# MOOCs—A Powerful Tool for Imparting Climate Literacy? Insights from Parleys with Students

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**Abstract** Climate literacy is a key impetus for triggering individual behavioural and societal change. Massive Open Online Courses (MOOCs), at first glance, entail a multiplier effect for climate literacy as they are recognized for offering non-formal learning opportunities to a wider audience. However, throughout the recent years MOOCs have been under manifold criticism from various corners challenging their educational value. A remedy for shedding light on the question whether MOOCs are a powerful tool for climate education is to bring in the students' perspectives on and experiences with MOOCs. These findings disclose the recipients' perceptions and give empirical evidence to assess the incorporation of non-formal learning into the students' learning context. Empirically, the chapter is based on 35 interviews conducted with students who participated in an English-speaking MOOC about interdisciplinary perspectives on climate change. The interviewed students represent a variety of different nationalities and academic backgrounds. During the semi-structured interviews, the students revealed diverse reasons for their participation in the MOOC, multiple learning outcomes and manifold opinions regarding the use of the MOOC in their personal learning context. This allows concluding that, albeit MOOCs are a promising tool for climate change education, they require a deeper understanding by incorporating the students' perspective.

**Keywords** Climate literacy · MOOCs · Climate change · Distance learning Interdisciplinarity · Students · Climate education

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## Introduction

If remaining scepticism about climate change needed to be eradicated, the latest IPCC reports wiped it away and pointed to its devastating effects (IPCC 2014). In addition, the amplified accuracy of the IPPC's models allows impact prognoses regarding the local short and middle range consequences for different countries and regions. Although this modelling process is still in an early phase, it can facilitate policy decisions on mitigation and adaptation strategies (Piontek et al. 2014).

Hence, while climate impact research delivers valuable data to formulate strong responses in terms of mitigation and especially adaptation, it falls short in generating a fundamental change of consciousness that needs to be triggered in societies all over the globe. This is the case for countries in the global South as well as in the global North. Utilizing and disseminating the idea of climate literacy in formal and non-formal education is a key impetus for a change in individual and societal behaviour towards climate change. Despite the fact that the classical educational system is the first important lever for climate literacy, Massive Open Online Courses (MOOCs) have turned out as an intriguing new and innovative tool to open up education (Bell et al. 2017; Diver and Martinez 2015; Jona and Naidu 2014; Liyanagunawardena et al. 2013). MOOCs can be either understood as complementary to or reaching beyond the educational system. One reason for the latter is that MOOCs are attributed to support informal learning (Fidalgo-blanco et al. 2014; Sangrà and Wheeler 2013). For some scholars informal learning is even perceived to be more pervasive than formal learning as it surpasses formative organized and controlled learning (Bates 2014). Especially the integration of social media in MOOCs has opened the door for informal learning, albeit hitherto the learning impact assessment lacks solid empirical findings. Notwithstanding this debate, MOOCs are predominantly described as instruments for non-formal learning (Bates 2014; Fidalgo-Blanco et al. 2016).

MOOCs are an important instrument to improve the openness and inclusiveness of education (Boyatt et al. 2014; Rodriguez 2013). Everyone in possession of a mobile device and an internet connection becomes the potential target group of a MOOC, in particular if the topic of the MOOC is of relevance or triggers curiosity. Using MOOCs to spread the idea of the urgency to tackle climate change and appropriate solutions thus make them prima facie a promising tool for climate literacy. However, a glance at the published literature demonstrates that the students' motivation to learn about new topics in MOOCs as well as to complete them are manifold and thus require further empirical review (Hew and Cheung 2014; Wang and Baker 2015).

In a nutshell, the current appraisal of MOOCs, generally speaking, is hitherto ambivalent (de Langen and van den Bosch 2013; Ebben and Murphy 2014). While some hype them as a disruptive technology that changes educational access and costs, others utter disbelief that MOOCs serve as an innovative model for education (Baggaley 2013, 2014; Bell et al. 2017; Fischer 2014).

The objective of this chapter therefore is twofold in critically assessing and discussing the added value of MOOCs and to evaluate its potential for fostering climate literacy. The latter is pivotal as climate literacy's "acceptance into mainstream discourse is relatively recent" and exploiting adequate educational approaches is a compelling necessity (Arndt and LaDue 2008). Furthermore, albeit extensive literature on MOOCs exists, only few contributions deal with interdisciplinarity and the quality of learning about climate change as a matter of priority (Burch and Harris 2014; Otto et al. 2016).

