



**TECNOLOGICO  
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**Learning Strategies and Digital Interventions: An Analysis of the Context of  
Education for Sustainable Development**

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## **Abstract**

The present document proposes explorative and explicative research with the purpose to determine if the implementation of Massive Online Open Courses (MOOCS) can help achieve the Education for Sustainable Development goals according to the conceptual framework issued by UNESCO by promoting education for sustainable development prompts and exercises. This study is of a mixed nature, for there are two methodology phases: First, the gathering of quantitative data through four online surveys that were run at the beginning and the end of the course, and second, the gathering of qualitative data that was obtained through sixteen semi-structured interviews that were made to users. Eight of the users interviewed left the course unfinished, and eight of them completed the MOOC successfully. The intention of selecting both types of users is to listen to the voice of the participants and to comprehend their main motivations, complaints, and hopes for future MOOCs that might be designed in down the road in order to teach about education for sustainable development. A proposal, pinpointing the main elements that the participants found attractive when signing up to the course, as well as the feedback that was received directly from the interviews that were made, presents a summary of whether the participant's expectations were met, as well as an analysis comparing the answers obtained before and after the course intervention to determine if there was a significant change or not in the participant's awareness of sustainability and its importance for future generations.

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## **Chapter 1. Theoretical Framework**

### **Background**

To this day, humankind has found different types of energy sources, such as fossil fuels, carbon, natural gas, natural gas liquid, crude oil, nuclear energy and power, hydroelectricity, wind, solar and even geothermal power (Sherlock, 2017). In recent years, however, the high prices of gasoline and natural gas as well as an increasing awareness to protect the Earth's environment have intensified the interest on the discovery, use and application of renewable energy sources around the world. Reducing the use of fossil fuels can decrease the contamination level in air and water (Duarte, 2006). The development of clean energy sources in Western Europe and Japan can motivate and have a positive effect in the creation of new politics that promote the use of renewable energy sources (Congressional Digest, 2007).

Two events that marked an important change in the education for sustainable development were the Earth Charter Commission and the Declaration of Thessaloniki. Both took place in 1997, after the Rio de Janeiro Earth Summit failed to reach an agreement on how governments should protect the future of planet Earth (Emilsa & Castillo, 2007).

The Commission undertook the task to write out the Earth Charter and insisted that the administration of all nations had to make a commitment to the wellbeing (the state of being comfortable, healthy and happy) of future generations: “Humanity is part of a vast universe in evolution. The Earth, our home, is alive with a unique community of life (...) It is imperative that us, the people of the Earth, declare ourselves responsible to others, to the biggest community of life and to future generations” (SEMARNAT, 2007) (OECD, 2014).

UNESCO declared the years between 2005 and 2014 “The United Nations Decade of

Education for Sustainable Development,” presenting tools of international convergence which had the main goal to strengthen the understanding of education as a vital tool for sustainable development in the future (De Sousa, A. C., & Uceda I Maza, F. X., 2017).

One of the foundations of the Decade for ESD was that UNESCO added to its agenda the goal that individuals around the world had to promote attitudes and take on the responsibility of satisfying their own needs at the present time without compromising the possibilities of upcoming generations to fulfill their own needs in (UNESCO, 2012). At the end of the decade, one key element evaluated was the participation of the educational community and social groups at the moment to reflect what changes could be done in daily life in order to make a positive impact for sustainable development in their surroundings, taking into account the configurations that took place in education and the role it played to meet the demands in their own educational setting.

This contributed to the creation of critical senses, greatly supported in promoting the understanding of the environmental dimension as a process that includes “a group of actors in the educational universe, with the purpose of comprehensively strengthening the commitment made by all of them. It implies thinking in the reality underneath the paradigm of complexity and define it as a new rationality and a space where nature, society, values and culture join” (De Sousa, A. C., & Uceda i Maza, F. X. (2017).

In 2015, UNESCO revealed the Sustainable Development Goals (SDGs), adopted by the global community with the objective to achieve a better world in 2030 (UNESCO, 2017). The goal number 4.7 talks about education, Education for Sustainable Development, and the related approaches, such as the Global Citizenship Education. Nowadays, UNESCO is responsible for the Global Action Programme (GAP) on ESD (UNESCO, 2017).

Since its announcement, a lot of nations, such as Spain, Mexico, United States and Japan have started their own efforts to teach and considerate UNESCO's goals at the moment of planning their curricular activities. One example is the Network of School for Sustainability in Catalonia (XESC). Their purpose is to “collaborate in the formation of the faculty and facilitate teaching and internal debate resources to keep pushing forward the conceptualization of Education for Sustainable Development.” Currently, the Network counts with more than 800 Catalan schools (Generalitat de Catalunya, 2019). It is important to notice that being part of this network does not only imply to adapt the school curriculum to cover the subjects appropriate for sustainable development, but it aims to involve the educational community in the project and modify the teaching methodologies with projects in which students take the lead role and teachers work more as facilitators than educators. It also aims to promote creativity, responsibility, equality, inclusion, and ecology values, as well as to bring raise of global issues (XESC, 2018).

Another example is the Network of Sustainable Schools of Terrassa (XEST), which holds events such as the *Jornada de Intercambio de Experiencias de las Escuelas* (Sharing Day of School Experiences), in which students present projects carried out in their school about environmental issues and sustainability. The third edition of this event took place in November 2018 in the Assembly Hall of the Central Library of Terrassa; 17 schools participated and presented 14 different projects. This Sharing Day takes place every two years and it helps maintain an active communication among schools of the Network (Ayunamiento de Terrassa, 2018).

Another important network is E-9, which existed before the announcement of the SDGs. The E-9 is a forum of nine countries that look to reach the goals of the movement Education

for All (EFA) by UNESCO. The “E” stands for education and “9” represents the nine participant countries: Bangladesh, Brazil, China, Egypt, India, Indonesia, Mexico, Nigeria and Pakistan (UNESCO, 2017). This Network opened a dialogue among countries to discuss their experiences with education, opening a forum in which they can exchange their best practices and monitor progress regarding the EFA goals (Gem Report, 2017).

The first Minister of Bangladesh, Sheikh Hasina, commented that the Sustainable Development Goal number 4 pointed mainly to assuring inclusive and quality education for everyone, promoting learning through the life of all the citizens of the world. She declared in the inauguration of the ministerial meeting of the E-9 in Dhaka the following:

As we enter the era of the Sustainable Development Goals (SDGs), we must align and integrate our initiatives and strategies with the SDG-4 (Education 2030) carrying out lessons and achievement of the MDGs and the EFA. We are living in a world in which we depend on each other despite our cultural diversity, religion, race and language. Education can perform the role of bridge between the promotion of mutual understanding, tolerance and friendship. (Hasina, 2017)

Furthermore, research have been carried out to elucidate how the teaching of specific subjects contribute to the Education for Sustainability. One example is the teaching of geography in Catalonia. The research defines a theoretical proposal of curriculum reorientation of the subject geography based on a case study to know the contributions, opportunities, obstacles and needs of the faculty team to achieve the learning goals and geographical scope that they wish to develop in their students (Sánchez, 2011). In another research, carried out with the contribution of Bandarin, Yang and Bossler, it was concluded that the subject Estudios de Patrimonio (Patrimony Studies) points and reflects a lot of the different dimensions of

sustainability and sustainable development. The authors also concluded that the inclusion of the four dimensions of sustainability (environmental, economic, social and cultural) opened a new line of exchange and perspective to the discussion surging among students that took the subject (Albert, 2015).

Besides the national and international networks that were formed through the years and the researches that have looked for ways to include these goals in the subjects already contemplated in school curricular design, it is important to confront the challenges that UNESCO has determined to be able to achieve real sustainable development in the future.

Table 1

*What are the challenges for sustainable development? (Taken from UN Decade of Education for Sustainable Development, 2005-2014: the DESD at a Glance by UNESCO)*

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**Going beyond environmental education to reach education for sustainable development:** the concept of sustainable development being closely related throughout its evolution to the question of the protection of the planet, environmental education today is widely known and practiced. The Decade is not limited, however, to environmental education. Developing adequate teaching contents is, thus, a challenge to take up immediately.

**Drawing up an inventory of what exists for the Decade:** many countries have carried out education for sustainable development programs or activities. Identifying these, evaluating the results, and disseminating information about them will allow us to accelerate the integration of this new vision of education into national plans.

**Mobilizing the media:** the media represents a powerful means of awareness-raising and dissemination about the principles and values of sustainable development, as well as about promising experiences. Making the media an ally for transmitting quality information to citizens is a pledge of success for the Decade.

**Establishing partnerships and creating synergies among the initiatives and programs:** no institution, even at a global scale, can manage to achieve the goals of sustainable development on its own. Only united together, from North to South, East to West, can we be sure to build a viable world for us and for generations to come.

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To achieve this, UNESCO, with the collaboration of international networks and educational institutions of all kinds have shared with the world various learning resources

and strategies that have been developed in the last 18 years, in order to familiarize and apply the SDGs envisioned for 2030.



Figure 1. Illustrative chart of UNESCO Sustainable Development Goals

### Massive Open Online Course, MOOCs

Since their first implementation by George Siemens and Stephen Downes (2008), Massive Open Online Courses (MOOCs) opened the door for different people around the world to access information acquire knowledge only with a working internet connection. The MOOCs are an active example of planned long-distance education, that allow a grand number of users to enroll and take a course simultaneously.

MOOCs are of an open, participative character and with a methodology based on the acquisition of knowledge through self-learning, using the tools provided from the moment of enrollment (Downes, 2011).

They are massive open and online, as their name states, characteristics for which are considered an ideal method to share knowledge to those who are interested in going further on a specific subject. These courses have been being perfected through time and with the use of new technology and resources that help students actively interact with the content.

Some predecessors of MOOCs helped define some of the main points that would later establish the standard for a massive open course online. Open Course Ware, Open Classrooms and the open educational resources from UNESCO were pioneers in this format (Karaman & Kursun, 2015).

The term Massive Open Online Course was first formally used by Dave Comier in 2008, talking about “Connectivism and Connective Knowledge”, a course that is also known by researchers as CCK08. This course was taught by George Simen and Stephen Downes, it included the participation of 25 students from the University of Manitoba and 2200 online students were able to take the course without any cost (Fini, 2009). The content was available for the general public through Really Simple Syndication, RSS, a platform online that helps spread information in a concise and summarized manner. The students that participated online were able to also take part in the course through collaborative digital tools, mainly blog entries and open forums (Bartolomé, 2015).

In 2011, Sebastian Thrun and Peter Norvig of Stanford University, organized a massive course on artificial intelligence. Over 160,000 people around the world enrolled, proving the reach of online courses. In 2012, the New York Times refers to MOOCs and their strong

boom that has started to develop. In fact, 2012 is known as the "Year of the MOOC" establishing that this new learning format will be able to give access to information to a wide public with the necessary information and resources to learn any topic (Pérez-Peña, 2012).

Poy and Aguilar (2014) say that the MOOC format opens the door to develop new business models, based on economic gain derived from payment of certificates, credits, publicity and subscription of the users that wish to have access to the material online. In other words, the course itself is free, but to be able to acquire the official certificate or to be part of the restricted access subscription list could become the source of income to those who design MOOCs; nonetheless, the knowledge acquired by the user, even without purchasing the official certificate, remains.

There is a constant debate about the advantages and disadvantages of this teaching model. Berracosos (2014) establishes the following advantages and disadvantages of MOOCs:

Table 2

*Advantages and Disadvantages of Massive Open Online Courses*

<b>Advantages</b>	<b>Disadvantages</b>
The teacher needs to adapt their methodologies to the characteristics of a network society.	Standardization of knowledge: the contents and activities are the same for all students.
Redefinition of roles.	Absence of a universal design for learning: differentiated educational attention.
Use of evaluation strategies that grant the student an active role.	Requires a certain level of digital competence and a high level of autonomy in learning.
Flexibility and adaptability of the academic offer.	Lack of knowledge of the development and evolution of e-learning.
The cooperation between different actors (teachers and participants).	Loss of value of the teaching function in the teaching-learning processes: evaluation



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	and tutorship.
Free access to a wide offer of information of international nature.	Presentation of supposed “educational innovations” that are no.
Development of technological tools to support the process of teaching-learning.	Predominance of the economic perspective in front of the pedagogic experimentation and education research.

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Rita Kop (2010) mentions that there are various factors that could be considered challenges for the achievement of the purpose of massive online courses. There are a few key elements that define if the subjects enrolled in the course manage to finish it satisfactorily. To be able to measure or define these elements, first it is necessary to answer the following question: when it is considered that a MOOC has successfully fulfilled its purpose?

It depends on the MOOC, particularly because the design of every course varies. For example, there can be a MOOC in which the final purpose is that the students reach the final topic after completing activities; some others, have short tests that want to verify that the reading of the content is satisfactorily enough for students to have a general idea of the subject; there are even MOOCs that set a minimum percentage to certify that the participants met the necessary requirements to get the diploma or credit.

However, for the purposes of this study, the general purpose of the MOOCs will be defined as the following: the subjects enrolled and participated as students in the Massive Open Online Course, and were able to acquire new knowledge and know how to apply it practically and theoretically. To achieve this, it is indispensable that there is a quality learning experience that can guaranty this result. To make this possible, Kop (2011) defines three main elements: a high level of autonomy, presence and active learning through connectivism.

One of the benefits of the MOOCs is they are managed through the web, which opens

the communication network to a broader and more accessible people that could even be found in different parts of the world; nonetheless, the disadvantage of this benefit is that the teacher, instructor or supervisor of the MOOC does not have as much control over students. Given that the subject is in their own space, the possibility that they acquire the knowledge they look for satisfactorily depends highly on their level of autonomy. This can be a benefit or a challenge, depending on everyone.

Furthermore, there is a relationship formed between the registered participants and the work material. According to Weller, there are two traditions that tend to present themselves in online learning: one in which the connections are made with other people, and one in which the connections are made to the resources or materials of the online course (Weller, 2007). Taking this into account, it is interesting to notice how relationships with online courses work. In a traditional classroom context, the teacher presents the content to the student using different resources that may include different mediums such as books, presentations, videos, audio files or simple conversation; however, in the MOOC context, the type of relationship that the students make directly with the learning content is extremely important, particularly because they need to initiate a conversation among them during the course to prove that they have successfully processed the information presented and can test their own knowledge. Therefore, there are two kinds of interactions that can take place in a MOOC with subcategories that emerge depending on the context.

Table 3

*Interactions between humans and resources*

<b>Interacción Humano- Humano</b>	<b>Interacción Humano-Recurso</b>
Teacher → Student	Teacher → Resources

---

Student → Teacher

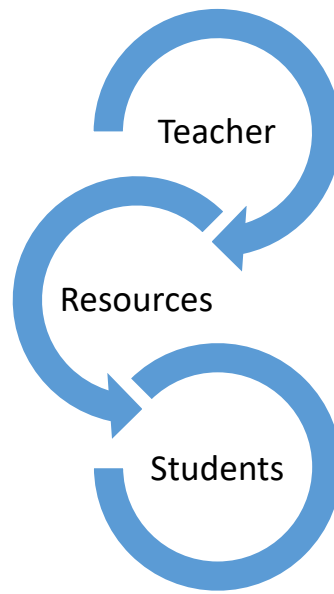
Student (individual) → Resources

Student → Student

Students (group) → Resources

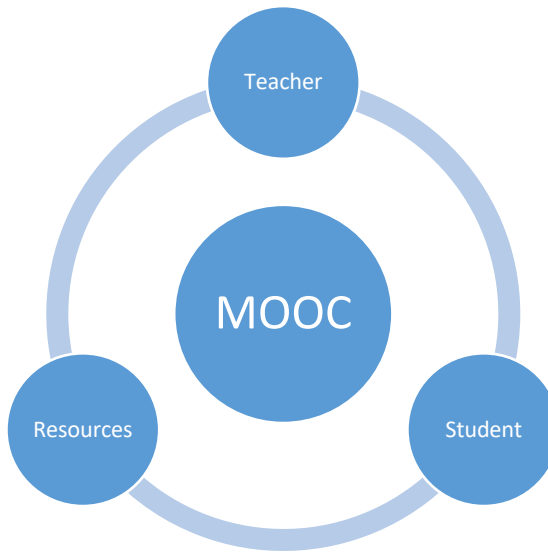
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Moreover, the context of a traditional classroom can be summarized the following way: the teacher uses the resources to directly transmit the knowledge that is supposed to be acquired by students. We can see the relationship between teachers, students and resources illustrated in the following diagram:



*Figure 2.* Traditional classroom

However, in a MOOC, the student must take an active role to be able to be in contact with other students and even to be able to find support in the teacher when solving doubts. Therefore, the context of MOOCs can be seen as a triangular relationship of all these elements. Below, there is a diagram that hopes to graphically present this relationship:



*Figure 3.* Interactions in a MOOC

With the pass of time, there was a fourth element that started to be considered at the moment of analyzing the level of autonomy and interest of students: the context where students learn. Depending if the environment where students work to focus and dedicate themselves to study, or if the use of technology can be a distracting factor that affects the quality of the studying time they invest into the acquisition new knowledge; the environment where enrolled subjects are plays an important role at the time of evaluating the learning process that takes place during a MOOC.

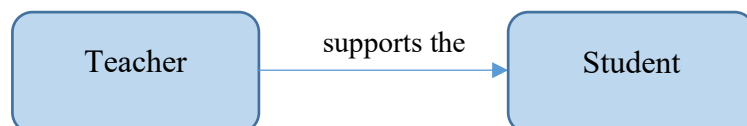
Sfard (1998) says that there are two metaphors to define in what way people are getting involved with knowledge during the learning process. The first refers to the acquisition of knowledge. During this stage, students receive knowledge from the teachers in a type of pre-packaged format designed to be transmitted in a simple and accessible way. For example, when teachers ask students to read a specific chapter of a determined book. The material that carries the knowledge, the resources that the student needs to becoming acquainted with the content of the course is key. During the acquisition of knowledge, it has been observed by

many scientists the behavior and cognitive process, opening the door to a wide variety of theories that have looked to regulate formal education through the years.

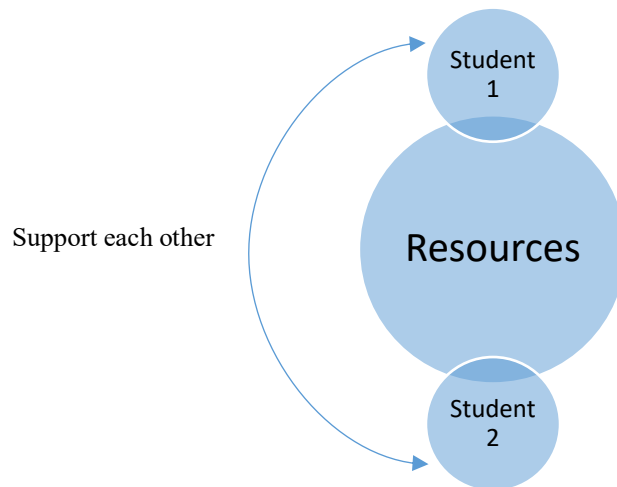
The second metaphor or phase that Sfard (1998) talks about is participation. During this phase, students begin to have an active role. Through activities and shared discussion, it is sought that the participants registered in the course stay awake and participative, which facilitates the satisfactory process of received information. This metaphor supports the formulation of social theories, like the social constructivism, the action theory and community practice. Furthermore, the participation in activities where it is looked to develop knowledge is a central axis for these theories (Kop & Hill, 2008).

Siemens & Downes (2009) proposed learning strategies where there is no need of formal teaching. Different dynamics have been proposed to allow the teacher to work more as a facilitator than an instructor. There are even scenarios in which the teacher is not needed in the process, these helped to study further the connectivism theory (Siemens & Downes, 2009).

It is important to notice that in this particular scenario, the phase of participation of the subjects that are in the learning process becomes extremely important, as it turns indispensable that the subjects take an active role to familiarize themselves and dominate the content of the course. During the learning process, the subjects are in contact with their fellow students to be able to start a discussion that can facilitate the learning process among them. Now students do not depend mainly on the transference of knowledge from the educator to them, but there is a new form of interaction that highly depends on the level of commitment and autonomy of the student. Below, there is a demonstrative diagram of this:



*Figure 4. Traditional process*



*Figure 5. Connectivism*

This scenario presents itself with frequency in courses available online. Depending on the activity of each individual and their commitment to understand and dominate the material consolidates the learning process. Furthermore, Kop (2011) says that the learning process for online activities is improved with the completion of the following four. The first is to add. During this activity, students have access to a wide collection of resources that help them read, observe, or play.

It allows them to interact with the content and begin to familiarize themselves with the key elements of their learning subject. The second is to connect. Once the students have finished adding new information to their previous knowledge, it is necessary that they begin

to use the information in a practical manner and not in a theoretical manner. During this activity, a process of reflection begins that can be affected by what the subject already knows or past experiences that have helped form a perspective of the world.

The third activity is to create. Once the students have processed the new information in their system, they can begin to create something of their own based in their new acquired knowledge. This activity can be rather simple, like writing a blog entry, start a discussion on the group forum or even make a video review of the analyzed material. The way is unimportant, what matters is that something new is created based on the new knowledge they have acquired. The fourth and last activity is, simply, to share. Today there are a wide variety of social media platforms that work to share news, pictures, stories and even knowledge. Once the students share their own perspective or interpretation of what they have learned, an active participative process begins and puts to practice their new knowledge. This participation has been analyzed and considered a main element for the success of online courses.

As mentioned by Canole, de Laat, Dillon & Darby, new forms of learning are required, since the present and complex learning environment is constantly changing and improving with new technology (Canole, de Laat, Dillon & Darby, 2008). Nonetheless, before developing new forms to assimilate information through online courses, it is important to define what are the difficulties presented in connectivism and how these challenges can define if a MOOC has been successfully completed or not.

As it was mentioned before, the student enrolled in a course has an active and participative role, but also counts with the responsibility to define various elements that were previously defined by a teacher in a traditional classroom. It is now up to the student to

manage their time, define their learning goals, find the necessary resources when doing a research, find new tools that help their leaning process and learn how to use these tools. Before, the teacher in the classroom was the one who defined the syllabus, made clear how much time should be invested in each activity and tried to support the students with the necessary materials; but given that in connectivism the professor plays more the role of a facilitator than a teacher, students must define these elements and must demand themselves to follow the study regime that they set out for.

This could be a benefit for the subjects that look for this kind of freedom at the time studying. In fact, there is a high chance that the people that look for an online course do it because they work during the day and need the flexibility of managing their own time in the best way for their personal learning process. Unfortunately, this also means that every student has their own needs, contexts, and motivations to participate in an online course. If there is a student that is motivated to take an online course but through time finds it difficult to adhere themselves to a study plan in which the main judge is the time invested in themselves, then it will be difficult for them to dominate satisfactorily the material provided.

### **Other Strategies Developed to Spread Education for Sustainable Development**

Besides digital interventions, there are some that take place in more traditional ways, though with innovative factors. We understand “traditional” as any intervention that could take place in an on-site form or impact the school curriculum. One example of a strategy used to spread Education for Sustainable Development are the laboratories of Social Innovations. These laboratories have the goal to open a space where companies, governments, the general public, and educational institutions can converge (Yañez-Figueroa, Ramírez-Montoya & Ramírez-Hernández, 2017). This helps so participants could familiarize themselves with the



same topic taking into consideration different experiences and perspectives, as each individual share different contexts and personal life lessons.

This type of intervention has the final goal that participants face the real challenges of the outside world, even if they are not aware of the problem at hand before the intervention. This is the reason why Education for Sustainable Development can be spread and supported by communities through Social Innovation Laboratories. The participants form a professional community of learning, are oriented by experts that can guide them through the research branch, the sciences linked to the pertinent subject and culminates with the creation of new knowledge came from the experiences of all the participants during the laboratory (DuFour, 2013).

Another on-site learning strategy are workshops where the participants go through a sort of intensive training and process of awareness of the need of a sustainable future to ensure the well-being of upcoming generations and the Earth. This kind of workshops are usually oriented to social awareness about how the waste of energy and resources can impact the world and have repercussions that can affect other humans, living beings and ecosystems. When the country in question has reached to consider Education for Sustainable Development as a key factor that must be treated in compulsory education, also other interventions can be carried out directly in the curriculum of public schools. One example took place in Japan from the year 2004, where UNESCO Associated School Project Network (MEXT, 2014). Their goals are the following:

Table 4

*The Guidelines for the UNESCO Associated School Project Network (Information taken*

from MEXT, 2014)

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**What is expected of members of the network?**

- Build an open network through collaboration with the different interested parts.
- Promote the ESD outside the school.
- Indicate in the school management policies the efforts to implement the activities of UNESCO's ASPnet.

**What is expected of the centers to promote ESD?**

- Clarify the qualities and abilities the school wishes to promote through ESD and make efforts to design study plans that emphasize in the learning process that lead to problem-solving.
  - Make efforts to improve teaching methods.
  - Participate in the research and practice and try to promote the concepts of ESD.
- 

The schools that are members of this network make constant changes in their curricula to update and implement new awareness strategies to the students on ESD.

**The Mexican Energy Reform**

The Energy Reform is a constitutional reform; the initiative was presented by President Enrique Peña Nieto the 12th of August 2013. The reform was promulgated by the Executive Branch the 20th of December of the same year and published the following day in *the Official Journal of the Federation (Diario Oficial de la Federación, 2013)*. Understanding what are the objectives of the reform and the impact it has to bring light to the interest of educating the Mexican population on the use of renewable energy sources to ensure a sustainable future will help define the historical and social context of Mexico in relation to the Education for Sustainable Development.

The laws and regulations that were updated helped trigger investment in the energy sector. Furthermore, the number of productive activities that to that moment had been

monopolized by the State was restricted. All these changes propelled the restructuring of the Productive State Enterprises (EPE in Spanish) and its functions. The changes in the energy and tax policy of Mexico updated in the past years to promote national or international business opportunities that are interested in investing in the energy sector (DOF, 2013).

Thanks to the technological advancements of the recent years, particularly in the access and processing of oil, the need to regulate the oil industry in Mexico under a new regimen became a political matter of great importance. The exploration and production of oil, as the industrialization process after the extraction required to be closely regulated. It proposes reforms to the articles 25, 27 and 28 of the Constitution. The document rules out the handing over of concessions to private individuals and it limits itself to different arrangements of contracts or licenses for the exploitation and exploration of the energetic resources in Mexico (DOF, 2013).

The reforms in the constitutional articles regulate the way in which any activity of exploration or use of energy should be processed, as much as the ones related to hydrocarbons as the ones related to electric power. Under the constitutional articles, in order of importance, there are a few secondary laws that play an important role in Mexico's energy market: The *Ley de Hidrocarburos* and the *Ley de Petróleos Mexicanos* (Law of Hydrocarbons and Law of Mexican Oils). These are laws with the most impact in the energy sector (Constitución Mexicana, 2018). Both laws are of public interest and have the purpose to regulate the organization, management, function, operation, control, evaluation and accountability of the productive company of the Mexican Oil State, as well as to establish a special regimen in matters of productive subsidiaries and affiliated companies, remuneration, procurement, leases, services and works, assets, responsibilities, state-owned dividends, budget and debts

relevant to Mexican oil. Moreover, promotes the development of a national electric system based on technical and economic principles that will be regulated and ran by the State, trying to lower the cost of electric power and natural gas for the final consumer, be it an individual or a legal entity. In the process of lowering the cost of electric bills, it is thought to increase investment in development of new technologies that facilitate the generation of energy in our country, particularly electric power. This is how the use of renewable energy sources creates a great opportunity to foster new inventions and business models. Among the ones that show more viability, the use of solar power represents an exceptional chance to produce an economical revolution in Mexico.

Thanks to the Energy Reform that started during 2013, a new era of innovation and education has started in the country. Constant research in the energy field have led to the production of new inventions, business models and work opportunities that will develop in upcoming years.

To ensure that the people who have dedicated their lives to the research and development of new inventions or industrial secrets related to the use of renewable energies, it is fundamental to educate the future generations on the different kinds of energy sources that exist, as well as the fundamental elements that want to achieve sustainable development for society. Innovation opens the door to new business models that will develop the economy and Mexico's growth in upcoming years. García-Ochoa and Graizbord (2016) proved that the energetic poverty in Mexico has reached 36.7% of the Mexican homes. The authors suggest integrating this poverty as a key dimension to the national politics of sustainable energy. If Mexico is capable to effectively educate its future generations on renewable energies, it is expected to reduce the percentages of homes in energetic poverty in the future.

