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The Characteristics of Successful MOOCs in the Fields of Software, Science, and Management, According to Students' Perception

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Abstract

The characteristics of successful MOOCs were explored in this study. Thousands of student reviews regarding five xMOOCs (Massive Open Online Course) in the fields of software, science, and management were extracted from the Coursetalk website and analyzed by quantitative and qualitative methods using the Garrison, Anderson, and Archer (2000) Community of Inquiry (CoI) model. The 14 characteristics found to contribute to the success of MOOCs (e.g., teacher, atmosphere, exercise) were partitioned into the teaching, social, and cognitive presence elements. In addition, cluster analysis revealed five types of learners, based on the characteristics they mentioned for course success: atmosphere, exercise, teacher, exam, and unspecified. This divides learners into groups that may prefer social, cognitive, or teaching presence. The findings of this study negate the perception that xMOOCs mostly contain teaching presence elements. This research contributes to the understanding of characteristics that contribute to successful MOOCs and sheds light on the students, too. Listening to the voices of the students and the types of characteristics that they chose to mention, enables further exploration of their preferences and expectations regarding MOOCs and, accordingly, to future adaptation between students' preferences and MOOC characteristics.

Keywords: MOOC, online learning, lifelong learning, Community of Inquiry

Introduction

Massive Open Online Courses (MOOCs) are a recent popular trend in the online learning landscape (Dabbagh et al., 2016). In the light of the high number of MOOC participants and the benefits of these courses to teaching and learning processes (Freitas, Morgan, & Gibson, 2015), in the past few years the academic community has been investigating how to maximize the potential of MOOCs. It was argued by Conole (2013) that the common partition of MOOCs into xMOOC and cMOOC is too simplistic to describe MOOCs, and better indicators still need to be developed in order to improve our understanding of the way in which students communicate with MOOCs and experience them.

Garrison, Anderson, and Archer (2000) suggested

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the CoI model (Community of Inquiry) for online learning. This model represents a process of creating a deep and meaningful (collaborative-constructivist) learning experience through the development of three interdependent elements – social, cognitive, and teaching presence. Garrison, Anderson, and Archer (2010) expected that the CoI model would be a predictor of learning processes and learning outcomes, both from the perspective of individual courses/programs of study and lifelong learning attitudes and participation.

In the research presented in this paper, the CoI model was harnessed with two main aims: first, to explore the characteristics that contributed to the success of MOOCs from the students' perception and, second, to learn about the students themselves and their preferences. For these purposes, more than 3,400 online student reviews regarding five courses in the fields of software, sciences, and management were analyzed. These courses were selected because they received an average score of 5/5 in the CourseTalk website (https://www.coursetalk.com).

The students' reviews were analyzed using quantitative and qualitative methods, in order to identify the characteristics that contributed to the success of MOOCs from the students' perspective. First, the students' review data was analyzed using a quantitative method. MOOC characteristics were identified and classified into one of the three presence elements according to the CoI model: social, cognitive, or teaching. Subsequently, the characteristics were ranked according to their relative importance. In addition, groups of students were identified based on similar characteristics that they mentioned in their reviews. The characteristics mentioned by the students may teach us about their preferences regarding components that are required for successful MOOCs and about their preferred learning styles. Finally, students' reviews were analyzed using a qualitative method to thoroughly understand the different groups of students that were identified in the previous quantitative stage. The previous related research presents the results of the quantitative analysis of the success characteristics, focusing on course level and the differences among them. This research paper focuses more on the qualitative analysis of the success characteristics from the students' point of view, in accordance with the defined groups of learners.

The findings of this research contribute to the knowledge in the field of MOOCs. Identification, sorting, and mapping of characteristics according to the CoI theoretical model may assist in improving MOOCs development and teaching and, consequently, will contribute to research and implementation of better MOOCs. In addition, the identification of students' characteristics will allow for better matching of MOOC characteristics to students' learning styles in the fields of software, sciences, and management.

Background

MOOCs and Their Quality

A MOOC is an online course conducted over the web and designed with an open concept for an unlimited number of students. In addition to the course materials (filmed lectures, reading material, and quizzes and assessments), MOOCs provide interactive forums to support community interaction between students, professors, and teaching assistants (Greene, Oswald, & Pomerantz, 2015; McAuley, Srewart, Siemens, & Cormeir, 2010). Two types of MOOCs have been identified: cMOOCs are based on the connectivist theory, and xMOOCs are based mainly on behaviorist theory (Siemens, 2012). xMOOCs are instructor-driven online learning environments offered by most MOOCs today. Grünewald, Meinel, Totschnig, and Willems (2013) proposed an evolution of the xMOOC that bridges the gap to the cMOOC model by developing tools that allow users to create diverging paths through the learning material, involve the user personally in the problem domain with (group) hands-on exercises, and reward user contributions by means of gamification.

According to *The New York Times* (Pappano, 2012), the year 2012 was the year of the MOOC. In 2012, edX, a Harvard and MIT startup without profit intentions, reached 370,000 students. Coursera was founded the same year and reached 1.7 Million students (and is growing faster than Facebook); Udacity, a startup by Professor Sebastian Thurn from Stanford, reached 150,000 students.