Core argument of this chapter is that hitherto no in-depth understanding exists of how students benefit from their participation in MOOCs. Learning motivation and learning experience of students need an enriched understanding. One cause of this criticism is rooted in the paucity of adequate qualitative data to excavate the educational use of MOOCs (Otto et al. 2016). Predominantly, quantitative data is presented to assess the success of MOOCs. Only gradually the benefits of qualitative analysis of MOOCs is becoming manifest (Abeer and Miri 2014; Liu et al. 2015). As Fischer argues, one reason could be rooted in the fact that MOOC providers do not necessarily collect the data deemed the most relevant by educators, "as with many data collection efforts, the data collected are those that are the easiest to collect, not necessarily the most relevant ones" (Fischer 2014, p. 150). Similar Veletsianos and George in their systematic analysis of MOOC literature find that "very few studies were informed by methods traditionally associated with qualitative research approaches (e.g., interviews, observations, and focus groups)" and that the current state of knowledge is based on an overwhelming dependence on particular data collection and analysis methods (Veletsianos and Shepherdson 2016). As a consequence, they urgently demand an expansion of the methodological approaches used for MOOC research.

For the case of climate literacy, qualitative data permits to unveil the mundane utilization of MOOCs by the students. For instance, how do students make use of MOOCs in their informal and personal learning environment? Is there a perceived benefit in taking MOOCs about climate change for their formal education? Empirically, the chapter builds on data derived from a MOOC about "Climate change—a question of justice". In addition to a quantitative evaluation, 35 interviews with students were conducted and evaluated to divulge their experiences. Qualitative content analysis was used to cluster the semi-structured interviews and carve out general trends.

For the structure of the chapter, in the first section MOOCs and their relevance for climate literacy are discussed. Criticisms as well as aptitudes are balanced against each other. In the second section, the content and scope of the MOOC is offered. The methodological approach is outlined to render how the data was obtained and evaluated. In the third section, the findings are presented and discussed. Finally, conclusions for further development of MOOCs are drawn against the background of these findings.

## MOOCs as a Tool for Improving Climate Literacy

Intuitively supposing that climate literacy is a recent phenomenon devoted to the mounting importance of climate change is a misconception. Early efforts to promote climate literacy can be dated back to the International Geophysical Year (IGY) of 1957–1958, when the U.S. National Academy of Sciences published a science education publication. The brochure emphasised that the alternation of the natural greenhouse effect can have dramatic impacts on the Earth's climate.[1] In accordance with the scientific evolvement, climate literacy has advanced to make a significant contribution to the public understanding of the human impact on the climate.

The National Oceanic and Atmospheric Administration (NOAA) in 2009 published a book formulating the claim that a climate-literate person (GCRP 2009)

- understands the essential principles of Earth's climate system,
- knows how to assess scientifically credible information about climate,
- communicates about climate and climate change in a meaningful way, and
- is able to make informed and responsible decisions with regard to personal actions that may affect climate.

Based on these principles, a diversity of Non-Governmental Organisations (NGOs) and research as well as educational institutions on all levels have spurred the idea that students, teachers and lifelong learners become climate literate citizens. For instance, the Earth Day Network (EDN) is launching a campaign for global environmental and climate literacy for the Earth Day in 2020.[2]

Albeit the idea of climate literacy is spreading, it still faces important hurdles and limitations. One problem is the common misconception of the scientific background of climate change (Harrington 2008). Another problem is the stagnant public confusion about the degree of scientific consensus around the human impacts on the climate system, especially in the US (McCaffrey and Buhr 2008).

However, leaving aside the misunderstandings and misconceptions about the contents of climate literacy, the manner of how to convey knowledge to the target audience is likewise a pivotal question. In a globalized world, characterized by a turn towards a technical and knowledge society, new ways of learning emerge as compelling (Stromquist and Monkman 2014). The digital evolution has triggered a disruptive change in education. Widespread and fast internet services have produced various new digital learning opportunities like virtual learning environments and communication tools. Physical presence in educational institutions can thereby be reduced or even replaced by blended learning or virtual seminars. Virtual mobility is a recent trend permitting the students to take a course abroad without leaving their home university (Becker and Otto 2016; Salgado et al. 2012). Students nowadays are capable to create their own personal learning environment and by this means tailor what and how they want to learn. This has likewise elicited new

[1] http://cpo.noaa.gov/OutreachandEducation/ClimateLiteracy.aspx.

