat** ○ **to some extent** ○ **to a great extent** ○ **completely**	**[Interaction type]**
C2B2_10		○ **Student – teacher interaction**		
C2B2_11		○ **Student – content interaction**		

C2B3_1	Likert-scale (7-point)	How satisfied have you been with this MOOC?	○ very unsatisfied ○ fairly unsatisfied ○ unsatisfied ○ fairly satisfied ○ satisfied ○ very satisfied ○ extremely satisfied	

	Text	To what extent were the following aspects important for your level of satisfaction with this MOOC:		
C2B3_2	Likert -scale	○ achievement of learning goals	○ extremely unimportant	

C2B3_3	(7-point)	○ work load	○ very unimportant ○ moderately unimportant ○ neutral ○ moderately important ○ very important ○ extremely important	
C2B3_4		○ content of the MOOC		
C2B3_5		○ learning environment (platform)		
C2B3_6		○ design of MOOC (structure of course)		
C2B3_7		○ interactions with other students within the MOOC		
C2B3_8		○ language style used in course material		
C2B3_9		○ accessibility of MOOC		
C2B3_10		○ theoretical deepening		
C2B3_11		○ usefulness for practice		
C2B3_12		○ flexibility of the MOOC		
C2B3_13		○ the lecturer/teacher/facilitator		
C2B3_14		○ duration of the MOOC		
C2B3_15		○ interface		
C2B3_16		○ certification options		

	Text	How do you judge the quality of the following components of the open online course?		
C2B3_17	Likert-scale (5-point)	○ Video lectures	○ terrible ○ very poor ○ poor ○ acceptable ○ good ○ very good ○ excellent	
C2B3_18		○ Academic material		
C2B3_19		○ Textbooks/Study books		
C2B3_20		○ Reference lists to external resources		
C2B3_21		○ Assignments		
C2B3_22		○ Tests		
C2B3_23		○ Social media activities		
C2B3_24		○ Other (Please specify)		
	Text	**How intensively have you used the following components of this MOOC and the learning environment?**		
C2B3_4		○ **Video lectures**	○ **never**	

C2B3_5	**Likert -scale (5-point)**	○ **Academic material**	○ **rarely** ○ **sometimes** ○ **regularly** ○ **often** ○ **very often** ○ **intensively**	**[Student engagement activity]**
C2B3_6		○ **Textbooks/Study books**		
C2B3_7		○ **Reference lists to external resources**		
C2B3_8		○ **Assignments**		
C2B3_9		○ **Tests**		
C2B3_10		○ **Social media activities**		
C2B3_11		○ **Other (Please specify)**		
	Text	How important were these components (list) to reach your learning goal?		
C2B3_12	Likert-scale (7-point)	○ Video lectures	○ absolutely not important ○ fairly important ○ somewhat important ○ important ○ quite important ○ very important ○ extremely important	
C2B3_13		○ Academic material		
C2B3_14		○ Textbooks/Study books		
C2B3_15		○ Reference lists to external resources		
C2B3_16		○ Assignments		
C2B3_17		○ Tests		
C2B3_18		○ Social media activities		

C2B3_19		○ Other (Please specify)		

	Text	Please rate the following statements regarding the usability of the MOOC virtual learning environment		
C2B4_1	Likert-scale (7-point!!!)	It is easy to learn to use this MOOC virtual learning environment	○ strongly disagree ○ disagree ○ somewhat disagree ○ undecided ○ somewhat agree ○ agree ○ strongly agree	
C2B4_2		It is easy to use this MOOC virtual learning environment		
C2B4_3		Navigating through this MOOC virtual learning environment is easy		
C2B4_4		I lose my orientation in this MOOC virtual learning environment		
C2B4_5		I know where to go in this MOOC virtual learning environment		
C2B4_6		Should I use this MOOC virtual learning		

		environment the next time, I still would know how to use it		
C2B4_7		This MOOC virtual learning environment crashes when I use it		
C2B4_8		This MOOC virtual learning environment clearly shows technical, content-related, and grammatical mistakes		
C2B4_9		On the whole I am satisfied with this MOOC virtual environment		
C2B4_10		The use of this MOOC virtual environment is frustrating		
C2B4_11		I Like this MOOC virtual environment		
C2B4_12		The information (such as online help, the screen messages and other documentation) that is included		

		with this MOOC virtual environment is clear		
C2B4_13		I feel to have control of this MOOC virtual environment		
C2B4_14		When I use this MOOC virtual environment, time seems to go faster		
C2B4_15		This MOOC virtual environment offer all the functionalities I need		
C2B4_16		This MOOC virtual environment saves me time		
C2B4_17		The design of the screens of this MOOC virtual environment is attractive		
C2B4_18		I find it strenuous when I use this MOOC virtual environment		

C2B5_1	single response	Have you obtained with this MOOC any of the following certification options?	○ Nothing obtained ○ Completion certificate ○ Badges ○ Authenticated certificate via onsite exam ○ Authenticated certificate via proctoring ○ ECTS credits ○ Part of a postgraduate professional qualification ○ Other	If 'nothing obtained' skip the next question.
C2B5_2	Multiple response	What do you plan to do with the certification received?	○ Accreditation of prior learning ○ Look for a job or change of job ○ Include it in my CV ○ Show lifelong learning in my current job	○

Chapter 3: Assessment

Code	Question type	Text	Answers	Comments
		Now we will focus on the assessment process of this MOOC		
C3B1_1	Single response	Did this MOOC include any type of assessment?	○ no ○ yes	If no, skip to C4B1_1 [Assessment existence]
C3B1_2	Multiple response	Which assessment activities were applied?	○ Participation level in forum discussion ○ Completing a piece of work and submitting it ○ Answering quiz ○ Completing an assignment as a group ○ Other -> please specify	[Type of assessment activities]
C3B1_3	Likert-scale (7-point)	The assessment activities applied in the course helped me to understand the course content	○ absolutely not ○ a little ○ sometimes ○ regularly ○ often ○ very often ○ always	[Assessment impact]

C3B1_4	Likert-scale (7-point)	The number of assessment activities was sufficient for acquiring the expected knowledge	○ strongly disagree ○ disagree ○ somewhat disagree ○ undecided ○ somewhat agree ○ agree ○ strongly agree	[Impact of no. of Assessment activities]
	Text	The assessment activities allowed me …		
C3B1_5	Likert-scale (7-point)	○ To identify what I know and can do	○ absolutely not ○ a little ○ sometimes ○ regularly ○ often ○ very often ○ always	[Impact assessment 1]
C3B1_6		○ To identify my weaknesses		[Impact assessment 2]
C3B1_7		○ To stimulate me to revisit earlier study and motivate me to engage in depth with the course topic		[Impact assessment 3] [Impact assessment 4]
C3B1_8		○ To understand the course content easier		
C3B2_1	Multiple response	Who was/is responsible to assess students' work?	○ The student herself (her own work) ○ the instructor/tutor	=> if student herself or peers / else => skip to C4B1_1

			○ the peers/other students ○ the system automatically	[person responsible to assess students' work]
C3B2_2	Single response	How many submissions from your classmates did you have to evaluate for each course assignment on average?	○ None (only my own work) ○ 1 ○ 2 ○ 3 ○ 4-5 ○ more than 5	[no. of submissions to be evaluated]
C3B2_3	Single response	Did you have to assess your own work during the course?	○ no ○ yes	=>if No skip to C3B2_5 [self-assessment existence]
C3B2_4	Single response	How did you have to evaluate your own work?	○ We had to evaluate our own work, but after evaluating the work of other classmates ○ We had to evaluate our own work but without the condition to evaluate first the work of	[Self-assessment method]

			other classmates ○ We had to evaluate our own work but with other condition [Please specify] ○ Other, please specify	
C3B2_5	Single response	Have you been provided any guidance on how to evaluate the work and assignments submitted either by you or by any of your classmates (peers)?	○ A guide or matrix with model answers and clarifications on the assessment criteria and the related points/credits ○ Group discussion about the assessment methods ○ A training session that you evaluated a few practice assignments that have	[Evaluation guidance]

			already been graded by course staff ○ Other (Please specify)	
C3B2_6	Likert-scale (7-point)	Guidance received to assess my own work or the work of my classmates helped me to acquire the expected knowledge from the online course.	○ never true ○ rarely true ○ sometimes true ○ fairly often true ○ often true ○ very often true ○ always true	[impact from guidance on assessment]

Chapter 4: Feedback

(11 items)

Code	Question type	Text	Answers	Comments
		Now we will focus on the feedback you have given or received during the MOOC. Feedback is defined here as a type of support to carry out an assignment or a task. The support can be about the content of the task, planning or monitoring the process of developing the assignment and it can be given while you are developing the activity or at the end.		
C4B1_1	Single response	Does this open online-course include any type of feedback?	○ no ○ yes	If no, skip to C6B1_1 [existence of feedback]
C4B1_2	Multiple choice	Who was/is responsible to provide you feedback	○ The student herself (feedback to her own work) ○ The instructor/trainer/tutor	[MOOC actor responsible for feedback]