The use of renewable energy sources that do not harm the environment and that ensure a responsible use will allow to count with the one of the fundamental elements that constitute a sustainable society. The Ministry of Energy, Architect Pedro Joaquín Coldwell, mentioned during his talk in the Solar World Congress in 2013, that one of the main purposes of the Mexican Energy Reform is to promote and multiply the use of clean energies. He also pointed out that other goals that the reform seeks to achieve is to improve the Mexican economic competitiveness, counting with a more efficient power sector, motivate the funding of top infrastructure for a better use of the natural resources of the country, as well as to encourage long term equality and social development (SENER, 2013).

Moreover, the Energy Reform seeks to establish a normative framework to carry out social consultations to the Mexican population in order to encourage active and inclusive participation of interested actors in the sector. Using evaluation processes of social impact, it looks so identify the benefits and challenges related to the projects that come from said reform, with the purpose to define and execute the necessary prevention and mitigation measures. Long term, its final goal is to achieve regional sustainable development for the Mexican population.

### **The Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training**

The Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training is an initiative that emerged thanks to the collaboration of the Ministry of Energy, the National Council of Science and Technology (CONACYT) and the Monterrey Institute of Technology and Higher Education (ITESM). The goal behind this initiative is to place Mexico at the same level of the most developed countries regarding the generation of

technology and knowledge about energy. The Bi-National Laboratory is formed by the Monterrey Institute of Technology, the National Institute of Technology in Mexico, the National Center of Research and Technological Development (CENIDET), the National Institute of Clean Power and Energy (INEEL), the Arizona State University (ASU) and the Berkeley Energy and Climate Institute (BECI) of the University of California (Ramírez-Montoya & Mendoza-Domínguez, 2018).

The responsible use of energy is a key attitude to ensure sustainable development for the future of the country, therefore this laboratory, in partnership with various national and international institutions, private and public, of higher education looks to provide with tools and support in training, research and infrastructure to achieve said goal.

The Laboratory aims to offer solutions to the sustainability energy challenges face by Mexico. The challenges listed in the official web page are as follows:

- Train talent specialized in the field.
- Develop intelligent technology to the energy value chain.
- Offer a group of courses based on MOOC technology to cover the needs of training in Mexico.
- Create cutting-edge infrastructure, physical and virtual, for the construction of national networks of research and technology.
- Explore the potential in new educational tendencies for the development of innovative solutions, characterized by citizen participation and the use of digital technology.

With the purpose to accomplish these goals, Mexico has designed and ran 12 MOOCs about diverse topics related to the use of sustainable energy in the country. These courses have been

created thanks to the collaboration of all the entities that are part of the project.

### **Sustainable Values, Attitudes and Behaviors**

In the last 20 years awareness to support a global sustainability transition towards the future has become a topic of conversation in a global scale, promoting values, attitudes and behaviors that in individual and societal values have impacted the promotion and application of sustainable actions. In order to measure the sustainable values and attitudes of the participants before and after they participated in the MOOCs, it was important to read about what these are and how they can be measured.

Leiserowitz et al (2006) define values as abstract ideals that evoke emotional reactions and that direct towards a specific goal, framing the attitudes and providing standards against which the behavior of societies and individuals can be judged with. Attitudes, in the other hand, refer to the evaluation of a specific object, quality or behavior as something positive or negative, something that can be labeled as good or bad. It is through attitudes that we can reflect the abstract values of the users, so in this specific study, since we can't measure the abstract values of the participants, we will try to get an idea of their perspective and positions through their attitudes towards diverse approaches to sustainability.

Finally, behaviors refer to concrete decisions and actions that can take place by individuals and groups of people, often rooted in values and attitudes which shape them. Thus, in part of this study we will directly ask the participants if they partake in certain actions or not, to measure the kind of sustainable behaviors that they put in action in their daily lives. Empirical data related to many of the subcomponents of sustainable development have been defined in few multinational and quasi-global surveys of public opinion that review global

attitudes and behaviors related to development and the environment, along with their role in the application of sustainable development.



## Chapter 2. Problem Statement

With a world population of around 7 billion people, and with a limited amount of natural resources, various societies and individuals have stressed on campaigns to promote learning in future generation, to be able to coexist in this planet sustainably. The General Assembly of the United Nations approved sustainable development for the first time in 1987, creating at the same time the concept of education to support it. The initial thoughts on Education for Sustainable Development can be seen portrayed in the 36th Chapter of the Agenda 21 and mark as main goals "the promotion of education, public awareness and training." (UN, 1987)

Motivated to change this, UNESCO released in 2015 the Sustainable Development Goals (SDGs) adopted by the global community with the purpose to reach a better world by 2030 (UNESCO, 2015). Goal 4.7 talks about education and ESD and related approaches like the Global Citizen Education. Currently UNESCO is responsible for the Global Action Programme (GAP) on ESD.

In the case of Mexico, the administration and the organized civil society have promoted and started the Environmental Institution Development Program supported by the National Association of Universities and Institutions of Higher Education (ANUIES) and the Mexican Consortium of University Environmental Programs for Sustainable Development (COMPLEXUS). Moreover, the Mexican government has assumed commitments that favor sustainable development, such as the Convention on Biological Diversity (1992) sponsored by the UN, the United Nations Convention to Combat Desertification and Drought (1994), Education for Sustainable Development Kyoto Protocol of the United Nations Framework

Convention on Climate Change (1998), The Dakar Framework for Action: Education for All: Meeting OUR Collective Commitments (2000), Global Citizen Education (2013), and others. The Mexican Government has also expressed in different official statements that it considers that education is fundamental to reach better conditions for its population.

During 2006, the Strategy for Environmental Education for Sustainability was developed. In its corpus the Environmental Education for Sustainability was defined "with the purpose to recognize, strengthen and give continuity to the contributions of over three decades of Environmental Education in Mexico."

The Japanese National Commission for UNESCO, along with the United Nations University and the Asia Pacific Cultural Center for UNESCO, celebrated the International Forum on ESD Dialogue in 2008. The implementation of activities and studies at local, national, regional, and international level started to promote teaching for sustainable development was discussed.

"Integrated studies" was introduced to the curriculum of Japanese schools at elementary school level to superior level of middle school in 2000, before adopting the DESD resolution in 2003. This class covers topics through traditional subjects and allows the implementation of instruction and learning activities related to education. Some of the topics and goals presented in this course include international understanding, information education, environmental education, health education, assistance education, and others.

The knowledge and skills are developed in integrated learning activities and the content is based on the personal interests of each student. Integrated Studies works as the base for ESD. To move forward with ESD, the programs implemented in this subject must be linked integrally and constantly promoting learning activities. To ensure this, the Ministry of

Education, Culture, Sports, Science and Technology (MEXT) supports: 1) The formulation of a Base Plan for the promotion of education that identifies ESD as a critical component; 2) The revision of study courses to allow ESD topics to enter different subject areas and 3) The expansion of the UNESCO Associated School Network (ASPnet) (UNESCO, 2009).

Moreover, UNESCO introduced strong initiatives of the practice of ESD through private companies and non-governmental actors. The Japan Association for International Education leads the interactions between researchers and professors of social sciences; additionally, the Japanese Society of Environmental Education works constantly with science teachers at elementary and middle school level. Both academic societies actively publish research papers and activities related to the Education for Sustainable Development.

On the other hand, the United States has implemented a series of strategies, reports and documents that have the aim to offer a general vision of the state of ESD in the US. In 2015, a report made by the United States Department of State was issued among professors of the ESD Network of Teacher Education of the United States. It has been observed that teacher education, in comparison to the rest of higher education, has been reluctant to accept sustainability as a key element of the development for the future (Nolet, 2013).

ESD is still not part of the requirements for teaching certification, but the Association for the Advancement of Sustainability in Higher Education has started to include it in its curriculum. Some examples of its implementation in the US took place in the Webster University School of Education, West Chester University and University of Antioquia (Nolet, 2009). Along ESD, there has been a great tradition in the United States to bring awareness to the new generation about global education (Maguth y Hillburn, 2015) and this topic can be seen in the publication *Partnerships for 21st Learning, Framework for State Action on*

*Global Education* (2014), as one of the crucial issues it discusses it the promotion of global and international competences.

The responsible for the initial training of teachers must arouse the training with global content and competencies. The report also recognized the value to encourage the creation of networks among teachers and the teachers' educators, and the value of teacher students that have international experience. More and more, universities are using the term global citizenship in courses and programs taught.

Besides the support from different administrations, the curricular practices, seminars and workshops that are designed to bring awareness in adults and youngsters about sustainable development and the efforts made in on-site format to support and raise consciousness about the key role of sustainability, it has also been considered the use of resources that can teach about these subjects in remote form. For example, an app called “SDGs in Action” was developed and shared on the App Store by Apple and the Play Store by Google. This app enlists the pending global tasks to reach all the Sustainable Development Goals. This app is available thanks to the GSMA Association, which represents over 800 mobile carriers around the world, and the project Everyone, a global non-profit campaign that works to spread the message (UNESCO, 2017).

Another practice adopted by countries around the world is the promotion of free access online courses to bring awareness to its peoples about sustainable development. This is what brings us to the research of Massive Open Online Courses, or MOOCs.

### **Definition of Education for Sustainable Development**

This construct is composed by two elements: education and sustainable development. The Royal Spanish Academy defines education as the “action and effect of educating / raising,

teaching and doctrine given to children and youngsters / instruction through teaching work” (RAE, 2017). This definition is quite clear; however, it is also interesting to consider, from a legal perspective, what is education and why it plays such a fundamental role in our society.

## **Worldwide Practices to Teach About Sustainable Development**

### **Mexico**

The Mexican Basic Law, the Political Constitution of the United Mexican States, and in the General Law of Education, education is a basic right of every man and woman for their quality as human beings (Constitución de México, 2018). The Article makes it a State duty to legally protect this right for every Mexican citizen. According to Bracho (2009), it is in this article where “a fundamental social election is expressed, that is part of the kind of society we want to live in. In other words, that is where the State is owed to the individuals.”

Dewey (1916) addressed the definition of education one century ago, contending that “the objective and reward of learning is the continuous capability of growth.” According to this author, education implies the continuous reconstruction and reorganization of the experience accumulated to the meaning of experience itself, and that it raises the ability to lead the course of future experiences. He also addressed the impact that social relationship can have, particularly between pupils and teachers.

Just like Freire (1972), he declared that the relationships for learning must be mutual, and that it is possible to achieve individual and social change through education. Whether it is seen as an action, a right, a process of instruction or a tool for growth, education is a key element that will help define the future world, according to UNESCO.

Koichiro Matsuura, General Director of UNESCO from 1999 to 2009, expressed that

education is not only an aim by itself, but it should also be considered as one of the most powerful resources we have to induce the necessary changes to achieve sustainable development (Matssura, 2007). Through time, more and more worldwide leaders have agreed with this statement, taking in consideration that investing in the education for future generations regarding sustainable development is one of the best strategies to assure a better future for everyone.

The second key element of our concept is sustainable development. Traditionally, sustainable development has been a difficult concept to define, particularly because it has constantly evolved since its conception (UNESCO, 2015). One of the first definitions of sustainable development comes from the *Brundtland Report* (1987), where it is defined as “the development that manages to meet the needs of the present without compromising the possibility of future generations meeting their own.”

It was for the first time in 1992 when the discussion on how sustainable development had to focus its attention on the educational system and support itself in it to ensure a sustainable future for everyone emerged at an international level. In the Agenda 21 the Rio Declaration defines in its 36th chapter the main problems the educational faced to achieve global sustainable development (Rio de Janeiro Earth Summit, 1992). There are four main areas detailed in this chapter:

1. Improve basic education
2. Redirect the existing education that deal with sustainable development
3. Develop the public understanding and raise awareness
4. Training

Education for Sustainable Development was a concept formed by the recognition of the

difference between “sustainable development education and education **for** sustainable development.” The former was perceived as a theoretical exercise, whereas the latter thought about education as a process that could be used as a tool to protect sustainability (McKeown, 2002).

UNESCO defines Education for Sustainable Development (ESD) as a “medium to change the way in which people think and work, prioritizing collaboration for a sustainable future for everyone.” Considering education as a motor for change, in December 2002, the General Assembly of the United Nations, in its Resolution 57/254, proclaimed the period from 2005 to 2014 as the Decade of Education for Sustainable Development; furthermore, designated UNESCO as the lead agency of promotion of the Decade (UNESCO, 2005).

To achieve the goals set by the Decade of ESD, UNESCO set out practical activities through the campaign as demonstrated by the extract below:

Table 5

*How to implement the Decade? (Taken from UN Decade of Education for Sustainable Development, 2005-2014: the DESD at a Glance by UNESCO)*

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**Promoting and improving quality education:** basic education needs to focus on sharing knowledge, skills, values and perspectives throughout a lifetime of learning in such a way that it encourages sustainable livelihoods and supports citizens to live sustainable lives.

**Reorienting educational programmes:** rethinking and revising education from nursery school through university to include a clear focus on the development of knowledge, skills, perspectives and values related to sustainability is important to current and future societies.

**Building public understanding and awareness:** achieving the goals of sustainable development requires widespread community education and a responsible media committed to encouraging an informed and active citizenry.

**Providing practical training:** All sectors of the workforce can contribute to local, regional and national sustainability. Business and industry are, thus, key sites for on-going vocational and professional training, so that all sectors of the workforce can have

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the knowledge and skills necessary to make decisions and perform their work in a sustainable manner. This Decade will also seek to create synergies with the other global initiatives that preceded it, like the Millennium Development Goals (MDGs) that centered on the reduction of poverty; Education for All (EFA) that focuses on the universal access to education; and the United Nations Literacy Decade (UNLD) that aimed to provide adults with education. All share a common vision: education is the key to sustainable development.

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This decade was a detonating factor in the production of projects, campaigns, and activities to improve the access to Education for Sustainable Development in all levels and social contexts. In great measure, these campaigns try to include subjects about sustainable development, like climate change and biodiversity in teaching and learning (UNESCO, 2002).

UNESCO has supported campaigns that encourage its participants to overcome challenges, respect cultural diversity and contribute to create a more sustainable world for future generations. The main challenge that has been faced during the execution of said campaigns is that the curriculum of most school tends to focus only on improving the academic skills of its students (UNESCO, 2002); nonetheless, just as was mentioned previously, UNESCO defines Education for Sustainable Development as a medium that transforms the way in which people work, collaborate, plan and think. Collaboration with the aim to construct a better present and a sustainable future for all is a high priority.

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### **United States**

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### **Research Problem**

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To ensure that the people who have dedicated their lives to the research and development of new inventions or industrial secrets related to the use of renewable energies, it is fundamental to educate the future generations on the different kinds of energy sources

that exist, as well as the fundamental elements that want to achieve sustainable development for society. Innovation opens the door to new business models that will develop the economy and Mexico's growth in upcoming years. García-Ochoa and Graizbord (2016) proved that the energetic poverty in Mexico has reached 36.7% of the Mexican homes. The authors suggest integrating this poverty as a key dimension to the national politics of sustainable energy. If Mexico is capable to effectively educate its future generations on renewable energies, it is expected to reduce the percentages of homes in energetic poverty in the future.

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- Explore the potential in new educational tendencies for the development of innovative solutions, characterized by citizen participation and the use of digital technology.

With the purpose to accomplish these goals, Mexico has designed and ran 12 MOOCs about diverse topics related to the use of sustainable energy in the country. These courses have been created thanks to the collaboration of all the entities that are part of the project.

One good example is the design of the content of the MOOC “Electric Power: Basic Concepts and Principles.” A wide variety of disciplinary areas took part in the creation of this course, in weekly on-site work sessions and individual activities carried out remotely, in which each participant worked on their own before the weekly meeting took place. The goal of this work structure was that on-site sessions could focus on jointly discussing or redesigning the material planned for the content of the course (Guajardo-Leal, Valenzuela-González & Mecías, 2017).

Observing the implementation of different MOOCs designed and ran by the Bi-National Laboratory, it is intended that the participants become aware and look to develop attitudes and conducts that allow or facilitate sustainable development.

## **Research Questions**

Research question:

- To what extent do people’s attitude and perception on sustainability change after completing one of the MOOCs in the context of non-formal learning?

Subordinate questions:

- What sort of impact in attitude and perception on sustainability did the course had in

users who completed the MOOC?

- What sort of impact did the courses had in users who didn't complete the MOOC?
- Which suggestions from the users should be considered for future implementations?

### **Research Purpose**

The main purpose of this research is to compare the self-perceived level of knowledge and change in attitudes and daily actions by the users who signed up for one of the offered Massive Open Online Courses. Another important element is to listen to the voices of the participant subjects and the suggestions they share for future creations of online courses related to the theme of Sustainable Development.

### **Research Justification**

This subject is considered of the utmost importance because it has, first, international impact. The effort made by various nations in the past years to achieve UNESCO's Sustainable Development Goals has led to the design and implementation of different learning strategies that have resulted in on-site and digital interventions. Notwithstanding if the intervention was carried on-site or with the support of long-distance learning strategies, it is important to evaluate the impact that these interventions have had in their participants. In the case of MOOCs, the amount of right answers the participant has had during the tests of the course is considered; however, measuring the level of learning or the impact the online course had on its students is yet to be defined, particularly when it is based on individual variables such as score tests (Deng & Gannaway, 2019).

Wilson (2014) made a study that focused on determining if the relation between attitude



behaviors of sustainable development and the sustainable behavior could reflect an improvement after the participants took part in an on-site seminar about the subject. To determine if the intervention had been effective, a survey was carried out before and after the course. It focused on determining the participants' knowledge before the seminar of the following topics: basic sustainability concepts and sustainable attitudes and behaviors. To achieve this, a practical object of the study was to determine which values define the level of knowledge on sustainability, as much as the reflection of sustainable attitudes and behaviors. Various studies that look to determine if a person is familiarized with the sustainable development subject assure that the first step is to identify if the participants understand what it means to be sustainable.

Dresner (2013) defines sustainability as the contextual combination of science and history of the 20th century that impacts ethics, metaphysics, economy, and social politics. Ott (2003) also shared an ethical idea that defines sustainability as "the fact that people, in the present and the future, share the right to find in average the same opportunities to realize their own project of a good human life."

Developing metrics to evaluate the levels of understanding of sustainable development has been an effort of nearly a decade in the works. The International Institute for Sustainable Development (IISD) collaborated with Canada to run two surveys that were applied to citizens of Manitoba and British Columbia in 2007.

The purpose behind this data collection was to establish a framework to evaluate the changes in levels of comprehension of sustainability and behavior through time. To set the groundwork for the development of standardized tests of knowledge, attitudes and behaviors related to the basic subjects of Education for Sustainable development was the final objective

of the study (IISD, 2009). The IISD team ran a survey of 47 questions, that was distributed 5000 times in Manitoba and came out with 506 completed surveys (IISD, 2009).

Newton & Meyer (2013) created a survey to determine if a lifestyle that seeks to respect the environment can somehow influence people's consumer behavior. Their survey had a sample of 1250 participants from Australia. The results supported the notion that the desire to have a more sustainable lifestyle does affect the behavior of the participants.

In Mexico, another survey was designed to determine if people had a sustainable behavior in 2013. It was determined that a sustainable behavior is a deliberate action, anticipated and with purpose, destined to protect the natural resources and humankind. It is a behavior oriented to the future, since it considers the needs of future generations while also fulfilling current needs for those in the present (Tapia-Fonllem et Al., 2013).

Based on the literature review and the fact that Education for Sustainable Development is "a medium to change the way in which people think and work, prioritizing collaboration for a sustainable future for everyone" (UNESCO, 2002), we can enlist the characteristics that must be measured to evaluate if an intervention, whether traditional or remote, is able to impact and share the key elements for sustainable development:

- Transform the way of thought of participants.
- Spread information about the Sustainable Development Goals.
- Explain the limitations of the environment and future risks.
- Awake a change in the behavior and actions of participants.

### **Research Limitations**

One of the scientific delimitations of this research is that it is an *expost facto* study,

meaning that it is not the researcher who intervenes to manipulate the variables but to gather data once the phenomenon has occurred. Furthermore, there is a time and space limitation given the fact that the data gathered from the platform where the MOOCs were taken was only collected during the time period when the courses were implemented, from January to May 2019.

## **Chapter 3. Methodology**

### **Research Design**

The design of this research is mixed methods (Creswell, 2014) with the gathering of data taking place with both quantitative and qualitative approaches. The design of this research is sequential, with a quantitative descriptive approach happening first, measuring the self-perception of the students about their level of education for sustainable development before and after they participated in the MOOC with an exploratory, descriptive design. Ferreyro y De-Longui (2014) define correlational as the search to evaluate or identify if there is a relation between two variables or constructs, trying to determine the sense and magnitude of said correlation. In this case, the correlation that is tried to be identified, is the digital strategy of the MOOC with the auto-perception of Education for Sustainable Development of the participants. The second part of the research has a qualitative approach, where interviews will take place to participants who finished and who disserted the online course. It is through this second phase of the research that suggestions by the users regarding future design of online courses addressing the theme of sustainable development will be gathered.

### **Research Context**

Data was gathered from the following MOOCs that are part of the Bi-National Laboratory on Smart Sustainable Energy Management and Technology:

- Energy Saving
- Energy: Past, Present and Future
- Conventional and Clean Energies and Their Technology
- The Mexican Energy Reform and its Opportunities

- Energy Markets: Business Opportunities

These massive courses have been running on the digital platform since August 2017 and have been collecting data of the participants since then. It is expected that the courses stop being available online in July 2019. There is a wide variety of instruments that will be used to evaluate the profiles of the participants, just as the impact the course had in their self-perception regarding their level of knowledge of Education for Sustainable Development.

The courses have been run in two different platforms designed especially for online courses: edX and MexicoX. They are completely free and have been open to the public since their first apparition in August 2017. In total, the courses have been run four times, though the data collected for this paper will focus solely in the data collected in the period of January to July 2019. More detailed information of these courses can be found in the following table:

Table 6

*MOOCs Instructional Characteristics*

MOOC	Energy Saving	Energy: Past, Present and Future	Conventional and Clean Energies and Their Technology	The Mexican Energy Reform and its Opportunities	Energy Markets: Business Opportunities
<b>Number of modules it had</b>	8 modules (1 Introduction, 6 Topics and 1 Conclusion)	8 modules (1 Introduction, 6 Topics and 1 Conclusion)	8 modules (1 Introduction, 6 Topics and 1 Conclusion)	8 modules (1 Introduction, 6 Topics and 1 Conclusion)	8 modules (1 Introduction, 6 Topics and 1 Conclusion)
<b>Main keywords of the MOOC</b>	Energy, saving, industry, transportation, success cases, efficient use of energy	Energy, past, present, future, daily life, sustainable energy, alternative energy	Energy, clean and conventional energy, analysis, diversification in the production of energy.	Mexico, change, opportunities, challenges, tools, structure, reform	Energy, Market, new business opportunities, Mexico

<b>Type of evaluation</b>	Multiple choice quiz, Auto evaluation through multiple choice questions, drag and drop exercises for important terms, individual exercise with the revision of five online classmates	Multiple choice quiz, Auto evaluation through multiple choice questions, drag and drop exercises for important terms, individual exercise with the revision of online classmates, gamified challenge	Multiple choice quiz, Auto evaluation through multiple choice questions, drag and drop exercises for important terms, individual exercise with the revision of online classmates. one essay	Multiple choice quiz, Auto evaluation through multiple choice questions, drag and drop exercises for important terms, individual exercise with the revision of online classmates, write a proposal	Multiple choice quiz, Auto evaluation through multiple choice questions, drag and drop exercises for important terms, individual exercise with the revision of online classmates
<b>Average length of videos in the MOOC</b>	4 minutes and 54 seconds	4 minutes and 55 seconds	6 minutes and 5 seconds	4 minutes and 50 seconds	3 minutes and 38 seconds
<b>Unique qualities of the specific MOOC</b>	It presented a real-life case regarding saving energy for the students to solve as a type of challenge through a multiple-choice question.	The participants had to solve a challenge that had characteristics of gamification, which resulted in them selecting a final option from a multiple-choice question	Participants had to write an essay that would be later be graded by another participant regarding the main topic of the MOOC.	Participants had to write a proposal for a make-believe case, in which they had to reflect on the changes made in the Mexican law in order to use the best strategy for their problem-solving obstacle.	Augmented reality was a key element of this MOOC, since there were three exercises where the participants were able to use augmented reality to understand a specific topic of the course
<b>Number of runs the MOOC has had</b>	6 runs	8 runs	8 runs	8 runs	6 runs
<b>Number of participants who signed up from</b>	313	228	788	196	477

<b>January to July 2019</b>					
<b>Number of participants who disserted the MOOC before finishing</b>	308	223	778	193	451

## **Population and Sample**

For the purposes of this research, the main population includes all the subjects that enrolled and took any of the following MOOCs from January to July 2019:

- Energy Saving
- Energy: Past, Present and Future
- Conventional and Clean Energies and Their Technology
- The Mexican Energy Reform and its Opportunities
- Energy Markets: Business Opportunities

The sample will be understood as all the subjects that are willing to answer the instruments, even if they just limit themselves to only answer the pre-instrument. Furthermore, all the subjects that agree to be contacted for research purposes and do a phone interview will take part of the sample that will be subject to qualitative analysis through semi-structured interviews. It is expected that at least eight participants who completed the MOOC and eight participants that dropped out of it will be interviewed, giving a total of 16 subjects. The result of the pre and post surveys will be analyzed first by their tendencies and finally making a comparison on the changes in the replies by the users who answered both. The possible amount of answered surveys for the pre survey is 252 and the for the post survey, it is 121.

## **Measuring Instruments**

There is a wide variety of devices quantitative and qualitative that are implemented in this research. In first instance, the main devices will be two surveys: “Level of Alphabetization Survey on Sustainable Development 1” that will measure the level of alphabetization on SD before taking the MOOC, and “Level of Alphabetization Survey on Sustainable Development 2,” a pre and a post survey, where the self-perception of the subject of ESD will be measured to see if it has improved as a consequence of taking the MOOC (see Appendix 1 and Appendix 2).

These tools include elements about the self-perception of subjects, their attitudes and sustainable activities in their daily life, as well as a series of questions that have the purpose to determine what elements and what kind of energy are prioritizing to ensure a sustainable future.

The elaboration and design of these tools was based on a series of devices that have been created and validated by experts on the subject. Wilson (2014) carried out a study that focused on determining if the relationship between the behavior of sustainable attitudes and sustainable behavior could improve after the subjects took an on-site seminar on the topic. To determine if they were effective, a survey was carried out before and after the intervention. They were focused on defining how much of the knowledge the participants had of basic sustainability concepts, sustainable attitudes, and sustainable behaviors. To achieve this, one practical goal of the study was to delineate what values determine the knowledge of sustainability, as well as the reflection of sustainable attitudes and behaviors. Various other studies that look to discover if a person is familiarized with the subject assure that the first



step is to verify that the participants understand what being sustainable means.

Dresner (2013) defines sustainability as the contextual combination of science and history of the 20th century that impacts ethics, metaphysics, economy and social politics. Ott (2003) also shared an ethical idea that defines sustainability as “the fact that people, in the present and the future, share the right to find in average the same opportunities to realize their own project of a good human life.”

Developing metrics to evaluate the levels of understanding of sustainable development has been an effort of nearly a decade in the works. The International Institute for Sustainable Development (IISD) collaborated with Canada to run two surveys that were applied to citizens of Manitoba and British Columbia in 2007.

The purpose behind this data collection was to establish a framework to evaluate the changes in levels of comprehension of sustainability and behavior through time. To set the groundwork for the development of standardized tests of knowledge, attitudes and behaviors related to the basic subjects of Education for Sustainable development was the final objective of the study (IISD, 2009). The IISD team ran a survey of 47 questions, that was distributed 5000 times in Manitoba and came out with 506 completed surveys (IISD, 2009).

Newton & Meyer (2013) created a survey to determine if a lifestyle that seeks to respect the environment can somehow influence people’s consumer behavior. Their survey had a sample of 1250 participants from Australia. The results supported the motion that the desire to have a more sustainable lifestyle does affect the behavior of the participants.

In Mexico, another survey was designed to determine if people had a sustainable behavior in 2013. It was determined that a sustainable behavior is a deliberate action, anticipated and with purpose, destined to protect the natural resources and humankind. It is

oriented to the future, since its focus takes in consideration the needs of future generations while also fulfilling current needs (Tapia-Fonllem et Al., 2013).