[2] http://www.earthday.org/campaigns/education/global-environmental-climate-literacy-campaign/.

educational innovation in climate change education like the use of digital storytelling or simulation and serious games (Otto 2014, 2017; Powers and Kirkpatrick 2012; Tobias and Fletcher 2012).

MOOCs have evolved to be a major contributor to the educational debate in the recent years (Diver and Martinez 2015; Fischer 2014). At the time when Dave Cormier from the University of Prince Edward Island first coined the term MOOC in 2008, describing a course about Connectivism and Connective Knowledge (CCK08), not many people might have been attentive to the educational implications (Liyanagunawardena et al. 2013). A fundamental notion is that MOOCs provide online courses open for everyone to join. The only precondition is to possess a computer or mobile device. Whereas a MOOC course, with varying duration between 4 and 12 weeks,[3] is free of charge, certification is usually fee-based. In the last years, the number of MOOC providers has incrementally increased using hosting platforms like Coursera, Udacity, or edX (Jansen and Schuwer 2015). Topics for MOOCs are manifold ranging from Biomimicry to Spanish for Beginners.

Hitherto, almost 10 years of intensive debate, inside and outside the scientific community, have not led to a final conclusion on whether MOOCs are rather a "disruptive innovation or a disturbing invention" (de Langen and van den Bosch 2013). Whereas a peak of the euphoria was reached when the New York Times called 2012 the "year of the MOOC", at the end of 2013 the Washington Post already declared the hype as exaggerated (Pappano 2012). However, the appearance of MOOCs in open and distance education has radically changed the way opening up education and distance education is discussed.

A more sober-minded look at MOOCs suggests that the reality lies somewhere in-between the range of euphoria and disillusionment. Overtly, there still is no clear agreement on a core definition of MOOCs. What can be classified as a MOOC is imprecise, for example the threshold of when a course can be characterized as 'massive'. Massiveness in MOOCs is often equivalent to far more than 10,000 inscribers. This simultaneously yields the consequence of high attrition rates among the participants. Taking into account the different methodologies, the percentage of MOOCs completion rates is around 7 and, in some cases, as low as 0.8 (Jordan 2015). Almost no big MOOC provider displays completion rates over 10% (Khalil and Ebner 2014). Articles addressing the challenge of high attrition have presented various strategies to cope with the problem, some of the most favouring methods suggested are accommodating students on different time tables, encouraging student completion and to enhance the interaction among the students and the interaction of students with their instructor (Khalil and Ebner 2014). However, furnishing proof of fruitful ways to lower attrition is enduring. This may be rooted in the fact that MOOC enrolment is easy while unsubscribing is not deemed necessary. Furthermore, various reasons for enrolment may exist which may not be congruent

[3]For example: http://www.uab.cat/web/study-abroad/mooc/plan-and-design-a-mooc/plan-the-course-1345668290863.html or https://uqx.uq.edu.au/content/educators.

with the providers' expectations, for instance certification. DeBoer et al. (2014) emphasize that "the massive open nature of MOOCs may be so different from traditional educational environments that terms like enrolment or dropout may need to be reconceptualised."

Openness of MOOCs is correspondingly an important term that needs elucidation (Boyatt et al. 2014). While openness is acknowledged to be a central characteristic of MOOCs, the debate on to what extend the different educational formats of MOOCs enable openness is ongoing (Alraimi et al. 2015; Mackness et al. 2010). Didactically, this has manifested in a dualism between cMOOCs and xMOOCs (Margaryan et al. 2015). While the dominant pedagogical model, called xMOOCs, is echoing classical teacher-oriented university courses, cMOOCs differ as they follow a connectivist learning approach intended to encourage interaction between the students. No clear answer has been given about a consistent pedagogical model for MOOCs (Baggaley 2013, 2014). This dualism is accompanied by the attribution of MOOCs as non-formal or informal learning. MOOCs are predominantly characterized as instruments for non-formal learning (Bates 2014), on the other hand cMOOCs endeavour to blur the barriers between the learning activities of students in MOOCs and their daily activities, for instance the use of social media (García-Peñalvo et al. 2015).

In a nutshell, notwithstanding many key issues in the debate remain open; MOOCs nevertheless perpetuate their role as a focal point for future learning: "Even the loudest critics of MOOCs do not expect them to fade away" (Fischer 2014).