			○ The peers/other students ○ The system automatically	
C4B1_3	Multiple response	How was the feedback given?	○ Written ○ Audio ○ Video ○ Chat or Skype ○ Other	Textfield after other [Feedback Mode]
C4B1_4	Multiple response	What was the content of the feedback?	○ General comments ○ Just a grade (correct/incorrect, overall percentage correct) ○ Solutions of the task/exercise but with no comments ○ Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.) ○ it informs you about an incorrect response and allows you one or more attempts to answer it ○ Suggestions on how to improve further the submitted work ○ Other	Textfield after other [Feedback content]

C4B1_5	Multiple response	How was the feedback provided to you?	○ Through dialogue (tried to stimulate response and continuing dialogue) ○ Through passive information transmission ○ Other	[Feedback provision]
C4B1_6	Multiple response	What was the focus of the feedback provided?	○ praising effort and focusing students on learning goals ○ praising ability or intelligence ○ Clarifying the learning content ○ Comparing between your performance with other students ○ Comparing performance with other measures of the individual's ability ○ Other (Specify)	[Feedback focus]
C4B2_1	Multiple response	When was feedback of your work provided?	○ Immediately after submission of my work ○ Delayed ○ Mixed	[Feedback timing]
C4B2_2	Single response	What was the frequency of the feedback provided?	○ More frequent than needed ○ As frequent as needed	[Feedback frequency]

			○ Less frequent than needed ○	
C4B2_3	Single response	Please indicate the length of feedback provided in general	○ Feedback was too long ○ Feedback was sufficient ○ Feedback was too short	[Feedback length]
	Text	Please indicate the attention you spent on the feedback provided		
C4B2_4	Likert-scale (5-point)	○ I gave special attention to all the feedback provided	○ never true ○ rarely true ○ sometimes true ○ fairly often true ○ often true ○ very often true ○ always true	[Attention on feedback 1]
C4B2_5		○ I gave special attention mainly to feedback on questions I was sure they were not correct		[Attention on feedback 2]
C4B2_6		○ I gave special attention to feedback on questions I was sure they were correct		[Attention on feedback 3]
C4B2_7		○ I didn't give special attention to any feedback provided		[Attention on feedback 4]
C4B2_8		○ Non applicable, the feedback provided		[Attention on feedback 5]

		was general and not per question		
C4B2_9	Likert-scale (5-point)	The feedback provided impacted positively my learning objectives and motivation	○ absolutely not ○ a little ○ sometimes ○ regularly ○ often ○ very often ○ always	[Feedback impact 1]
	Text	At which level the indicated feedback practices can help you to acquire the expected knowledge in this MOOC?		
C4B2_10	Likert-scale (7-point)	○ to receive corrections to know where I'm having difficulties	○ never true ○ rarely true ○ sometimes true ○ fairly often true ○ often true ○ very often true ○ always true	[Feedback impact 2] [Feedback impact 3]
C4B2_11		○ To receive concise feedback so that is actually read and used		[Feedback impact 4] [Feedback impact 5]
C4B2_12		○ To receive marks on my submitted work and assignments		[Feedback impact 6] [Feedback impact 7]
C4B2_13		○ to be able to resubmit my work and assignments based on the feedback you have received		

C4B2_14		○ automated testing with feedback that can be attempted as many times as I wish		
C4B2_15		○ To receive suggestions for improvement, priorities to focus etc		

Chapter 5: Language Learning in MOOCs (optional)

(2 items)

Code	Question type	Text	Answers	Comments
C5B1_1	Dropdown	In the past, in how many languages MOOC courses have you enrolled?	○ 1 - 20	
	Text	How do you rate your improvement in the different descriptors of communicative skills at the end of your language MOOC course?	○	
C5B1_2	Likert-scale (7-point)	○ Listening (Understanding spoken language, Listening to audio media, etc)	○ no improvement at all ○ very small improvement ○ small improvement ○ moderate improvement ○ improvement ○ much improvement ○ very much improvement	
C5B1_3		○ Reading (Overall reading comprehension, Reading reports and articles, Reading strategies, etc)		
C5B1_4		○ Spoken Interaction (Spoken interaction strategies)		
C5B1_5		○ Spoken Production (Overall spoken		

		production, Addressing audiences, etc)		
C5B1_6		○ Writing (Overall written production)		
C5B1_7		○ Working with texts (Note-asking, Processing texts, Translation L2 to L1, Translation L1 to L2)		
C5B1_8		○ Communicative Language Competence (Vocabulary control, Sociolinguistic competence, etc)		

Chapter 6: Post-survey recruitment

(1 item)

Code	**Question type**	**Text**	**Answers**	**Comments**
C6B1_1	Single choice	I allow the research group to contact me in the future for a follow-up questionnaire.	○ no ○ yes	Textbox for EMail

Chapter 7: Barriers

Code	**Question type**	**Text**	**Answers**	**Comments**

	numeric field	How many of them did you not complete in the past? (No exact number has to be given)	0 ≤ answer ≤ N	
	text	I did not complete this MOOC, because …		After filling in this, send to exit page.
C7B2_1	single response (7-point Likert scale)	the MOOC did not meet my expectations regarding its contents	○ never true ○ rarely true ○ sometimes true ○ fairly often true ○ often true ○ very often true ○ always true	
C7B2_2		the MOOC was after all not so interesting		
C7B2_3		the MOOC was after all not so fun		
C7B2_4		the MOOC failed to show its relevance or value		
C7B2_5		the MOOC had no signifiers of completion such as badges or credentials		
C7B2_6		the quality of the MOOC was bad		
C7B2_7		the MOOC was too complex for me to follow		
C7B2_8		the MOOC caused an information overload		
C7B2_9		I got no feedback of the course facilitators		
C7B2_10		the MOOC lacked interactivity		

C7B2_11		my computer was too slow		
C7B2_12		I had technical problems with my computer		
C7B2_13		I had no access to a computer		
C7B2_14		my internet connection was too slow		
C7B2_15		the site of the MOOC was too often inaccessible		
C6B2_16		following the MOOC constrained too much my free time with my family and friends		
C6B2_17		following the MOOC isolated me too much from my social environment		
C6B2_18		following the MOOC caused a lot of stress for me		
C6B2_19		following the MOOC gave me a hard time		
C6B2_20		I did have less time than expected to put into the MOOC		
C6B2_21		I could not find appropriate solutions		

		for the problems that suddenly raised		
C6B2_22		I was too much distracted with other things to pay sufficient attention to the MOOC		
C6B2_23		continuously, other things came in of higher priority that needed my attention		
C6B2_24		I lacked the pre-knowledge and skills required for completing the MOOC		
C6B2_25		I failed to plan the times at which I would work on the MOOC		
C6B2_26	textfield	other		

ANNEX B: Part of Questionnaire related to the research (used for study 1)

Study 1 – Relevant questionnaire parts

Feedback factor number	Relevant questionnaire parts	Linked variable
1	Students' activities in the MOOC (i.e., watching all lecture videos, completing all quizzes, handing in the assignments, doing the final assessment, accessing only a MOOC section, participating in specific activities and watching selected lectures).	Student Engagement (dependent variable)
2	Students' interaction levels between students, teacher and student, and student and system content.	Student Engagement (dependent variable)
3	Intensity of students' activities (i.e., intensity/frequency of using various MOOC components such as video lectures, academic material, text/study books, reference lists to external resources, assignments, tests, social media activities).	Student Engagement (dependent variable)
4	Existence of assessment activities	Existence of Assessment (independent variable)
5	The type of assessment activities such as their participation level in forum discussions, the completion of an assignment individually, or as a group, answering a quiz.	Type of Assessments (independent variable)
6	The impact of assessment activities in understanding the course content (Namely, the assessment activities applied in the course helped the student to understand the course content).	Impact of Assessments (independent variable)
7	The number of assessment activities for acquiring the expected knowledge (Namely, the number of assessment activities was sufficient for acquiring the expected knowledge). [only in study 1 and not in 2]	Impact of number of assessments (independent variable)
8	The level that assessment activities allowed them to identify what they know and can do, their weaknesses, to stimulate them to revisit earlier study and motivate them to engage in depth with the course topic, to understand the course content easier.	Impact of Assessments (independent variable)