By observing the diverse applications of the different MOOCs designed and ran by the Bi-National Laboratory on Smart Sustainable Energy Management, it is intended that the participants become aware and look to develop attitudes and conducts that allow or enable sustainable development.

The couple of main instruments that will work as the focal point of the analysis, given that the main scenario is in the digital platform of the MOOCs Energy Saving, Energy: Past, Present and Future, Conventional and Clean Energies and Their Technology, the Mexican Energy Reform and its Opportunities and Energy markets: business Opportunities, it is described to detail in the operationalization table below. It is important to notice that since these are tools of before and after character there are two different charts.

Table 7

*Operationalization Pre-Test*

<b>Element</b>	<b>Characteristics</b>	<b>Questions in the Pre-MOOC survey</b>
<p>Privacy policy and privacy notice for the participants.</p> <p>This element was essential at the beginning of the instrument because to be able to run the survey in the Massive Online Course on behalf of ITESM it was important that the participants agreed to give out their information.</p>	<p>That the participants have read the privacy rules and the privacy notice terms of the ITESM.</p> <hr/> <p>That the participants have read the privacy rules and the privacy notice terms of the ITESM.</p>	<p>I have read and accept the ITESM privacy policies and the privacy notice. Please confirm your agreement by marking “Accept” to continue with the survey.</p> <p>For this question an “Accept” box was provided for the participants to check and be able to proceed with the instrument.</p>

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That the participants have read the privacy rules and the privacy notice terms of the ITESM.

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Identification Details of the Participants.

To understand the participants, a series of identification details will be requested.

First and last name of the participant

Name (s) - Free space

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Another reason behind the request of their personal information is it to be able to compare the answers between the before and after completing the intervention (in this case, the MOOC).

Last name (s) – Free Space

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It is important to notice that the participants gave out their first and last name at the beginning of the MOOC, and provided more details about their profile; such as their education level, age, location and others. The answers to this instrument will be used to locate the participants and put together their individual profiles in more detail. Nonetheless, to be able to identify them within the instrument previously mentioned, it is necessary to identify their profiles. Email will be used to find their information in the other survey and their identities will be verified matching their names.

Email address (to be able to contact them in case they agree to be interviewed for research purposes)

Email address (it is asked of to the participants to give the same email address that was used at the time of enrollment to the MOOC) – Free space

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The MOOC to which each participant enrolled to.

It is important to understand what material was the one that the participants worked on during the intervention. It will be asked of each of them to identify which was the course they enrolled to. Part of what is being looked for is also to study if, depending on the MOOC subject, the answers show some type of tendency.

What MOOC the participant enrolled to

Name of the MOOC you are enrolled in. (The participants must choose the MOOC from a drop-down list so they can choose an answer. The options of the MOOCs available are:

Energy: Past, Present and Future

Conventional and Clean Energies and their Technology

Energy Saving

The Mexican Energy Reform and its Opportunities

Energy Literacy

Energy Markets: Business Opportunities)

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Level of familiarization that the participants had with the subject of each MOOC before taking the course

Before this course, how familiarized were you with the main subject of the course? (Likert Scale from 1 to 5. 1 meaning you are new to the topic and 5 you are an expert in the topic)

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Sustainability:

In 1987, the *Brundtland Report* was written, within the action of the United Nations, and it defined it as the capability of satisfying the needs of the current human generation without voiding future generation's possibilities to fulfil their own needs.

Sustainable Development:

Sustainable Development has also in mind social conditions, politics and economics of the social body; therefore, it incorporates the

Level of understanding that the participant has of the term "sustainability"

I consider that my understanding of sustainability is at expert level.

(Likert Scale 1 to 5; 1 being totally disagree and 5 totally agree)

---

human vision that human development besides fulfilling its needs, and that in this development human actions are in benefit of the care of their environment and natural surroundings.

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UNESCO Sustainable Development Goals:

They are about seventeen ambitious objectives, broken down into 169 goals that precise the collaboration of civil society and the private and public sectors. Their success means a more equal and habitable world.

It is wished to know if the participant is aware of the existence of these goals.

I am familiarized with the Sustainable Development Goals proposed by UNESCO.  
(Likert Scale 1 to 5; 1 being totally disagree and 5 totally agree)

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Participants' previous knowledge

Before taking the MOOC, there is the possibility that the participants have been subjected to other kinds of interventions about sustainability and sustainable development. To dimension if these previous experiences have affected in any way their self-perception of the knowledge of the subject, it is recommended to explore if the participants have had on-

Previous interventions through digital mediums or online

Precious on-site interventions (like extracurricular or formative activities outside the classroom; seminars, for example).

I have taken online courses before in which sustainable development was a topic of discussion.  
(Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)

I have taken seminars before in which sustainable development was a topic of discussion.  
(Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)

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<p>site interventions (within or outside the curriculum) or even remotely (like online courses, videos, etc.)</p>	<p>Previous on-site interventions (like curricular or mandatory activities).</p>	<p>I have taken on-site courses before in which sustainable development was a topic of discussion. (Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)</p>
<p>Sustainable activities in the daily life of their participants</p>	<p>Participants' self-perception that they generally carry a sustainable lifestyle</p>	<p>Matriz con el tema: What are the sustainable activities that you do in your every day life? "I consider that my lifestyle is highly sustainable."</p>
<p>There are a lot of actions that can take place in the daily life of the participants in which they can reflect their pro-sustainability attitudes. They are invited to mark or mention what activities they carry out to reach a more sustainable future.</p>	<p>Waste reduction in the best way possible</p>	<p>"I consciously adjust my personal lifestyle to reduce waste as much as possible."</p>
	<p>The use of recycled materials is encouraged</p>	<p>"I try to recycle at home."</p>
	<p>A conscious effort is made to not use the car as the main way of transportation. Walking or bicycles are encouraged</p>	<p>"I try to substitute the use of vehicles with walks or biking."</p>
<p>Perspective of the participants regarding the problems that Sustainable Development faces An interesting piece of information that is looked to be measured through this tool is the perspective that the participants have about the nature behind the problematic's sustainable development faces. According to the authors, almost all the time there are participants that tend to state that it is a problem that corresponds to the following three categories:</p>	<p>Ecological problem</p>	<p>Matriz con el tema: What is your perspective of the problems of sustainable development? "I consider that sustainable development is an ecological problem."</p>
	<p>Economic Problem</p>	<p>"I consider that sustainable development is an economic problem."</p>
	<p>Social Problem</p>	<p>"I consider that sustainable development is a social problem."</p>

<p>Perspectives on what actors have the most influence over the sustainability of a society</p> <p>According to the literature, there tend to be four actors that have an important role into developing sustainability in a society. Based on the instrument already ran by a researcher, it is asked for the participant to enlist in order of priority (from one to four) who they consider plays the most important role when developing this role of influence.</p>	<p>Government</p> <hr/> <p>Business</p> <hr/> <p>Academy</p> <hr/> <p>Citizens</p>	<p>Enlist in priority order who has the most influence in society's sustainability. 1 being the one with most priority and 4 being the least:</p> <ul style="list-style-type: none"> <li>▪ Government</li> <li>▪ Business</li> <li>▪ Academy</li> <li>▪ Citizens</li> </ul>
<p>Evaluation of the participant about the level of importance of different energy sources</p> <p>Nowadays, the main energy sources have diversified. It is wished to know the opinion of the participant on what kind of energy source they consider to be the most important and with the most development in the next ten years.</p>	<p>Oil</p> <hr/> <p>Natural gas</p> <hr/> <p>Carbon</p> <hr/> <p>Nuclear</p> <hr/> <p>Solar</p> <hr/> <p>Wind</p>	<p>Matriz con el tema: Evaluate the following energy sources and grade them according to their importance to society in the future 10 years:</p> <ul style="list-style-type: none"> <li>▪ Oil</li> <li>▪ Natural gas</li> <li>▪ Carbon</li> <li>▪ Nuclear</li> <li>▪ Solar</li> <li>▪ Wind</li> </ul>
<p>Disposition to be interviewed via telephone for research purposes</p> <p>It is wished, as the second part of the data collection, to carry out a series of interviews to the participants that show availability. This listing has the function to let us to know if they want to be interviewed or not.</p>	<p>If the participants are interested in doing an interview for research purposes</p>	<p>Would you agree to be contacted to do an interview for research purposes?</p>

Table 8

*Operationalization Post-Test*

<b>Construct</b>	<b>Elements of the Construct</b>	<b>Questions in the Post-MOOC Survey</b>
<p>Privacy policy and privacy notice for the participants.</p> <p>This element was essential at the beginning of the instrument because to be able to run the survey in the Massive Online Course on behalf of ITESM it was important that the participants agreed to give out their information.</p>	<p>That the participants have read the privacy rules and the privacy notice terms of the ITESM.</p> <hr/> <p>That the participants have read the privacy rules and the privacy notice terms of the ITESM.</p> <hr/> <p>That the participants have read the privacy rules and the privacy notice terms of the ITESM.</p>	<p>I have read and accept the ITESM privacy policies and the privacy notice. Please confirm your agreement by marking “Accept” to continue with the survey.</p> <p>For this question an “Accept” box was provided for the participants to check and be able to proceed with the instrument.</p>
<p>Identification Details of the Participants</p> <p>To understand the participants, a series of identification details will be requested.</p>	<p>First and last name of the participant</p>	<p>Name (s) - Free space</p>



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Another reason behind the request of their personal information is it to be able to compare the answers between the before and after completing the intervention (in this case, the MOOC).

Last name (s) – Free Space

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It is important to notice that the participants gave out their first and last name at the beginning of the MOOC, and provided more details about their profile, such as their education level, age, location, and others. The answers to this instrument will be used to locate the participants and put together their individual profiles in more detail. Nonetheless, to be able to identify them within the instrument previously mentioned, it is necessary to identify their profiles. Email will be used to find their information in the other survey and their identities will be verified matching their names.

Email address (to be able to contact them in case they agree to be interviewed for research purposes)

Email address (it is asked of to the participants to give the same email address that was used at the time of enrollment to the MOOC) – Free space

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The MOOC to which each participant enrolled to.

It is important to understand what material was the one that the participants worked on during the intervention. It will be asked of each of them to identify which was the course they enrolled to. Part of what is being looked for is also to study if, depending on the MOOC subject, the answers show some type of tendency.

What MOOC the participant enrolled to

Name of the MOOC you are enrolled in. (The participants must choose the MOOC from a drop-down list so they can choose an answer. The options of the MOOCs available are:

Energy: Past, Present and Future

Conventional and Clean Energies and their Technology

Energy Saving

The Mexican Energy Reform

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and its Opportunities  
Energy Literacy  
Energy Markets: Business  
Opportunities)

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Level of familiarization that  
the participants had with the  
subject of each MOOC before  
taking the course

Before this course, how  
familiarized were you with  
the main subject of the  
course? (Likert Scale from 1  
to 5. 1 meaning you are new  
to the topic and 5 you are an  
expert in the topic)

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Sustainability:

In 1987, the *Brundtland Report* was written, within the action of the United Nations, and it defined it as the capability of satisfying the needs of the current human generation without voiding future generation's possibilities to fulfil their own needs.

Sustainable Development:

Sustainable Development has also in mind social conditions, politics and economics of the social body; therefore, it incorporates the human vision that human development besides fulfilling its needs, and that in this development human actions are in benefit of the care of their environment and natural surroundings.

Level of understanding that  
the participant has of the term  
“sustainability”

I consider that my  
understanding of  
sustainability is at expert  
level.  
(Likert Scale 1 to 5; 1 being  
totally disagree and 5 totally  
agree)

<p>Impact of the MOOC in awakening the participant's interest in sustainable development. After taking the MOOC, it is interesting to ask the participant of the material he learned during the course awakened their interest in sustainability.</p>	<p>If the participant became interested enough in sustainability to research about the subject on their own.</p>	<p>This course motivated me to research more about sustainable development. (Likert Scale 1 to 5; 1 being totally disagree and 5 totally agree)</p>
<p>UNESCO Sustainable Development Goals: They are about seventeen ambitious objectives, broken down into 169 goals that precise the collaboration of civil society and the private and public sectors. Their success means a more equal and habitable world.</p>	<p>It is wished to know if the participant is aware of the existence of these goals.</p>	<p>I am familiarized with the Sustainable Development Goals proposed by UNESCO. (Likert Scale 1 to 5; 1 being totally disagree and 5 totally agree)</p>
<p>Participants' previous knowledge  Before taking the MOOC, there is the possibility that the participants have been subjected to other kinds of interventions about sustainability and sustainable development. To dimension if these previous experiences have affected in any way their self-perception of the knowledge of the subject, it is recommended to explore if the participants have had on-site interventions (within or outside the curriculum) or even remotely (like online courses, videos, etc.)</p>	<p>Previous interventions through digital mediums or online</p>	<p>I have taken online courses before in which sustainable development was a topic of discussion. (Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)</p>
<p></p>	<p>Precious on-site interventions (like extracurricular or formative activities outside the classroom; seminars, for example).</p>	<p>I have taken seminars before in which sustainable development was a topic of discussion. (Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)</p>
<p></p>	<p>Previous on-site interventions (like curricular or mandatory activities).</p>	<p>I have taken on-site courses before in which sustainable development was a topic of discussion. (Likert Scale from 1 to 5, 1 being totally disagree and 5 totally agree)</p>

Sustainable activities in the daily life of their participants	Participants' self-perception that they generally carry a sustainable lifestyle	What are the sustainable activities that you do in your everyday life? "I consider that my lifestyle is highly sustainable."
There are a lot of actions that can take place in the daily life of the participants in which they can reflect their pro-sustainability attitudes. They are invited to mark or mention what activities they carry out to reach a more sustainable future.	Waste reduction in the best way possible	"I consciously adjust my personal lifestyle to reduce waste as much as possible."
	The use of recycled materials is encouraged	"I try to recycle at home."
	A conscious effort is made to not use the car as the main way of transportation. Walking or bicycles are encouraged	"I try to substitute the use of vehicles with walks or biking."
Perspective of the participants regarding the problems that Sustainable Development faces An interesting piece of information that is looked to be measured through this tool is the perspective that the participants have about the nature behind the problematics sustainable development faces. According to the authors, almost all the time there are participants that tend to state that it is a problem that corresponds to the following three categories:	Ecological problem	What is your perspective of the problems of sustainable development? "I consider that sustainable development is an ecological problem."
	Economic Problem	"I consider that sustainable development is an economic problem."
	Social Problem	"I consider that sustainable development is a social problem."
Perspectives on what actors have the most influence over the sustainability of a society According to the literature, there tend to be four actors	Government	Enlist in priority order who has the most influence in society's sustainability. 1 being the one with most priority and 4 being the least:
	Business	

that have an important role into developing sustainability in a society. Based on the instrument already ran by a researcher, it is asked for the participant to enlist in order of priority (from one to four) who they consider plays the most important role when developing this role of influence.

Academy

- Government
- Business
- Academy
- Citizens

Citizens

Evaluation of the participant about the level of importance of different energy sources  
 Nowadays, the main energy sources have diversified. It is wished to know the opinion of the participant on what kind of energy source they consider to be the most important and with the most development in the next ten years.

Oil

Natural gas

Carbon

Nuclear

Solar

Wind

Evaluate the following energy sources and grade them according to their importance to society in the future 10 years:

- Oil
- Natural gas
- Carbon
- Nuclear
- Solar
- Wind

Disposition to be interviewed via telephone for research purposes

It is wished, as the second part of the data collection, to carry out a series of interviews to the participants that show availability. This listing has the function to let us to know if they want to be interviewed or not.

If the participants are interested in doing an interview for research purposes

Would you agree to be contacted to do an interview for research purposes?

For the purposes of this dissertation an explorative, explicative research with mixed method character is proposed, and enriched with qualitative data that helps determine if the intervention of a learning strategy like MOOCs can help accomplish all the Education for Sustainable Development Goals according to the conceptual framework issued by UNESCO.

As complementary tools to have in-depth knowledge of the profiles of the participants, it has been asked within the pre-post instruments relevant to Education for Sustainable Development that they write down the email address they used to enroll to the MOOC. Two other surveys will be used to evaluate the profiles of the participants: a demographic survey they filled in at the beginning of the course, which includes information like age, study degree, and their gender and an end of course survey participants replied after completing the MOOC. This data will help to cross information with the survey that participants filled out at the end of the course, where they shared information regarding their identity, motives for enrollment and final impressions once the course is completed.

This way, thanks to the application of this four surveys, it is expected to get a clear view of the profiles of the participants; furthermore, the email address provided can be used as a tool that will allow to explore and revise the development that each individual had in their respective course, even pointing out if they were able to complete it or not.

Another important element of the self-perception surveys about sustainable development is that one of the questions asked is if they agree to be contacted for research purposes. All subjects that have answered affirmatively to this question will receive an email invitation to be interviewed through a telephone call. The semi-structured interviews that will take place are another qualitative instrument that will be used with the intention to know the perspective of the participants to a deeper level, also to find out why they finished or not the

online course. It is expected that at least five subjects from three of the courses previously mentioned will agree to the interview and a total of 15 interviews will be able to be completed.

The questions that will be asked in the semi structured interview consist of three main blocks, which are divided in the following way:

#### Block One. Profile of the Person Being Interviewed

1. Tell me a little about yourself. What is your job?
2. Do you remember the MOOC you enrolled in?
  - How did you find out about the MOOC?
  - What motivated you to enroll?
  - How familiarized were you with the main subject of the MOOC before starting the online course?
3. Before this MOOC, had you participated in an online course whose theme involved sustainable development?
4. Had you participated in a seminar or extracurricular activity that involved the theme of sustainable development?
5. Had you taken any curricular classes in your studies which presented the theme of sustainable development?

#### Block Two. About Sustainability and the Attitude of Participants Regarding It

6. Please, tell me the first three words you relate to “sustainability”
7. Are you familiar with the Sustainability Development Goals from UNESCO?
  - Depending on the answer of the participants, they will be introduced to them or they will be requested to explain where they learned about them.
8. Do you consider you adopt many pro-sustainability activities in your daily life?

-Ask why

-Ask for examples

9. Regarding the problems that sustainable development is trying to address, do you consider them to be of more ecological, economic or social approaches? Why?

10. After taking the course, were you interested in looking for more information or learning more about sustainable development? Why?

Block Three. Better approaches for future MOOCs, Strategies of the Future for Education for Sustainable Development

11. What changes would you suggest for future massive online courses whose goals would be to teach about sustainable development?

12. Do you consider the lack of education about sustainable development is a global problem? What international collaborative strategies would you consider valuable for the diffusion about this theme in future generations?

13. Do you believe MOOCs have the transforming potential to educate about sustainable development? Why?

14. If MOOCs are not that convincing for you, what other approaches would you suggest?

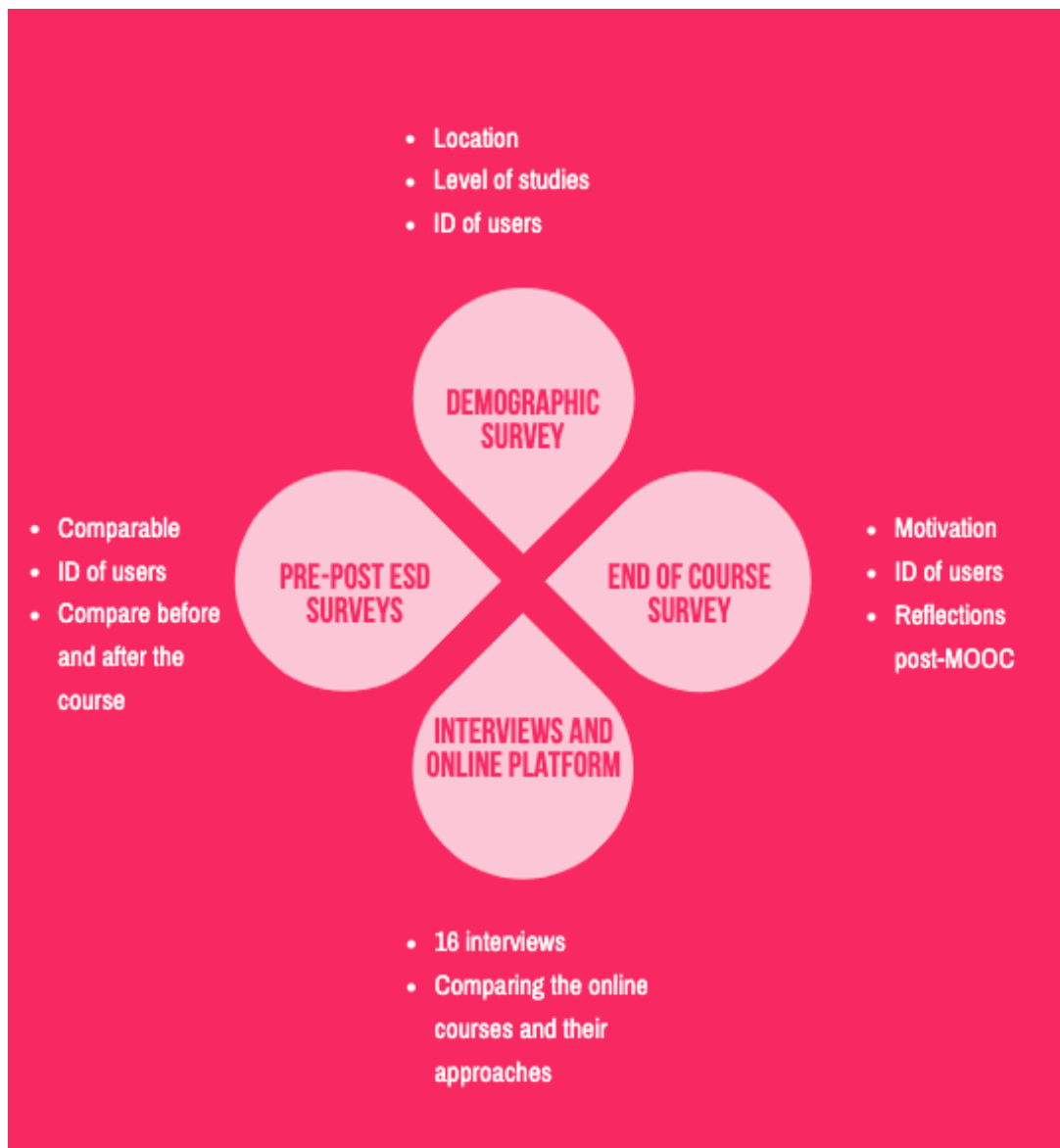
15. After taking the course, do you consider you went through a sensitizing process about the subject of sustainable development? Why?

16. Thank you for your time. If you can any last comments or suggestions, feel free to share them with me in this moment.

Also, there will be an analysis of the information gathered in the platform of the MOOC



themselves, including the forum interactions and the results of the tests that they took to be able to pass the course.



*Figure 6.* Tools for gathering data

Given that the intention behind the research is to compare the results of this online learning intervention, the MOOCs, with other type of practices of on-site manner that also involve sustainable development education, tools that will work to evaluate the presence of the participants in these on-site interventions, from the curricula as extracurricular, as well

as pre-post surveys, including interviews and even a focus group about one curricular activity that allows the subject to express their own opinions of these interventions will be used. Finally, there will be a qualitative study about the field notes that were elaborated during said on-site interventions.

### **Pilot Test Implementation**

During January and February 2019, a brief pilot test of the pre-post instruments was applied specifically for the purposes of this paper. First, the pilot pre-instrument took place in January, where 44 complete answers of the instrument were collected. The results show that the participants answered most of the questions without any issues and that over 80% expressed consent to be contacted for research purposes after completing the survey.

Upon further analysis of the 44 completed surveys that were received during the pilot test, it was discovered that two of them were duplicates, since the participants seemed to have submitted the pre-test twice by mistake. Thus, note was taken that the data had to be analyzed with detail, to avoid the use of data that was submitted twice by a technical mistake.

Some of the results regarding the questions that were answered by the participants, such as which massive open online course they enrolled in and how they perceived their level of knowledge regarding sustainable development can be seen in the following graphics and tables:

Table 9

*Pilot Test Data Collected in the Pre-Survey per MOOC*

<b>Massive Open Online Course</b>	<b>Number of students per course who answered the pre-course survey</b>
Energy Markets: Opportunities for Business	9
Conventional Clean Energies and their Technology	8

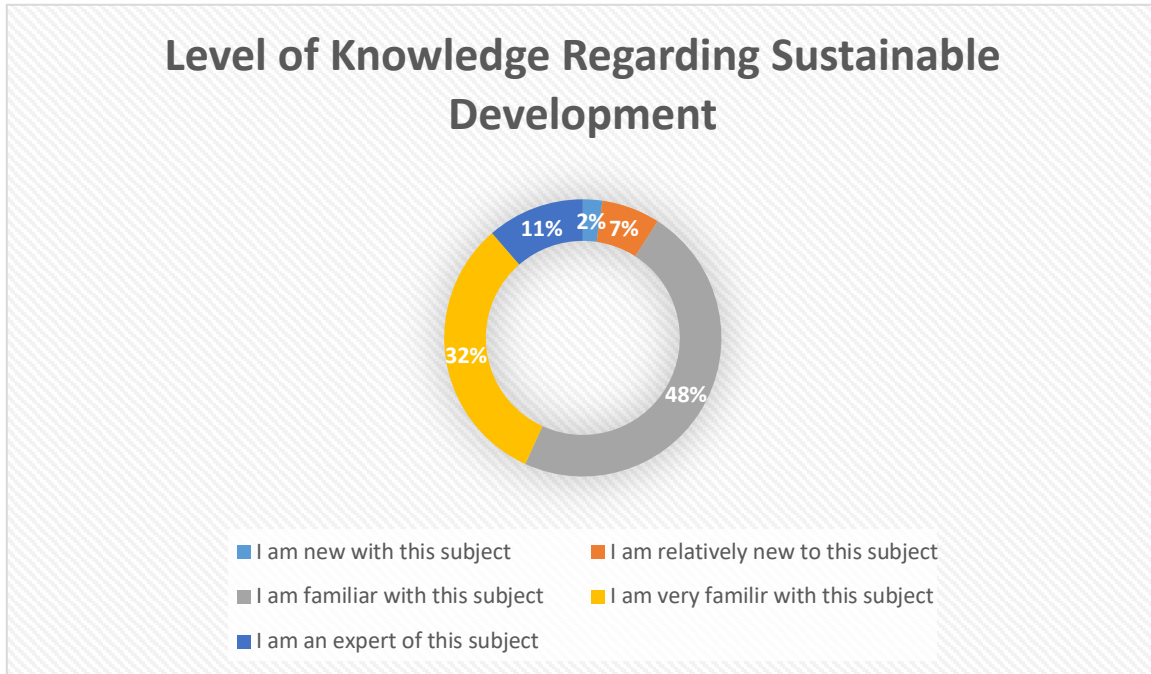


Figure 7. Pilot test replies from the pre-test survey, where users replied regarding their level of knowledge about sustainable development before participating in the MOOC.

A second pilot test, the one after the users completed the MOOCs, ran in January and February 2019. Given that this instrument was placed to be answered in the final week of the course, it was expected to collect data of this instrument in the second month of the run. There were 48 total answers of the post-instrument between January and February 2019. However, out of these 48 replies, only 18 were replies from the same users who answered the pre-test during the pilot phase in January. Thus, only 18 of the pre-post answered surveys could be directly compared by the replies of the users who participated in the pre-test survey during the pilot phase. There were 19 subjects that consented to be contacted for research

purposes after the second phase of the pilot.