This chapter is therefore intended to provide a deeper look at the target group of MOOCs: the students. Despite the fact that vital discussions about the future pedagogical model of MOOCs are important, the debate about what students really pursue with MOOCs is often neglected. What is the learning motivation and how do students assess their learning outcomes and the further use of their MOOC participation. In the case of climate change, disclosing the students' experiences with MOOCs can lead to a more differentiated picture and be valuable to determine the use of MOOCs to improve climate literacy.

## A Brief Note on Methods

Whereas a variety of studies about MOOCs occur using quantitative data analysis (Liyanagunawardena et al. 2013), there is a dearth of qualitative analyses about the students' learning experiences with MOOCs (Abeer and Miri 2014; Otto et al. 2016; Zheng et al. 2015). This is particularly true for the case of climate change.

The findings presented in this chapter are based on 35 interviews with students who participated in the MOOC "climate change—a question of justice" that was conducted in 2015. Overall, 2908 students participated in the MOOC, 302 of them earning a certificate at the end of the course. This leads to a completion rate of around 11% which is in the range of completion rates of MOOCs that can be found

in the literature (Jordan 2015). The students represented 78 countries ranging from Albania to Zambia.

The MOOC aimed to provide the students the competences to be critical observers of the 21st Conference of the Parties (COP) held under the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015.

The MOOC was offered by the FernUniversität in Hagen in cooperation with the Lund University in Sweden. Using the dominant pedagogical model, the course was designed as an xMOOC (using an instructional design), and ran eight weeks in anticipation of the start of the COP in Paris. The MOOC entailed eight units with four video lectures, each being approximately ten minutes long. Virtual forums were provided to spur the discussions between the students all supervised by a tutor. Supplementary material like access to scientific articles was offered and a weekly consultation hour took place with the lecturers. For the validation of their knowledge and to obtain a certificate multiple-choice quizzes were provided for each of the units. To obtain a certificate for the MOOC, the students had to watch at least 80% of the lectures and successfully complete the multiple-choice questions for each unit with a success rate of at least 80%. Afterwards, the certificate could be downloaded by the students free of charge.

An interdisciplinary course approach was selected to provide the students a comprehensive understanding of climate change. A key objective was to impart the students the competences to be a critical observer of the upcoming climate change conference in Paris where 196 parties bargained for a binding agreement to keep the earth warming below 2 °C (Otto 2016). Having established a common knowledge foundation in the first lectures, students were supposed to learn about different facets of climate justice for example land-grabbing, climate security, the changing of lifestyles and the question of degrowth or green growth.

At the end of the course, the most active students were asked whether they would be willing to conduct a personal interview to share their learning experiences. Over 70 students signalled their willingness for bilateral parleys via Skype. Due to limited internal capacities, only 35 students could be selected for the interviews. The criteria for the selection were an even distribution of key variables such as age, country of birth and academic background. The interviews were audio-recorded and afterwards transcribed on an anonymous basis. 35 interviews, each lasting approximately 15 minutes, were conducted. In order to facilitate comparability as well as flexibility, semi-structured interviews were used (Louise Barriball and While 1994) (Table 1).

The interviews were coded and clustered using Mayring's structured qualitative content analysis to map out trends and tendencies (Mayring 2000) and to render the students underlying motivations and individual learning experiences. The focus of the interviews was therefore person-centred instead of variable-centred (Wiebe et al. 2015). Learning is a non-linear process which has to commensurate with the personal objectives and distinctive learning goals (Table 2).

**Table 1** Interview guide

| Interview guide |
|---|
| 1. Have you been dealing with the topic of climate change politics before? If yes, in which way? |
| 2. Why did you participate in the MOOC? |
| 3. Which contents of the MOOC interested you the most? |
| 4. Which personal learning outcomes did you gain from the MOOC? |
| 5. What motivated you to complete the course? |
| 6. Do you expect to benefit in the future from completing the course? And if yes, in which way? |
| 7. Is the certificate useful for you? In which way? |