9	The person (the student herself (her own work), the teacher, the peers/other students or system responsible to assess their work.	Actor for assessments (independent variable)
10	The number of submissions from their peers that they had to evaluate on average (i.e., How many submissions from their classmates did they have to evaluate for each course assignment, on average.)	Number of submissions to be evaluated (independent variable)
11	Whether they had to assess their own work during the course (self-evaluation).	Existence of self-assessment (independent variable)
12	The way they had to evaluate their own work (i.e., We had to evaluate our own work, but after evaluating the work of other classmates, We had to evaluate our own work but without the condition to evaluate first the work of other classmates, We had to evaluate our own work but with other condition).	Self-Assessment method (independent variable)
13	The kind of guidance they had for self-evaluating or peer-reviewing (i.e. A guide or matrix with model answers and clarifications on the assessment criteria and the related points/credits, group discussion about the assessment methods, a training session that you evaluated a few practice assignments that have already been graded by course staff, the quality of the guidance received for self-evaluating or peer-reviewing in order the participant to acquire the expected knowledge from the MOOC). [only in study 1 and not in 2]	Assessment Guidance (independent variable)
14	Guidance received to assess their own work, or the work of their classmates helped in acquiring the expected knowledge from the online course. [only in study 1 and not in 2]	Assessment Guidance Impact (independent variable)
15	Existence of feedback in the MOOC.	Existence of Feedback (independent variable)
16	The person/system responsible for providing feedback (i.e., The student themself (feedback to their own work), the instructor/trainer/teacher, the peers/other students, the system automatically). [only in study 1 and not in 2]	Actor responsible for feedback (independent variable)
17	The modality (written, audio, video, chat/skype, other) of the feedback provided. [only in study 1 and not in 2]	Feedback Mode (independent variable)
18	The feedback content (i.e., General comments, just a grade (correct/incorrect, overall percentage correct, solutions of the task/exercise but with no comments, solutions of the task/exercise with comments (e.g., suggestions for improvements, common errors etc.), it informs you about an incorrect response and allows you one or more attempts	Feedback Content (independent variable)

	to answer it, suggestions on how to improve further the submitted work, other)	
19	The way the feedback (Feedback provision) was communicated (i.e., Through dialogue (tried to stimulate response and continuing dialogue), through passive information transmission, other. [only in study 1 and not in 2]	Feedback provision (independent variable)
20	The feedback focus (i.e., praising effort and focusing students on learning goals. [only in study 1 and not in 2]	Feedback focus (independent variable)
21	Praising ability or intelligence, Clarifying the learning content, comparing between your performance with other students, comparing performance with other measures of the individual's ability, other (Specify). [only in study 1 and not in 2]	Feedback focus (independent variable)
22	When the feedback was provided (i.e., Immediately after submission of the work, delayed, mixed.	Feedback timing (independent variable)
23	The frequency of the feedback (i.e., More frequent than needed, as frequent as needed, less frequent than needed). [only in study 1 and not in 2]	Feedback frequency (independent variable)
24	The length of the provided feedback (i.e., Feedback was too long, feedback was sufficient, feedback was too short).	Feedback length (independent variable)
25	Attention was given to the feedback provided by the participant (i.e., How many times: ● I gave special attention to all the feedback provided, ● I gave special attention mainly to feedback on questions I was sure they were not correct, ● I gave special attention to feedback on questions I was sure they were correct, ● I didn't give special attention to any feedback provided, ● Non applicable. (The feedback provided was general and not per question).	Feedback attention (independent variable)
26	The impact of feedback to the participants’ learning objectives and motivation (i.e., How often the feedback provided impacted positively my learning objectives and motivation). [only in study 1 and not in 3]	Feedback impact (independent variable)
27	[only in study 1 and not in 3] Relation between the type of feedback provided and its contribution to acquire the expected knowledge in the MOOC (i.e., How often ● I received corrections to know where I'm having difficulties,	Feedback impact (independent variable)

- I received concise feedback so that I actually read and used,
- I received marks on my submitted work and assignments,
- Was able to resubmit my work and assignments based on the feedback I have received,
- I had automated testing with feedback that can be attempted as many times as I wished,
- I received suggestions for improvement, priorities to focus etc)

Annex B: Part of Questionnaire related to the research (used for study 1)

ANNEX C: Second version of Questionnaire (used for study 2)

Chapter 1- Linking your pre-course and post-course responses

Module 1

Code	type	text	answers	comments
pQt1	textbox	**Why these questions?**	The MOOCKnowledge data collection phase is divided in two parts, pre-course and post-course questionnaire. In order to generate a temporal code that allows matching the responses between these two moments, we need to ask you about the initials of your name and last name. We are fully committed with your privacy and therefore once matched we will systematically eliminate this information.	
pQ1*	text	What are the first two letters of your first name?		
pQ2*	text	What are the first two letters of your surname??		

Chapter 2- Sociodemographics

code	type	text	answers
pQt2	textbox		In this chapter we would like to know about the characteristics of MOOC students. Please, respond to the following questions

Module 2a: Demographics

Code	type	text	answers	comments
pQ3*	single - radio	What is your gender?	○ 1:Male ○ 2:Female	
pQ4*	single - dropdown	What is your birth year?	[2000-1935]	

Module 2b1: Demographics

Code	type	text	answers	comments
pQ5*	single-dropdown	What is your nationality?	• 1:Albanian • 2:Algerian • 3:American • 4:Andorran • 5:Angolan • 6:Argentinean • 7:Armenian • 8:Australian • 9:Austrian • 10:Azerbaijani • 89:Bangladeshian • 11:Belarusian • 12:Belgian • 13:Bosnian • 14:Brazilian • 15:British • 16:Bulgarian • 17:Canadian • 18:Cape Verdean • 19:Chilean • 20:Chinese • 21:Colombian • 22:Croatian • 23:Cuban • 24:Cypriot • 25:Czech • 26:Danish • 27:Dutch • 28:Egyptian • 29:Estonian • 30:Ethiopian • 31:Finnish • 32:French • 33:Georgian	

			• 34:German • 35:Greek • 37:Hungarian • 38:Icelander • 39:Indian • 40:Indonesian • 41:Iranian • 42:Iraqi • 43:Irish • 44:Israeli • 45:Italian • 46:Japanese • 47:Kenyan • 48:Latvian • 49:Lebanese • 50:Libyan • 51:Liechtensteiner • 52:Lithuanian • 53:Luxembourger • 54:Macedonian • 55:Maltese • 56:Mexican • 57:Moldovan • 58:Monacan • 59:Moroccan • 60:New Zealander • 62:Norwegian • 63:Pakistani • 64:Polish • 65:Portuguese • 66:Romanian • 67:Russian • 68:San Marinese • 70:Senegalese • 71:Serbian • 72:Slovakian • 73:Slovenian • 74:Somali • 75:South African • 76:South Korean • 77:Spanish • 78:Surinamer • 79:Swedish • 80:Swiss • 81:Thai • 82:Tunisian • 83:Turkish • 84:Ukranian	

			• 85:Vietnamese • 87:Syria • 88:Other,please specify	
pQ6	text	Specify your nationality		{pQ5}=='88'
pQ7	single-dropdown	What is your country of residence?	• 1:Albania • 2:Algeria • 3:United States • 4:Andorra • 5:Angola • 6:Argentina • 7:Armenia • 8:Australia • 9:Austria • 10:Azerbaijan • 11:Belarus • 12:Belgium • 13:Bosnia and Herzegovina • 14:Brazil • 15:UK • 16:Bulgaria • 17:Canada • 18:Cape Verde • 19:Chile • 20:China • 21:Colombia • 22:Croatia • 23:Cuba • 24:Cyprus • 25:Czech Republic • 26:Denmark • 27:The Netherlands • 28:Egypt • 29:Estonia • 30:Ethiopia • 31:Finland • 32:France • 33:Georgia • 34:Germany • 35:Greece • 37:Hungary • 38:Iceland • 39:India • 40:Indonesia • 41:Iran • 42:Iraq	

			• 43:Ireland • 44:Israel • 45:Italy • 46:Japan • 47:Kenya • 48:Latvia • 49:Lebanon • 50:Libya • 51:Liechtenstein • 52:Lithuania • 53:Luxembourg • 54:Republic of Macedonian • 55:Malta • 56:Mexico • 57:Moldova • 58:Monaco • 59:Morocco • 60:New Zealand • 62:Norway • 63:Pakistan • 64:Poland • 65:Portugal • 66:Romania • 67:Russia • 68:San Marino • 70:Senegal • 71:Serbia • 72:Slovakia • 73:Slovenia • 74:Somalia • 75:South Africa • 76:South Korea • 77:Spain • 78:Surinam • 79:Sweden • 80:Switzerland • 81:Thailand • 82:Tunisia • 83:Turkey • 84:Ukraine • 85:Vietnam • 87:Syria • 88:Other,please specify	
pQ8	text	Specify your country of residence		{pQ7}=='88'

Module 2b2: Demographics

code	type	text	answers	Comments
pQ9	single-dropdown	What is your native language?	• 1:Albanian • 2:Arabic • 3:Basque • 4:Belarusian • 5:Bosnian • 6:Bulgarian • 7:Catalan • 8:Chinese • 9:Croatian • 10:Czech • 11:Danish • 12:Duthc • 13:English • 14:Estonian • 15:Finnish • 16:French • 17:Galician • 18:Georgian • 19:German • 20:Greek • 21:Hebrew • 22:Hungarian • 23:Icelandic • 24:Irish • 25:Italian • 26:Japanese • 27:Korean • 28:Latvian • 29:Lithuanian • 30:Luxembourgish • 31:Macedonian • 32:Norwegian • 33:Polish • 34:Portuguese • 35:Romanian • 36:Russian • 37:Serbian • 38:Slovakian • 39:Slovene • 40:Spanish • 41:Swedish • 42:Turkish • 43:Ukranian • 44:Other,please specify	

pQ10	text	Specify your native language		{pQ9}=='44'
pQ11	single-radio	What is your proficiency level in the language of this MOOC?	[1:Beginner|2:Elementary|3:Intermediate|4:Upper intermediate|5:Advanced|6:Mastery|7:Native language]	