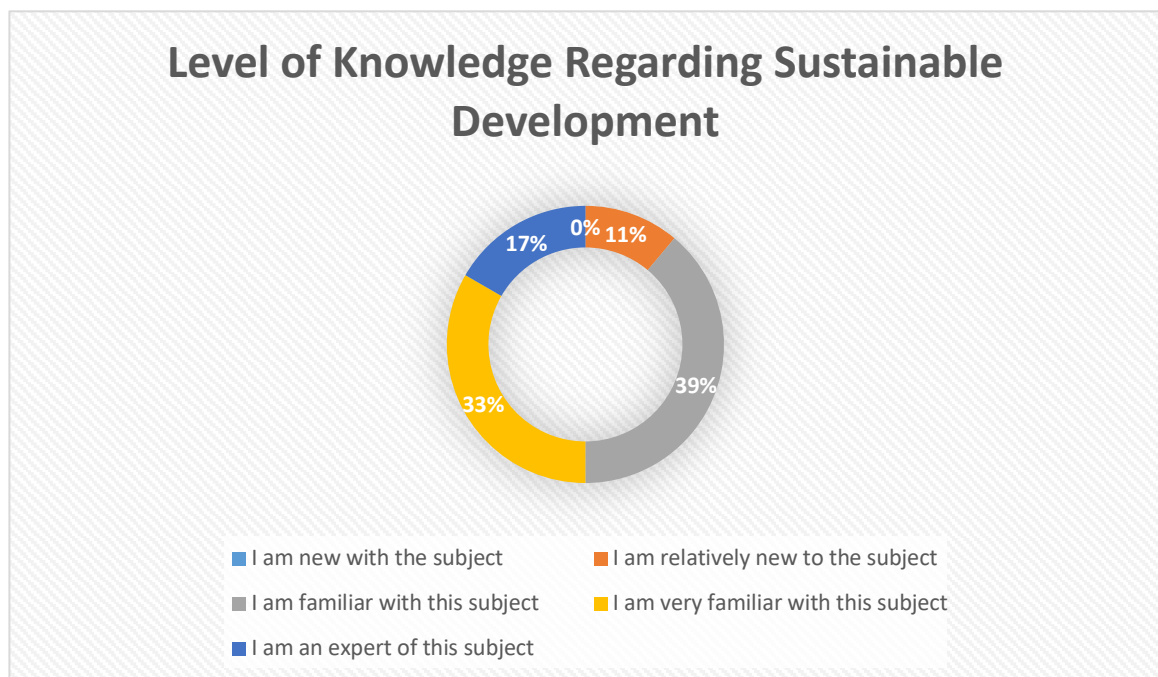
Out of the 18 post-surveys, the distribution of the users per MOOC was as follows:

Table 10

*Pilot Test Data Collected in the Post-Survey per MOOC*

<b>Massive Open Online Course</b>	<b>Number of students per course who answered the pre-course survey</b>
Energy Markets: Opportunities for Business	6
Conventional Clean Energies and their Technology	3
Energy Savings	8
Energy: Past, Present and Future	1

Regarding their level of knowledge about sustainable development after taking the course, the users who had already answered the pre-MOOC replied in the following way:



*Figure 8.* Pilot test replies from the post-test survey, where users replied regarding their level of knowledge about sustainable development before participating in the MOOC.

As observed in the figure, there was a higher level of self-perceived knowledge after the users participated in the MOOC, since none of the users who replied both the pre and post surveys considered they were new in the subject after they took the massive open online course.

After the pilot for the surveys was completed, it was concluded that no further modifications were necessary because the instruments fulfilled the purpose of the research and the participants did not express any confusion regarding the questions nor its elements.

A pilot of the semi structured interview took place in May, where two interviews were conducted; one of them to a user who had only answered the pre-survey, which means that they did not finish the MOOC, and one to a user who answered both the pre and post survey. After running both interviews, it was determined that the structure of the interview was correct in order to gather the data that was of interest for effects of this investigation. Thus, all instruments were run and the official gathering of data for the dissertation began to take place.

### **Analysis Strategies**

To deepen the thematic of the digital and on-site interventions about ESD, a descriptive analysis of the samples and variables that will be tried to be measured through the instruments will be done.

The results of the surveys will be analyzed to determine the predispositions to decide the type of statistic that fits better to pick the mean comparisons tests (Valenzuela, 2016) to determine if the change after the intervention was significant or not.

Furthermore, there will be a qualitative study of the interviews that will be carried out, creating categories about the collected information and making an analysis of the most

repeated words and the comments of the participants, including feedback to improve the interventions for future implementations. There will be a digital analysis of the MOOCs, highlighting the differences and similarities that the used material presents in each of the different interventions and the end result of each proposed scenario; be it the digital intervention of the MOOCs or the curricular or extracurricular activity that includes the topic of sustainable development. This will be achieved by the analysis of the platform, the length of the videos that were running during the MOOCs and the amount of online interactions in the forums of the platform. To better illustrate the timeline for this dissertation, the following chart was created.

A PREPARATORY TIMELINE

# PHASES OF THE DISSERTATION



## INITIAL PHASE

### QUANTITATIVE GATHERING

users register to the MOOC. They reply to the demographic survey, along with the initial Education for Sustainable Development Survey.



## MOOCs RUN

### OBSERVATION

Observation of the online platform where the MOOCs are taking place.



## INTERMEDIATE PHASE

### QUANTITATIVE GATHERING

Users either abandon or finish the MOOC. They reply (or not) the end of the course survey, along with the post survey for Education in Sustainable development.



## FINAL PHASE

### QUALITATIVE GATHERING

Users who gave consent for being interviewed are contacted. Transcription of said interviews take place, along with the creation of categories.



## ANALYSIS

### FINAL COMPARISON

Analysis of the 4 surveys, along with the information obtained from the 16 interviews are compared and contrasted. A table of observations from the online platforms is created as well.

DISCOVERIES AND CONCLUSIONS ARE REDACTED

Figure 9. Timeline for the dissertation

## Chapter 4. Results

### Introduction

This chapter will present the results from four surveys that were run during the application of the MOOCs, along with the results obtained from 16 interviews that took place after the MOOCs ended. First, the results of the surveys will be presented, and the results from the interviews will be presented in the latter half of this chapter.

The first instrument is the Initial Demographic Data Survey, which will be presented in two sections: The first section will present all the answers received in this instrument, in order to present the population of the users who enrolled into any of the MOOCs that were available during the timeframe that was explained in the Methodology chapter of this thesis. Later, the specific sample that is of interest for the scope of this dissertation, which includes all participants who enrolled in either of the five courses that were presented in the Methodology chapter, will be studied and analyzed, presenting only the results from the participants who replied to the pre and post Education for Sustainable Development surveys.

This instrument, titled “*Encuesta inicial sobre intereses, motivaciones y conocimientos previos en MOOC*” (“Initial assessment for evaluate interests, motivation and previous knowledge”; EIIMC-MOOC; Valenzuela, Mena, & Ramírez-Montoya, 2017), referred to as “Initial Demographic Data Survey” in this chapter was evaluated and approved by Valdivia et al (2018), who did an analysis of the results obtained in the MOOC “Energetic Reform and its Opportunities” . This instrument collects information regarding participants’ reported motivation and previous knowledge.

Next, the results of the pre-MOOC Education for Sustainable Development survey results will be presented. This survey was designed and run for this dissertation, so it is



important to validate the functionality of this instrument. An analysis to validate this instrument will be made through Cronbach's Alpha to guarantee that the survey has internal consistency and can be considered valid for the purposes of this research. Once validity has been verified, the answers obtained through this instrument will be presented. In total, 152 complete surveys were obtained for this instrument.

After that, the results of the post-MOOC Education for Sustainable Development survey results will be presented. Because this instrument was also designed for this thesis, validation is necessary. Applying Cronbach's Alpha, verification that the instrument has internal consistency will take place in this chapter. Once validity has been proven, the results from this instrument will be presented. For this survey, 70 participants sent complete surveys at the end of their course.

This brings us to the next section of the chapter: Applying the Wilcoxon Signed Rank Test, a comparison between the means obtained in the pre and post surveys in order to determine if there was a significant change or not after the participants took the MOOC.

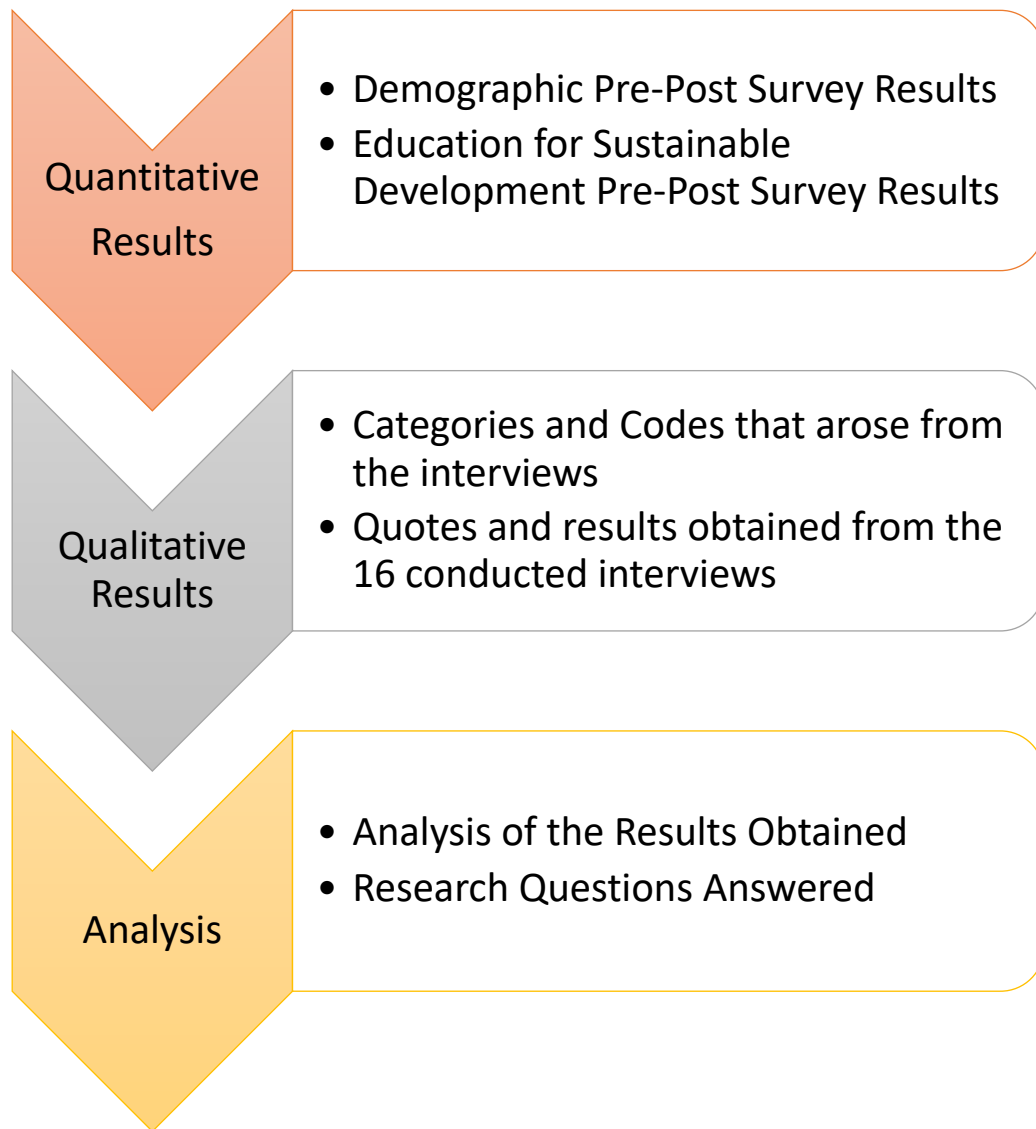
It is important to note that the sample that will be evaluated and will be the main focus of this research is divided in two categories: Participants who replied only to the pre-MOOC survey regarding Education for Sustainable Development, and participants who replied to both the pre and post survey regarding Education for Sustainable Development.

In the last portion of the quantitative results that were obtained, the End of Course survey results will be presented. The original title of this instrument was "*Encuesta final sobre intereses, motivaciones y conocimientos previos en MOOC*" ("Ending assessment for interests, motivations, and previous knowledge"; EFMC- MOOC; Valenzuela, Mena, & Ramírez-Montoya, 2017). This instrument is a mixed-format, 17-item tool designed to

evaluate the changes in motivation and knowledge that participants experienced after attending a MOOC.

First, just like with the initial demographic data, all the answers received will be presented, to give a notion of what the participants replied as a whole. After that, the results from the specific sample that answered all three previous instruments results will be presented. Only 63 out of the 70 participants who had answered the first three instruments sent a complete survey for the End of the Course survey. The results for this specific sample will be presented. This will conclude the first half of this chapter.

The second half will focus on qualitative results, including the answer to open questions that were presented in the End of the Course survey. Once all the results for the surveys have been presented, a brief introduction to the profile of the sixteen participants who agreed to be interviewed for the purpose of this dissertation will be presented, in order to give a little context about who they are. Next, different categories and elements that arose during the interviews will be presented. Finally, the results from the interviews that took place will be presented, ending the chapter of Results for this dissertation.



*Figure 10. Organization of the Results Chapter*

### **Initial Demographic Survey Results**

The reagents for this survey can be found in Attachment 1 at the end of this document. The objective behind this instrument was to get to know the profiles of the participants who enrolled in the MOOC during the specific timeframe where data was gathered for this dissertation. The first reagent asked for the participants to accept the Privacy Policy regarding this research. This was a mandatory element of the survey and all the persons whose results

will be presented here agreed to said policy before providing any of their personal information. In total, 1966 participants answered this first instrument. However, some of the entries obtained were incomplete, and thus the data was cleaned up in order to filter out uncomplete or abandoned surveys. In the end, 1290 completed surveys were obtained for this instrument.

As mentioned before, the scope of this research is focused on the participants who enrolled in the courses that were presented in the Methodology portion of this dissertation: Energy Saving, Energy: Past, Present and Future, Conventional and Clean Energies and Their Technology, The Mexican Energy Reform and its Opportunities and Energy Markets: Business Opportunities. The reasoning behind the selection of these specific courses was that the themes were more centered on sustainability and the topics were more applicable for sustainable attitudes and behaviors.

However, the results for this first section include the results for all the initial demographic data that was gathered from all the courses that were available by the Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training from the timeframe of January to May 2019, in order to give better context of the population from where the final sample for deeper analysis was taken from. The intention is to also give a broad understanding of the different types of profiles the participants had when enrolling to the MOOC's platform.

## **Initial Demographic Survey Results from the Whole Population of Active Participants**

Table 11

*Participants' gender*

<b>Gender</b>	<b>Number of participants</b>	<b>Percentage</b>
Male	948	73.49%
Female	336	26.05%
Non-binary	6	0.47%
Total	1290	100%

Here we can see that more than half of the population was formed by participants who identified themselves as “males”, representing 74% of the participants. Only 26% of the persons who signed up to the MOOCs identified themselves as “females”, while there were only six specific cases of participants who didn’t identify themselves with either gender who opted for the non-binary option.

Table 12

*Participants’ age*

<b>Age</b>	<b>Number of participants</b>	<b>Percentage</b>
1-10 years old	1	0.08%
11- 20 years old	48	3.72%
21- 30 years old	558	43.26%
31- 40 years old	317	24.57%
41-50 years old	181	14.03%
51-60 years old	104	8.06%
61-70 years old	52	4.03%
71-80 years old	9	0.70%
Did not disclose	20	1.55%

Total	1290	100%
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We can observe that the bigger age group was for participants who were from 21 to 30 years old, followed by the 31 to 40 and 41 to 50 years old age group. Thus, we can see that the participants were mostly from ages 21 to 50, with a specific outlier presented as a single participant who registered himself as someone from 1 to 10 years old.

It is important to mention that one of the instructions presented in the platform when the participants had to sign up to the course of their selection, it was recommended for the student to have at least finished middle school at least, since the content of the courses were designed for participants who were in High School or older. However, there was no demand to prove that the participants had finished middle school when signing up, so anyone with an email address had the liberty to enroll regardless of their age or level of education.

Table 13

*Participants' country*

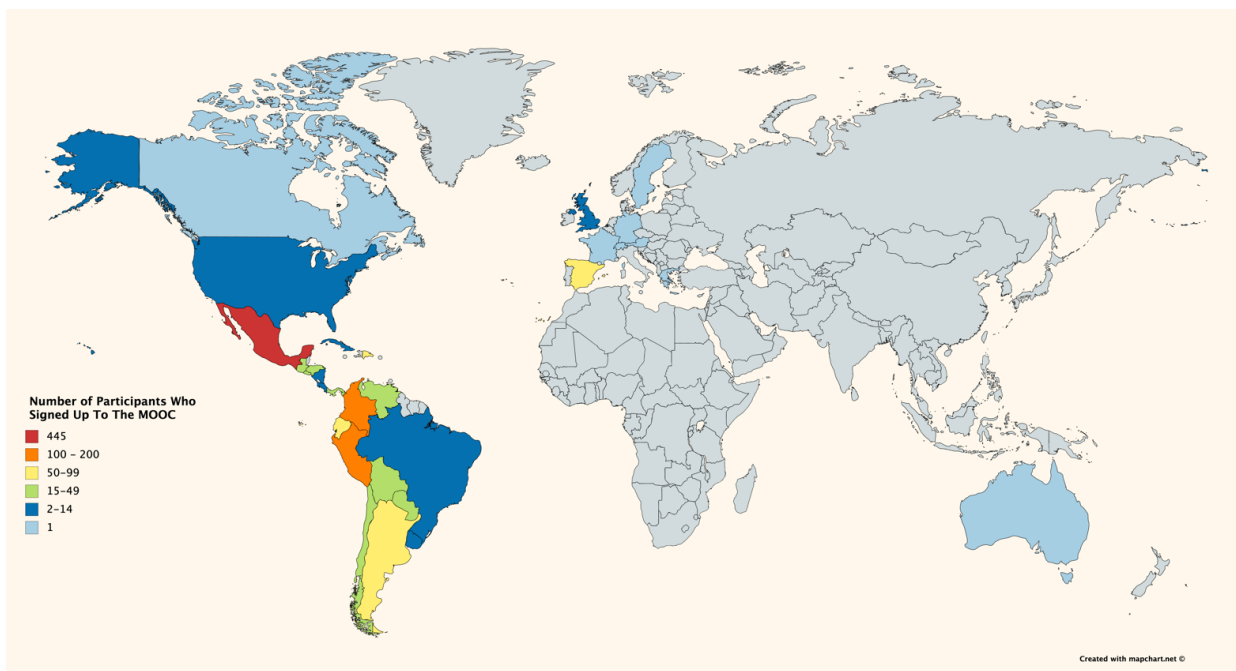
Country	Number of participants	Percentage
Argentina	52	4.03%
Australia	1	0.08%
Austria	1	0.08%
Bolivia	27	2.09%
Brazil	9	0.70%
Canada	1	0.08%
Chile	34	2.64%

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Colombia	198	15.35%
Costa Rica	12	0.93%
Cuba	2	0.16%
Dominican Republic	62	4.81%
Ecuador	64	4.96%
El Salvador	26	2.02%
France	1	0.08%
Germany	1	0.08%
Greece	1	0.08%
Mexico	445	34.50%
Spain	73	5.66%
Sweden	1	0.08%
Switzerland	1	0.08%
Guatemala	23	1.78%
Honduras	36	2.79%
Nicaragua	11	0.85%
Panama	28	2.17%
Paraguay	22	1.71%
Peru	114	8.84%
United Kingdom	2	0.16%
United States	12	0.93%
Uruguay	6	0.47%
Venezuela	24	1.86%
Total	1290	100%

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To better demonstrate the reach that the MOOCs had over the world, please observe the following illustration, where the countries have been color coded depending on the number of participants who signed up to the courses.



*Figure 11.* Number of Participants Who Signed Up to the Courses per Country

Using the illustration above, we can observe that the region of Latin America as a whole enrolled actively in the courses, placing Mexico as number one with the most active users who signed up to the courses available.

However, we can observe that Colombia and Peru had over a hundred users who decided to join these courses, followed by Spain, Ecuador, the Dominican Republic, and Argentina who had over fifty users enroll in the courses. It is important to mention that the contents of the courses were originally in Spanish, so it is understandable to observe that the countries with the most active number of participants are Spanish speaking countries. This



came as a surprise, since the contents of the MOOCs were designed with the Mexican population being the end user to be expected.

Not only did the MOOCs exceed these expectations and motivated various countries from Latin America to enroll, but surprisingly, non-native Spanish speaking countries also enrolled to the available courses. As we can observe from the illustration, North America, Europe, and Ocenia also had active participants join the courses, which means that the answers obtained from the surveys that were run with these population give us an international perspective regarding MOOCs and Education for Sustainable Development. As mentioned before, the end user that was envisioned at the moment of designing the courses were Mexican participants. Out of the 445 participants from Mexico who enrolled, the distribution per region can be observed in the following table.

Table 14

*Mexican users' region*

<b>Region</b>	<b>Number of participants</b>	<b>Percentage</b>
Aguascalientes	5	1.12%
Baja California	13	2.92%
Campeche	6	1.35%
Chiapas	14	3.15%
Chihuahua	8	1.80%
Mexico City	71	15.96%
Coahuila	10	2.25%
Colima	14	3.15%
Durango	6	1.35%

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Estado de Mexico	33	7.42%
Guanajuato	11	2.47%
Guerrero	1	0.22%
Hidalgo	25	5.62%
Jalisco	21	4.72%
Michoacan	9	2.02%
Morelos	12	2.70%
Nayarit	2	0.45%
Nuevo León	71	15.96%
Oaxaca	3	0.67%
Puebla	20	4.49%
Queretaro	8	1.80%
Quintana Roo	6	1.35%
San Luis Potosí	7	1.57%
Sinaloa	4	0.90%
Sonora	10	2.25%
Tabasco	10	2.25%
Tamaulipas	2	0.45%
Tlaxcala	2	0.45%
Veracruz	28	6.29%
Yucatán	7	1.57%
Zacatecas	6	1.35%
Total	445	100%

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The following illustration demonstrates the map reflecting the number of participants in Mexico:



*Figure 12.* Number of Participants Who Signed Up to the Courses in Mexico

The two states that had the largest amount of people enrolled were Nuevo León and Mexico City. The courses were promoted in various online platforms, including YouTube ads promoting the courses in Mexico, which proved to be effective, since participants enrolled from 30 different states out of the 32 the country has.

Table 15

*Participants' maximum level of studies*

<b>Level of studies</b>	<b>Number of participants</b>	<b>Percentage</b>
Highschool	188	14.57%
College	615	47.67%
Technical Career	138	10.70%

Specialty	83	6.43%
Masters	209	16.20%
PhD	20	1.55%
Primary or Middle School	37	2.87%
Total	1290	100%

In total, 14.57% had completed their Highschool studies, while 47.67% replied that they had completed their studies in college. This is a large amount, since it reflects almost half of the population that is being presented. Graduate participants include master's with 16.2% and doctoral studies with 1.55%. Participants who expressed their higher level of education was a technical career represent 10.7% of the sample, while 6.43% mentioned their highest level of studies were a specialty. Only 2.87% of the participants mentioned they had a lower level of education than high school. From the presented data, we can say that 17.44% of the participants who replied the survey were undergraduate students, 58.27% had completed college or the equivalent through a technical career at the moment of taking the courses and 24.18% of the participants had completed a graduate program when they enrolled to the MOOC of their selection.

As mentioned before, the courses that were available had been designed with the basic entry level of education being high school, since the material that was being taught regarding energy and sustainability had certain level of complexity that required some basic skills that are developed at this level of education, including reading comprehension and the ability to do some research. Interestingly, after comparing the data and observing the final replies of the participants who did complete the course, even participants who had a lower level of

completed studies than high school did finish the courses with enough percentage of correct answers and completed activities to be awarded a certificate in case they requested one.

Another factor that was of interest to comprehend the daily routine and the lifestyle of the persons that enrolled into these courses, users had to reply what their main occupation was. The answers they provided are presented in the following table.

Table 16

*Participants' main occupation*

<b>Occupation</b>	<b>Number of participants</b>	<b>Percentage</b>
Full Time Job	586	45.43%
Part Time Job	69	5.35%
High School Student	17	1.32%
College Student	282	21.86%
Graduate Program	45	3.49%
Primary or Middle School	2	0.16%
Retirement	18	1.40%
Business Owners	126	9.77%
Unemployment	89	6.90%
Other	56	4.34%
Total	1290	100%

As observed from the data gathered, most participants were working a full-time job as their main occupation, although the second highest reply was that the participant was in the process of completing their college studies. The third most common reply was that the participants were the owners of their own businesses. Later in this chapter, we will delve

deeper into this element, since two participants that were interviewed fell into this category and gave a lot of insight as to why business owners are interested in the topic of energy and sustainability as a whole.

The next element that was brought up by the initial demographic level was whether the participants had any previous experience coursing MOOCs. Their replies are presented in Table 7.

Table 17

*Participants' previous experience with MOOCs*

<b>Number of MOOCs previously enrolled in</b>	<b>Number of participants</b>	<b>Percentage</b>
None (first timers)	689	53.41%
One MOOC	283	21.94%
Two MOOCs	94	7.29%
Three or more MOOCs	224	17.36%
Total	1290	100%

As observed in the previous table, most of the participants decided to enroll to a MOOC for the first time through this platform, representing 53.41% of the population. However, 21.94% of the users expressed their had enrolled to a MOOC at least once before, while only 7.29% of the participants had enrolled in at least two MOOCs before signing up to this one. Interestingly, 17.36% of the users who signed up to the platform and answered this initial survey declared they had more experience with MOOCs in the past, claiming they had enrolled in three or more MOOCs before enrolling to this new one they were just starting out.

From this data, we can see that even though there was a grand majority of first time MOOC users in the sample, we also have a relatively high level of participants who were more experienced when it came to online platforms and distance learning.

An important factor for analysis was to take in consideration which course the participants had enrolled in when they signed up to the platform.

The next reagent in the survey asked for participants to select which course they had signed up to. The answers they provided are shown in the next table:

Energy Saving, Energy: Past, Present and Future, Conventional and Clean Energies and Their Technology, The Mexican Energy Reform and its Opportunities and Energy Markets: Business Opportunities.

Table 18

*MOOC the participants signed up to*

<b>Title of the MOOC</b>	<b>Number of participants</b>	<b>Percentage</b>
<b>Energy Saving</b>	163	12.64%
Electric Energy Distribution	113	8.76%
Electric Energy: Basic concepts and principles	190	14.73%
<b>Energy: Past, Present and Future</b>	54	4.19%
<b>Conventional and Clean Energies and Their Technology</b>	165	12.79%
The new electric industry in Mexico	27	2.09%
<b>The Mexican Energy Reform and its Opportunities</b>	43	3.33%

Carbon Markets	145	11.24%
<b>Energy Markets: Business Opportunities</b>	151	11.71%
Smart Grid	157	12.17%
Electric Energy Transmissions	82	6.36%
Total	1290	100%

The courses which will be further analyzed for the scope of this research have been highlighted with bold in Table 7. As we can observe from the population of all the people that signed up, 12.64% of the participants signed up to the Energy Saving course, 4.19% signed up to the course titled Energy: past, present and future, 12.79% joined the course regarding Conventional and Clean Energies and their Technology, and 11.71% enrolled in the course regarding the Energy Market and its Business Opportunities. Only 3.33% of the participants joined the course regarding the Mexican Reform and its Opportunities. If we add up all of these percentages, then we come upon the realization that the scope of analysis for this research will focus in roughly 44.66% of the population that signed up to the courses as a whole.

After analyzing the results that have been presented, it is interesting to compare and contrast what the original designers of these MOOCs had thought the profile of their users would be, compared to the results obtained from the initials survey. In the first chapter from the book “Innovation and sustainable energy”, titled “Evaluation from the experiences in the development”, the authors claim that the profile for whom the MOOCs were designed in this project envisioned participants to be from 17 to 65 years old, who had at least finished high school before enrolling to the course (Valdivia-Vazquez et al, 2017).



As observed by the previous results, the youngest user to enroll in a MOOC was 10 years old, while 52 participants disclosed that they were aged between 61 to 70 years old. There were also at least 9 cases in which participants exceeded the age group that the design team had envisioned, declaring their age to be between 71 to 80 years old.

Another factor that the team behind the MOOCs thought would reflect in the profile of the users was that they predicted that the participants would mostly be native Spanish speakers, and that a large portion of the users who enrolled might be employees by the Federal Energy Commission of Mexico. (Valdivia-Vazquez et al, 2017).

This, however, was not necessarily what was found after observing the profiles of the participants who enrolled to the MOOC platform. There were users who enrolled from countries whose native language is not Spanish, as an example, there were users who enrolled from Brazil, Canada, France, Germany, Greece, Sweden, the United States and other non-native Spanish countries, which can be observed in Table 3. Finally, the team behind the MOOCs expected that most of the users who enrolled might be in a training program for the Federal Energy Commission of Mexico, but it was soon revealed that more than 20% of the participants who enrolled were college students, not to mention that almost 10% of the enrolled users were business owners who were seeking knowledge to apply to their own ventures. As a result, the variety of profiles and interests in the participants exceeded what had been envisioned by the design team behind the MOOCs.