MOOCs appeal to very diverse populations: the ages of students range between 11 and 85 (Konrad, 2015; Weinzimmer, 2012). More than 40% of the students are under 30 years old, and less than 10% are above the age of 60 (Christensen et al., 2013). Significantly more men are registered (approximately 60%); in addition, 34.3% of the learners are from the U.S., 31% are from OECD countries not including the U.S., 14.8% are from BRICS (Brazil, Russia, India, China, and South Africa), and 19.9% are from other developing countries (Dillahunt, Wang, & Teasley, 2014).

In the light of the rapid growth of MOOCs and their integration in education, especially in higher education, the issue of MOOCs quality is a major concern (Yuan & Powell, 2013). Since MOOCs are online courses, their quality assessment can be based on online learning quality assessment methods. Shelton (2011) analyzed 13 research works on online learning quality as perceived by different institutes. He found that the most important factor (in 10 out of 13 research papers) is the institutional commitment, support, and leadership. The second factor was found to be the teaching and learning effectiveness, which focuses on the quality of teaching and learning.

The analysis of teaching and learning quality from the students' perspective is debated among scholars. Daniel (2012) is concerned that MOOCs' assessments will be consolidated into league tables that rank the courses, while Raban (2007) says that the competition between quality and improvement is not a zero sum game and suggests that modernizing quality assurance procedures is a solution. This will allow higher education institutions to take the risk of innovating. This statement is important, especially in the context of increased use of technology in learning in general, and specifically with MOOCs. MOOCs bolster innovation and the potential for an exciting learning experience that promotes social learning, but still have the risk of reducing quality levels. According to Conole (2013), there is still a need to develop good quality measures to better understand the way students communicate with a MOOC and experience it. That is one of the drivers for this research, combining distant learning theory and students' reviews, as found in the Coursetalk website.

CoI Model

The CoI framework theory of Garrison et al. (2000) is a model that represents the process of creating a deep and meaningful (collaborative-constructivist) online learning experience through the development of three interdependent elements: social, cognitive, and teaching presence, as displayed in Figure 1.

Social presence is "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009).

Teaching presence is the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes (Garrison et al., 2000).

Cognitive presence is the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse (Garrison et al., 2000).

Figure 1. CoI model (Garrison et al., 2000)

A number of research works have provided validation to the CoI model (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kozan, 2016; Mills et al., 2016). While there is still work left in validating the combination of presence elements within diverse populations (such as universities, professional development, and high schools) and disciplines, the framework has proved to be reasonably robust. Garrison et al. (2010) expect that the CoI model will be a predictor of learning processes and learning outcomes, both from the perspective of individual courses/programs of study and lifelong learning attitudes and participation. Shea and Bidjerano (2010) suggest adding an additional dimension to the CoI model: learning presence. They suggest that learning presence should include elements such as self-efficacy and cognitive, behavioral, and motivational abilities that allow online students to manage themselves.

Students' Learning Styles

The concept that students learn in different ways has been researched for decades. Among others, Claxton and Murrell (1987) identified different learning styles and found that adapting instructional methods to students' learning style can lead to improved learning. Gregorc and Ward (1977) noted that in order to address the needs of the individual learner successfully, educators must relate teaching style to individual learning preference. D. Kolb (1985) defined Learning Style Inventory (LSI), which identifies knowledge results from the combination of grasping and transforming experiences. The LSI model defines two modes of grasping experience – concrete experience (CE) and abstract conceptualization (AC) – and two modes of transforming experience – reflective observation (RO) and active experimentation (AE). Another typology of the physiological dimensions of learning styles is Visual, Aural, Read\Write, and Kinesthetic (VARK) (Drago & Wagner, 2004). Finally, Duff (2004) differentiates between students with deep approach and surface approach, among many more learning style models.

Felder and Silverman (1988) recognized that, although the diverse styles with which students learn are numerous, the inclusion of a relatively small number of techniques in an instructor's repertoire should be sufficient to meet the needs of most or all of the students in any class, while Coffield, Moseley, Hall, and Ecclestone (2004) made a recurrent criticism of the 13 learning style models and found that too much is being expected of relatively simple self-report tests. D. Kolb's list as modified by A. Y. Kolb (2005), for example, now consists of no more than 12 sets of four

words to choose from, and Richardson (2000) has pointed to a number of problems with this approach. Thus, Coffield et al. (2004) advise against pedagogical intervention based solely on any of the learning style instruments. Entwistle and Peterson (2004) developed a methodology where in-depth qualitative studies are used in conjunction with an inventory to capture a more rounded picture of students' approaches to learning. In addition, Neuhauser (2010) found no significant differences in learning style and effectiveness between online and face-to-face instruction, while Shea and Bidjerano (2010) found a positive connection between learners' self-efficacy and self-regulation measures and their ratings of their learning quality in virtual environments.

The literature emphasizes that MOOCs are based on active learner engagement in accordance with learning aims and objectives, as well as learners' earlier knowledge and skills (McAuley et al., 2010). However, xMOOCs and cMOOCS represent two distinct types of courses, pedagogically (Siemens, 2013). While xMOOCs emphasis is on scalability and addressing large classes, cMOOCs emphasis are on community and connections and are designed based on connectivism (Ravenscroft, 2011). There are researchers who argue that the xMOOCs might be better suited for studying a wide range of knowledge that can be learned through repetitive practice, while the cMOOCs enable learners to obtain "higher order creative skills" (Grünewald et al., 2013). Thus, these two pedagogical types should not be treated or evaluated in the same way (Daniel, 2012).