Module 3a: Socioeconomic Status

Code	type	text	answers	comments
pQ12*	single-radio	What is the highest degree or level of school you have completed?	○ 0:Early childhood education/Pre-primary education ○ 1:Primary education ○ 2:Lower secondary education ○ 3:Upper secondary education ○ 4:Post-secondary non-tertiary education ○ 5:Short-cycle tertiary education ○ 6:Bachelor or equivalent ○ 7:Master or equivalent ○ 8:Doctoral or equivalent	
pQ13*	single-radio	Are you currently…?	○ 1:employed ○ 2:self-employed ○ 3:unemployed and looking for a job ○ 4:unemployed but not currently looking for a job ○ 5:a student (not in the labour force) ○ 6:in retirement or early retirement ○ 7:permanently disabled ○ 8:a home maker (fulfilling domestic tasks) ○ 9:other, please specify	

pQ14	text	Specify your current situation.		{pQ13}=='9'
pQ15	single-radio	Are you a teacher?	○ 0:No ○ 1:Yes	{pQ13}=='1' or {pQ13}=='2'
pQ16	single-radio	Study subject	○ 1:Mathematics ○ 2:Computer and information science ○ 3:Physical sciences ○ 4:Earth and related environmental sciences ○ 5:Biological sciences ○ 6:Engineering ○ 7:Medicine/health sciences ○ 8:Agriculture ○ 9:Psychology ○ 10:Business and economics ○ 11:Educational sciences ○ 12:Sociology ○ 13:Law ○ 14:Political sciences ○ 15:History and Archaeology ○ 16:Languages and literature ○ 17:Philosophy, Ethics and Religion ○ 18:Arts ○ 19: Other, please specify	{pQ13}=='5'
pQ17	text	Specify your study subject		{pQ16}=='19'

pQ18	single-dropdown	How many hours do you work per week?	1-5 hours 6 – 10 hours 11-15 hours 16 – 20 hours 21-25 hours 26 – 30 hours 31-35 hours 35 – 40 hours More than 40 hours	{pQ13}=='1' or {pQ13}=='2'
pQ19	single-radio	Do you have …	○ 1:A permanent job or a contract with unlimited duration ○ 2:A temporary job or a contract of limited duration	{pQ13}=='1' or {pQ13}=='2'

Module 3b: Socioeconomic Status (teachers)

Code	**Question type**	**Text**	**Answers**	**Comments**
{pQ15}=='1'				
pQ20	single-radio	What is the position level of your current job?	○ 1:Non-teaching ○ 2:Teacher ○ 3:Teacher's assistant ○ 4:Administration and support ○ 5:Department Chair ○ 6:Assistant Principal ○ 7:Principal ○ 8:Education Administration ○ 9:School Psychologist ○ 10:Other, please specify	
pQ21	text	Specify your current job position level.		{pQ20}=='10'
pQ22	single-radio	Please specify the level of the school where you currently work	○ 1:Pre-/Elementary ○ 2:Secondary	

			○ 3:Tertiary (College/University) ○ 4:Vocational ○ 5:Other, Please specify	
pQ23	text	Specify the level of school where you work.		{pQ22}=='5'
pQ24	single-radio	Please specify the type of school where you currently work	○ 1:Public ○ 2:Private ○ 3:Charter ○ 4:Other, please specify	
pQ25	text	Specify the type of school where you work.		{pQ24}=='4'

Module 3c: Socioeconomic Status

Code	**Question type**	**Text**	**Answers**	**Comments**
{pQ13}=='1' or {pQ13}=='2'				
pQ26	numeric	Please provide an estimate of your annual income (gross salary).		
pQ26_2*	single-dropdown	Select your currency…	• 1:Euros • 2:British pounds • 3:Bulgarian levs • 4:Croatian kuna • 5:Czech koruna • 6:Danish Krone • 7:Swiss Franc • 8:Norwegian krone • 9:Polish zloty • 10:Serbian dinar • 11:Swedish Krona • 12:Turkish lira • 13:Ukranian hryvnia	{pQ26}>0

			• 14:US dollars • 15:Brazilian reals • 16: Canadian dollars • 17:Chilean pesos • 18:Chinese yuan • 19:Australian dollar • 20:Colombian pesos • 21:Indian rupee • 22:Japanese yen • 23:Mexican peso • 24:Moroccan dirham • 25:Pakistani rupee • 26:Russian ruble • 27:Singapore dollar • 28:South African rand • 29:Argentine peso • 30:Other,please specify	
pQ26_3	text	Specify the currency		{pQ26_2}=='30'
pQ27	single-radio	What is the position level of your current job?	○ 1:Fresh/Entry level ○ 2:Experienced worker ○ 3:Middle manager in Small organisation ○ 4:Middle manager in a medium or big organisation ○ 5:Senior manager in a small organisation ○ 6:Senior manager in a medium/big organisation	{pQ15}=='0'

			○ 7:Self-employed without employees ○ 8:Own business with employees ○ 9:Other, please specify	
pQ28	text	Specify the position level of your current job.		{pQ27}=='9' and {pQ15}=='0'
pQ29	single-radio	At what type of organisation do you work?	○ 1:Private ○ 2:Public	{pQ15}=='0'

Chapter 3- Learning Experience

code	type	text	answers
pQt3	textbox		In this chapter we would like to know about your learning experience in this MOOC.

Module 4a: Participation in MOOC

Code	type	text	answers	comments
pQ30*	single-radio	Please select the most appropriate option regarding your participation in this MOOC	○ 0:I never started the MOOC I was enrolled for ○ 1:I started the MOOC but did not complete ○ 2: I started and completed the MOOC	

Module 4b: Learning Experience

Code	type	text	answers	comments
{pQ30}=='1' or {pQ30}=='2'				
pQ31*	single-radio	Did the MOOC meet your expectations?	○ 1:Not at all ○ 2:Very little ○ 3:Little ○ 4:Somewhat ○ 5:To some extent ○ 6:To a great extent ○ 7:Completely	

Module 4c: Learning Experience

Code	**type**	**text**	**answers**	**comments**
{pQ30}=='1' or {pQ30}=='2'				
pQ33	single-radio	Did you have enough time to participate in the MOOC according to your objectives?	○ 1:Yes ○ 2:Yes, but I decided to invest less time ○ 3:No, I had not	
pQ34	multiple-checkbox	The reason(s) I did not have enough time was (were) due to: *(multiple answers possible)*	○ pQ34a:Family obligations ○ pQ34b:Work obligations ○ pQ34c:Course required more study hours than indicate ○ pQ34d:Other	{pQ33}=='3'
pQ35	text	Please indicate the reason		{pQ34d}==true
pQ36	numeric	Overall, how many **HOURS** (including online and offline activities) did you devote to MOOC related activities?	[1-150]	
	Battery		○ 1:1 Not at all ○ 2:2 Very little ○ 3:3 Little ○ 4:4 Somewhat ○ 5:5 To some extent ○ 6:6 To a great extent ○ 7:7 Completely	
pQ37	matrix	Were the course learning objectives clear to you?	○	
pQ38	matrix	Were the course learning objectives aligned with your personal learning objectives?		
pQ39	single-radio	When were the course learning objectives clear to you?	○ 1:Before the start of the course ○ 2:At the beginning of the course	

			○ 3:During the Course ○ 4:At the end of the course ○ 5:Never	

Module 5a: Specific personal behavior

Code	type	text	answers	comments
{pQ30}=='1' or {pQ30}=='2'				
pQ40 *	**single-radio**	**In *this* MOOC I have…….**	○ **1:Browsed the content** ○ **2:Browsed, downloaded and read learning materials** ○ **3:Participated in some selected modules that I found interesting** ○ **4:Participated in some selected modules that I need in order to achieve my personal goals** ○ **5:Participated in all modules (even if partially)**	
pQ41	multiple-checkbox	Have you obtained with this MOOC any of the following certification options? *(multiple answers possible)*	○ pQ41a:Nothing obtained ○ pQ41b:Certificate of participation ○ pQ41c:Certificate of completion ○ pQ41d:Badge/s ○ pQ41e:Authenticated certificate of accomplishment via onsite exam ○ pQ41f:Authenticated certificate of accomplishment via proctoring ○ pQ41g:ECTS credits ○ pQ41h:Part of a post-graduate professional qualification ○ pQ41i:Other	
pQ42	text	Please specify		{pQ41i}==true

pQ43	multiple-checkbox	What do you plan to do with the certification received? *(multiple answers possible)*	○ pQ43a:Accreditation of prior learning (ECTS credits) ○ pQ43b:Look for a job or change of job ○ pQ43c:Include it in my CV ○ pQ43d:Show lifelong learning in my current job	{pQ41a}==false
pQ44	single-radio	In *this* MOOC I have participated in	○ 1:Less than ¼ of the modules ○ 2:From ¼ to ½ of the modules ○ 3:From ½ to ¾ of the modules ○ 4:From ¾ to 4/4 of the modules ○ 5:In all the modules	{pQ40}=='3' or {pQ40}=='4'
pQ45	**single-radio**	**In the modules you participated in, usually you…**	○ **1:Did some learning activities** ○ **2:Did most learning activities** ○ ○ **3:Did all learning activities**	**{pQ40}=='3' or {pQ40}=='4' or {pQ40}=='5'**

