

## MOOCs in Citizen Science

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**Abstract.** Involving citizens in science projects has become a more common method to collect data and gather information for science projects. A good tool is needed to carry out a successful citizen science project. Massive Open Online Courses (MOOC) can provide various strengths to deal with some challenges in citizen science. Two MOOCs, produced at the University of Innsbruck, concerning public engagement, interactivity and transferring scientific knowledge were analysed. The current state of our research indicates that a MOOC can help reduce difficulties in the field of citizen science.

**Keywords:** Citizen Science, Massive Open Online Course, concerning public engagement and interactivity, transferring scientific knowledge

### 1 Introduction

Citizen science is a partnership between members of the general public and scientists within scientific research projects to address real-world problems. Volunteers participate as field assistants and gather information for scientific studies. The collected data is reliable when volunteers are trained properly beforehand by scientists [1, 2]. The involvement of volunteers in science has faced some challenges, but the number of participants in citizen science has been increasing in the different research fields all over the world [2–4]. One approach to solving those challenges within citizen science is offering Massive Open Online Courses (MOOCs). MOOCs are university level online courses without limits to the number of participants while being openly accessible on the internet to welcome all interested parties [5, 6]. MOOCs have developed into an established component in the educational field. They take several forms such as cMOOCs and xMOOCs or a hybrid form [7, 8]. Especially xMOOCs have gained more awareness within the public, because it has attracted a high number of participants. When referring to MOOCs, the authors refer to data collected from the group of xMOOCs.

Could MOOCs be a good solution for solving some of the challenges of citizen science? It could be assumed that MOOCs help to reduce complications in citizen science projects. For example, they provide scientific knowledge to a broader public,

prepare complex relations in an intelligible format and provide interaction between scientists and citizen scientists. The availability of knowledge and information provided in MOOCs, can help to expand opportunities in citizen science projects [2, 9]. In 2018 at the University of Innsbruck, two MOOCs were offered, each having different intentions and implementations. The following paragraphs provide convincing evidence that MOOCs can be used to handle some of the challenges faced by citizen science projects.

## **2 Methodology**

### **2.1 Challenges of Citizen Science Projects and Strengths of MOOCs**

A cooperation between scientists and citizens presents several challenges. The first challenge is to overcome the general opinion that science and research is inaccessible and unworldly. Therefore, a main aim is to overcome the fear of participating in scientific discourse. The second challenge is the preparation of scientific content for the layperson. Therefore, diverse interconnected and complex scientific structures have to be offered in an easy and well-prepared manner. Finally, systems must be provided in order to allow intercommunication between scientists and the general public. Interaction between scientists and citizens is necessary to build a sustainable and active community. A bidirectional exchange of knowledge and ideas is another big challenge in citizen science [10].

MOOCs offer a number of advantages over traditional courses [5, 11]. First of all MOOCs, by virtue of the acronym, are designed to deal with a large number of participants [5, 12]. Secondly, the courses are often offered for free, although it is debatable whether MOOCs are truly open regarding the idea of open educational resources [13]. Thirdly, although MOOCs are university level courses, anyone is allowed to participate. This means that formal qualifications are not a prerequisite to participation in courses. The participants of these courses will have access to the expertise of professors in various disciplines at higher educational institutes (HEI) [5] without the traditional access restrictions. In addition, care will be taken to ensure that the contents are clearly presented. The fourth strength of MOOCs is their global availability. This means that lecturers and learners will have world-wide exposure, which could lead to better teaching techniques and knowledge sharing [11]. Fifth, MOOCs are structured around the learner, which means that learners may learn at their own pace. Learners may also repeat the same learning resources, such as lectures, so that they may learn according to their own cognitive abilities [5]. Finally, learners' performance can be monitored by the data collected during the course [11]. These data allow a targeted intervention, for example to force communication.

### **2.2 Case Studies at the University Innsbruck**

iMooX [14] is a platform for MOOCs founded by the University of Graz and the Graz University of Technology. All courses on iMooX are free of charge, and mostly they

are accessible even after the individual MOOC has ended. All the courses are published under a Creative Commons license. It is a main aim of the iMooX platform to make academic and general knowledge accessible to everyone interested.

In 2018, the University of Innsbruck produced two MOOCs that were hosted on the iMooX platform. The #MeKoMOOC18 was created with the aim of developing a free online course for teachers, students, future teachers, anyone interested to increase his/her knowledge in the topic of media literacy, and administrative personal at universities. The MeKoMOOC consists of six modules, and the first run started in March, 2018. The modules were released on a weekly basis, and consisted of several videos, additional literature, and a quiz at the end of the module. To increase interaction between the lecturers and participants the course forum was supervised, and attendees were instructed to answer questions in the forum weekly. The second run was the #MeKoMOOC19 [15], which started in October, 2018, with some changes to the content and a new semi-supervised forum.