The Research

Research Goals and Questions

There are two main goals to the current research: the first is to identify the characteristics that contributed to the success of MOOCs and to classify them into one of the three CoI model presence elements: social, cognitive, or teaching. The second goal is to determine the learning preferences of the participants in MOOCs based on the characteristics that are mentioned in their reviews and to identify groups of learners with similar preferences.

Accordingly, the research questions are:

1. What are the characteristics that contribute to the success of MOOCs in the fields of software, sciences, and management, according to the students' perception?

2. What types of learners predominate, based on their descriptions of characteristics, for course success in the collected reviews?

Population and Research Field

Coursetalk (https://www.coursetalk.com) is the international source of students' reviews for online courses and MOOCs. The website is managed by AcademicsDirect and contains more than 40,000 courses and over 100,000 reviews. In order to explore the characteristics that contributed to successful MOOCs from students' perception, more than 3,400 reviews were retrieved from the Coursetalk.com website in 2016, regarding five courses in the fields of software, science, and management. All five courses received a 5/5 scale grade.

Partial demographic information was collected regarding the population of the five MOOCs that were selected. Since the exact information about the MOOCs' populations could not be found on the Coursetalk site, the information was collected from diverse sources. It was discovered that the general demographic information about MOOCs participants that is described in the background section above matches the information that was collected about the analyzed courses. Table 1 describes the MOOCs that were analyzed in this research, their populations, and the quantity of received reviews for each course. All analyzed MOOCs were considered to be xMOOCs.

Table 1. The analyzed MOOCs and their populations

MOOC name	Population	Reference	Initiative	Number of reviews
Introduction to Interactive Programming in Python	54,000 students from a large number of countries (e.g. Asia, Europe, and America) were registered for the first session of the course in October 2012. The student ages were between 11 and 72. A similar population was found in the 2015 course session.	Weinzimmer (2012)	Coursera	2,580
Epidemics - the Dynamics of Infectious Diseases	28,000 students participated in the first session of the course. 20% of them completed the course. The participants came from 158 countries. 25% of the students reported that they were employed.	Cohn(2014)	Coursera	330
The Science of the Solar System	2,000 students participated in the course.	Smith (2015)	Coursera	254
Introduction to Environmental Science	NA	NA	edX	230
An Introduction to Operations Management	87,000 students registered for the first session of the course. 7,000 of them completed the course. Students from all the continents except Antarctica participated in this course.	Barber (2013)	Coursera	109

Procedure

The research was conducted in two stages in accordance with the research questions, as described in Figure 2.

- The first stage focused on collecting the reviews and mapping the characteristics that contributed to the MOOCs' success. This stage was divided into four steps:
  (a) the reviews regarding the five courses were collected from the Coursetalk site using a dedicated Python programming language tool for this purpose. The tool enabled the automatic reading of thousands of students' reviews, spread over hundreds of web pages. The reviews were sorted, categorized, and saved using Microsoft Excel tables. The tables included the course name, the review content, the grade given by the reviewer, and information about course completion;
  (b) the words that appeared in high frequency were identified using R software and, while analyzing the text, conjunctions were removed and stemming was performed (removal of headers and endings from similar words such as read, reading, readings, etc.) (Lovins,

1968);
(c) a list of characteristics was built by combining similar words into attributes. In addition to the collection of data from the website, the researcher participated in the lectures, exercises, and forums of the five courses that were analyzed. This helped to improve the precision of the process of grouping words into characteristics;
(d) the characteristics were classified into one of the three presence elements: teaching, social, or cognitive, according to the CoI model.

- The second stage focused on clustering the students into groups with similar preferences, deduced from the characteristics mentioned in their reviews. This stage was completed using Cluster analysis (Kaufman & Rousseeuw, 2009). Subsequently, a qualitative analysis was performed in order to learn more about students' group preferences.