Module 5b: Specific personal goals (Activities)

Code	type	text	answers	comments
{pQ30}=='1' or {pQ30}=='2'				
	Battery **Which of the following activities did you carry out in the MOOC?:**		○ **1:1 None** ○ **2:2 Some** ○ **3:3 Most** ○ **4:4 All** ○ **5:Not applicable**	
pQ46_1	**matrix**	**Browsed the content**		
pQ46_2	**matrix**	**downloaded learning material**		
pQ46_3	**matrix**	**watched video lectures**		
pQ46_4	**matrix**	**Made the general quizzes/assignments**		
pQ46_5	**matrix**	**Made the end-of-module quizzes/assignments**		

pQ46_6	**matrix**	**read the (forum) discussions**		
pQ46_7	**matrix**	**Actively participated in the (forum) discussions**		
pQ46_8	**matrix**	**Studied the literature**		
pQ46_9	**matrix**	**Did the peer-review tasks**		
pQ46_10	**matrix**	**Participated in social media activities related to the course**		
pQ46_11	**matrix**	**communicated with the teacher or course assistant**		
pQ46_12	**matrix**	**communicated with other students in the course**		
pQ46_13	**matrix**	**other**		

Module 5c: Goals achievement

Code	**type**	**text**	**answers**	**comments**
{pQ30}=='1' or {pQ30}=='2'				
	battery		○ 1:1 Not at all ○ 2:2 Very little ○ 3:3 Little ○ 4:4 Somewhat ○ 5:5 To some extent ○ 6:6 To a great extent ○ 7:7 Completely	
pQ56 *	matrix	I achieved my personal learning goals by participating in this MOOC.		

Module 6: Barriers

Code	**type**	**text**	**answers**	**comments**
{pQ30}=='1' or {pQ30}=='2'				
pQ57 *	multiple-checkbox	Which barriers did you encounter in this MOOC? *(multiple*	□ pQ57a:None □ pQ57b:Family issues □ pQ57c:Lack of support from family/friends	

		answers possible)	□ pQ57d:Workplace commitments □ pQ57e:Lack of support from workplace □ pQ57f:Lack of time in general □ pQ57g:Insufficient academic background (prior knowledge) □ pQ57h:Insufficient technology background □ pQ57i:Technical problems with the computer □ pQ57j:Bad internet connection □ pQ57k:Technical problems with the site □ pQ57l:Lack of motivation □ pQ57m:Lack of personal commitment □ pQ57n:Lack of interaction (with other students or instructor) □ pQ57o:Lack of in-MOOC support □ pQ57p:Lack of instructor presence □ pQ57q:Lack of decent feedback □ pQ57r:Lack of instant feedback □ pQ57s:Course content was too easy □ pQ57t:Course content was too hard	

Module 6b: Barriers

Code	type	text	answers	Comments
({pQ30}=='1' or {pQ30}=='2') and {pQ57a}!=true				
	Battery To what extent were you able to overcome the barrier(s)?		○ 1:1 Not at all ○ 2:2 To some extent ○ 3:3 Neutral ○ 4:4 To a large extend ○ 5:5 Completely	
pQ58b	**matrix**	Family issues		{pQ57b}==true
pQ58c	**matrix**	Lack of support from family/friends		{pQ57c}==true
pQ58d	**matrix**	Workplace commitments		{pQ57d}==true
pQ58e	**matrix**	Lack of support from workplace		{pQ57e}==true
pQ58f	**matrix**	Lack of time in general		{pQ57f}==true
pQ58g	**matrix**	Insufficient academic background (prior knowledge)		{pQ57g}==true
pQ58h	**matrix**	Insufficient technology background		{pQ57h}==true
pQ58i	**matrix**	Technical problems with the computer		{pQ57i}==true
pQ58j	**matrix**	Bad internet connection		{pQ57j}==true
pQ58k	**matrix**	Technical problems with the site		{pQ57k}==true
pQ58l	**matrix**	Lack of motivation		{pQ57l}==true
pQ58m	**matrix**	Lack of personal commitment		{pQ57m}==true
pQ58n	**matrix**	Lack of interaction (with other students or instructor)		{pQ57n}==true
pQ58o	**matrix**	Lack of in-MOOC support		{pQ57o}==true

pQ58p	**matrix**	Lack of instructor presence		{pQ57p}==true
pQ58q	**matrix**	Lack of decent feedback		{pQ57q}==true
pQ58r	**matrix**	Lack of instant feedback		{pQ57r}==true
pQ58s	**matrix**	Course content was too easy		{pQ57s}==true
pQ58t	**matrix**	Course content was too hard		{pQ57t}==true

Module 7: Interaction

Code	**type**	**text**	**answers**	**comments**
{pQ30}=='1' or {pQ30}=='2'				
	Battery How much have the following interactions been facilitated within the MOOC?		○ 1:1 Not at all ○ 2:2 Very little ○ 3:3 Little ○ 4:4 Somewhat ○ 5:5 To some extent ○ 6:6 To a great extent ○ 7:7 Completely	
pQ59	**matrix**	Student – student interactions		
pQ60	**matrix**	Student – teacher interaction		
pQ61	**matrix**	Student – content interaction		

Module 8a: Satisfaction

Code	**type**	**text**	**answers**	**comments**
{pQ30}=='1' or {pQ30}=='2'				
	Battery		○ 1:1 Very unsatisfied ○ 2:2 Fairly unsatisfied ○ 3:3 Unsatisfied ○ 4:4 Fairly satisfied ○ 5:5 Satisfied ○ 6:6 Very satisfied ○ 7:7 Extremely satisfied	
pQ62*	matrix	How satisfied have you been with this MOOC?		

	Battery How do you judge the quality of the following components/characteristics of this MOOC?		○ 1:1 Terrible ○ 2:2 Very poor ○ 3:3 Poor ○ 4:4 Acceptable ○ 5:5 Good ○ 6:6 Very good ○ 7:7 Excellent	
pQ63	**matrix**	Adequacy of the MOOC for the achievement of learning goals		
pQ64	**matrix**	Adequacy of the workload		
pQ65	**matrix**	content of the MOOC		
pQ66	**matrix**	learning environment (platform)		
pQ67	**matrix**	design of MOOC (structure of course)		
pQ68	**matrix**	interactions with other students within the MOOC		
pQ69	**matrix**	language style used in course material		
pQ70	**matrix**	accessibility of MOOC		
pQ71	**matrix**	theoretical deepening		
pQ72	**matrix**	flexibility of the MOOC		
pQ73	**matrix**	the lecturer/teacher/facilitator		
pQ74	**matrix**	Adequacy of the duration of the MOOC		
pQ75	**matrix**	interface		
pQ76	**matrix**	certification options		
pQ77	**matrix**	Usefulness of acquired knowledge/skills for the labour market		
pQ78	**matrix**	Usefulness of acquired knowledge/skills for personal life		

Module 8b: Satisfaction

Code	**type**	**text**	**answers**	**comments**

{pQ30}=='1' or {pQ30}=='2'				
	Battery How do you judge the quality of the following components of this MOOC?		○ 1:1 Terrible ○ 2:2 Very poor ○ 3:3 Poor ○ 4:4 Acceptable ○ 5:5 Good ○ 6:6 Very good ○ 7:7 Excellent ○ 8:8 Not applicable	
pQ80	**matrix**	Video lectures		
pQ81	**matrix**	Academic material		
pQ82	**matrix**	Textbooks/Study books		
pQ83	**matrix**	Reference lists to external resources		
pQ84	**matrix**	Assignments		
pQ85	**matrix**	Tests		
pQ86	**matrix**	Social media activities		
pQ87	**matrix**	Forum or real time chat		
pQ88	**matrix**	Communication channels with the teacher or assistant		

Chapter 4- Feedback and Assessment

code	**type**	**text**	**answers**	**comments**
pQt4	**textbox**		**Now we will focus on the assessment and feedback process of this MOOC,**	**{pQ30}=='1' or {pQ30}=='2'**
pQt4_2	**textbox**		**In a previous question, you indicated that you did not start the MOOC. Therefore, your answers to this chapter are not needed. Click next to continue**	**{pQ30}=='0'**

Module 9a: Assessment

Code	type	text	answers	comments
{pQ30}=='1' or {pQ30}=='2'				
pQ105	single-radio	Did this MOOC include any type of assessment?	○ 0:No ○ 1:Yes	
pQ106	multiple-checkbox	Which assessment activities were applied? *(multiple answers possible)*	○ pQ106a:Participation level in forum discussion ○ pQ106b: Completing a piece of work and submitting it ○ pQ106c:Answering quiz ○ pQ106d:Completing an assignment as a group ○ pQ106e:Other	{pQ105}=='1'
pQ107	textbox	Please, specify		{pQ106e}==true
	Battery		○ 1:1 Never ○ 2:2 Rarely ○ 3:3 Sometimes ○ 4:4 Regularly ○ 5:5 Often ○ 6:6 Very often ○ 7:7 Always	{pQ105}=='1'
pQ108	matrix	The assessment activities allowed me to understand the course content easier		