The intention of the MOOC “Ökologie des Wassers” [16], was to create a MOOC based on one introductory course as part of the biology curriculum. For participating university students, the attendance of the MOOC was not mandatory and they could complete their university introductory course also without attending the MOOC.

Nevertheless, it provided the students with the opportunity to use additional learning resources throughout the semester. Additionally, anyone interested in the topic of limnology had the opportunity to access a free, online introductory course. The MOOC has been divided into eight modules that were all accessible right from the start of the MOOC. This opened an opportunity for all attendees to work through the materials at their own pace, and to consume the materials in any desired order. The modules offered several videos and a quiz at the end of the module. Additional standard literature of the field of limnology was included in the first part of the MOOC, the introduction module.

### **3 Results and Discussion**

We analysed our three runs of MOOCs concerning the challenges of citizen science and the strength of MOOCs. As mentioned in the methodology, the first challenge is to overcome the general opinion that science is an elitist field and research is inaccessible. To overcome this opinion, it generally helps that MOOCs are online, open to a worldwide audience, and free of charge. When comparing the participation levels between our MOOCs, the MOOC designated #MeKoMOOC18 reached 1180, followed by #MeKoMOOC19 with 385, and finally “Ökologie des Wassers” with 172. It should be noted that “Ökologie des Wassers” was created for a special lecture at the University of Innsbruck. 97% of the MekoMOOC participants and 44% of the “Ökologie des Wassers” participants were neither faculty, nor staff nor students of the

University of Innsbruck. This indicates that MOOCs are a good way to promote public engagement in a specific topic.

The second challenge is the preparation of scientific content for the layperson. MOOCs provide multiple forms of presentation to transfer scientific knowledge. The forms used in our MOOCs were videos, transcripts, text files, audio files and quizzes. The great advantage of a MOOC is that learners can use the material depending on their own learning needs. Originally, we added transcripts to our videos to provide accessible material for people with disabilities. Surprisingly we received feedback from many participants that these transcripts are very helpful for their individual learning process.

The third challenge is about intercommunication. Usually there is a high frequency of dropouts in MOOCs [17, 18]. The same trend was recognised in our MOOCs: Only 25% of participants had finished the #MeKoMOOC18 with a certificate, and 5% finished the “Ökologie des Wassers” with a certificate, which may be traced back to the grade of supervision. Concerning the interactivity between scientists and participants, it was interesting to see that the #MeKoMOOC18, with good oversight, had many contributions in forums (over 640 posts, n=1180). Table 1 shows that the #MeKoMOOC19, with semi-supervision, only had 27 posts (n=385). The MOOC, “Ökologie des Wassers”, without any supervision, only had 3 posts (n=172). To deal with the challenge of building up a sustainable and active community, it is necessary to encourage activities like discussions, webinars, etc. It is also apparent that quizzes were taken in the supervised MOOC more often than in the other MOOCs. A similar effect can be seen within the awarded digital badges, which could be additionally gained for successful finished lessons. This indicates that task oversight is important in keeping participants motivated and on task. It can be observed that even without using the full capacity of interactive tools within xMOOCs, they are effective in transferring basic knowledge to citizens.

**Table 1.** Numbers of participants and interactions in the MOOCs of the University of Innsbruck (downloaded on 13.02.2019).

	MekoMOOC18	MekoMOOC19	“Ökologie des Wassers” MOOC
participants	1180	385	172
lessons	6	6	8
contributions in a forum	641	27	3
quizzes filled	287	104	26
badges (total)	2468	818	389
certificates	291	101	9

MOOCs make it possible to overcome some of the challenges of citizen science, starting with the great opportunity of knowledge transfer between the parties. Nevertheless, there are some remaining points to be considered: At the start of a MOOC, the number of participants is often very high and to be able to keep a sustainable community, measures must be taken to maintain the motivation level of the participants. It is important to note that these actions result in an increased workload for the lecturer [19].

Interaction needs oversight. Tools and communication platforms must be part of the MOOC. For the needs of citizen science, an exchange model of teaching rather than a unidirectional teaching is necessary. Alternatively, using a form of inverse blended learning is very effective in increasing interaction while also decreasing the drop-out rate [20]. As our MOOCs are still active at the time of writing, a comprehensive analysis will be available in further research.

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