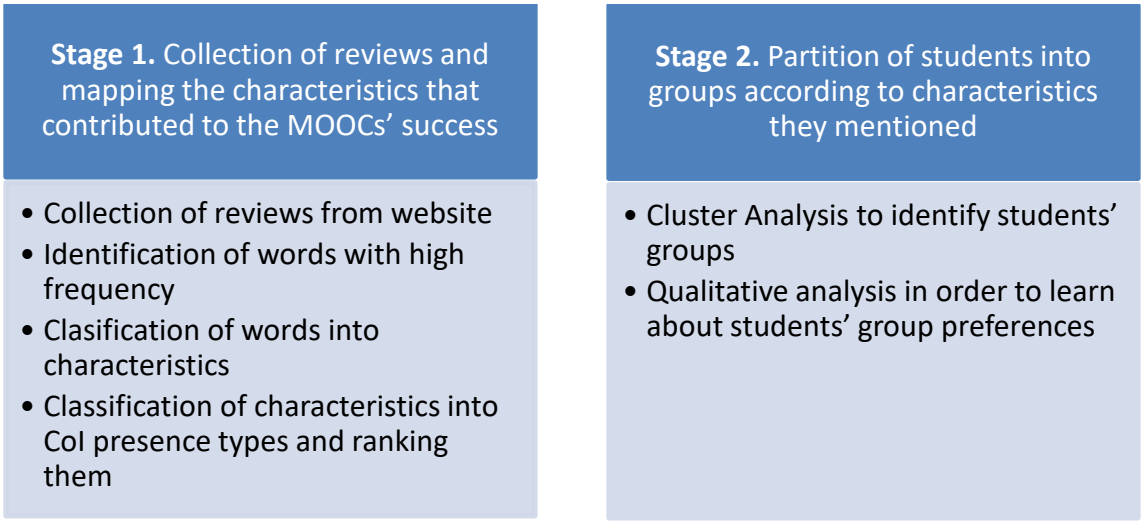

Figure 2. Research procedure

Research Method

The current research combined quantitative and qualitative analysis of the reviews (Johnson & Onwuegbuzie, 2004). It should be emphasized that it was assumed that the characteristics mentioned by the students were positive. The analysis of the reviews showed that only 1% of the students gave a grade lower than 4. In addition, 10% of the reviews with a grade higher than 4 were checked manually, and less than 0.1% of the characteristics mentioned were found to be negative.

Research Limitations

The main limitation of the research was the small number of courses that it was based on, although the courses included hundreds or thousands of reviews and a high score of 5/5. Thus, future research should be expanded to include additional courses. In addition, the reviews were collected from different sessions of the same course that were conducted during the last three years. Over this period, changes were probably made to the courses. The research is based on reviews from students that decided to post on the Coursetalk website and does not include all the students that participated in the selected courses. Not less important is the fact that the reviews on the Coursetalk website were mostly positive and related to learning from successful courses. Additional information from negative reviews in a similar quantity may add information to the list of characteristics that contributed to successful MOOCs.

Results and Discussion

The Characteristics of Successful MOOCs in the Software, Sciences, and Management Domains

The semantic analysis of the students' reviews created a list of relevant high frequency words. The words were manually grouped into characteristics. For instance, the words professor, teacher, and lecture were grouped into the characteristic called teacher. In total, 55 high frequency words were found and grouped into 14 characteristics. The following section presents the characteristics and their related words:

1. **Teacher** - Professor, lecture, teach, instruct, video, Joe, Scott, Christian, Terwiesch, Friedland, Andrew
2. **Exercise** - Project, game, build, exercise, practice, assignment
3. **Atmosphere** - Fun, entertain, humor, enjoy, passion, interesting
4. **Work load** - Work, hour, pace, week, time
5. **Peer assessment** - Peer, assess, review
6. **Complexity** - Complex, challenge, hard
7. **Forum** - Forum, discuss, community
8. **Exam** - Quiz, exam
9. **Support** - Assist, clinic, support, code-clinic
10. **Course content and organization** - Plan, organize, content, material
11. **Tools** - Codesku, tool
12. **Platform** - Coursera
13. **Material** - Paper, read
14. **Illustration** - Animation, trip

The quality of the manual grouping of words into characteristics was checked with the Chi square test, which analyzed the interdependency between the characteristics. The results yielded significant differences among the characteristics ($p<0.001$). After the quality of the characteristics' grouping was verified, the defined characteristics were sorted to find the most significant contributors to course success, and they were then classified according to the CoI model. The analysis of the MOOCs**'** reviews revealed the four leading characteristics to be teacher, exercise, atmosphere, and work load (in this order). Table 2 displays the rank of the characteristics, classified into the different presence elements. The empirical findings strengthen the CoI model by Garrison et al. (2000), since it was found that the top three characteristics are divided between teaching, social, and cognitive presence elements.

Although Siemens (2012) claims that xMOOC emphasizes a traditional learning method using video presentations and short quizzes, it can be seen that all three presence elements appear in the analyzed xMOOCs. Furthermore, as expected, the results show the significant influence of each presence element on course quality. It can be seen that the social presence element is significant, yet smaller than the other elements (23% for social presence, versus 36% for the cognitive and teaching elements). It is logical that in online learning, where there are no face-to-face meetings, the social presence element will be lower rated than other presence elements. The results show that the social presence element is not zero, as assumed by MOOC critics. In addition, there is a slight influence from the technological presence, as described by Anderson and Dron (2010). These findings support the claim that constructing a successful MOOC can be accomplished by including all of the presence elements.

Table 2. The characteristics that contributed to the success of MOOCs, sorted by their rank and grouped into presence elements

Presence element	Characteristic	Percentage (rank)
Teaching	Teacher	56
Social	Atmosphere	40
Cognitive	Exercise (project)	38
Cognitive	Work load	35
Teaching	Planning and course material	20
Cognitive	Complexity level	14
Teaching	Exams	12
Social	Forum	11
Technology	Tools	6
Technology	Platform	6
Social	Support	5
Cognitive	External reading material	4
Social	Peer review	4
Teaching	Illustration	3

Looking at the accumulative percentage of the characteristics classified into presence elements (Figure 3), the findings indicate that all three presence elements are of significant value: the teaching and cognitive presence elements reached 36% each, while social presence was 23%, and technological presence was 5%. This emphasizes the point that the findings of the current study strengthen the CoI model.