Module 9b: Assessment

Code	type	text	answers	comments
({pQ30}=='1' or {pQ30}=='2') and {pQ105}=='1'				
pQ111	multiple-checkbox	Who was/is responsible to assess students' work? *(multiple answers possible)*	○ pQ111a:The student herself (her own work) ○ pQ111b:The instructor/tutor	

			○ pQ111c: The peers/other students ○ pQ111d:The system automatically	
pQ111_2	single-radio	How many submissions from your classmates did you have to evaluate on average?	○ 0:None (only my own work) ○ 1:1 ○ 2:2 ○ 3:3 ○ 4:4 ○ 5:5 ○ 6:More than 5	{pQ111c}==true
pQ113	single-radio	How did you have to evaluate your own work?	○ 1:We had to evaluate our own work, but after evaluating the work of other classmates ○ 2:We had to evaluate our own work but without the condition to evaluate first the work of other classmates ○ 3:We had to evaluate our own work but with other condition ○ 4:Other	{pQ111a}==true
pQ113_2	text	Please specify the condition or the way you had to evaluate your own work		{pQ113}=='3' or {pQ113}=='4'

Module 9c: Feedback

Code	type	text	answers	comments
{pQ30}=='1' or {pQ30}=='2'				
Pqt5	textbox		Now we will focus on the feedback you have given or received during the MOOC.	

			Feedback is broadly defined here as a type of support to carry out an assignment or a task. The support can be about the content of the task, planning or monitoring the process of developing the assignment and it can be given while you are developing the activity or at the end.	
pQ114	**single-radio**	**Does this open online-course include any type of feedback?**	○ **0:No** ○ **1:Yes**	
pQ115	**multiple-checkbox**	**What was the content of the feedback?** ***(multiple answers possible)***	○ **pQ115a:General comments** ○ **pQ115b:Just a grade (correct/incorrect, overall percentage correct)** ○ **pQ115c:Solutions of the task/exercise but with no comments** ○ **pQ115d: Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.)** ○ **pQ115e: it informs you about an incorrect response and allows you one or more attempts to answer it** ○ **pQ115f: Suggestions on how to improve further the submitted work** ○ **pQ115g:Other**	**{pQ114}=='1'**
pQ115_2	**text**	**Please specify**		**{pQ115g}==true**

pQ116	**single-radio**	**Please indicate the length of feedback provided in general**	○ **1:Feedback was too long** ○ **2:Feedback was sufficient** ○ **3:Feedback was too short**	**{pQ114}=='1'**
	battery		○ **1:1 Never true** ○ **2:2 Rarely true** ○ **3:3 Sometimes true** ○ **4:4 Fairly often true** ○ **5:5 Often true** ○ **6:6 Very often true** ○ **7:7 Always true**	**{pQ114}=='1'**
pQ116_2	**matrix**	**In general I gave special attention to all the feedback provided…**		**{pQ114}=='1'**

Chapter 5- Post-survey recruitment

Module 10: participation in questionnaire and recruitment

Code	type	text	answers	comments
pQ117*	single-radio	Did you participate in the pre-course questionnaire at the beginning of this course?	○ 0:No ○ 1:Yes	
Qt6	textbox		In order to enhance the knowledge about MOOCs, it is very important to know how students are using the knowledge and skills acquired in these courses. For that purpose, we would appreciate it if you allow us to contact you	

			again in some months.	
pQ118*	single-radio	I allow the research group to contact me in the future for a follow-up questionnaire.	○ 0:No ○ 1:Yes	
pQ119	email	Please, facilitate your email for allowing the contact. We will only use this for research purposes.		{pQ118}=='1'

ANNEX D: Part of Questionnaire related to the research (used for study 2)

Study 2 Relevant questionnaire components

#	Relevant Questionnaire parts	Linked variable
1	Student activities such as browsing the content, browsing downloads and reading learning materials, participating in some selected modules that found interesting or necessary for achieving their personal goals, participating in all modules (even if partially).	Student Engagement (dependent variable)
2	Amount (some, most, all) of learning activities in general implemented in the participating modules.	Student Engagement (dependent variable)
3	Amount (none, some, most, all, n/a) of specific activities implemented such as browsing the content, downloading learning material, watching video lectures, doing the general quizzes/assignments, doing the end of module quizzes/assignments, reading the forum discussions, actively participating in the forum discussions, studying the literature, doing the peer-review tasks, participating in social media activities related to the course, communicating with the teacher or course assistant).	Student Engagement (dependent variable)
4	Students' interaction level between students, teacher and student, and student and system content.	Interaction type and level (independent variable)
5	Existence of assessment activities.	Existence of Assessment (independent variable)
6	The type of assessment activities such as their participation level in forum discussions, the completion of an assignment individually, or as a group, answering a quiz.	Type of Assessments (independent variable)
7	The impact of assessment activities in understanding the course content (Namely, the assessment activities applied in the course helped the student to understand the course content).	Impact of Assessments (independent variable)
8	The person (the student themself (their own work), the teacher, the peers/other students or system responsible to assess their work.	Actor for assessments (independent variable)
9	The number of submissions from their peers that they had to evaluate on average (i.e., How many submissions from	Number of submissions to be evaluated (independent variable)

	your classmates did you have to evaluate for each course assignment on average?).	
10	Whether they had to assess their own work during the course (self-evaluation).	Existence of self-assessment (independent variable)
12	Existence of feedback in the MOOC.	Existence of Feedback (independent variable)
13	The feedback content (i.e., General comments, just a grade (correct/incorrect, overall percentage correct, solutions of the task/exercise but with no comments, solutions of the task/exercise with comments (e.g., suggestions for improvements, common errors, etc.), it informs you about an incorrect response and allows you one or more attempts to answer it, suggestions on how to improve further the submitted work, other).	Feedback Content (independent variable)
14	The length of the provided feedback (i.e., Feedback was too long, feedback was sufficient, feedback was too short).	Feedback length (independent variable)
15	Attention given to the feedback provided by the participant (i.e. how many times: ● I gave special attention to all the feedback provided, ● I gave special attention mainly to feedback on questions I was sure they were not correct, ● I gave special attention to feedback on questions I was sure they were correct, ● I didn't give special attention to any feedback provided, ● Non applicable, the feedback provided was general and not per question).	Feedback attention (independent variable)
16	Whether they had to evaluate their own work: a) but after evaluating the work of other classmates, b) without the condition to evaluate first the work of other classmates, c) with other conditions.	Self-assessment method (Independent variable)

ANNEX E: Formulation of hypotheses on study 2 between feedback practices (independent variables) and student engagement (dependent variables) based on the questionnaire variables and the related questions and its codes in the questionnaire

No.	Independent Variables for Research Question 2 (1)	Related Questions in Post Questionnaire for the independent variables (2)	Independent Variables Elaboration	Hypothesis statement (4)
1	Interaction type	pQ59, pQ60, pQ61	How much have the following interactions been facilitated within the MOOC (Likert: 1:Not at all – 7:completely)? pQ59 Student – student interactions pQ60 Student – teacher interaction pQ61 Student – content interaction	influence
2	Type of Assessment Activities	pQ106 (pQ106a, pQ106b, pQ106c pQ106d, pQ106e)	Which Assessment Activities were applied in each MOOC course (Multiple Checkbox) pQ106a Participation level in forum discussion pQ106b Completing a piece of work and submitting it pQ106c Answering quiz pQ106d Completing an assignment as a group pQ106e Other	influence
Bis	Assessment Impact	pQ108	The assessment activities allowed me to understand the course content easier 1 1 Never 2 2 Rarely 3 3 Sometimes 4 4 Regularly 5 5 Often 6 6 Very often 7 7 Always	influence
3	Subject responsible to assess	pQ111 (pQ111a, pQ111b, pQ111c,	Who was responsible to assess students' work (multiple checkbox) pQ111a The student herself (her own work)	influence

	students' work	pQ111d)	pQ111b The instructor/tutor pQ111c The peers/other students pQ111d The system automatically		
4	No. of submissions to be evaluated from your classmates	pQ111_2	in case pQ111c was selected above) How many submissions/assignments from your classmate did you have to evaluate? (pQ111_2) 0 None (only my own work) 1 1 2 2 3 3 4 4 5 5 6 More than 5	influence	
5	Existence of self-assessment	pQ111a	[in case pQ111a was selected above) Did students have to assess their own work in each MOOC course (xls filename)	influence	
6	Self-Assessment Method	pQ113	How did students have to evaluate their own work in each Mooc (single radio)? pQ113 1 We had to evaluate our own work, but after evaluating the work of other classmates 2 We had to evaluate our own work but without the condition to evaluate first the work of other classmates 3 We had to evaluate our own work but with other condition 4 Other (pQ113_2)	influence	
7	Existence of feedback	pQ114	Existence of feedback (single-radio) (0:no, 1:yes)	influence	
8	Feedback Content	pQ115 (pQ115a, pQ115b, pQ115c, pQ115d, pQ115e	What was the content of the feedback per MOOC (xls filename)? (multiple answers possible) pQ115a General comments pQ115b Just a grade (correct/incorrect, overall percentage correct) pQ115c Solutions of the task/exercise but with no comments	Influence	

		pQ115f, pQ115g)	pQ115d Solutions of the task/exercise with comments (e.g. suggestions for improvements, common errors etc.) pQ115e it informs you about an incorrect response and allows you one or more attempts to answer it pQ115f Suggestions on how to improve further the submitted work pQ115g Other (pQ115_2 Please specify)		
9	Feedback length	pQ116	What was the length of feedback provided?(pQ116) Please indicate the length of feedback provided in general 1 Feedback was too long 2 Feedback was sufficient 3 Feedback was too short	Influence	S (
10	Attention on feedback	pQ116_2	In general I gave special attention to all the feedback provided… 1 1 Never true 2 2 Rarely true 3 3 Sometimes true 4 4 Fairly often true 5 5 Often true 6 6 Very often true 7 7 Always true	influence	S (