One of the main objectives of the Demographic survey was to understand the profiles of the participants, along with their intentions and motivations regarding the course they signed up to. Thus, participants were asked to select the main reasons as to why they enrolled to the MOOC they were about to start. Participants could pick all the reasons that resonated

with them, there was not a limit as to how many reasons could be selected. Table 9 presents the results that were obtained from the participants regarding their motivations to enroll.

Table 19

*Reasons for enrolling in the MOOC*

<b>Reason</b>	<b>Number of participants</b>	<b>Percentage</b>
Curiosity	209	16.20%
The desire to connect with other students who are interested in the same topic	109	8.45%
I have friends who signed up to the course	20	1.55%
The course is related to my academic program	435	33.72%
The course is related to my field of work	602	46.67%
This course will help me get a better job	566	43.88%

As shown by the previous table, the main three reasons participants felt motivated to enroll in the MOOC they signed up to were related to their field of work, their desire to better their odds at finding a better job after taking the course, or to enrich their academic journey by learning about topics that were related to their program. Over 200 participants enlisted Curiosity as one of the reasons they signed up, while 109 of the participants mentioned they were interested in the network potential of making new contacts who were also interested in the same topics as they were. The least popular option was that there was someone they knew who had signed up to the MOOC as well.

According to Deng& Gannaway (2019), some of the main motivations as to why users

signed up to MOOCs were reflected in the results from this sample, as well as in other MOOCs whose results have been analyzed previously. Some of the main reasons users signed up to MOOCs included: personal interest and curiosity, desire to learn more about a topic or the current job or future career, the wish to learn more about a topic for their current or future field of study, the wish to find and share resources with others and the possibility to receive a certificate or credits. There was also mention of professional networking and the goal of enhancing the resume. In the specific case of our sample, we can see some of these motivations reflected in the results obtained from this specific line of questioning in said survey.

After figuring out the main motivations for enrolling to the MOOC, participants were requested to select one of the following options regarding what they had envisioned or hoped to achieve by the end of the MOOC. This specific reagent is related to the level of compromise and the end goal of the participants. The results are shown below.

Table 20

*Level of compromise and final goal of the participants regarding the MOOC*

<b>Objective</b>	<b>Number of participants</b>	<b>Percentage</b>
I have interest in getting to know the contents of the course, but I do not plan on attending all sessions or completing the activities.	10	0.78%
I am just interested in consulting some of the content of the course, but not participate actively in it.	25	1.94%
I plan on seeing some sessions and taking part in some of the activities, but I	40	3.10%

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am not interested in finishing the course completely.		
I plan on learning from all the available lessons and completing all activities and exams because I am interested in obtaining the official certificate of this course.	409	31.71%
I plan on learning from all the available lessons and completing all activities and exams even though I am not interested in obtaining the official certificate of this course.	795	61.63%
Other (please specify)	11	0.85%
Total	1290	100%

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As shown in the previous table, most participants planned to partake in all the lessons and activities, many of them aiming to request the official certificate once they completed 80% of the course, which was the required percentage to grant the certificate to the participants. However, 75 out of 1290 participants expressed from the very beginning that they had no intention of reaching the end of the course. Also, users who selected the option “Other” were requested to fill in the blank and explain their objective behind their involvement with the MOOC.

Seven out of the eleven participants who chose this option stated similar expressions related to “I just want to learn” or “I am just interested in obtaining new knowledge that might be useful in the future”. One user said that he was interested in creating contacts with people who could be interested in partaking in his personal business, so he enrolled to the

course in order to reach out to people who were interested in the theme of sustainability, which is what his company focuses on. Another participant who selected the “other” option claimed he had joined for “research purposes” and that he planned to use the new knowledge he obtained in order to finish a paper he was working on. Another participant who decided to fill in the blank regarding their main objective behind signing up to the MOOC said they “Wanted to learn from the experts in order to share the knowledge with my community”. And finally, the last participant who had selected “Other” as an option simply wrote “I just want to try the MOOC out”.

This concludes the first half of the Initial Demographic Data results that were obtained from the whole population. The second half of the survey was designed to be a Likert Scale portion, enlisting “I strongly disagree” with the value of 1 and “I strongly agree” with a value of 5. Participants were requested to say if they agreed or disagreed with the following statements. The results for this Likert scale portion of the survey for the whole population are presented as follows.

Table 21

*I believe this MOOC will satisfy my training needs*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	10	0.78%
I neither agree nor disagree	0	0%
I agree	574	44.50%
I strongly agree	706	54.73%
Total	1290	100%

Table 22

*I believe this MOOC will help me with my professional future*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	3	0.23%
I disagree	19	1.47%
I neither agree nor disagree	0	0%
I agree	543	42.09%
I strongly agree	725	56.20%
Total	1290	100%

Table 23

*I believe this MOOC will help me get a better job in the future*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	3	0.23%
I disagree	73	5.66%
I neither agree nor disagree	0	0%
I agree	618	47.91%
I strongly agree	596	46.20%
Total	1290	100%

Table 24

*I believe this MOOC will allow me to network and create professional relationships with people that have the same interests I do*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
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I strongly disagree	8	0.62%
I disagree	105	8.14%
I neither agree nor disagree	0	0%
I agree	679	52.64%
I strongly agree	498	38.60%
Total	1290	100%

Table 25

*I believe this MOOC will positively affect my academic needs*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	4	0.31%
I disagree	19	1.47%
I neither agree nor disagree	0	0%
I agree	573	44.42%
I strongly agree	694	53.80%
Total	1290	100%

Table 26

*I believe I have the perseverance to finish this MOOC successfully*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	11	0.85%
I disagree	26	2.02%
I neither agree nor disagree	0	0%

I agree	590	45.74%
I strongly agree	663	51.40%
Total	1290	100%

Table 27

*I believe I have the required abilities (studying, ICT skills) to finish this course successfully*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	0.08%
I disagree	17	1.32%
I neither agree nor disagree	0	0%
I agree	550	42.64%
I strongly agree	722	55.97%
Total	1290	100%

Table 28

*I believe I have the required competences regarding digital tools to complete this MOOC (understanding of how to use the website, email, and Microsoft Office)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	8	0.62%
I neither agree nor disagree	0	0%
I agree	382	29.61%
I strongly agree	900	69.77%



Total	1290	100%
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Table 29

*I believe I have the required competences to deal with the technological platform where the MOOC will take place*

Answer	Number of participants	Percentage
I strongly disagree	0	0%
I disagree	7	0.54%
I neither agree nor disagree	0	0%
I agree	414	32.09%
I strongly agree	869	67.36%
Total	1290	100%

Table 30

*I believe I have the required competences to search for information that is relevant to the topics of this course*

Answer	Number of participants	Percentage
I strongly disagree	2	0.16%
I disagree	15	1.16%
I neither agree nor disagree	0	0%
I agree	463	35.89%
I strongly agree	810	62.79%
Total	1290	100%

Table 31

*I am able to use my social media for academic purposes related to this MOOC*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	2	0.16%
I disagree	50	3.88%
I neither agree nor disagree	0	0%
I agree	533	41.32%
I strongly agree	705	54.65%
Total	1290	100%

Table 32

*I believe I have some notion of the contents of this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	8	0.62%
I disagree	101	7.83%
I neither agree nor disagree	0	0%
I agree	688	53.33%
I strongly agree	493	38.22%
Total	1290	100%

Table 33

*I have previous hands on experience in the energy field*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	46	3.57%

I disagree	284	22.02%
I neither agree nor disagree	0	0%
I agree	601	46.59%
I strongly agree	359	27.83%
Total	1290	100%

Table 34

*After checking the course plan, I consider my present knowledge to exceed at least 50% of the topics being taught in the course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	37	2.87%
I disagree	514	39.84%
I neither agree nor disagree	0	0%
I agree	544	42.17%
I strongly agree	195	15.12%
Total	1290	100%

Table 35

*My current knowledge will allow me to solve challenges related to at least one topic in this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	17	1.32%

I disagree	112	8.68%
I neither agree nor disagree	0	0%
I agree	804	62.33%
I strongly agree	357	27.67%
Total	1290	100%

Table 36

*I will be able to come up with innovative solutions to problems related to at least one topic in this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	22	1.71%
I disagree	139	10.78%
I neither agree nor disagree	0	0%
I agree	807	62.56%
I strongly agree	322	24.96%
Total	1290	100%

This concludes the first section of this chapter, where the results obtained from the whole population regarding the initial demographic survey were presented. The intention behind sharing this data is to give a clearer context about the various profiles and answers that were shared by the participants regardless of the course they signed up to. However, as mentioned before, the main scope of this dissertation is to take in consideration the answers and the changes that a very specific sample from this population experienced during their

MOOC experience. This sample will be referred to as the “selected sample” in this chapter, and it involves all participants who enrolled in any of the following MOOCs: Energy Saving, Energy: Past, Present and Future, Conventional and Clean Energies and Their Technology, The Mexican Energy Reform and its Opportunities and Energy Markets: Business Opportunities.

In the second section of the presentation of results from this survey, the selected sample consisted of 70 participants, who had answered both the pre and post education for sustainable development surveys. The number of the sample obtained reflects something that has been brought up constantly in the literature review when it comes to MOOCs. Despite there being an initial strong enthusiasm when signing up, participants in MOOCs seem to meet with serious problems that end up reflecting in enormous dropout rates. According to Armstrong (2014) only 4% of the students attending Coursera MOOCs completed their courses. The first published work by Valdivia et al (2017) about the level of competition for the first run of these MOOCs stated that they had a completion rate of 16% during the first year of these MOOCs being available online. However, from the results obtained for this specific time frame and sample, only 5.43% of the users who signed up finished all the courses they signed up to successfully, which means that the sample for users who answered both the pre and post instruments is closer to the 4% that Armstrong mentioned in their own research.

The results obtained from the sample that completed the MOOCs successfully will be now presented.

### **Selected Sample Results from the Initial Demographic Survey**

Table 37

*Participants' gender (selected sample)*

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<b>Gender</b>	<b>Number of participants</b>	<b>Percentage</b>
Male	45	64.29%
Female	25	35.71%
Non-binary	0	0%
Total	70	100%

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Table 38

*Participants' age (selected sample)*

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<b>Age</b>	<b>Number of participants</b>	<b>Percentage</b>
1-10 years old	0	0%
11- 20 years old	2	2.86%
21- 30 years old	30	42.85%
31- 40 years old	14	20.00%
41-50 years old	9	12.86%
51-60 years old	6	8.57%
61-70 years old	8	11.43%
71-80 years old	1	1.43%
Total	70	100%

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Table 39

*Participants' country (selected sample)*

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<b>Country</b>	<b>Number of participants</b>	<b>Percentage</b>
Argentina	7	10.00%

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Bolivia	1	1.43%
Brazil	1	1.43%
Colombia	7	10.00%
Dominican Republic	7	10.00%
Ecuador	5	7.14%
Mexico	25	35.71%
Spain	6	8.57%
Guatemala	1	1.43%
Honduras	3	4.29%
Nicaragua	1	1.43%
Panama	1	1.43%
Peru	3	4.29%
Venezuela	2	2.86%
Total	70	100%

Table 40

*Mexican users' region (selected sample)*

<b>Region</b>	<b>Number of participants</b>	<b>Percentage</b>
Chiapas	1	4.00%
Mexico City	2	8.00%
Colima	1	4.00%
Estado de Mexico	1	4.00%
Hidalgo	10	40.00%
Jalisco	1	4.00%

Morelos	1	4.00%
Nuevo León	3	12.00%
Puebla	5	20.00%
Total	25	100%

Table 41

*Participants' maximum level of studies (selected sample)*

<b>Level of studies</b>	<b>Number of participants</b>	<b>Percentage</b>
Highschool	3	4.29%
College	40	57.14%
Technical Career	5	7.14%
Specialty	3	4.29%
Masters	16	22.86%
PhD	2	2.86%
Primary or Middle School	1	1.43%
Total	70	100%

Table 42

*Participants' main occupation (selected sample)*

<b>Occupation</b>	<b>Number of participants</b>	<b>Percentage</b>
Full Time Job	31	44.29%
Part Time Job	5	7.14%
High School Student	1	1.43%
College Student	20	28.57%



Graduate Program	3	4.29%
Business Owners	4	5.71%
Unemployment	5	7.14%
Other	1	1.43%
Total	70	100%

Table 43

*Participants' previous experience with MOOCs (selected sample)*

<b>Number of MOOCs previously enrolled in</b>	<b>Number of participants</b>	<b>Percentage</b>
None (first timers)	37	52.86%
One MOOC	14	20.00%
Two MOOCs	6	8.57%
Three or more MOOCs	13	18.57%
Total	70	100%

Table 44

*MOOC the participants signed up to (selected sample)*

<b>Title of the MOOC</b>	<b>Number of participants</b>	<b>Percentage</b>
Energy Saving	27	38.57%
Energy: Past, Present and Future	6	8.57%
Conventional and Clean Energies and Their Technology	11	15.71%

The Mexican Energy Reform and its Opportunities	3	4.29%
Energy Markets: Business Opportunities	23	32.86%
Total	70	100%

Table 45

*Reasons for enrolling in the MOOC (selected sample)*

<b>Reason</b>	<b>Number of participants</b>	<b>Percentage</b>
Curiosity	9	12.86%
The desire to connect with other students who are interested in the same topic	6	8.57%
I have friends who signed up to the course	4	5.71%
The course is related to my academic program	32	45.71%
The course is related to my field of work	44	62.86%
This course will help me get a better job	31	44.29%

Table 46

*Level of compromise and final goal of the participants regarding the MOOC (selected sample)*

<b>Objective</b>	<b>Number of participants</b>	<b>Percentage</b>
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I have interest in getting to know the contents of the course, but I do not plan in attending all sessions or completing the activities.	0	0%
I am just interested in consulting some of the contents of the course, but not participate actively in it.	1	1.43%
I plan on seeing some sessions and take part in some of the activities, but I am not interested in finishing the course completely.	3	4.29%
I plan on learning from all the available lessons and complete all activities and exams because I am interested in obtaining the official certificate of this course.	34	48.57%
I plan on learning from all the available lessons and complete all activities and exams even though I am not interested in obtaining the official certificate of this course.	31	44.29%
Other (please specify)	1	1.43%
Total	70	100%

The participant who enlisted “Other” as their answer explained that the main objective, they had from signing up to the MOOC was “Just to learn”.

Table 47

*I believe this MOOC will satisfy my training needs (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	32	45.71%
I strongly agree	37	52.86%
Total	70	100%

Table 48

*I believe this MOOC will help me with my professional future (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	32	45.71%
I strongly agree	37	52.86%
Total	70	100%

Table 49

*I believe this MOOC will help me get a better job in the future (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	2.86%

I neither agree nor disagree	0	0%
I agree	40	57.14%
I strongly agree	28	40.00%
Total	70	100%

Table 50

*I believe this MOOC will allow me to network and create professional relationships with people that have the same interests I do (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	1.43%
I disagree	4	5.71%
I neither agree nor disagree	0	0%
I agree	38	54.29%
I strongly agree	27	38.57%
Total	70	100%

Table 51

*I believe this MOOC will positively affect my academic needs (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	2.86%
I neither agree nor disagree	0	0%
I agree	29	41.43%

I strongly agree	39	55.71%
Total	70	100%

Table 52

*I believe I have the perseverance to finish this MOOC successfully (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	27	38.57%
I strongly agree	42	60.00%
Total	70	100%

Table 53

*I believe I have the required abilities (studying, ICT skills) to finish this course successfully (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	27	38.57%
I strongly agree	42	60.00%
Total	70	100%

Table 54

*I believe I have the required competences regarding digital tools to complete this MOOC (understanding of how to use the website, email, and Microsoft Office) (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	27	38.57%
I strongly agree	42	60.00%
Total	70	100%

Table 55

*I believe I have the required competences to deal with the technological platform where the MOOC will take place (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.43%
I neither agree nor disagree	0	0%
I agree	17	24.29%
I strongly agree	52	74.29%
Total	70	100%

Table 56

*I believe I have the required competences to search for information that is relevant to the topics of this course (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	2.86%
I neither agree nor disagree	0	0%
I agree	23	32.86%
I strongly agree	45	64.29%
Total	70	100%

Table 57

*I am able to use my social media for academic purposes related to this MOOC (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	2.86%
I neither agree nor disagree	0	0%
I agree	25	35.71%
I strongly agree	43	61.43%
Total	70	100%

Table 58

*I believe I have some notion of the contents of this course (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
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I strongly disagree	0	0%
I disagree	4	5.71%
I neither agree nor disagree	0	0%
I agree	36	51.43%
I strongly agree	30	42.86%
Total	70	100%

Table 59

*I have previous hands on experience in the energy field (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	1.43%
I disagree	17	24.29%
I neither agree nor disagree	0	0%
I agree	26	37.14%
I strongly agree	26	37.14%
Total	70	100%

Table 60

*After checking the course plan, I consider my present knowledge to exceed at least 50% of the topics being taught in the course (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	1.43%
I disagree	25	35.71%

I neither agree nor disagree	0	0%
I agree	32	45.71%
I strongly agree	12	17.14%
Total	70	100%

Table 61

*My current knowledge will allow me to solve challenges related to at least one topic in this course (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	3	4.29%
I neither agree nor disagree	0	0%
I agree	47	67.14%
I strongly agree	20	28.57%
Total	70	100%

Table 62

*I will be able to come up with innovative solutions to problems related to at least one topic in this course (selected sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	7	10.00%

I neither agree nor disagree	0	0%
I agree	42	60.00%
I strongly agree	21	30.00%
Total	70	100%

This concludes the presentation of the results obtained from the selected sample.

### **Pre-MOOC Education for Sustainable Development Survey**

This was the second survey that participants were invited to answer, although this survey was only accessible for users who had signed up to any of the five courses that are being studied in this research. The elements and questions of this survey were presented in Table 7.

Because this survey was developed with the intention of answering the questions of this research, it is necessary to first demonstrate the validity of this instrument. In order to do so, a Cronbach Alpha test was run to verify the reliability of the survey. The results from the test are presented below:

#### **Reliability**

**Scale: ALL VARIABLES**

Table 63  
*Case Processing Summary for the Pre-MOOC Survey*

	<b>N</b>	<b>%</b>
Valid cases	70	100%
Excluded Cases		0%
Total	70	100%

No cases needed to be excluded, since only complete surveys were used in order to calculate the Cronbach Alpha.

Table 64  
*Reliability Statistics for the Pre-MOOC Survey*

<b>Cronbach's Alpha</b>	<b>Cronbach's Alpha Based on Standardized Items</b>	<b>N of Items</b>
,806	,805	13

It is important to note that each item's inter-relatedness and dimensionality affect the value of alpha. There are different reports about the acceptable values of alpha, ranging from 0.70 to 0.95 (Nunnally, 1994; Bland, 1997; DeVellis, 2003).

As shown by the previous table, this specific survey received a .806 Cronach Alpha, which would be considered and acceptable value to test reliability. Thus, the results obtained from this instrument can be presented in the following section.

### **Pre-MOOC Survey Education for Sustainable Development Results (whole sample)**

In total, 252 responses were gathered. After filtering out the replies that were not completed or repeated replies from the main users, 152 results were gathered from the participants that contained a reply to every single element of the survey. The answers obtained by the users are presented in the following tables.

Table 65

*Privacy policy and notice for the participants: Did they agree to the terms and conditions of the survey?*

<b>Response options to the question</b>	<b>Number of participants</b>	<b>Percentage</b>
I agree with the terms and conditions of this survey	152	100%
I do not agree with the terms and conditions of this survey	0	0%
Total	152	100%

Participants were requested, first and foremost, to give consent so that all the data that was being obtained from them through the survey could be used for analysis of this dissertation. None of the users denied this right to the researcher, meaning that all of these 152 replies will be used in the analysis of this dissertation.

After this question, participants were asked to provide identification details. All 152 participants provided their first and last name, as well as the email address they used to sign up to the course in the first place. The email address has been used as a sort of code for each of the users, since the participants filled out the same email address in the other three surveys. This means that the email address of the users will help to assure that we are analyzing the results of the same participant in order to compare and contrast the way their replies changed before and after the intervention, which in this case, is the MOOC itself.

However, in this first section of the pre-MOOC survey, we will first present the results obtained from all 152 answers that were provided by the users.

Table 66

*Which MOOC did you enroll to?*

<b>Massive Open Online Course</b>	<b>Number of participants</b>	<b>Percentage</b>
Energy Markets: Opportunities for Business	40	26.32%
Conventional Clean Energies and their Technology	27	17.76%

Energy Savings	70	46.05%
Energy: Past, Present and Future	11	7.24%
Energy Literacy	2	1.32%
The Energy Reform in Mexico and its Opportunities	2	1.32%
Total	152	100%

As seen in the previous table, most of the participants had enrolled into the Energy Savings MOOC, followed by Energy Markets: Opportunities for Business and Conventional and Clean Energies and their Technology. The two MOOCs with less participants willing to answer the survey were the Energy Literacy and the Energy Reform in Mexico MOOCs, which also had less activity in the platform in general. Comparison between these numbers and the total amount of signed up users through the different runs of the MOOC were similar, placing Energy Savings as the most popular MOOC out of all the options as well. Thus, it can be observed that the sample was presenting similar results in this regard to the population that is being analyzed in this research: all the users who signed up to any of these MOOCs during the period of data gathering.

The following three tables present the results from the three questions in the survey whose role was to measure the level of self-perceived knowledge when it came to sustainability, the level of knowledge they had in regard to the topic of the MOOC they had enrolled in, as well as if they were aware or not of UNESCO's Sustainability Development Goals, which is an important element to take in consideration in order to raise awareness about the necessity of sustainability for future generations.

Table 67

*Level of familiarity and expertise users had regarding sustainability before taking the MOOC*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with sustainability	12	7.89%
I am a little familiar with sustainability	20	13.16%
I am somewhat familiar with sustainability	63	41.45%
I am familiar with sustainability	46	30.26%
I am an expert in sustainability	11	7.24%
Total	152	100%

Table 68

*Level of familiarity and expertise users had regarding the MOOC they enrolled in*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with the topic of the MOOC I enrolled to	29	19.08%
I am a little familiar with the topic of the MOOC I enrolled to	54	35.53%
I am somewhat familiar with the topic of the MOOC I enrolled to	47	30.92%
I am familiar with the topic of the MOOC I enrolled to	21	13.82%
I am an expert in the topic of the MOOC I enrolled to	1	0.66%
Total	152	100%

Table 69

*Are you familiar with UNESCO's Sustainability Development Goals?*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar with them	47	30.92%
I know about them	50	32.89%
I know everything about	55	36.18%

them		
Total	152	100%

---

More than half of the users seem to have at least heard about the Goals, however 31% of the participants had never even heard of them in the first place. Very few of the participants expressed to be an expert in the field of sustainability or the topic of the MOOC they enrolled in, and thanks to the post-MOOC survey it is possible to tell if their responses changed after they took the course, which will be discussed in the post-MOOC survey results.

The next element that was measured in the survey was if the participants had ever had a previous experience that involved the theme of sustainability, either because they had taken part of an online course who touched upon this subject, they had taken part of a seminar or in person intervention that had brought up the subject, or maybe they had enrolled in a class during their studies that had taught them about sustainability. Regarding online courses, 75 of the 152 users replied that they had previously enrolled in an online course which had touched about sustainability.

Regarding extracurricular and in person activities, such as seminars, 97 out of the 152 users had had an intervention that had taught them at least a basic understanding of what sustainability. Finally, regarding if they had had any curricular classes through their studies that touched upon the subject of sustainability, over 108 users replied that sustainability had been a topic they had learned about during their formal education. This last bit of data was compared with the demographic data that was run at the beginning of each of the courses.

The users' emails were searched and then the 108 users who had replied they had previous curricular experience with the theme of sustainability were analyzed. More than half of the users had already finished their university degree and their majors were indeed related



to the theme of sustainability somehow; for example, a lot of the participants were Engineers in Sustainable Development or were enrolled in a major that focused in energy saving and renewable energy research.

The next element that was measured in the pre-MOOC survey were the sustainable activities the participants involved themselves with in their daily lives. Participants were requested to reply if they partook in any of the following pro-sustainability activities in their daily life.

Table 70

*Pro-Sustainability activities in their daily lives*

<b>Activity</b>	<b>Participants who claimed they participated actively in this activity in their daily lives</b>	<b>Percentage</b>
Attempt to keep general lifestyle pro-sustainability	137	90.13%
Avoid waste of things, be it food, clothes or any other item without purpose	146	96.05%
Actively attempt to recycle at home	142	93.42%
Avoid the use of cars for transportation, opting to either use public transportation or a bike to move themselves around	134	88.16%

Interestingly, even though over 47 participants were not knowledgeable of the SDG's, it seems that the great majority of the participants attempted to partake in daily activities that promoted the main goals of the SDGs one way or another.

When participants were requested to express if they thought that the challenges for the world in general when it came to the lack of sustainable development were ecological,

economic or social, 24 participants claimed that all three options were the answer and that they strongly believed that all three approaches had a key role in promoting the use of sustainable actions and attitudes for future generations.

However, not everyone agreed with this perspective. Fifteen users claimed that the matter at hand was not ecological at all, on the contrary, they considered that the ecological challenges that might be faced were not relevant or important when it came to secure a sustainable future for everyone. Only eight users considered that economics didn't play a relevant role when it came to the challenges that sustainable development needs to face, while 40 users placed it as the most important factor that weights in as a whole. Seven users considered that society was the real factor that had no relevance at all with sustainable development, a couple of them stating that ecology was not relevant either, but that economy did play an important role somewhat, but not in a very high level.

Finally, four participants considered that neither the ecological, economic or social factors weighted in when it came to challenges for sustainable development. Out of these four users, three of them replied the post survey as well. Interestingly, one of the participants did not change his perspective at all.

However, the other two users showed a change of perspective after they participated in the MOOC, one of them realizing that society played an important role and categorizing it as a very important factor to weight in when it came to the challenges sustainable development has to face in the present. This participant even gave ecology a role, although less important than the social approach. The user also considered economy to become a relevant factor after taking the course, giving it a stronger role than ecology but less important than society. This participant was interviewed and further details regarding his change of

perspective after participating in the course was delved upon. This change of perspective will be further touched upon in the interview results that will be presented in this chapter.

As a second part of this line of questioning, participants were requested to present in order of priority which entity played a more influential role when it came to promote sustainable actions for the future: the government, businesses, academia or society in general.

Interestingly enough, 64 of the 152 participants enlisted the government as the most influential entity as a whole, but users who placed government as their number one option didn't necessarily agree with the order of the other three entities. Thirteen users placed businesses as the main influencers, while only ten users claimed that education and academia were the real influencers that deserved the number one spot when it came to promote sustainable development attitudes and activities for the future. Finally, over 56 users claimed that the number one influence was society, placing both government and society as the top two influencers agreed upon by the sample of participants who replied the pre-MOOC survey.

Finally, participants were requested to share what type of energy sources would be more relevant for the future of the world in the next 10 years. The options they were provided with were: Fossil, Natural Gas, Nuclear, Solar and Air powered energy sources.

Only 16 users placed fossils as a very important and relevant source of energy for the future, while 29 users considered that natural gas was one of the most important sources of energy that would assure a sustainable future for everyone. When it came to nuclear powered energy, 22 users considered that it was one of the most powerful and important sources of energy for the future, whereas solar powered energy earned the number one place as one of the most influential, powerful and relevant sources of energy for the sake of a sustainable future for everyone with an outstanding 118 amount of participants who placed it as the best

option. In second place, 105 users considered that air powered energy sources had one of the most powerful and important potentials for the future.

As an ending requests in the survey, participants were asked if they would be willing to be contacted in order to provide an interview to give a deeper insight on their perspectives and opinions when it came to the course, their learning experience and their advice for future development for this type of course. Thankfully, 115 participants expressed they would be willing to be contacted in order to partake in an hour-long interview. Out of these 115 participants, 70 of them also answered the post MOOC survey. Thus, from this pool of 115 participants who expressed consent in order to be interviewed, 45 of them deserted or did not finish the MOOC they enrolled in.

All 152 answers that were gathered from this pre-MOOC survey results have been presented thus far, but it is important to make note that out of those 152 participants, only 70 of them answered the post-MOOC survey which was paired with this instrument. Thus, the following section will demonstrate the results obtained from those 70 specific individuals for this first pre-MOOC survey as well.