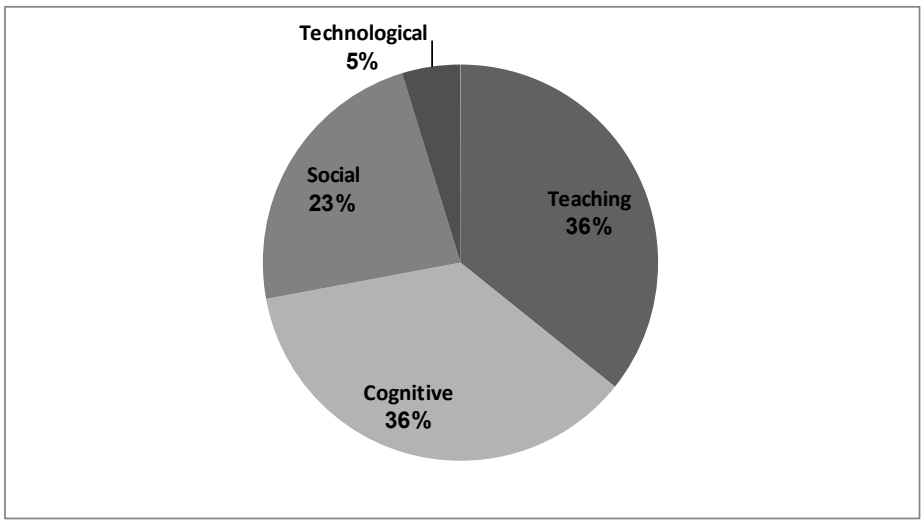

Figure 3. Accumulative percentage of the characteristics classified into presence elements

Types of Students with Similar Learning Preferences as Reflected in Their Reviews

This section presents groups of students with similarly mentioned characteristics that they perceived to be in a successful MOOC. These groups were created using k-means cluster analysis. First, four groups of students were tested through the analysis in order to fit the presences of the CoI model (social presence, cognitive presence, teaching presence, and no presence preference). This revealed a weak model (27.5%). Five groups were then tested, which revealed a fair model (35.8%). As presented in Table 3, the first group of students (N=633) mentioned mainly the atmosphere, which is related to social presence as a success factor. The second group (N=1,054) did not mention any specific characteristic. The third group (N=595) mostly mentioned exercise, which is related to the cognitive presence. The fourth group (N=838) mentioned teacher, which is related to the teaching presence; and the fifth group mentioned teacher and exam (N=340), which were both related to the teaching presence.

Table 3. Cluster Analysis - Grouping the students by success characteristics that they mentioned (without variables that have values lower than 0.1)

Group / Characteristics	Social N=633	No data N=1,054	Cognitive N=595	Teacher-Teaching N=838	Exam - Teaching N=340
Teach	0.86	0.00	0.45	1.00	0.86
Exercise	0.77	0.00	1.00	0.00	0.71
Atmosphere	1.00	0.20	0.15	0.34	0.53
Work	0.69	0.15	0.37	0.21	0.69
Assessment	0.02	0.02	0.03	0.02	0.04
Complex	0.23	0.06	0.16	0.12	0.28
Forum	0.20	0.03	0.10	0.11	0.23
Exam	0.00	0.03	0.03	0.03	1.00
Course content and organization	0.22	0.15	0.21	0.24	0.21
Tools	0.05	0.01	0.04	0.02	0.10
Platfrom	0.09	0.02	0.04	0.08	0.11

Figure 4 graphically presents the data described in Table 3 by using Linear Discriminant Analysis (LDA) (Klecka, 1980). This method illustrates the separation between the resulting clusters on a centroid plot, opposing the 1st and 2nd discriminant functions. Projection of the data onto the first discriminant axis (LD1 - Linear Discriminant 1) has the highest class separation onto the second discriminant axis (LD2). When LDA is used for dimensionality reduction, the data can be projected on the first two axes, and the remaining axes are discarded. LDA shows that the separation between the five groups on the x axis is fair (54%), but not optimal on the y axis (25%). The first group of students (N=633), appearing in black, mentioned mainly the atmosphere. The second group (N=1,054), appearing in red, did not mention any specific characteristics. The third group (N=595), appearing in green, mentioned mostly exercise. The fourth group (N=838), appearing in royal blue, mentioned teacher; and the fifth group, appearing in dark blue, mentioned teacher and exam (N=340). In addition, group number One (black) is less separated from the other groups since students that mentioned the atmosphere also mentioned the teacher and exercise that created it. According to LDA, the separation percentages are: LD1 -54%, LD2 -25%, LD3 -16%, LD4 -3%. Figure 4 shows separation on the horizontal axis using LD1 and on the vertical axis using LD2.