Table 72: Formulation of hypothesis between feedback practices (independent variables) and student engagement (dependent variables) based on the questionnaire variables

ANNEX F: Relation to study 2 between the question code (dependent variable) in questionnaire and the different student engagement activities

No.	Student Engagement Variable (dependent variable)	Student Engagement Value
1	pQ40	In this MOOC I have……. 1 Browsed the content 2 Browsed, downloaded and read learning materials 3 Participated in some selected modules that I found interesting 4 Participated in some selected modules that I need in order to achieve my personal goals 5 Participated in all modules (even if partially)
2	pQ44	In this MOOC I have participated in 1 Less than ¼ of the modules 2 From ¼ to ½ of the modules 3 From ½ to ¾ of the modules 4 From ¾ to 4/4 of the modules 5 In all the modules
3	pQ45	In the modules you participated in, usually you… 1 Did some learning activities 2 Did most learning activities 3 Did all learning activities
4	pQ46	Which of the following activities did you carry out in the MOOC?
5	pQ46_1 (Browsed the content)	Did you browse the content? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
6	pQ46_2 (downloaded learning material)	Did you download learning material? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
7	pQ46_3 (watched video lectures)	Did you watch video lectures 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable

8	pQ46_4 (Made the general quizzes/assignments)	Did you made the general quizzes/assignments 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
9	pQ46_5 (Made the end-of-module quizzes/assignments)	Did you made the end-of-module quizzes/assignments 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
10	pQ46_6 (read the (forum) discussions)	Did you read the (forum) discussions? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
11	pQ46_7 (Actively participated in the (forum) discussions)	Did you actively participate in the (forum) discussions? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
12	pQ46_8 (Studied the literature)	Did you study the literature? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
13	pQ46_9 (Did the peer-review tasks)	Did you do the peer-review tasks? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
14	pQ46_10 (Participated in social media activities related to the course)	Did you participate in social media activities related to the course? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
15	pQ46_11 (communicated with the teacher or course assistant)	Did you communicate with the teacher or course assistant? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable

Annex F: Relation to study 2 between the question code of dependent variable in questionnaire and the different student engagement activities

16	pQ46_12 (communicated with other students in the course)	Did you communicate with other students in the course? 1 1 None 2 2 Some 3 3 Most 4 4 All 5 Not applicable
17	pQ46_13 (other)	Other? [TAKEN AS MISSING VALUE]

Table 73: Full set of different student engagement variables in study 2 before PCA

ANNEX G: Hypotheses in the study 1 linked with literature

Study 1- hypotheses linking independent variables (feedback) and dependent variables (Student engagement) and supporting literature

	Feedback factors (Independent Variables for Research Question 2)	Literature Source	Hypotheses
1	**Interaction type**	Jason Frand (2000), Nicol and Macfarlane-Dick (2006), Bevan, Badge, Cann, Willott & Scott, (2008), Nicol (2010), Scott (2014), LeBay and Comm, (2004), Li and Irby (2008), Macquarie University (2009), Handley and Williams (2011), Adamopoulos (2013), Smith, Caldwell, Richards & Bandara (2017),	**Hypothesis 1**: If the interaction between students and teachers in MOOCs is increased, then student engagement is influenced **Hypothesis 2**: If the interaction among students in MOOCs is increased, then student engagement is influenced **Hypothesis 3**: If the interaction between the students and the system in MOOCs is increased, then student engagement is influenced
2	**Existence of Assessment**	Black and Wiliam (1998), Frand (2000), Falchikov and Goldfinch (2000), Rovai, (2002), Gibbs and Simpson (2004), Willging and Johnson (2004), LeBay and Comm, (2004), Nicol and Macfarlane-Dick (2006), Carless (2006), Boud (2007), Hattie and Timberly, (2007), Krause and Coates, (2008), Li and Irby, (2008), Nicol (2010), Sadler (2010), Fleckhammer and Wise (2011), Chih-Yan Sun and Rueda (2011), Vardi (2012), Adamopoulos (2013), Scott (2014), Suen (2014), Admiraal, Huisman Van de Ven (2014), Ashton and Davies (2015), Staubitz et al. (2016), Dawson et al (2019)	**Hypothesis 4:** If assessment exists in MOOCs then student engagement is influenced
3	**Type of Assessments**	Black and Wiliam (1998), Frand (2000), Falchikov and Goldfinch (2000), Rovai, (2002), Gibbs and Simpson (2004), Willging and Johnson (2004), LeBay and Comm (2004), Nicol and Macfarlane-Dick (2006), Carless (2006), Boud (2007), Krause and Coates (2008), Li and Irby (2008), Nicol (2010), Sadler (2010), Fleckhammer and Wise (2011), Chih-Yan Sun and Rueda (2011), Vardi (2012), Adamopoulos (2013), Scott (2014), Suen (2014), Admiraal Huisman Van de Ven, (2014), Staubitz et al. (2016) Wise and Cui (2018), Dawson et al (2019), Winstone and Boud (2020)	**Hypothesis 5**: If participation level in forum discussions is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 6**: If the completion of an assignment individually is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 7**: If the completion of an assignment as a group is part of assessment activities in MOOCs, then student engagement is influenced **Hypothesis 8**: If answering a quiz is part of assessment activities in MOOCs, then student engagement is influenced
4	Impact of Assessments	Boud (2000), Falchikov and Goldfinch, (2000), Yorke (2003), Gibbs and	**Hypothesis 9**: If assessment activities allowed the students in MOOCs to identify

	Assessment activities that allow students to identify what they know and can do	Simpson (2004), Hattie and Timperley(2007), Dawson et al, (2019)	what they know and can do, then student engagement is increased
5	Impact of Assessments Assessment activities that allow students to identify their weaknesses	Boud (2000), Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Hattie and Timperley(2007), Bevan, Badge, Cann, Willott & Scott (2008), Dawson et al. (2019), Winstone and Boud (2020)	**Hypothesis 10**: If assessment activities allowed the students in MOOCs to identify their weaknesses, then student engagement is increased
6	Impact of Assessments Assessment activities that stimulate students to revisit earlier study and motivate them to engage in depth with the course topic	Deci and Ryan, (1991), Deci and Ryan, (2000), Chanock (2000), Boud (2000), Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Nicol (2008), Skinner et al. (2009) Handley and Williams (2011), Reeve (2012), Boud and Molloy (2013), Carless (2015), Hew (2015), Carless (2016), Winstone et al. (2017), Winstone and Carless (2019), Dawson et al. (2019),	**Hypothesis 11**: If assessment activities supported the students in MOOCs to stimulate them to revisit earlier study and motivate them to engage in depth with course topic then student engagement is increased.
7	Impact of Assessments Assessment activities that allow students to understand the course content easier	Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Hattie and Timberly (2007), Li and De Luca (2014), Dawson et al. (2019), Winstone and Boud (2020)	**Hypothesis 12**: If assessment activities allowed students in MOOCs to understand the course content easier then student engagement is influenced.
8	Impact of no. of assessments	Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Nicol and Macfarlane-Dick (2006), Hattie and Timberly (2007), Nicol (2010), Handley and Williams (2011), Scott (2014), Dawson et al (2019),	**Hypothesis 13:** If number of assessment activities is sufficient then student engagement is influenced
9	Number of submissions to be evaluated	Jiang et al (2014)	**Hypothesis 14:** If the number of peer-assessment is increased in MOOCs, then student engagement is influenced
10	**Existence of self-assessment**	Deci and Ryan, (1991), Deci and Ryan (2000), Hattie and Timperley(2007), Skinner et al. (2009), Reeve (2012), Hew (2015), Dawson et al (2019)	**Hypothesis 15:** If there is self-assessment in MOOCs, then student engagement is influenced
11	Self-Assessment Method	Deci and Ryan (1991), Deci and Ryan (2000), Hattie and Timperley(2007), Skinner et al. (2009), Reeve (2012), Hew (2015), Dawson et al (2019)	**Hypothesis 16:** If students had to evaluate their own work but after evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 17:** If students had to evaluate their own work but without the condition of evaluating the work of other classmates in MOOCs, then student engagement is influenced **Hypothesis 18:** If students had to evaluate their own work but with any other condition other than the ones above, then student engagement is influenced
12	Assessment Guidance	Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Hattie and Timberly (2007), Handley and Williams (2011), Scott (2014), Dawson et al (2019)	**Hypothesis 19:** If as guidance for self- or peer-assessment, a guide or matrix with model answers and clarifications on the assessment criteria and the related points/credits is provided, then student engagement is influenced **Hypothesis 20:** If as guidance for self- or peer-assessment, a group discussion on the