**Pre-MOOC Survey Education for Sustainable Development Results (pre and post sample)**

Table 71

*Which MOOC did you enroll in? (pre and post sample)*

<b>Massive Open Online Course</b>	<b>Number of participants</b>	<b>Percentage</b>
Energy Markets: Opportunities for Business	23	32.86%
Conventional Clean Energies and their Technology	11	15.71%
Energy Savings	27	38.57%

Energy: Past, Present and Future	6	8.57%
Energy Literacy	2	2.86%
The Energy Reform in Mexico and its Opportunities	1	1.43%
Total	70	100%

As shown in the table, we can observe that the sample that answered both pre and post instruments mainly enrolled into the Energy Market and Energy Savings courses.

Table 72

*Level of familiarity and expertise users had regarding sustainability before taking the MOOC (pre and post sample)*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with sustainability	11	15.71%
I am a little familiar with sustainability	12	17.14%
I am somewhat familiar with sustainability	28	40.00%
I am familiar with sustainability	15	21.43%
I am an expert in sustainability	4	5.71%
Total	70	100%

Table 73

*Level of familiarity and expertise users had regarding the MOOC they enrolled in (pre and post sample)*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with the topic of the MOOC I enrolled to	20	28.57%
I am a little familiar with the topic of the MOOC I enrolled	26	37.14%

to		
I am somewhat familiar with the topic of the MOOC I enrolled to	16	22.86%
I am familiar with the topic of the MOOC I enrolled to	7	10.00%
I am an expert in the topic of the MOOC I enrolled to	1	1.43%
Total	70	100%

Table 74

*Are you familiar with UNESCO's Sustainability Development Goals? (pre and post sample)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar with them	37	52.86%
I know about them	19	27.14%
I know everything about them	14	20.00%
Total	70	100%

As shown by the previous tables, only four participants who answered both pre and post surveys considered themselves to have expert knowledge regarding sustainability. One participant claimed to be an expert in the topic of the MOOC, and after checking their ID through their email address, it was observed that that specific participant had signed up to the Energy Savings course.

Finally, it seems that most of the participants that became part of this sample were not aware the SDGs existed, and only 14 of them claimed they knew everything about them. Thanks to the post-MOOC survey it is possible to tell if their responses changed significantly after they took the course, which will be discussed in the post-MOOC survey results.

The next element that was measured in the survey was if the participants had ever had a previous experience that involved the theme of sustainability, either because they had taken part of an online course who touched upon this subject, they had taken part of a seminar or in person intervention that had brought up the subject, or maybe they had enrolled in a class during their studies that had taught them about sustainability. Regarding online courses, 26 out of 70 users replied that they had previously enrolled in an online course which had touched about sustainability.

Regarding extracurricular and in person activities, such as seminars, 39 out of the 70 users had had an intervention that had taught them at least a basic understanding of what sustainability is. Finally, regarding if they had had any curricular classes through their studies that touched upon the subject of sustainability, over 45 users replied that sustainability had been a topic they had learned about during their formal education.

Following with the data that was gathered through this instrument, the specific sample that had answered both pre and post replied the following regarding the pro-sustainability activities in their daily life.

Table 75

*Pro-Sustainability activities in their daily lives (pre and post sample)*

<b>Activity</b>	<b>Participants who claimed they participated actively in this activity in their daily lives</b>	<b>Percentage</b>
Attempt to keep general lifestyle pro-sustainability	64	91.43%
Avoid waste of things, be it food, clothes or any other item without purpose	63	90.00%
Actively attempt to recycle at home	65	92.86%
Avoid the use of cars for	62	88.57%

transportation, opting to either  
use public transportation or a  
bike to move themselves  
around

---

As mentioned before, participants were requested to express if they considered the challenges for the world when it came to sustainable development were of ecological, economic or social nature, nine out of the seventy participants considered that the answer was that all three of them were just as important and that all approaches were key when dealing with solving these challenges in the future.

However, there were other perspectives that arose out of these questions. Twenty-two participants considered that it was not an ecological problem at all. Thirteen participants expressed that economics was not the real nature behind the challenges, while ten participants expressed that they didn't consider the challenges to be of social nature.

Out of this specific sample, eleven users considered the problem to be highly of ecological nature, twenty of them considered that it was an economic challenge and thirty-one claimed it was a challenge of a social nature.

Finally, six participants decided that they did not consider the challenges to be of any of these natures, rating the challenges to not be specifically of either ecological, economic or social nature. Next, participants were requested to present in order of priority which entity played a more influential role when it came to promote sustainable actions for the future: the government, businesses, academia, or society in general.

Interestingly enough, 32 of the 70 participants enlisted the government as the most influential entity as a whole, but users who placed government as their number one option didn't necessarily agree with the order of the other three entities. Seven users placed businesses as the main influencers, while only three users claimed that education and



academia were the real influencers that deserved the number one spot when it came to promote sustainable development attitudes and activities for the future.

Finally, 25 of the 70 users who belong to this sample claimed that the number one influence was society, placing both government and society as the top two influencers, taking government the number one spot.

As the final section of this survey, participants had to rate the following energy sources, imagining which ones would be the most important and relevant in the next 10 years. Their options included: Fossil, Natural Gas, Nuclear, Solar and Air powered energy sources.

Out of the sample of 70 users, 11 users placed fossils as a very important and relevant source of energy for the future, while 19 users considered that natural gas was one of the most important sources of energy that would assure a sustainable future for everyone. When it came to nuclear powered energy, 8 users considered that it was one of the most powerful and important sources of energy for the future, whereas solar powered energy earned the number one place as one of the most influential, powerful and relevant sources of energy for the sake of a sustainable future for everyone with an outstanding 55 amount of participants who placed it as the best option. In second place, 52 users considered that air powered energy sources had one of the most powerful and important potentials for the future.

When asked if they would be interested in being contacted in the future to participate in an interview, 51 out of the 70 participants gave green light to being contacted later on. Out of these 51 users, 8 of them were interviewed. Their background and their thoughts regarding education for sustainable development applied through online platforms will be touched upon later on in this chapter.

## Education for Sustainable Development Post-MOOC Survey

After answering the first two instruments whose results have already been enlisted in this chapter, participants participated in the MOOC for a period of 8 weeks. During the last week of the course, once they had completed all activities and exams for the MOOC, they were once again invited to answer two more instruments: the post MOOC Education for Sustainable Development survey, and the End of Course Survey.

According to the literature that was revised earlier in this document, it was expected that a lot of the users who had signed up to the MOOCs wouldn't reach the last week of the course, since the level of desertion is quite high. As mentioned before, only 70 participants completely answered the post MOOC Education for Sustainable Development survey. Because this survey was designed for this research, validity must be confirmed first.

## Reliability of Post-MOOC ESD Survey

Table 76

### *Case Processing Summary for the Post-MOOC ESD Survey*

	N	%
Valid cases	70	100%
Excluded Cases		0%
Total	70	100%

No cases needed to be excluded, since only complete surveys were used in order to calculate the Cronbach Alpha.

Table 77

*Reliability Statistics for the Post-MOOC Survey*

<b>Cronbach's Alpha</b>	<b>Cronbach's Alpha Based on Standardized Items</b>	<b>N of Items</b>
,776	,778	14

No cases needed to be excluded, since only complete surveys were used in order to calculate the Cronbach Alpha.

Because the result is higher than .70, it has been proven that the instrument is within the acceptable values to consider that the instrument has reliability (Nunnally, 1994; Bland, 1997; DeVellis, 2003). The results for the Post-ESD Survey will now be presented.

**Post-MOOC Survey Education for Sustainable Development Results**

Table 78

*Which MOOC did you enroll in?*

<b>Massive Open Online Course</b>	<b>Number of participants</b>	<b>Percentage</b>
Energy Markets: Opportunities for Business	23	32.86%
Conventional Clean Energies and their Technology	11	15.71%
Energy Savings	27	38.57%
Energy: Past, Present and Future	6	8.57%
Energy Literacy	2	2.86%
The Energy Reform in Mexico and its Opportunities	1	1.43%
<b>Total</b>	<b>70</b>	<b>100%</b>

As shown in the table, we can observe that most participants enrolled in the Energy Market and Energy Savings courses.

Table 79

*Level of familiarity and expertise users had regarding sustainability after taking the MOOC*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with sustainability	5	7.14%
I am a little familiar with sustainability	6	8.57%
I am somewhat familiar with sustainability	27	38.57%
I am familiar with sustainability	25	35.71%
I am an expert in sustainability	7	10.00%
Total	70	100%

Table 80

*Level of familiarity and expertise users had regarding the MOOC they enrolled in post MOOC*

<b>Level of Familiarity</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar at all with the topic of the MOOC I enrolled to	1	1.43%
I am a little familiar with the topic of the MOOC I enrolled to	7	10.00%
I am somewhat familiar with the topic of the MOOC I enrolled to	18	25.71%
I am familiar with the topic of the MOOC I enrolled to	23	32.86%
I am an expert in the topic of the MOOC I enrolled to	21	30.00%
Total	70	100%

Table 81

*Are you familiar with UNESCO's Sustainability Development Goals? Post MOOC*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I am not familiar with them	19	27.14%
I know about them	19	27.14%
I know everything about them	32	45.71%
<b>Total</b>	<b>70</b>	<b>100%</b>

As shown by the previous tables, there were some interesting changes in the distribution of the answer's participants gave after they took the course. Only one user still gave himself a 1 out of 5 after taking the MOOC, and after comparing his answer to the pre-MOOC survey, it was observed that he had also graded his understanding of the topic of the MOOC with the lowest rating. A direct analysis of whether the responses changed in a significant way will be presented in the next section of this chapter, but just from observing the results briefly, it can be observed that the participant's awareness of the SDGs and their knowledge regarding sustainability grew after they participated in the MOOC.

Regarding the next portion of the survey, participants were requested to update and reaffirm if they had had an online course or interaction that touched upon the theme of sustainability. Interestingly, only 59 out of the 70 participants who answered the post-survey considered that they had.

Regarding extracurricular and in person activities, such as seminars, 60 out of the 70 post MOOC participants said that they had participated in at least one them. Finally, regarding if they had had any curricular classes through their studies that touched upon the subject of sustainability, over 60 users replied that sustainability had been a topic they had learned about during their formal education.

Next, participants gave their answers regarding pro-sustainability activities they partook in their daily lives.

Interestingly enough, according to Matutinovis (2012) the analysis of public opinion studies in the EU 27, US, and around the world suggested that on the average people did not start yet to question seriously about their consumption habits and lifestyles in the context of sustainability. The diffusion of environmental values in observed populations was relatively low and, consequently, people’s actions in pre- serving environment are mostly low-effort and low-scale. However, the complete opposite was observed in the results obtained from the participants who enrolled to the MOOCs. The results can be observed in the following table.

Table 82

*Pro-Sustainability activities in their daily lives post MOOC*

<b>Activity</b>	<b>Participants who claimed they participated actively in this activity in their daily lives</b>	<b>Percentage</b>
Attempt to keep general lifestyle pro-sustainability	68	97.14%
Avoid waste of things, be it food, clothes or any other item without purpose	65	92.86%
Actively attempt to recycle at home	66	94.29%
Avoid the use of cars for transportation, opting to either use public transportation or a bike to move themselves around	68	97.14%

As we can observe from these results, there was a very high percentage of activities that the users claimed they partook in their daily lives in order to secure a pro-sustainable

way of life. However, when comparing these results with the conversations that took place in the interviews (Tables 235, 236, 237, 251, 252) in both samples, it is clear that even though participants take actions personally in their daily lives to support a sustainable future, they still consider that there is a lack of education for sustainable development in their societies, since they constantly claimed there was a need for awareness campaigns that could help promote this type of actions in other people, especially younger generations.

However, despite the challenges ahead, education for sustainable development offers consistent elements to show that it is a science that is increasingly consolidated and presents alternative visions and consequent paradigms for the construction of a sustainable society (Leff, 2002; 2006; Vilches & Gil Pérez, 2016).

Research in the field of ESD contributes to encourage the participation of people in all kinds of communities and social groups to reflect on the configurations in order to make more conscious decisions towards a more sustainable future (De Sousa & Uceda, 2017). Thus, even if we see that users claim and take pro sustainable activities in their daily lives, this does not mean that they are not aware of the challenges that sustainable development must face in the long run.

In order to give users, the possibility to express their posture about the challenges ahead, participants were requested to express if they considered the challenges for the world when it came to sustainable development were of ecological, economic or social nature. Ten out of the seventy participants considered that the answer was that all three of them were just as important and that all approaches were key when dealing with solving these challenges in the future. This is one more participant when comparing the results from the pre-MOOC survey.

However, just like in the pre-MOOC survey, different opinions and perspectives were shared in this part of the survey. Thirteen participants considered that it was not an ecological problem at all. Six participants expressed that economics was not the real nature behind the challenges, while eight participants expressed that they didn't consider the challenges to be of social nature.

Out of the post-MOOC sample, 39 users considered the problem to be highly of ecological nature, 43 of them considered that it was an economic challenge and 30 claimed it was a challenge of a social nature.

Finally, only three participants decided that they did not consider the challenges to be of any of these natures, rating the challenges to not be specifically of either ecological, economic or social nature. When the pre-MOOC survey ran, six participants had this posture. However, after taking the course, only three participants kept their posture the same way regarding this point. Next, participants were requested to present in order of priority which entity played a more influential role when it came to promote sustainable actions for the future: the government, businesses, academia, or society in general.

Interestingly enough, 25 of the 70 participants enlisted the government as the most influential entity as a whole, which is lower than the amount that was recorded in the pre-MOOC results. Nine users placed businesses as the main influencers, which is 2 participants more when comparing to what the users had answered in the pre-MOOC survey. Only five users claimed that education was the biggest influence when it came to promoting sustainable development attitudes, and taking a huge rise compared to what had been answered before the MOOC, twenty eight participants declared that citizenship was the real influence that deserved the number one spot when it came to promote sustainable development attitudes and activities for the future.



As the final section of this survey, participants had to rate the following energy sources, imagining which ones would be the most important and relevant in the next 10 years. Their options included: Fossil, Natural Gas, Nuclear, Solar and Air powered energy sources.

Out of the sample of 70 users, 8 users placed fossils as a very important and relevant source of energy for the future, while 16 users considered that natural gas was one of the most important sources of energy that would assure a sustainable future for everyone.

When it came to nuclear powered energy, 11 users considered that it was one of the most powerful and important sources of energy for the future, whereas solar powered energy earned the number two place as one of the most influential, powerful and relevant sources of energy for the sake of a sustainable future for everyone with 51 participants who placed it as the best option. In first place, 52 users considered that air powered energy sources had one of the most powerful and important potentials for the future.

An extra question that was not present in the original pre-MOOC Education for Sustainable Survey was added. The question focused on whether the MOOC the participants had enrolled in had motivated them to research more about sustainability in their own time. The results to this question are presented in the following table:

Table 83

*Did you feel motivated to research more about sustainability after taking this MOOC?*

<b>Level of Motivation</b>	<b>Number of participants who replied this</b>	<b>Percentage</b>
I was not motivated at all	5	7.14%
I was a little motivated	1	1.43%
I was motivated	12	17.14%
I was very motivated	34	48.57%
I was exceedingly motivated	18	25.71%
Total	70	100%

As observed from the previous table, most participants leaned towards feeling at least a little motivation to research more on the topic of sustainability after participating in the MOOC. Finally, when asked if they would be interested in being contacted in the future to participate in an interview, 57 out of the 70 participants gave green light to being contacted later. Out of these 57 users, 8 of them were interviewed. The purpose behind the set of the pre and post interview regarding sustainable development education, awareness, attitudes and perspectives was to compare and contrast if there was a change or not in the way the participants expressed themselves about this topic before and after participating in the MOOC. This survey was one more attempt to define the multiple scales and methodologies that can be applied in order to identify and understand the key relationships between sustainability values, attitudes and behaviors, although clearly much work remains to be done in this field (Leiserowitz, Kates & Parris, 2006).

Now that the results for both the pre and post surveys regarding Education for Sustainable Development have been demonstrated, the results of the Wilcoxon Signed Rank Test will now be presented in order to determine if the replies by the participants had a significant change, statistically speaking, after they participated in the MOOC they enrolled in.

### **Education for Sustainable Development Pre and Post Survey Results**

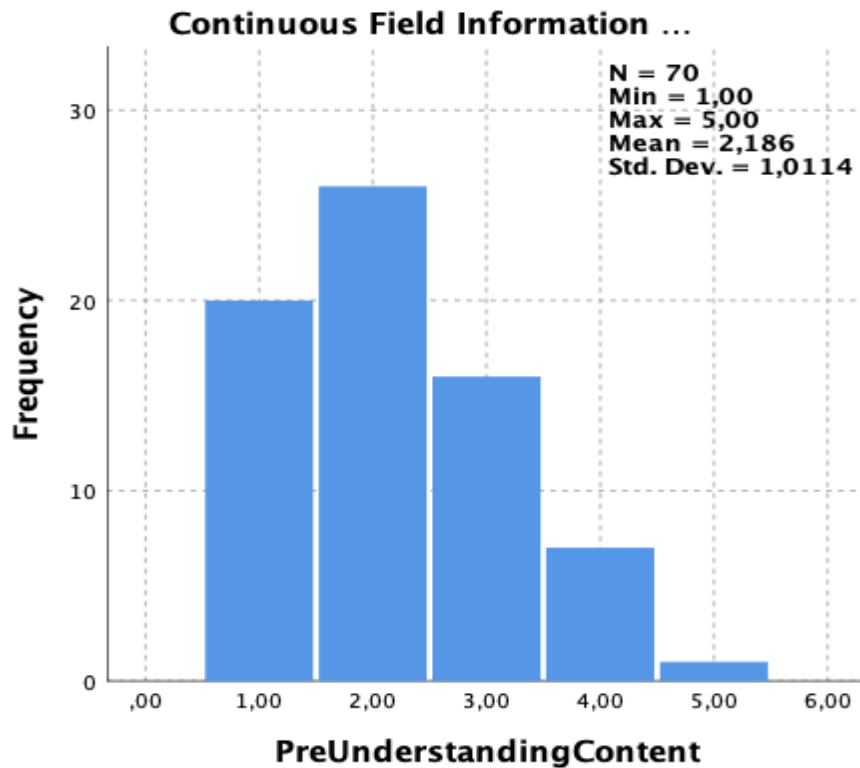
In order to compare the results before and after the MOOC, a Related-Sample Wilcoxon Signed Rank Test was run. In this type of test, the null hypothesis states that there was no significant change in the median differences from the pre and the post results obtained from the surveys. Because the data that was gathered from the Likert scales places in the surveys was not distributed normally, a non-parametric test comparing two related samples

was required. The Wilcoxon test often has the words “matched pairs” in its title. This is because each score is matched in one sample with the score in the second sample. Thus, each one of the users who replied to both instruments were considered a “pair” themselves, the pair being defined as the results they obtained in the pre-MOOC survey and the post-MOOC survey. Another thing to note is that the Wilcoxon test not only compares the sign of the differences (be it positive or negative) but it also compares the size of the differences.

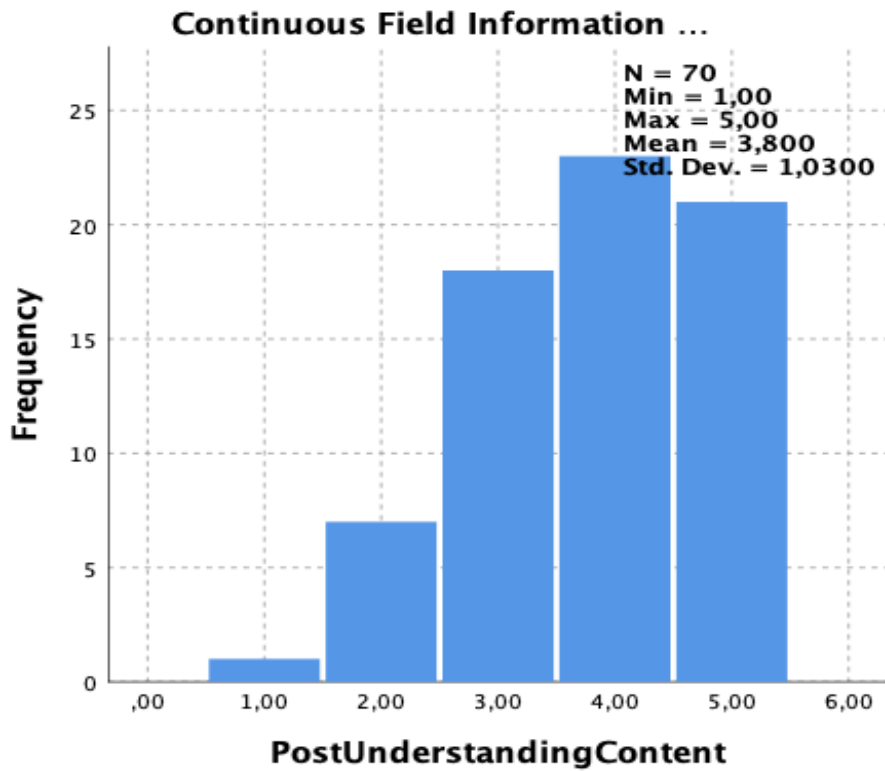
The results obtained from the elements that were measured in these instruments will now be presented. First, the frequencies and the differences obtained from each test are presented below. Next, a brief descriptive statistics table will be presented for each variable that will be analyzed. Following that, two tables will present the results that were obtained from the Wilcoxon Signed Rank Test for each variable. Finally, the null hypothesis result will be presented for each variable, followed by a brief description of what the result means.

## Pre-Understanding Content vs. Post Understanding Content

The test to compare the results regarding the understanding participants had regarding the content of the MOOC before and after taking the course are presented below.



*Figure 13.* Distribution of the Answers in the Pre-MOOC survey regarding Participant's Understanding of the Content of the MOOC



*Figure 14.* Distribution of the Answers in the Post-MOOC survey regarding Participant's Understanding of the Content of the MOOC

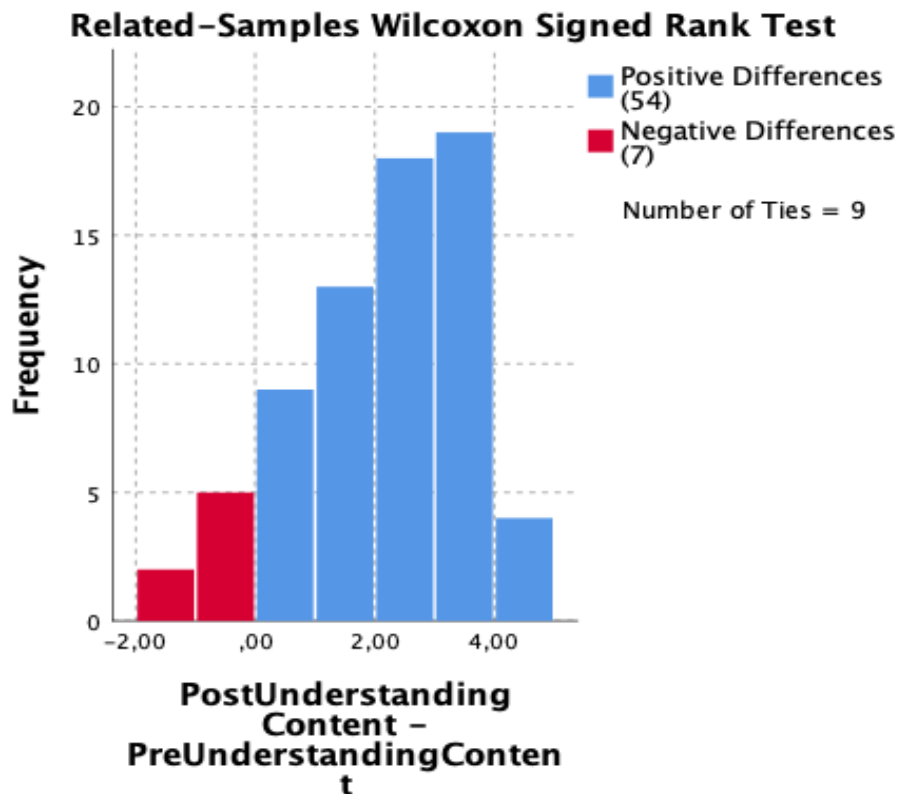


Figure 15. Wilcoxon Signed Rank Test Results for the Understanding of the MOOC Content

Table 84

Descriptive Statistics for Understanding of MOOC Content Variable – Pre and Post

	N	Mean	Std. Deviation	Minimum	Maximum
Pre Understanding Content	70	2,1857	1,01143	1,00	5,00
Post Understanding Content	70	3,8000	1,02999	1,00	5,00

Table 85

Wilcoxon Signed Rank Test for “Understanding of MOOC Content Variable

	N	Mean Rank	Sum of Ranks
Negative Ranks	7 <sup>a</sup>	14,93	104,50
Positive Ranks	54 <sup>b</sup>	33,08	1786,50
Ties	9 <sup>c</sup>		

Post Understanding Content - Pre UnderstandingContent	<b>Total</b>	70
<ul style="list-style-type: none"> <li>a. PostUnderstandingContent &lt; PreUnderstandingContent</li> <li>b. PostUnderstandingContent &gt; PreUnderstandingContent</li> <li>c. PostUnderstandingContent = PreUnderstandingContent</li> </ul>		

Table 86

*Wilcoxon Signed Rank Result for “Understanding of MOOC Content Variable*

<b>Post Understanding Content – Pre Understanding Content</b>	
<b>Z</b>	-6,109 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,000

Table 87

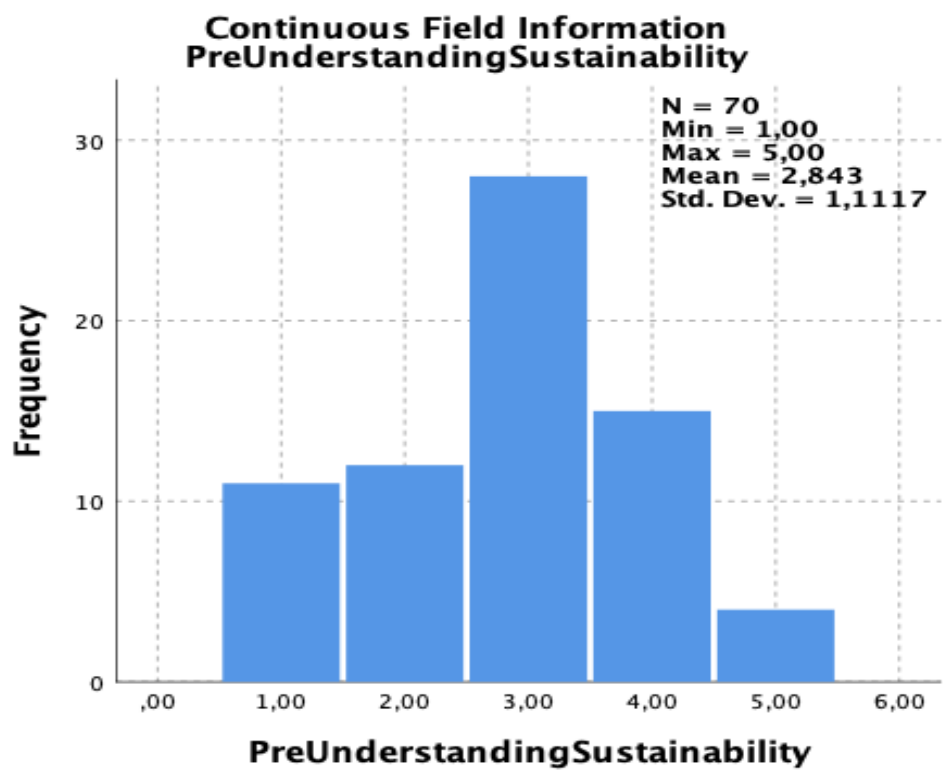
*Understanding of MOOC Content Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreUnderstandingContent and PostUnderstandingContent equals 0.	Related-Samples Wilcoxon Signed Rank Test	,000	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s understanding of the MOOC content before and after they partook in the open online course they signed up to.