**Table 2** Gender, nationality and education

| Number | Gender | Nationality | Current educational program or employer |
|---|---|---|---|
| 1 | W | Netherlands | Ph.D. candidate with climate related topic |
| 2 | M | Zambia | Master in Climate Change Science<br>Working in the Ministry of Agriculture |
| 3 | M | Montenegro | Master in Political Science |
| 4 | W | Germany | Journalist |
| 5 | M | Mauritius | Working in Climate Change Adaptation |
| 6 | W | Columbia | Degree in Sustainability Science |
| 7 | M | France | Ph.D. candidate in Climate Change Politics |
| 8 | W | Romania | Master unrelated to Climate Change |
| 9 | M | South Africa | Policy government adviser in climate change |
| 10 | W | Ecuador | Ph.D. candidate in Climate Change |
| 11 | W | Germany | Ph.D. candidate in Climate Change (energy storage) |
| 12 | W | Germany | Master in Sustainability Economic |
| 13 | W | Germany | Working as youth consoler in the division for Energy Literacy |
| 14 | W | Germany | Degree Program in Philosophy |
| 15 | M | Jordan | Master Degree in Environmental Management<br>Ph.D. candidate in Climate Change |
| 16 | W | Switzerland | Degree Program in Environmental Engineering |
| 17 | W | Madagascar | Working for German Society for International Cooperation (GIZ) |
| 18 | M | Germany | Master in Earth Science |
| 19 | W | South Africa | Masters in Climate Change and Development |
| 20 | M | Germany | Policy Adviser |
| 21 | M | Germany | Degree Program in Computer Science |
| 22 | W | Spain | Master in International Economics |
| 23 | M | Nigeria | Ph.D. candidate in environmental conflicts |
| 24 | W | Australia | Degree Program related to Climate Change |

(continued)

**Table 2** (continued)

| Number | Gender | Nationality | Current educational program or employer |
|---|---|---|---|
| 25 | M | Portugal | Journalist |
| 26 | W | Germany | Bachelor in Policy Management |
| 27 | M | Australia | Working for the government in Australia<br>Ph.D. candidate in Climate Change |
| 28 | M | Germany | Federal Foundation for the Environment |
| 29 | W | Germany | German Federal Environment Foundation |
| 30 | W | Turkey | University teacher for environmental topics |
| 31 | M | France | Master in Environmental Economics |
| 32 | W | USA | Applying for a fellowship in Climate Protection |
| 33 | W | Germany | Working for World Vision Germany |
| 34 | M | Nigeria | Working for the Nature Cares Resource Centre<br>Preparing a Ph.D. proposal in climate change |
| 35 | W | Norway | Master in Globalization |

## Findings

A central objective was to examine whether MOOCs are a promising educational tool for climate literacy. After critically scrutinizing the interviews, five broader categories were formed to elucidate the students learning motivation and learning experience: (1) *Prior experience with the topic*. (2) *Motivation for participation*. (3) *Most interesting aspects of the MOOC*. (4) *Personal learning outcomes*. (5) *Benefits*.

### *Prior Experience with the Topic*

A first noteworthy observation is that merely four of the students interviewed had no prior experience with the topic of climate change. Most of the students stated that their current educational program is related to climate change, for example a Bachelor, Master, or Ph.D. (Table 3).

**Table 3** Prior experience

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Education | 24 | 68.57 | 68.57 |
| Career | 13 | 37.14 | 37.14 |
| None | 4 | 11.43 | 11.43 |
| Overall (valid) | 35 | 100.00 | 100.00 |
| Missing | 0 | 0.00 | – |
| Overall (valid) | 35 | 100.00 | – |

Thus the rationale of the majority was to obtain thorough knowledge in a topic they are presently studying. Student 7 for example said that he is researching a climate related topic in his Ph.D.: "*Right now I am a Ph.D. student between a university in France and one in Germany. And one of the topics that I am dealing with, with my Ph.D. project is REDD, REDD+ [Reducing Emission from Deforestation and Degradation]*."

Interestingly, 13 students have working experience or are at present working in a field related to climate change. Student number 27 is a typical example: "*I am working in the climate change policy sector for the government of Australia. Specifically on climate change for 12 months but I have also been dealing with climate change through other policy areas for four years*."

## *Motivation for Participation*

The category *motivation for participation* was intended to offer more detailed information about the students' rationale to join the MOOC. Knowledge acquisition through participation in the MOOC was most frequently named as a motivation (21 times) (Table 4).

This suggests that the students' main motivation is not necessarily bounded to a formal learning context. Especially the key topic of the MOOC "climate justice" raised discernible interest. Like student 32 said: "*I am involved with climate change issues with different organisation, like grass-root organisations but sometimes, that issue of climate justice gets lost and I wanted to have better understanding of what were the main issues and how you could understand climate justice from a global perspective*."

Another important motivation was to support the personal educational circumstances or career paths through participating in the MOOC. This does not essentially encompass formal learning contexts. The students were confident that the MOOC can help them accomplish certain personal goals; to develop a research proposal for a Ph.D., apply for a fellowship, or prepare a course for learners.