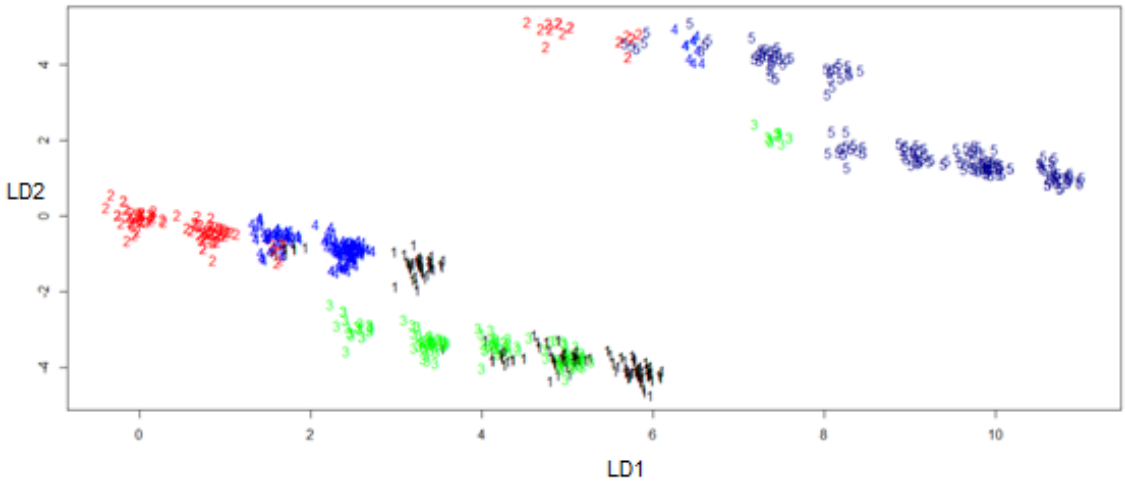

Figure 4. Student groups by mentioned characteristics

It can be seen that the students were grouped into five groups based on the characteristics that they mentioned in the reviews: atmosphere, exercise, teacher, exam, or none. These characteristics were divided between the social, cognitive, and teaching presence categories. These results are aligned with the theoretical model by Shea and Bidjerano (2010) that adds learning presence to the CoI model by Garrison et al. (2000). Learning style models have been very common in the literature for many years (Curry, 1983). Students' review data was used to find that the students can be partitioned into groups according to the characteristics that they mentioned, which in turn can indicate their learning style. A good separation (although not perfect) was found between the different groups of students. This level of separation among the groups can be explained by the fact that many students have more than one preference. This is aligned with Lujan and Dicarlo (2006), who claim that most students have multiple learning styles, and with Kraetzig and Arbuthnott (2006), who found that students use different combinations of learning models to learn effectively. An exception to the clear separation is the group of students that preferred the atmosphere characteristic (first group) and gave significant values to the teacher and exercise characteristics. In this case, it is assumed that the atmosphere is created by the teacher and the exercise.

It should be noted that forum characteristics, which might represent collaboration between learners, was identified as a contributor to MOOC success. This is in alignment with the CoI model which is based on collaborative-constructivist theory. Collaborative learning is usually associated with activities on forums or joint work on tasks or projects. However, the cluster analysis grouped the learners based on atmosphere, exercise, teacher, and exam characteristics, while forum characteristics was not identified as representing one of the learner groups and project characteristics was not mentioned explicitly.

Qualitative Analysis of Student Reviews in Each Revealed Group

Each group of students that was found in the quantitative analysis previously presented was mostly characterized by one presence. In this section, a thorough description of these groups will be given by using a qualitative analysis of the students' reviews. The reviews were analyzed according to the characteristics that were identified as dominant in each group: atmosphere, exercise, teacher, and exam. Notably, each review could possibly contain a description of more than one characteristic.

The group that perceived the importance of atmosphere for course success

This group of students emphasized the importance of the atmosphere characteristic. The students in the Python course mentioned the importance of humor, fun, and games in improving their learning capabilities. The following citation illustrates this perception:

"It was fantastic. The instructors were engaging, funny and thorough. They always look like they're having so much fun! I learned a lot about Python and how to write code for interactive games."

Additionally, in the same group, the students in the Epidemics course mentioned the importance of entertainment by using different kinds of video and animation to help students focus their attention:

"I'd taken a few other [C]oursera courses before this one but this [was] by far the most entertaining and engaging course. The animations in the videos and the different instructors keep your attention and help make the more difficult concepts easier to understand."

The students in the Environment course mentioned the added value in communication with students around the globe:

"Great experience! Highly recommend this to anyone… It was interesting to read student feedback as students were from around the world and from different walks of life."

The students of the Solar System course mentioned the importance of the combination between interesting material, the teacher's in-depth knowledge and passion, and humor, which helped engage students in learning:

"This is a phenomenal course. Mike Brown is a passionate professional in this field and brings both knowledge and wry humor to the subject. The material presented is absolutely fascinating and leaves you hungering [hungry] *for more!"*

Finally, the students in the Management course mentioned the importance of engaging the curiosity of the students:

"*In each of the modules covered, Prof*[essor] *Terwiesch was very good at engaging us to learn and exciting us with curiosity to calculate those seemingly very complex and difficult operational problems."* [This quotation was edited for grammar]

In all of the researched courses there were students that emphasized the importance of enjoyment as a significant factor in learning engagement. A variety of methods contributed to students' enjoyment of the different courses. The courses used humor, games, curiosity, animation, interesting video, various instructors, and more.

In the group that mentioned the atmosphere characteristic as significant for learning, it can be seen that for many of the students, atmosphere is composed of humor and of additional components such as curiosity, diversity, and interest. The importance of humor, engagement, and curiosity for this group of students is in accordance with other research (Harasim, 2000; Mclnnerney & Roberts, 2004; Poole, 2000) that identified the sense of belonging to community as a significant component that affects student participation, engagement, and attitude towards online learning. As well, Han and Johnson (2012) found correlation between emotional intelligence and social connections and between interactions in online learning.

The group that perceived the importance of exercise for course success

This group represents students that perceived the importance of the exercise characteristic. Students from the Python course mentioned that exercise, which includes building games, is a motivator for learning. In addition, they said that even though the course included intensive work, the enjoyment of building the project created motivation for the exercise and resulted in a significant learning experience:

"What makes the course engaging is that it uses game programming as the basis for homework and project assignments. ...I actually learned some interesting things I wasn't expecting to learn."

"Instead of developing complex[,] statistical algorithms, the professors make you write (and evaluate) games!"