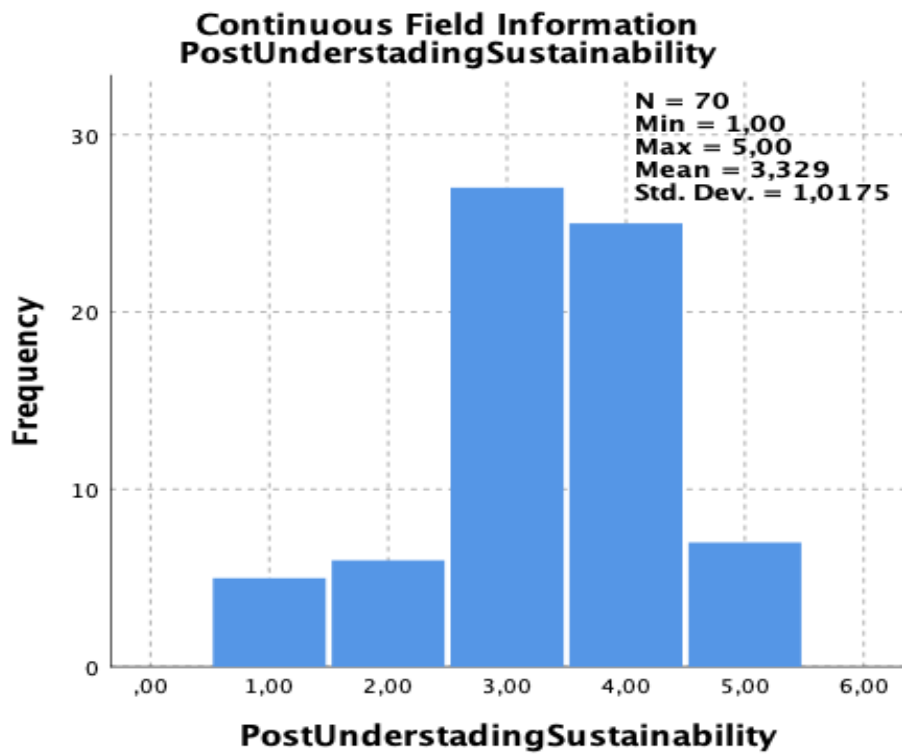
### **Pre-Understanding vs. Post Understanding Sustainability**

The test to compare the results regarding the understanding participants had about sustainability before and after taking the course are presented below.



*Figure 16.* Distribution of the Answers in the Pre-MOOC survey regarding Participant's Understanding of Sustainability





*Figure 17.* Distribution of the Answers in the Post-MOOC survey regarding Participant's Understanding of Sustainability

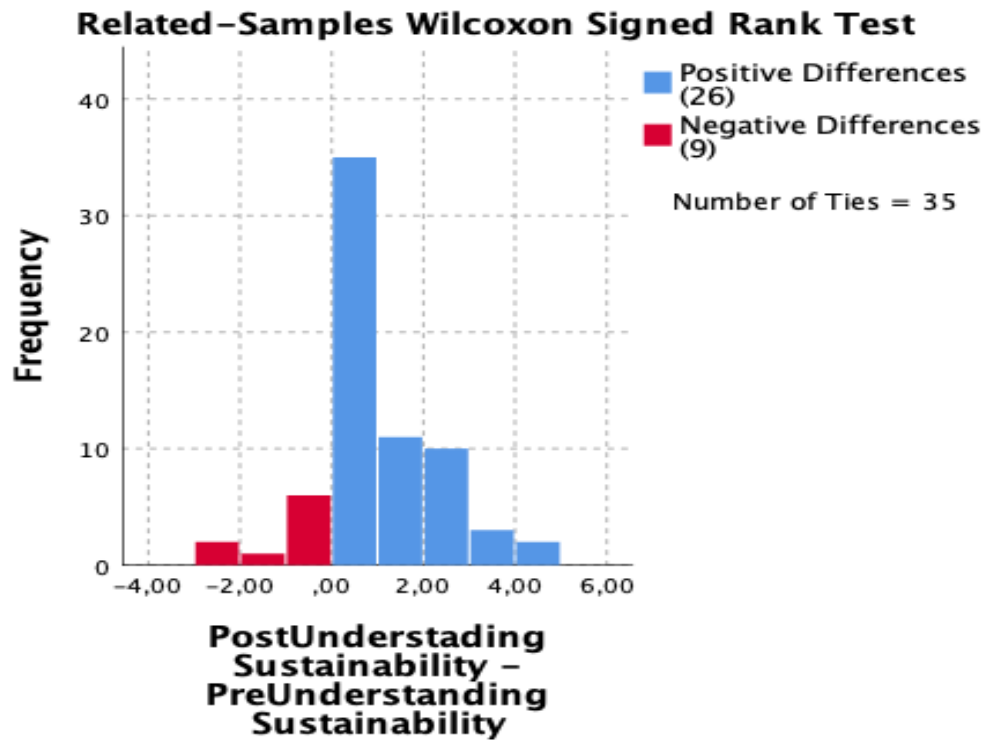


Figure 18. Wilcoxon Signed Rank Test Results for the Understanding of Sustainability

Table 88

*Descriptive Statistics for Understanding of Sustainability Variable – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
Pre Understanding Sustainability	70	2,8429	1,11167	1,00	5,00
Post Understanding Sustainability	70	3,3286	1,01755	1,00	5,00

Table 89

*Wilcoxon Signed Rank Test for Understanding of Sustainability Variable*

		N	Mean Rank	Sum of Ranks
PostUnderstandingSustainabilit	Negative Ranks	9 <sup>a</sup>	15,44	139,00
	Positive Ranks	26 <sup>b</sup>	18,88	491,00
PreUnderstandingSustainability	Ties	35 <sup>c</sup>		

- a. PostUnderstandingSustainability < PreUnderstandingSustainability
- b. PostUnderstandingSustainability > PreUnderstandingSustainability
- c. PostUnderstandingSustainability = PreUnderstandingSustainability

Table 90

*Wilcoxon Signed Rank Result for Understanding of Sustainability Variable*

	<b>PostUnderstandingSustainability - PreUnderstandingSustainability</b>
Z	-2,935 <sup>b</sup>
Asymp. Sig. (2-tailed)	,003

Table 91

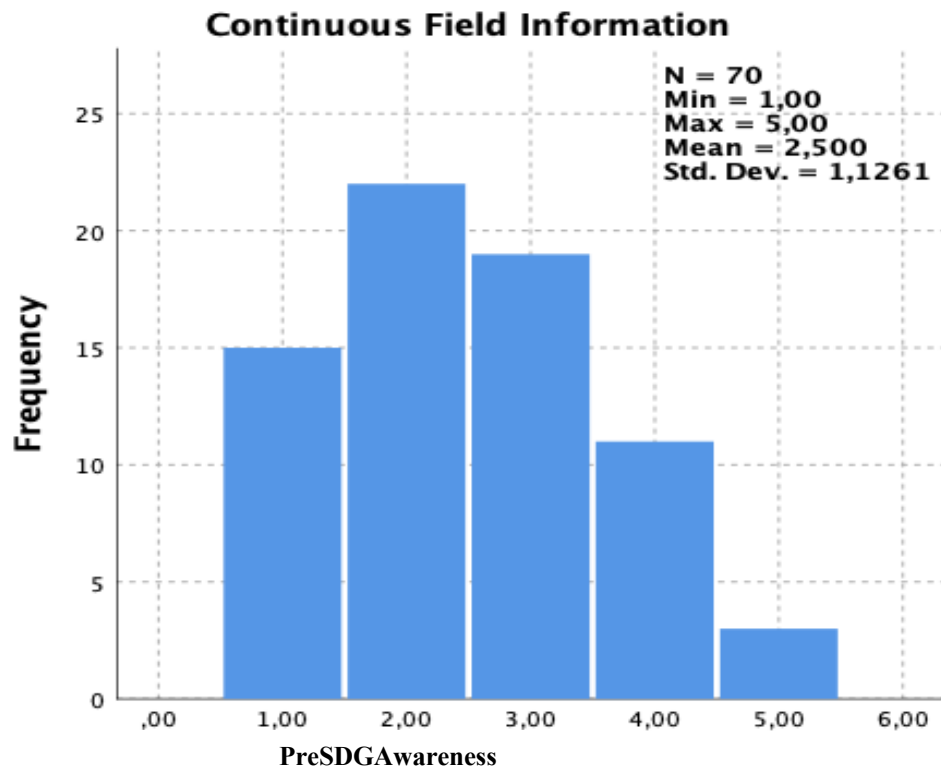
*Understanding of Sustainability Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreUnderstandingSustainability and PostUnderstadingSustainability equals 0.	Related-Samples Wilcoxon Signed Rank Test	,003	Reject the null hypothesis.

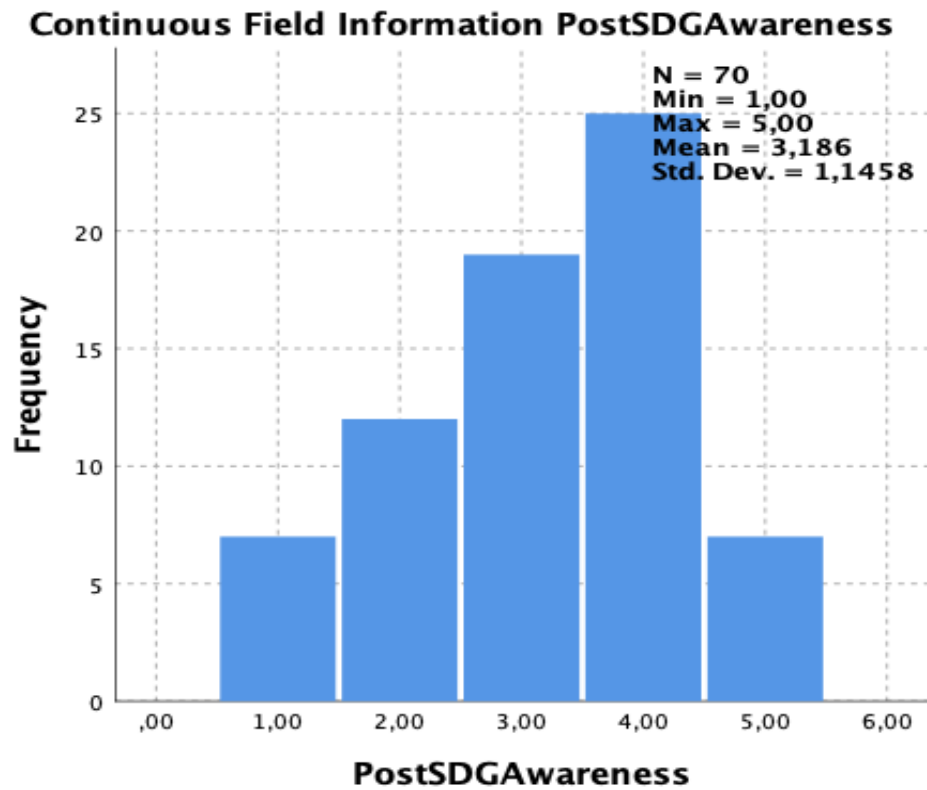
The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s understanding of sustainability before and after they participated in the open online course they signed up to.

**Pre SDG-Awareness vs. Post SDG Awareness**

The test to compare the results regarding the awareness participants had regarding the Sustainable Development Goals before and after taking the course are presented below.



*Figure 19.* Distribution of the Answers in the Pre-MOOC survey regarding level of Awareness Participants had about SDGs



*Figure 20.* Distribution of the Answers in the Post-MOOC survey regarding level of Awareness Participants had about SDGs

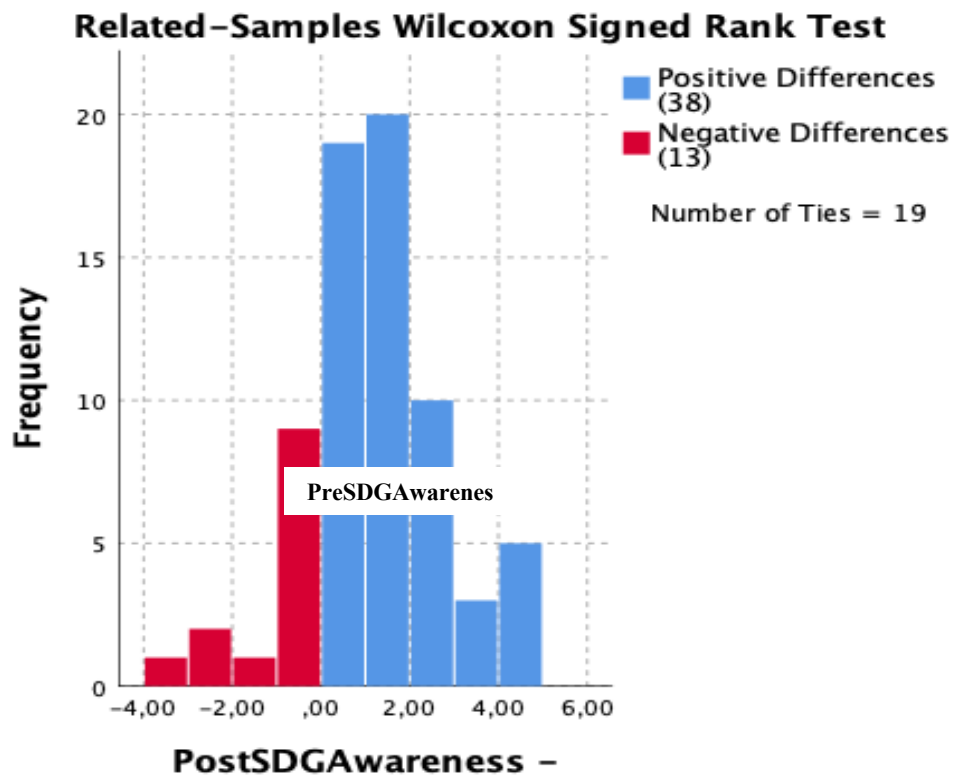


Figure 21. Wilcoxon Signed Rank Test Results for Awareness of SDGs

Table 92

*Descriptive Statistics for the Awareness of the SDGs Variable – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
Pre SDG Awareness	70	2,5000	1,12611	1,00	5,00
Post SDG Awareness	70	3,1857	1,14579	1,00	5,00

Table 93

*Wilcoxon Signed Rank Test for the Awareness of the SDGs Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostSDGAwareness-	Negative Ranks	13 <sup>a</sup>	23,42	304,50
PreSDGAwareness	Positive Ranks	38 <sup>b</sup>	26,88	1021,50
	Ties	19 <sup>c</sup>		
	Total	70		

- a. PostSDGAwareness < PreSDGAwareness
- b. PostSDGAwareness > PreSDGAwareness
- c. PostSDGAwareness = PreSDGAwareness

Table 94

*Wilcoxon Signed Rank Result for Awareness of the SDGs Variable*

	PostSDGAwareness - PreSDGAwareness
Z	-3,443 <sup>b</sup>
Asymp. Sig. (2-tailed)	,001

Table 95

*SDG Awareness Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PreSDGAwareness and PostSDGAwareness equals 0.	Related-Samples Wilcoxon Signed Rank Test	,001	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s level of awareness regarding the Sustainable Development Goals before and after they participated in the open online course they signed up to.

### **Pre-Digital Intervention vs. Post Digital Intervention**

Participants were requested to share if they had a Digital Intervention regarding the theme of sustainability before and after taking the course. The results comparing their answers are presented below.

### Continuous Field Information PreDigitalIntervention

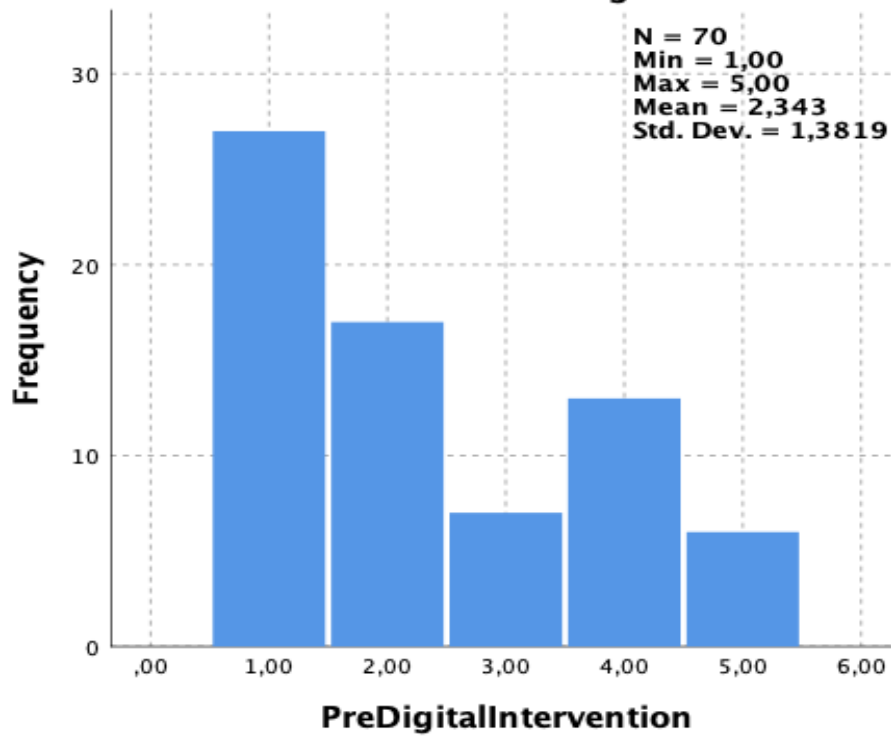
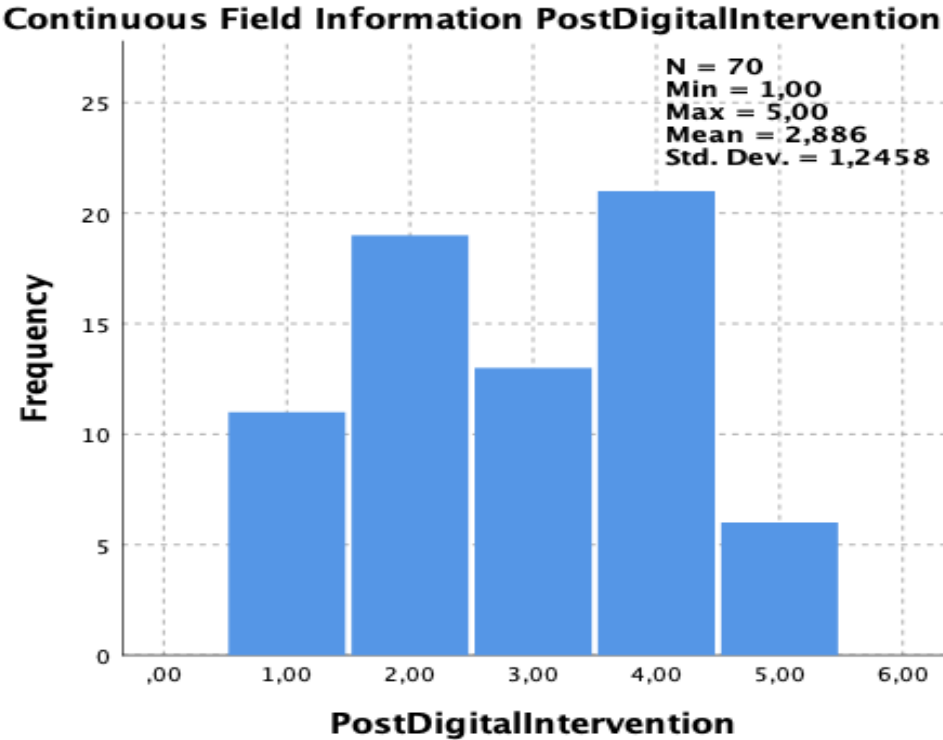


Figure 22. Distribution of the Answers in the Pre-MOOC survey regarding if participants had any previous digital interventions





*Figure 23.* Distribution of the Answers in the Post-MOOC survey regarding if participants had any previous digital interventions

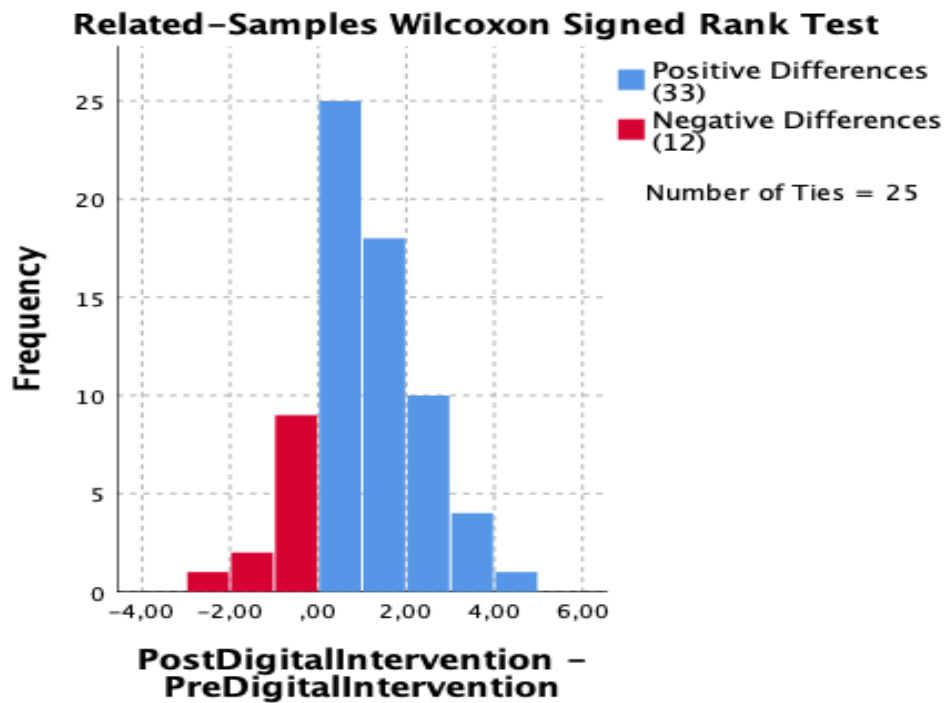


Figure 24. Wilcoxon Signed Rank Test Results for Previous Digital Interventions

Table 96

*Descriptive Statistics for Previous Digital Interventions – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreDigital Intervention	70	2,3429	1,38193	1,00	5,00
PostDigital Intervention	70	2,8857	1,24578	1,00	5,00

Table 97

*Wilcoxon Signed Rank Test for Previous Digital Interventions*

		N	Mean Rank	Sum of Ranks
PostDigital Intervention- PreDigital Intervention	Negative Ranks	12 <sup>a</sup>	19,58	235,00
	Positive Ranks	33 <sup>b</sup>	24,24	800,00
	Ties	25 <sup>c</sup>		
	Total	70		

- a. PostDigital Intervention < PreDigital Intervention
- b. PostDigital Intervention > PreDigital Intervention
- c. PostDigital Intervention = PreDigital Intervention

Table 98

*Wilcoxon Signed Rank Result for Digital Intervention*

<b>PostDigital Intervention – PreDigital Intervention</b>	
Z	-3,284 <sup>b</sup>
Asymp. Sig. (2-tailed)	,001

Table 99

*Digital Intervention Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreDigitalIntervention and PostDigitalIntervention equals 0.	Related-Samples Wilcoxon Signed Rank Test	,001	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change from what participants answered, with more positive ranks in the post survey. Thus, we can observe that more participants claimed they had a digital intervention regarding sustainability after they participated in the MOOC.

### Pre-Extracurricular vs. Post Extracurricular

Participants were requested to share if they had any previous experiences in extracurricular activities that touched upon the theme of sustainability. The results comparing their answers before and after they participated in the MOOC are presented below.

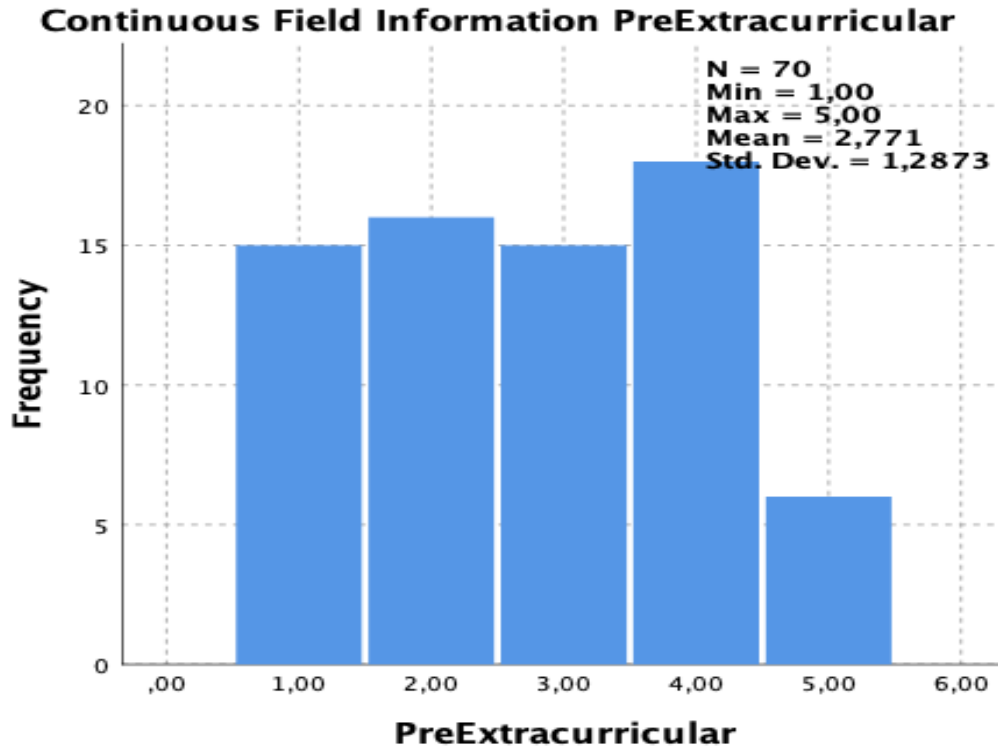
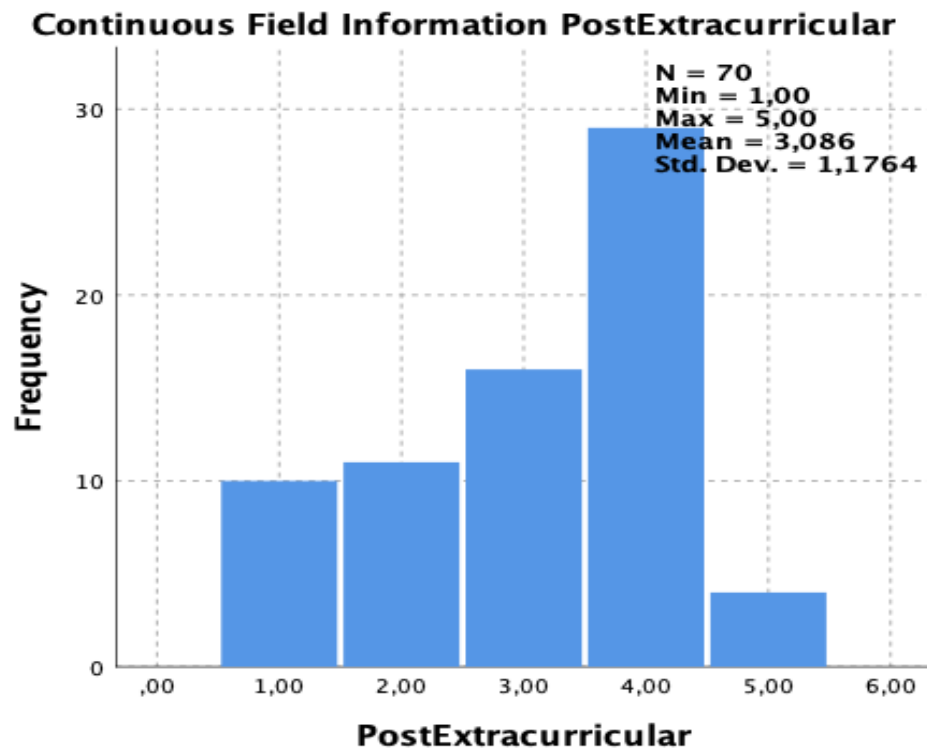


Figure 25. Distribution of the Answers in the Pre-MOOC survey regarding if participants had any previous extracurricular interventions



*Figure 26.* Distribution of the Answers in the Post-MOOC survey regarding if participants had any previous extracurricular interventions