**Table 4** Motivation

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Knowledge acquisition | 21 | 60.00 | 61.76 |
| Education | 19 | 54.29 | 55.88 |
| Career | 11 | 31.43 | 32.35 |
| Take part in a MOOC | 2 | 5.71 | 5.88 |
| Access to structured knowledge | 1 | 2.86 | 2.94 |
| Overall (valid) | 34 | 97.14 | 100.00 |
| Missing | 1 | 2.86 | – |
| Overall | 35 | 100.00 | – |

Student 3 expresses the need to learn the basics of climate change: "*I think it is an important topic and because, as a post graduate student of political science, I thought I should know at least the basics of climate change*."

In the working context, job search, developing new perspectives and networking was mentioned, for example by student 34: "*For me it was an opportunity to [get into contact with] big networks and actually it worked out with one or two networks during the course*."

Interestingly, student 32 in particular mentioned the additional materials which were offered in the platform: "*So I think it's very helpful for me to have those extra materials because I am going to finish reading through them and that will help me to get new ideas on how I approach my proposal [for fellowship]*."

## *Most Interesting Aspects of the MOOC*

Climate change is a rather fuzzy topic and can best be understood using an interdisciplinary approach (Hulme 2009). Albeit the main focus was on climate justice, the MOOC covered all relevant scientific disciplines (natural science, political science, economics, etc.). This broader perspective is echoed in the students answers as there occurs no dominant category to be the most interesting. However, possible solutions to solve climate change were indicated to be an especially exciting aspect, closely followed by the international governance system, the North-South relations, and eco-colonialism regarding justice (Table 5).

The interviews moreover revealed that the students have a strong interest to discover concrete opportunities for personal action, a focus not necessarily found in university curricula (McKernan 1996). (Too) often curricula focus on the

**Table 5** Most interesting aspects

| Name | Frequency | Percentage | Percentage (Valid) |
|---|---|---|---|
| Solutions | 14 | 40.00 | 41.18 |
| International climate governance | 13 | 37.14 | 38.24 |
| North-South relations and eco-colonialism regarding justice | 12 | 34.29 | 35.29 |
| Carbon markets | 8 | 22.86 | 23.53 |
| Multidimensionality of cc | 7 | 20.00 | 20.59 |
| Climate refugees, migration, climate wars | 7 | 20.00 | 20.59 |
| Physical science basis | 7 | 20.00 | 20.59 |
| Transnational climate governance | 6 | 17.14 | 17.65 |
| Overall (valid) | 34 | 97.14 | 100.00 |
| Missing | 1 | 2.86 | – |
| Overall | 35 | 100.00 | – |

communication of theories and methods neglecting to promote the practical implication for instance through incorporating the teachers' practical knowledge (Van Driel et al. 2001). Student 17 said: "*And the other thing is the example from the Philippines presented by the lecturer. It gave to me something more concrete, more real, how to adapt and how to make it appropriate for the beneficiaries*." Beyond, many students expressed willingness for local engagement. Students 32 mentioned: "*I think the last chapters made a little bit of possible solutions, like what people could to. Like people that were taking the MOOC, like what we could do in our local environment, in a local context, the ways for us to get involved and do more about it*." This shows that students, beside profound knowledge, are also looking for areas of activity in their personal environment.

Since the MOOC was intended to prepare for the climate change conference in Paris, the governance system was another field of interest. Student 31 said: "*I also found interesting the whole dynamics that make the negotiations. And the analysis of different groups, interest groups, that was made*."

Another area that found high approval is the North-South-relations and eco-colonialism as a matter of climate justice. There was, in particular, interest to discern the different dimensions of climate justice and how it manifests in the international discourse as stated by student 31: "*But the dimension of the North-South relationship, the intergenerational dimension but also the chain of discourse was some of the justice dimension that was particularly interesting*."

Remarkably, the physical science basis was not perceived as one intriguing aspect. When the students were asked about less interesting lectures, the scientific underpinning of climate change was named. That may be rooted in the complex nature of climate sciences and the scientific consensus on climate change which cannot be easily understood without prior knowledge. This underscores that understanding the scientific consensus is difficult, not only for layer people.

## *Learning Outcomes*

A major objective was to determine whether the students perceived to have achieved learning success after the MOOC and how they define it. Through coding of the interviews, two main categories in terms of learning outcomes were identified: learning about the content and developing specific competences to cope with the challenge of climate change (Table 6).