Students from the Epidemiology course also mentioned the importance of games and animation as motivators to complete the exercises and learn during the course. They found that the games created motivation for investing more hours in doing exercises that they enjoyed, which contributed to the learning.

"…try out the mobile/Simulation Vax game, you would definitely put in more workload hours and find this course even more enjoyable."

The students from the Environment course agreed that the lack of exercises hurt their learning experience. However, the students in the Solar System course mentioned that the challenging exercise was very satisfying, due to the feeling of having successfully coped with the challenge, and they emphasized that it caused them to experience satisfaction from the learning. They also emphasized that there was a particular level of complexity that enabled the exercise to be difficult but not impossible and that contributed to their satisfaction from the learning.

"At first, I had some doubts about the type[s] of questions in the homework. I've decided they [were] more thoughtfully crafted than I [had] originally thought. The course requires more time and application than I expected. Also[, it] leaves me feeling more satisfied than I would have [felt] otherwise."

"Each homework [assignment] is pitched (IMHO) at the right difficulty to make me think, but not to discourage me from returning week after week."

Moreover, the students in the Management course described two different methods of exercise in their course. The first method included a project with a practical implementation that contributed to students' learning. The second method included a questionnaire for students that preferred a lighter workload that contributed to learning course terminology.

"I took the easy route and just completed the course by doing the homework and not by performing the case study (which is much more rewarding but a lot more work!). I found the homework to be very easy and fast because Prof. Terwiesch had similar examples in his lectures. He clearly wanted the course to be very accessible to all." (This quotation was edited for grammar)

It can be concluded that the courses that had exercises involving games resulted in positive student engagement, extensive investment, and deep understanding of the material. In addition, the students mentioned that challenging but level-appropriate exercises caused a feeling of achievement. Moreover, students that elected to complete the practical project experienced a significant learning experience, while students in courses that lacked challenging exercises described them as needing improvement.

Many of the students in this group, which mentioned the exercise characteristic as an enabler of significant learning, found that the game exercises resulted in engagement, significant investment, and deeper understanding of the learning material. Moreover, the students mentioned that challenging but reasonable exercises generated a feeling of achievement. Students that selected practical projects as exercises experienced significant learning. This finding is in alignment with Cook (2005), who claims that teaching methods that involve interactive games might fit the requirements of active students, according to the definition of LSI by D. Kolb (1985), who are expected to be more successful in an online interactive learning environment.

The group that perceived the importance of teacher for course success

This group emphasized the importance of the teacher characteristic. The instructor was found to be a dominant factor for MOOC success in all the courses used for this study. Students from the Python course stated the importance of teachers who use entertainment and humor in their teaching for the purpose of engaging students; additionally, the creation of a challenge, clear explanations, and creation of the feeling that the tasks are feasible were important.

"The teaching staff was fabulous and [they] designed [the] course in a way that we never feel that things are getting out of reach..."

"... and because of the funny and engaging teaching style[,] it's never boring."

The students in the Epidemiology course mentioned the added value in the variety of instructors. They also emphasized the importance of the teachers' expertise, their enthusiasm, and the quality of their explanations. They mentioned the thorough coverage of subjects and the combination between theory and practical examples.

"Absolutely loved the way the instructors taught and explained. Each had their own style and enthusiasm."

"Professors covered a wide range of topics and strengthened the impact of presented theory with well-chosen, real world case studies. Great to have a class taught by so many different experts!"

The students in the Environment course mentioned the fact that the teacher explained complex ideas in a simple manner, created a pleasant atmosphere, and was available to respond to questions in the forum.

"I enjoyed the course very much and the instructor explained the complex phenomena in such an easy way that I was able to clearly understand the concepts." (This quotation was edited for grammar)

"Professor Friedland's easy manner made the learning experience not just unintimidating, but pleasant. The professor and staff engaged constructively in the discussion forum."

Additionally, the students in the Solar System course emphasized the enthusiasm the teacher had for the subject he was teaching, his ability to create curiosity among students by asking questions, his thorough knowledge, and his ability to engage students in the learning.

"Prof. Mike brings his passion for astronomy to every lecture[;] it will leave you with more answers, and more questions [than] you ever dreamed [of]."

"The instructor is engaging and knowledgeable..."

The students in the Management course also mentioned the importance of enjoyment in learning, of humor, of clear explanations, and of practical examples.

"I had [a] fantastic time learning with Prof. Terwiesch! His humor was hilarious and he made the course very interesting and pertinent with everyday examples."

The students who mentioned the teacher characteristic as central to the learning process described the contributing elements: engagement of students by using humor, entertaining, good atmosphere, creating a feasible challenge, explaining complex concepts in a simple manner, and participating in the forum. From the analysis of the reviews one can understand the importance of the teacher characteristic to these students. This finding is aligned with Garrison and Cleveland-Innes (2005), who claim that teaching presence provides the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes. It is also aligned with Cook (2005), who claims that online learning will fit the reflective student, according to the LSI definition by D. Kolb (1985), due to the asynchronous and independent nature that allows the student to progress at his/her own pace.

The group that perceived the importance of exam for course success

This group of students emphasized the importance of the exams for course success.

The students in the Python course mentioned the complexity of the quizzes, which prepared them for higher quality learning. The same is true for the alignment between the quizzes and the projects, which enabled the students to learn the subject, build the project, and understand the course material.