			assessment methods takes, then student engagement is influenced **Hypothesis 21:** If as guidance for self- or peer-assessment, a training session bases on a few practice assignments as exemplars, then student engagement is influenced **Hypothesis 22:** If as guidance for self- or peer-assessment, a training session bases on a few practice assignments as exemplars, then student engagement is influenced
13	Guidance on assessment that helps students to acquire the expected knowledge from the online course.	Chanock (2000), Falchikov and Goldfinch, (2000), Gibbs and Simpson (2004), Nicol and Macfarlane-Dick (2006), Nicol (2008), Poulos and Mahony (2008), Handley and Williams (2011), Boud and Molloy (2013), Scott (2014), Li and De Luca, (2014), Carless (2015), Ashton and Davies (2015), Carless (2016), Winstone et al (2017), Winstone and Carless (2019), Dawson et al. (2019)	**Hypothesis 23**: If guidance received to assess the students' own work or the work of their classmates helped them to acquire the expected knowledge from the MOOC, then student engagement is influenced
14	Existence of feedback	Many publications on that and here just some indicative, Ramaprasad (1983), Crooks, (1988), Black and Wiliam, Kluger and DeNisi (1996), Black & Wiliam (1998), Hattie and Timperley (2007), Carter (2009), Sadler (2010), Havnes, Smith, Dysthe and Ludvigsen (2012), Scott (2014)	**Hypothesis 24:** If there is feedback mechanism in MOOC, then student engagement is influenced
15	**Actor responsible for feedback or assessing student's work**	Boud (2007), Nicol (2010), Sadler (2010), Vardi (2012), Adamopoulos, (2013), Brown, Chung & Ho (2016), Smith, Caldwell, Richards, and Bandara (2017), Cabrera & Ferrer (2017), Dawson et al. (2019)	**Hypothesis 25:** If actor responsible for providing feedback or assessing student's work in MOOCs is the student himself/herself, then student engagement is influenced **Hypothesis 26:** If actor responsible for providing feedback or assessing student's work in MOOCs is the instructor/teacher, then student engagement is influenced **Hypothesis 27:** If actor responsible for providing feedback or assessing student's work in MOOCs is the peer, then student engagement is influenced **Hypothesis 28:** If actor responsible for providing feedback or assessing student's work in MOOCs is the system, then student engagement is influenced
16	**Feedback Mode**	Chanock (2000), Gibbs and Simpson (2004), Nicol (2008), Handley and Williams (2011), Boud and Molloy, (2013), Chew, (2014), Arieli & Attali (2015), Carless, (2015), Carless (2016), van der Kleij, Adie and Cumming (2017), Winstone et al, (2017), Winstone and Carless, (2019), Dawson et al (2019)	**Hypothesis 29:** If written feedback is provided in MOOC, then student engagement is influenced **Hypothesis 30:** If audio feedback is provided in MOOC, then student engagement is influenced **Hypothesis 31:** If video feedback is provided in MOOC, then student engagement is influenced **Hypothesis 32:** If feedback via chat/skype is provided in MOOC, then student engagement is influenced

17	**Feedback Content**	Deci and Ryan, (1991), Black & Wiliam (1998), Deci and Ryan, (2000), Chanock (2000), Gibbs and Simpson (2004), Macfarlane-Dick (2006), Carless (2006), Hattie and Timperley(2007), Garrison, Ehringhaus, (2007), Nicol (2008) Nicol and Bevan, Badge, Cann, Willott & Scott, (2008), Skinner et al. (2009), Sutton and Gill (2010), Handley and Williams (2011), Reeve, (2012), Lonka and Ketonen (2012), Lonka (2012), Onah, Sinclair & Boyatt (2014), Li and De Luca (2014), Scott (2014), Hew (2015), Carless (2015), Carless (2016), Winstone et al, (2017), Winstone and Carless (2019), Dawson et al. (2019)	**Hypothesis 33:** If the feedback content is general comments, then student engagement is influenced **Hypothesis 34:** If the feedback content is just a grade, then student engagement is influenced **Hypothesis 35:** If the feedback content is on solutions of the task/exercise but with no comments, then student engagement is influenced **Hypothesis 36:** If the feedback content is on solutions of the task/exercise but with comments, then student engagement is influenced **Hypothesis 37:** If the feedback content informs you about an incorrect response and allows you one or more attempts to answer it, then student engagement is influenced **Hypothesis 38:** If the feedback content suggests on how to improve further the submitted work, then student engagement is influenced
18	Feedback provision	Orsmond, Merry, and Reiling (2005), Carless (2006), Nicol (2010), Chew, (2014), (Chen 2015), Anderhoven, Raes, Montrieux, Rotsaert & Schellens, (2015), Arieli & Attali (2015), van der Kleij, Adier and Cumming (2017)	**Hypothesis 39**: If the feedback was communicated via dialogue (trying to stimulate response), then student engagement is influenced. **Hypothesis 40**: If the feedback was communicated passively (one-way communication), then student engagement is influenced.
19	Feedback focus	Black & Wiliam, (1998), Hattie and Timperley (2007), Sutton and Gill (2010), Dawson et al (2019)	**Hypothesis 41**: If the feedback focused on praising students' effort and on learning goals, then student engagement is influenced **Hypothesis 42**: If the feedback focused on praising the students' ability or intelligence, then student engagement is influenced **Hypothesis 43**: If the feedback focused on clarifying the learning content, then student engagement is influenced **Hypothesis 44**: If the feedback focused on comparing student's performance with other students, then student engagement is influenced **Hypothesis 45**: If the feedback focused on comparing student's performance with other measures of the individual's ability (e.g., creativity, critical thinking, etc), then student engagement is influenced
20	Feedback timing	Falchikov and Goldfinch, (2000), Boud 2000, Frand (2000), Gibbs and Simpson, (2004), Hattie and Timperley (2007), Shute (2008), Handley and Williams, (2011), Scott (2014), Li and De Luca, (2014), Dawson et al, (2019)	**Hypothesis 46**: If the feedback timing changes, then student engagement is influenced
21	Feedback frequency	Falchikov and Goldfinch, (2000), Gibbs and Simpson, (2004), Orsmond, Merry, and Reiling (2005), Carless (2006), Nicol (2010), Pokorny and Pickford	**Hypothesis 47**: If the frequency (how often) of the feedback changes, student engagement is influenced

		(2010), Lonka and Ketonen, (2012), Lonka (2012), Dawson et al. (2019)	
22	Feedback length	Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Orsmond, Merry, and Reiling (2005), Carless (2006), Hattie and Timperley (2007), Hounsell (2008), Nicol (2010), Ferguson (2011), Dawson et al, (2019)	**Hypothesis 48**: If the length of the feedback changes, then student engagement is influenced
23	Attention on feedback	Chanock (2000), Gibbs and Simpson (2004), Nicol (2008), Handley and Williams, (2011), Boud and Molloy, (2013), Carless (2015), Winstone et al. (2017) Carless (2016), Winstone and Carless, (2019), Dawson et al, (2019)	**Hypothesis 49**: If students read frequently and the whole feedback provided, then student engagement is influenced
24	Feedback impact	Deci and Ryan (1991), Deci and Ryan (2000), Falchikov and Goldfinch (2000), Gibbs and Simpson (2004), Zhao and Kuh, (2004), Skinner et al. (2009), Chih-Yan Sun and Rueda, (2011), Reeve (2012), Lonka and Ketonen (2012), Lonka (2012), Li and De Luca (2014), Hew (2015), Dawson et al. (2019)	**Hypothesis 50**: If feedback impacts positively student's learning objectives and motivation, then student engagement is influenced

ANNEX H: Publications emerged from this PhD thesis

Floratos, N., Guasch, T., & Espasa, A. (2017). Student Engagement in MOOCS with appropriate formative assessment and feedback practices. In *Proceedings of the EDULEARN - International Conference on Education and New Learning Technologies,* March 2017. DOI:10.21125/edulearn.2017.1347

Floratos, N., Guasch, T., & Espasa, A. (2016). Is student engagement higher in MOOCS with appropriate formative assessment and feedback practices? *Proceedings of the 9th International conference on Technology, Education and Development*, 2016, DOI: 10.21125/iceri.2016.1124,

Floratos, N., Guasch, T., & Espasa, A. (2015). Recommendations on Formative Assessment and Feedback Practices for stronger engagement in MOOCs. *Open Praxis*, *7*(2), 141-152.