Nearly 86% of the student mentioned content related learning. Clustered according to the different topics of the MOOC, climate politics and the multidimensionality of climate change were most frequently named (Table 7).

That is of little astonishment as conveying a basic political understanding to the students was a core aim of the MOOC. Student 34, for example, mentioned the comprehensive view he obtained: "*Having the broad view of what is the political interest of the groups, understanding of the politic interest of the global South and global North in terms of decision-making. It gives me a good understanding of*

**Table 6** Learning outcomes

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Content | 30 | 85.71 | 88.24 |
| Competence | 18 | 51.43 | 52.94 |
| Overall (valid) | 34 | 97.14 | 100.00 |
| Missing | 1 | 2.86 | – |
| Overall | 35 | 100.00 | – |

**Table 7** Learning outcomes about topics

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Multidimensionality of climate change | 14 | 40.00 | 46.67 |
| Climate politics | 14 | 40.00 | 46.67 |
| Overall understanding of the topic | 10 | 28.57 | 33.33 |
| Climate justice | 4 | 11.43 | 13.33 |
| Climate science | 3 | 8.57 | 10.00 |
| Solutions | 2 | 5.71 | 6.67 |
| Economics of climate change | 1 | 2.86 | 3.33 |
| Eco-colonialism | 1 | 2.86 | 3.33 |
| Climate refugees | 1 | 2.86 | 3.33 |
| Carbon market | 1 | 2.86 | 3.33 |
| Overall (valid) | 30 | 85.71 | 100.00 |
| Missing | 5 | 14.29 | – |
| Overall | 35 | 100.00 | – |

*challenges of climate change policies and implementation in different countries*." On the other hand, the students enhanced their understanding about the multidimensionality of climate change and similarly their overall understanding of the topic. This perception might be due to the interdisciplinary approach of the MOOC. Student 35 expressed: "*I think I have more, like diversified knowledge, like I can see more aspects of climate change now than I did before. Also I learned about new kind of problems and situations which is really good*."

In terms of competences, clustering disclosed a more manifold picture than with regards to the content. The students mentioned a broad spectrum of different trajectories ranging from analysing the political process to reflecting one's own lifestyle (Table 8).

There is also indication that the new-found competences were used to convey the importance of climate change to colleagues or friends. Student 17 said: "*So I used what I learned from the MOOC to explain to my colleagues in the area where I work and as well for the colleagues I have in the whole Madagascar. To explain, where it comes from and why do we act do to this, to implement this sustainable handprint, so the principles behind the decision or the methodology of the company*

**Table 8** Competences

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Follow, analyse, evaluate climate politics | 5 | 14.29 | 27.78 |
| Argumentation, advocating, follow/participate in discussions | 5 | 14.29 | 27.78 |
| Understand and critically assess the media | 4 | 11.43 | 22.22 |
| Transfer/apply knowledge in research/proposal/job | 3 | 8.57 | 16.67 |
| Explain climate change/politics to others | 2 | 5.71 | 11.11 |
| Increased interest | 2 | 5.71 | 11.11 |
| Reflect own lifestyle | 1 | 2.86 | 5.56 |
| Overall (valid) | 18 | 51.43 | 100.00 |
| Missing | 17 | 48.57 | – |
| Overall | 35 | 100.00 | – |

*to implement it*." Likewise advocating for climate change in discussions is a competence many students obtained. Student 9, who is working as a policy adviser, said he is "*(…) more involved in suggesting really big chances and then showing people that inequality, if you really see where it comes from and manifest, you can use that as an argument on which you based big change recommendations*." The MOOC also managed to enable the students to scrutinize the dominant public information about climate change for example the political process. Student 30 stated: "*I was having difficulties to understand the negotiations part, but this course provided me with some tools to understand and evaluate the information about climate change*."

## *Benefits from MOOC*

All the students interviewed successfully passed the course and received a certificate. One pivotal question was therefore how the students, beyond certification, expect to benefit from their MOOC participation (Table 9).

Clustering disclosed that the students perceive the benefits to be predominantly helpful for their future career. In terms of career chances, the students primarily want to improve their current job position or apply for new jobs. Student 2 for example said that "*(…) currently I am working in the Ministry of Agriculture. So I do a lot work in terms of adaptation of small-scale farmers to climate change. I would like to move on to policy issues and I feel some of the knowledge I've gained I use it in engaging in policy matters*."