"The amount of material offered, in term[s] of quizzes, mini-projects[,] and pedagogical tools, is pretty phenomenal for a MOOC... The quizzes are usually longer, better elaborated[,] and more complex than what I've seen elsewhere."

"...every question on the quiz was aimed to help with [the] mini-projects!"

The students in the Epidemiology course mentioned the importance of quiz complexity, which enabled thorough learning. In addition, the flexibility of the schedule for completing the tests allowed the students to close the learning gap.

"The quizzes were challenging and made me really think."

"Furthermore, the flexible quiz deadlines did not exert pressure on me, so I had the opportunity to determine the time I wanted to allocate to each module according to my schedule and complete the quizzes when I wanted."

The students in the Environment course also said that the exams helped in understanding and structuring learning.

"They check your understanding and weekly quizzes help us to reinforce whatever we have learned."

The students in the Solar System course mentioned that the quizzes tested their understanding thoroughly and did not simply repeat the lecture content.

"The quizzes weren't the usual bland checks [of information] that one had listened to [during] the lectures[,] but required me [to] really examine what I thought I knew. The inter lecture questions really helped me stay on track."

Finally, the students in the Management course mentioned the combination between lectures, examples, exercises, and quizzes.

"There are plenty of examples in the lectures and more for practice at home. These examples helped me solve the assignment questions."

The group of students that mentioned the exam characteristic as significant to the learning process emphasized the importance of the complexity of the quizzes and the importance of the connection between the lectures, the exercises, and the tests for structured learning. Here, also, the qualitative analysis helps to understand the nature of the exam characteristic as a contributor to learning. This is aligned with Howland and Moore (2002), who suggest that online courses enable flexibility for students that need more feedback and scaffolds, and with Mupinga, Nora, and Yaw (2006), who recommend performing exams frequently to enable consistency. To support this they recommend automatic or peer reviewed exams.

The qualitative analysis of students' reviews strengthens the quantitative findings regarding the student groups that were identified. The student groups preferred atmosphere, exercise, teacher, and exam. However, in most cases, students from all the groups mentioned one or more of the following characteristics in their review: atmosphere, teacher, course content and organization, exam, complexity, workload, exercise, illustration tools, and forum. For example, the following review that is related to the group that mentioned exercise as an important characteristic, also mentioned teacher, course content and organization, forum, workload, and auxiliary material characteristics: "Wonderful presentation, interesting facts, and this course had something for everyone. If you decided to read the extra recommended articles, participate in the various thought provoking discussion boards, or try out the mobile/Simulation Vax game, you would definitely put in more workload hours and find this course even more enjoyable. Great job to the entire team! I have prior medical education and experience and this course was not as technical as a few other science courses that I previously completed through Coursera."

Conclusions

The findings show that the characteristics that contribute to successful MOOCs are teacher, exercise, atmosphere, and workload. These characteristics are part of the three CoI model presence elements: teaching, social, and cognitive. In the analyzed MOOCs the three presence elements have significant values (teaching 36%, social 23%, and cognitive 36%). Similarly, the students were clustered into three groups (teaching, social, and cognitive), indicating their main preferences. These findings negate the perception that xMOOCs mostly contain teaching presence elements.

The qualitative analysis of students' reviews shows that many participants, taking part in the same course, mentioned different characteristics that contributed to their learning. The characteristics students chose to mention may indicate their learning preference. In addition, there are students that mentioned a few characteristics that contributed to the success of the course, yet only a few students mentioned a single characteristic. This is aligned with the quantitative analysis that found an overlap between the groups, with Lujan and DiCarlo (2006), who found that most students prefer to use more than one form of data presentation, and with Grünewald et al. (2013), who claim that MOOCs contain video presentation, text, and opportunities to take an active part in learning and social interaction, enabling the support of different learning styles. Furthermore, it can also be seen that the students were more appreciative of the learning when the course was more challenging and it strengthened their self-efficacy.

The current research identified, sorted, and mapped the characteristics of good MOOCs according to the CoI model in order to assist in improving MOOCs development and teaching and, consequently, will contribute to implementation and research of better MOOCs. Furthermore, the identification of students' characteristics sheds light on students' learning styles and preferences, which may assist in better matching of MOOCs to students' needs.

Future research could analyze how MOOCs allow students to consume content according to their different preferences, as well as using students' online reviews to improve MOOC pedagogy.

Additionally, since the CoI model is based on collaborative-constructivist theory and since forum characteristics might represent collaboration between learners, it was identified as a contributor to MOOC success. However, the findings clustered the learners into groups based on atmosphere, exercise, teacher, and exam characteristics, which do not represent collaborative learning; therefore, further research is needed to focus on analyzing the reviews that may be associated with collaborative learning.

These finding are different from the common perception that MOOCs contain mostly teaching presence elements (Guo, Kim, & Rubin, 2014), and they comply with Ally (2004), who foresees that online learning material will be designed in small, coherent slices to allow for redesign according to different students and different contexts. The findings also comply with Ocepek, Bosnić, Šerbec, and Rugelj (2013), who claim that learning style is the most important parameter in the students' selection of online materials.

Due to these findings, we recommend that MOOC scholars and implementers take into account the different learning styles of students when designing and researching MOOCs, so that the learning material will allow students to choose between teaching, social, and cognitive presence elements. Such a design will enable the students to maximize the benefits of MOOCs.

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