Analogous expectations can be observed for the issue of education. Participation in the MOOC can help to prepare for a fellowship, as students 23 explains.

**Table 9** Benefits from MOOC

| Name | Frequency | Percentage | Percentage (valid) |
|---|---|---|---|
| Career | 19 | 54.29 | 55.88 |
| Knowledge acquisition | 17 | 48.57 | 50.00 |
| Education | 16 | 45.71 | 47.06 |
| Access to structured knowledge | 10 | 28.57 | 29.41 |
| Overall (valid) | 34 | 97.14 | 100.00 |
| Missing | 1 | 2.86 | – |
| Overall | 35 | 100.00 | – |

"*I gained a lot. Currently I am putting up a proposal for (…) a climate protection fellowship*." Primarily, the students' perceived an added value for their current or future educational program. This comprises Bachelor, Master or Ph.D. programs. The opportunity to learn in this non-formal context for instance was useful for student 1 in formal matters: "*We have a science researcher school. It consists of seven different universities here in the Netherlands. So, I sent them an email to get credit out of that and I got 2.3 credits out of this course*." Participating in a MOOC can likewise be a precondition for participating in a formal learning context like for student 3: "*Because of the course, I was now able to enrol in a simulation game on climate change here in my university*."

## Conclusion

This chapter pursues to provide a profound analysis of the pertinence of MOOCs for climate literacy. Based on the findings presented, there is no easy answer. The interviews illustrate a kaleidoscope of rationales why and how students use MOOCs as a tool for their informal and formal learning context.

Notwithstanding this, some corollaries can be derived from the findings which might contribute to the further understanding of MOOCs and for climate literacy.

*MOOCs educate the educated*

The idea that MOOCs are a tool to educate the uneducated about climate change has to be rejected. This finding is not exclusively valid for the case of climate change, but is reinforced by other studies (Emanuel 2013). Based on the findings presented, only four students had no prior contact (working or degree) with the topic and all interviewed students had a higher educational background. This impression is complemented by the quantitative analysis that was conducted for the MOOC. In this respect, MOOCs cannot be considered as helpful to empower a multitude of climate literates. With regard to the starting assumption MOOCs cannot be perceived as a tool to elevate climate change in the consciousness of people.

*MOOC (elements) as a customized personal setting*

The interviews refute the myth that MOOCs are studied the same ways as classical university courses. University courses are predominantly studied target-oriented and in a linear fashion over a fixed period of time. Contrarily, the interviews illustrate a vivid picture. Parleying with students disclosed a variety of utilizations for the personal learning context. Supporting the individual educational path or job situation was one of the main motivations for the students to enrol. Non-formal learning in MOOCs is therefore integrated into the formal learning context. On the other hand, this does not necessarily mean that students want accreditation for their participation in a MOOC. They reconcile MOOC resources with their individual formal and informal demands. This can also be observed when the students uttered statements about their favourite course content. However, the students interviewed were goal-oriented and aware what they wanted to obtain through the MOOC. But these goals cannot be captured by applying classical motivational categories, for instance guidance for local engagement.

*Learning what and how*

Indication could be identified that learning occurs through MOOC participation. This encompasses content as well as competences. Although this conclusion is based on the students' self-perception, the author is inclined to believe a knowledge growth arose. In particular, a noteworthy merger occurred that blurred the distinction between learning and action. The interviews provided intimations that students are looking for tangible opportunities of how to cope with climate change in the personal life situation. Reconciling the input of researchers and practitioners is therefore an auspicious approach. Again, these positive impressions are limited to those who were by this time sensitized about the topic.

## Outlook

The urgency of climate change is hasting and climate literacy therefore is a key impetus to capture the problem of climate change. The findings presented suggest that MOOCs are not the persuasive answer to foster climate literacy, but constitute an auspicious tool to cross the boundary between formal education and lifelong learning. Hitherto, this ascription is limited to people inside the educational system. However, there is indication that MOOCs can broaden the (disciplinary) perspective of students towards the problem and point to essential topics like climate justice or possible solutions. In the best case, practical implications possibly will follow.

In terms of MOOCs, there is obviously a need to broaden the scope of analysis and to go beyond classical measurement. Albeit the depicted picture then becomes vivid, this does not mean that compelling results become disguised. On the contrary, the findings represent the whole bandwidth that exists when students

participate in a MOOC. This fuzzy picture should be kept in mind when it is suggested that MOOCs have certain generalized characteristics and in particular when opportunities are discussed of how to advance them.

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