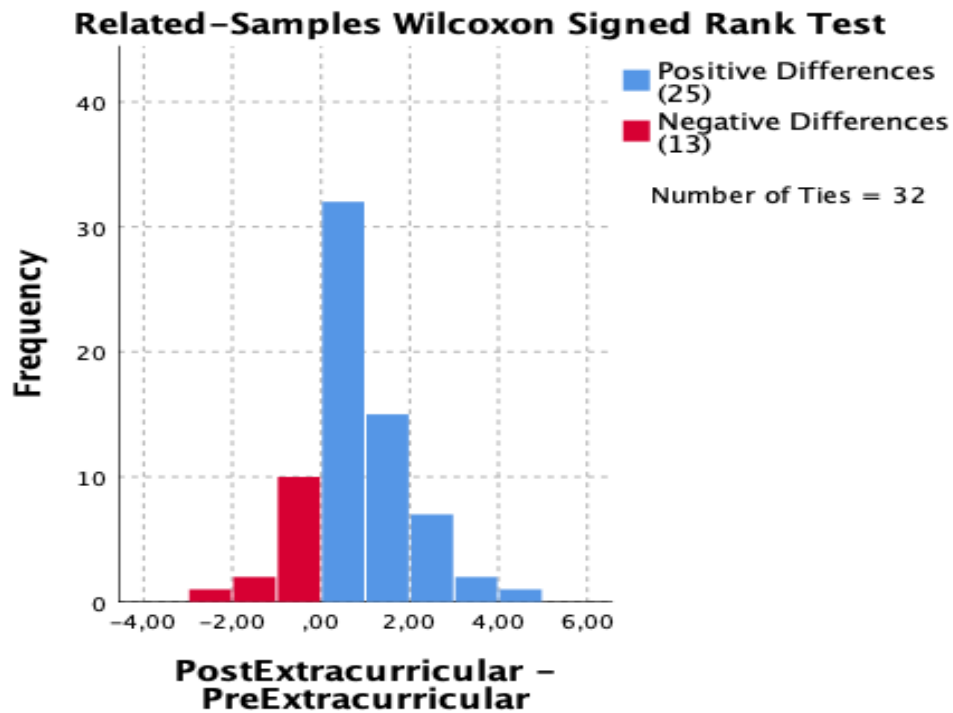


Figure 27. Wilcoxon Signed Rank Test Results for Previous Extracurricular Interventions

Table 100

*Descriptive Statistics for Previous Extracurricular Interventions – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreExtracurricular Intervention	70	2,7714	1,28730	1,00	5,00
PostExtracurricular Intervention	70	3,0857	1,17637	1,00	5,00

Table 101

*Wilcoxon Signed Rank Test for Previous Extracurricular Interventions*

		N	Mean Rank	Sum of Ranks
PostExtracurricular Intervention- PreExtracurricular Intervention	Negative Ranks	13 <sup>a</sup>	17,38	226,00
	Positive Ranks	25 <sup>b</sup>	20,60	515,00
	Ties	32 <sup>c</sup>		
	Total	70		

- a. PostExtracurricular Intervention < PreExtracurricular Intervention
- b. PostExtracurricular Intervention > PreExtracurricular Intervention
- c. PostExtracurricular Intervention = PreExtracurricular Intervention

Table 102

*Wilcoxon Signed Rank Result for Extracurricular Interventions*

	<b>PostExtracurricular Intervention – PreExtracurricular Intervention</b>
<b>Z</b>	-2,175 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,030

Table 103

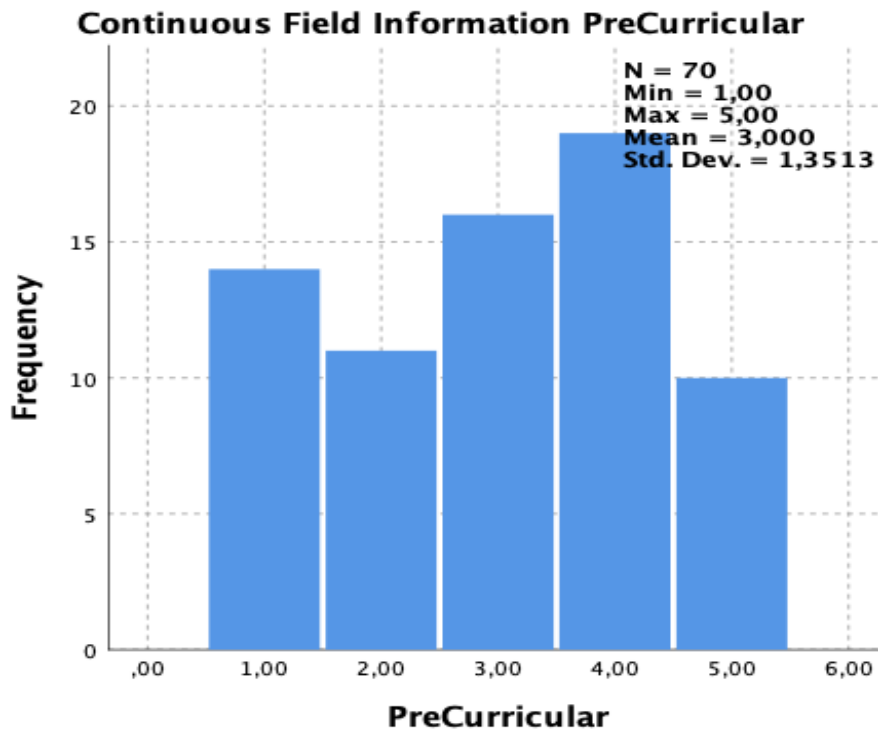
*Extracurricular Intervention Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreExtracurricular and PostExtracurricular equals 0.	Related-Samples Wilcoxon Signed Rank Test	,030	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change from what participants answered before and after the MOOC. Thus, we can observe that more participants claimed they had an extracurricular intervention regarding sustainability after they participated in the MOOC.

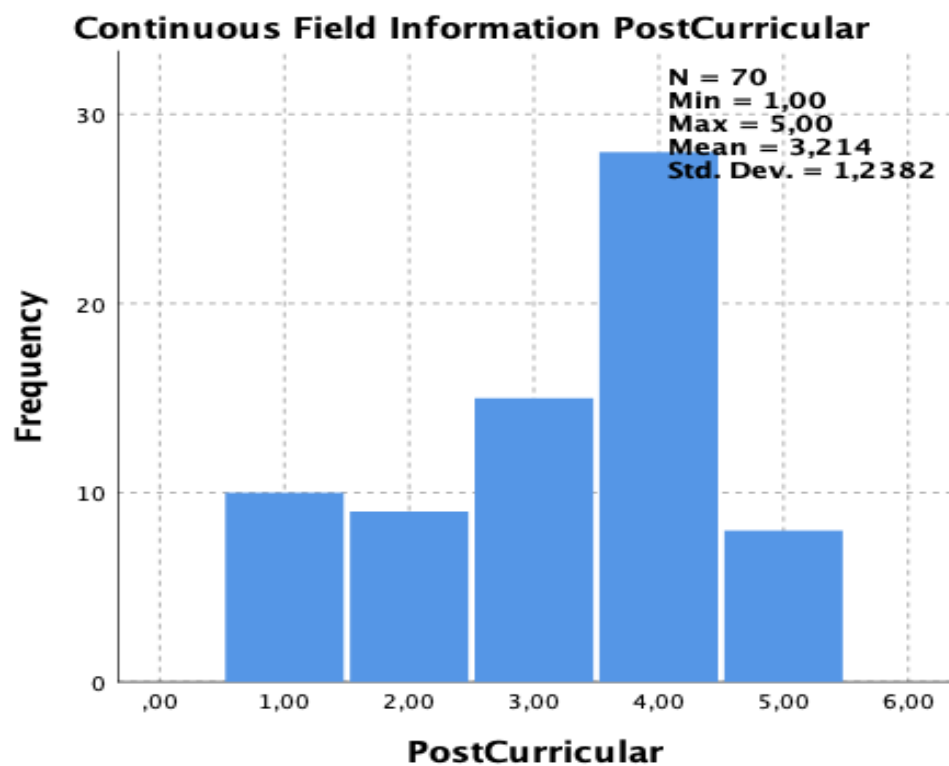
## Pre Curricular vs. Post Curricular

Participants were requested to share if they had any previous experiences in curricular activities that touched upon the theme of sustainability. The results comparing their answers before and after they participated in the MOOC are presented below.



*Figure 28.* Distribution of the Answers in the Pre-MOOC survey regarding if participants had any previous curricular interventions





*Figure 29.* Distribution of the Answers in the Post-MOOC survey regarding if participants had any previous curricular interventions

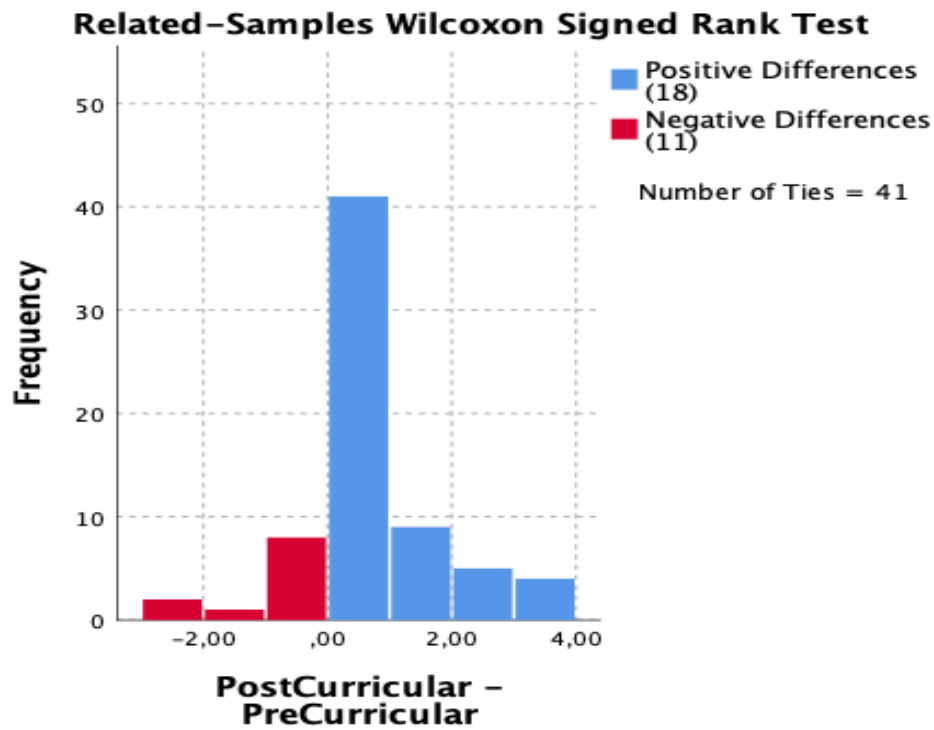


Figure 30. Wilcoxon Signed Rank Test Results for Previous Curricular Interventions

Table 104

*Descriptive Statistics for Previous Curricular Interventions – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreCurricular Intervention	70	3,0000	1,35133	1,00	5,00
PostCurricular Intervention	70	3,2143	1,23819	1,00	5,00

Table 105

*Wilcoxon Signed Rank Test for Previous Curricular Interventions*

	N	Mean Rank	Sum of Ranks
PostCurricular Intervention- Negative Ranks	11 <sup>a</sup>	13,23	145,50
PreCurricular Intervention Positive Ranks	18 <sup>b</sup>	16,08	289,50
Ties	41 <sup>c</sup>		
Total	70		

- a. PostCurricular Intervention < PreCurricular Intervention
- b. PostCurricular Intervention > PreCurricular Intervention
- c. PostCurricular Intervention = PreCurricular Intervention

Table 106

*Wilcoxon Signed Rank Result for Curricular Interventions*

<b>PostCurricular Intervention – PreCurricular Intervention</b>	
<b>Z</b>	-1,599 <sup>b</sup>
Asymp. Sig. (2-tailed)	,110

Table 107

*Curricular Intervention Hypothesis*

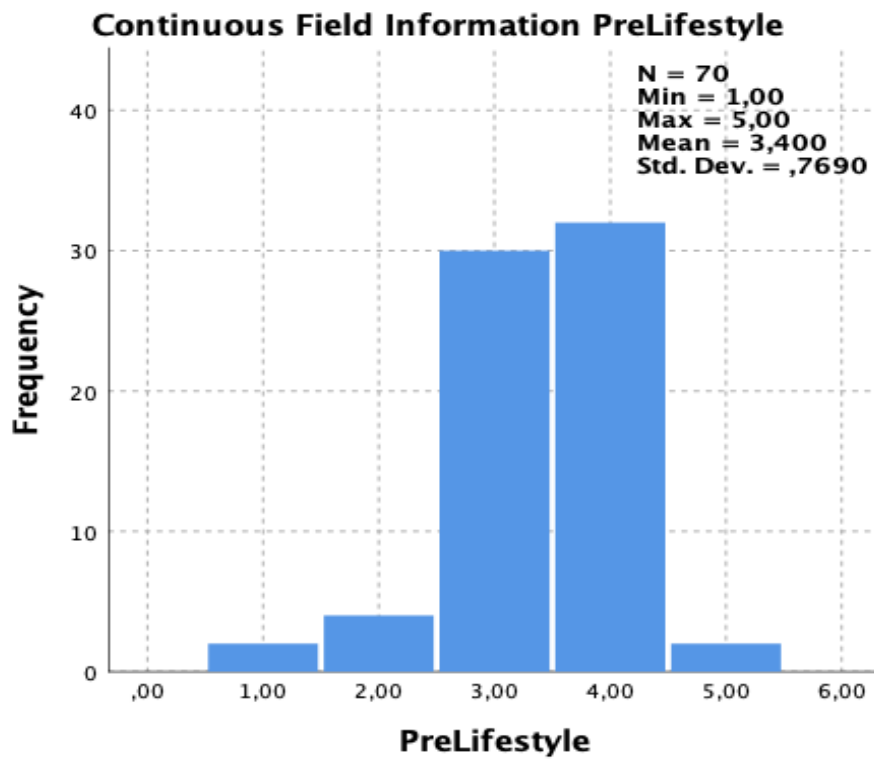
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreCurricular and PostCurricular equals 0.	Related-Samples Wilcoxon Signed Rank Test	,110	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there was not a rise or downfall in curricular interventions the participants had enrolled in before and after the participated in the MOOC.

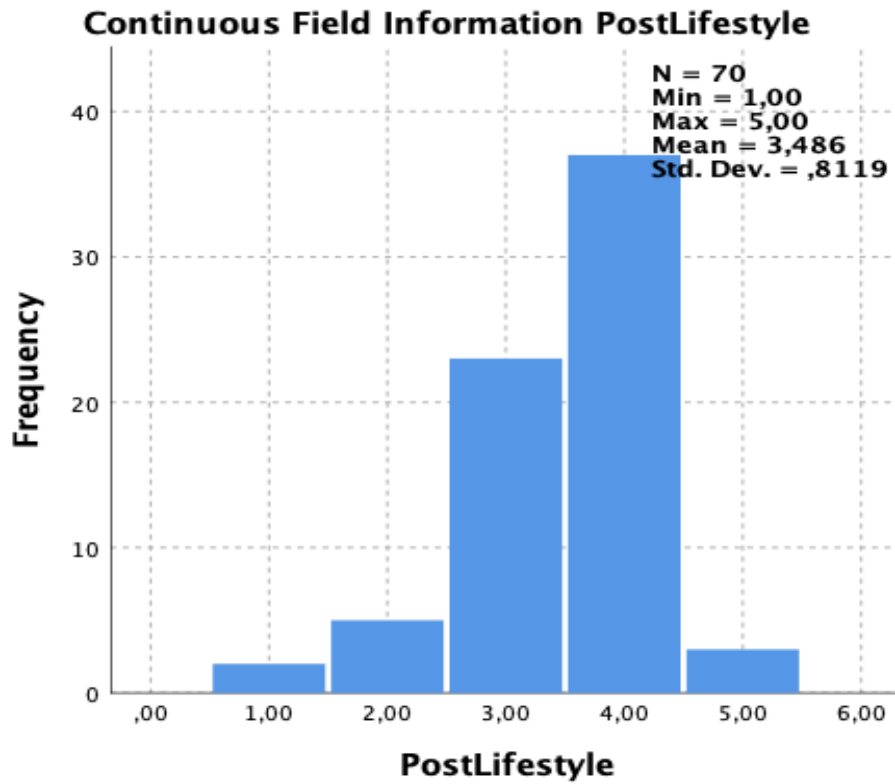
**Pre-Lifestyle vs. Post Lifestyle**

The next section of the instruments explored the participants attitudes and behaviors in their everyday life. The first element asked participants to rate if their lifestyle was pro-

sustainability. The results comparing their answers before and after they participated in the MOOC are presented below.



*Figure 31.* Distribution of the Answers in the Pre-MOOC survey regarding Participants Lifestyle being Pro-sustainability



*Figure 32.* Distribution of the Answers in the Post-MOOC survey regarding Participants Lifestyle being Pro-sustainability

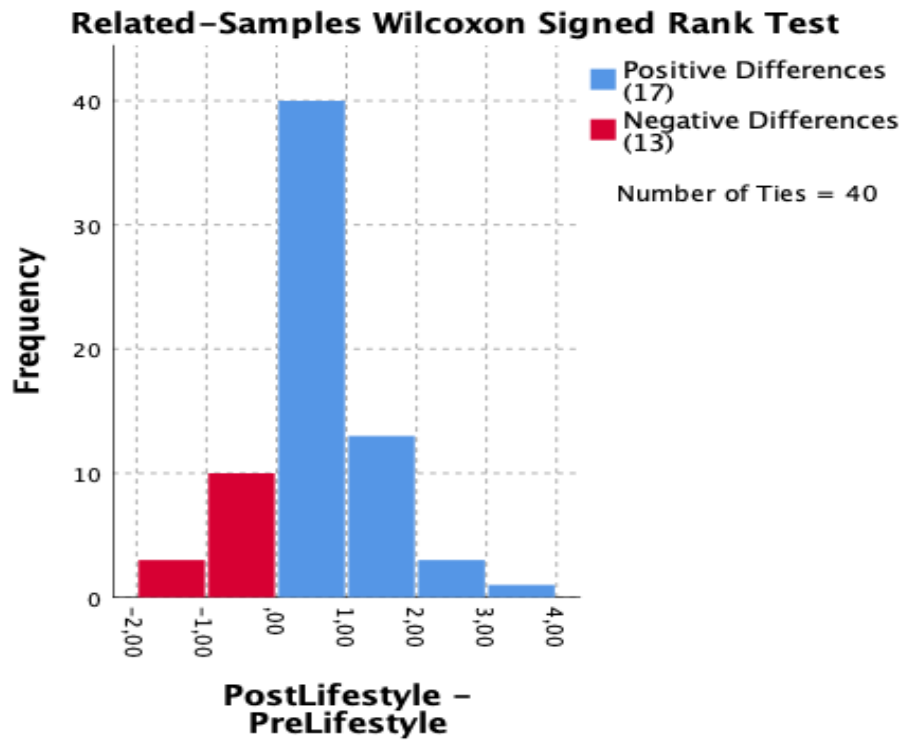


Figure 33. Wilcoxon Signed Rank Test Regarding the Participants Lifestyle being Pro-Sustainability

Table 108

*Descriptive Statistics for Participants Lifestyle being Pro-Sustainability – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreLifestyle	70	3,4000	,76896	1,00	5,00
PostLifestyle	70	3,4857	,81192	1,00	5,00

Table 109

*Wilcoxon Signed Rank Test for Participants Lifestyle being Pro-Sustainability*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostLifestyle	- Negative Ranks	13 <sup>a</sup>	15,35	199,50
PreLifestyle	Positive Ranks	17 <sup>b</sup>	15,62	265,50
	Ties	40 <sup>c</sup>		
	Total	70		

a. PostLifestyle < PreLifestyle

b. PostLifestyle > PreLifestyle

c. PostLifestyle = PreLifestyle

Table 110

*Wilcoxon Signed Rank Result for Participants Lifestyle being Pro-Sustainability*

		<b>PostLifestyle – PreLifestyle</b>
Z		-,719 <sup>b</sup>
Asymp. Sig. (2-tailed)		,472

Table 111

*Participants Lifestyle being Pro-Sustainability Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreLifestyle and PostLifestyle equals 0.	Related-Samples Wilcoxon Signed Rank Test	,472	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *was not* a significant change from what

participants answered before and after the MOOC. Thus, we can observe that there wasn't a rise or downfall in participant's grading of their lifestyle being pro-sustainability after they participated in the MOOC.

### Pre-Waste Reduction vs. Post Waste Reduction

The next element asked participants to rate if they attempted to reduce their waste in their daily lives, including the waste of things, be it food, clothes, or any other item without purpose. The results comparing their answers before and after they participated in the MOOC are presented below.

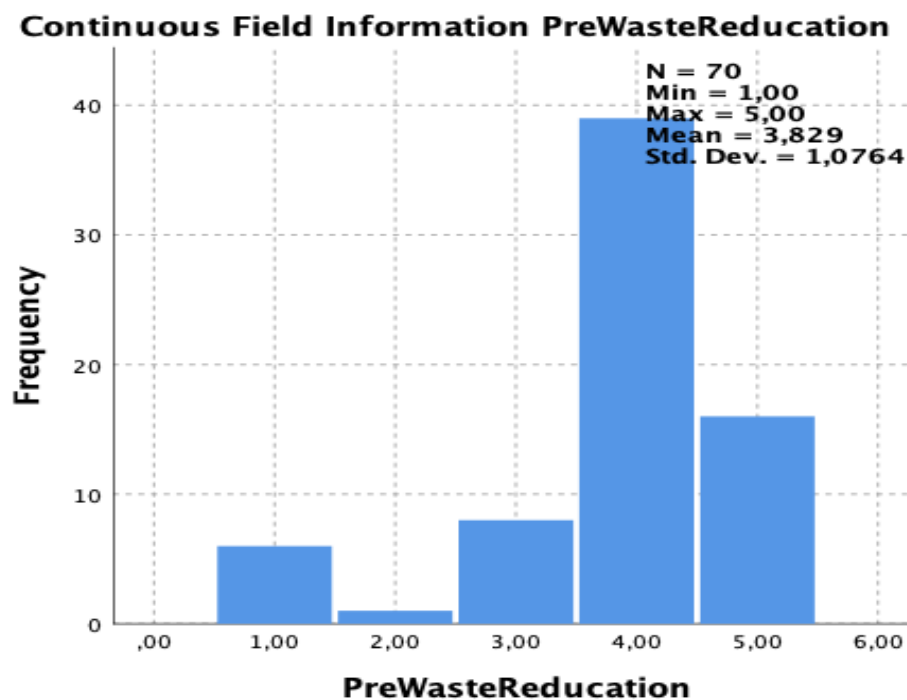
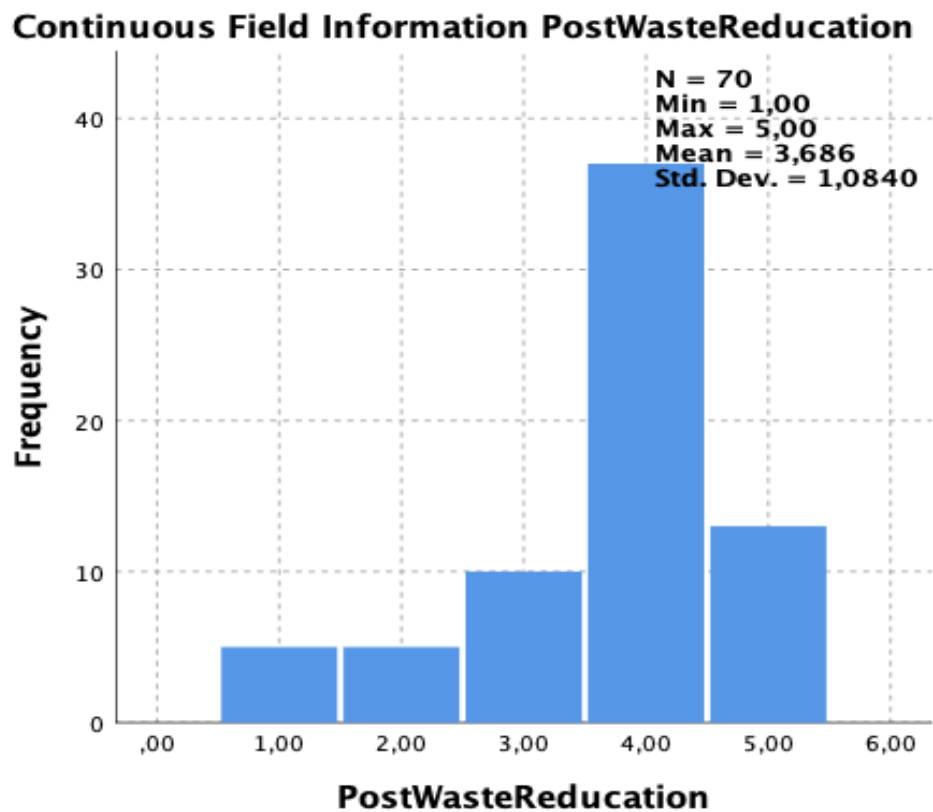


Figure 34. Distribution of the Answers in the Pre-MOOC survey regarding Participants Efforts to Reduce Waste in their Daily Lives





*Figure 35.* Distribution of the Answers in the Post-MOOC survey regarding Participants Efforts to Reduce Waste in their Daily Lives

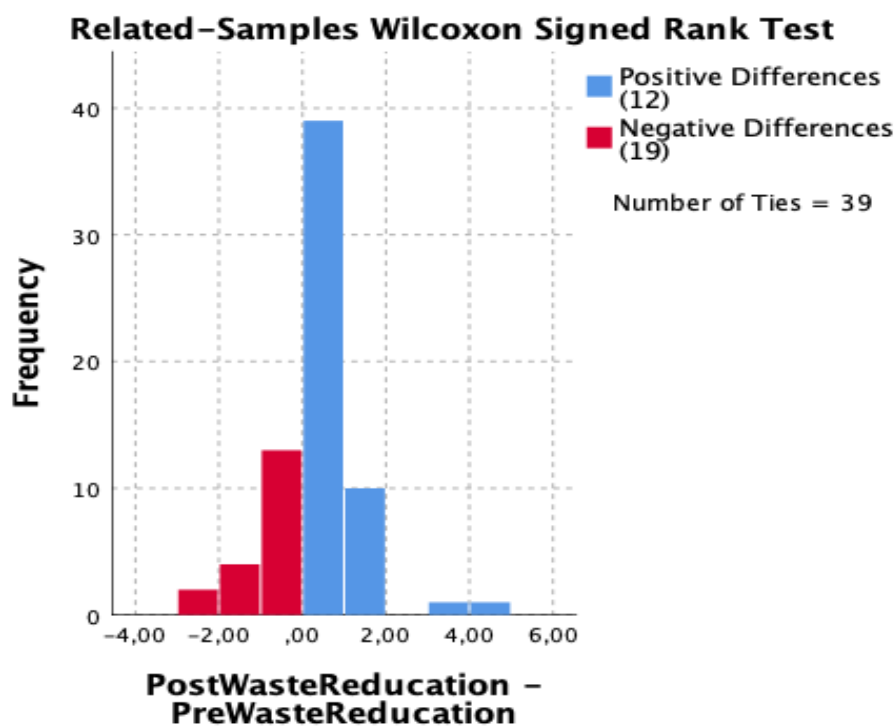


Figure 36. Wilcoxon Signed Rank Test Regarding the Participants Efforts to Reduce Waste in their Daily Lives

Table 112

*Descriptive Statistics for Participants Efforts to Reduce Waste in their Daily Lives– Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
<b>PreWasteReduction</b>	70	3,8286	1,07638	1,00	5,00
<b>PostWasteReduction</b>	70	3,6857	1,08405	1,00	5,00

Table 113

*Wilcoxon Signed Rank Test for Participants Efforts to Reduce Waste in their Daily Lives*

		N	Mean Rank	Sum of Ranks
PostWasteReduction	- Negative Ranks	19 <sup>a</sup>	16,63	316,00
PreWasteReduction	Positive Ranks	12 <sup>b</sup>	15,00	180,00
	Ties	39 <sup>c</sup>		
	Total	70		

a. PostWasteReduction < PreWasteReduction

b. PostWasteReduction > PreWasteReduction

c. PostWasteReduction = PreWasteReduction

Table 114

*Wilcoxon Signed Rank Result for Participants Efforts to Reduce Waste in their Daily Lives*

PostWasteReduction – PreWasteReduction	
<b>Z</b>	-1,403 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,161

Table 115

*Participants Efforts to Reduce Waste in their Daily Lives Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PreWasteReduction and PostWasteReduction equals 0.	Related-Samples Wilcoxon Signed Rank Test	,161	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there wasn't a

rise or downfall in participant's answer regarding their efforts to reduce waste in their daily lives.

### Pre-Recycling vs. Post Recycling

Participants were asked to rate their efforts for recycling in their daily activities. The results comparing their answers before and after they participated in the MOOC are presented below.

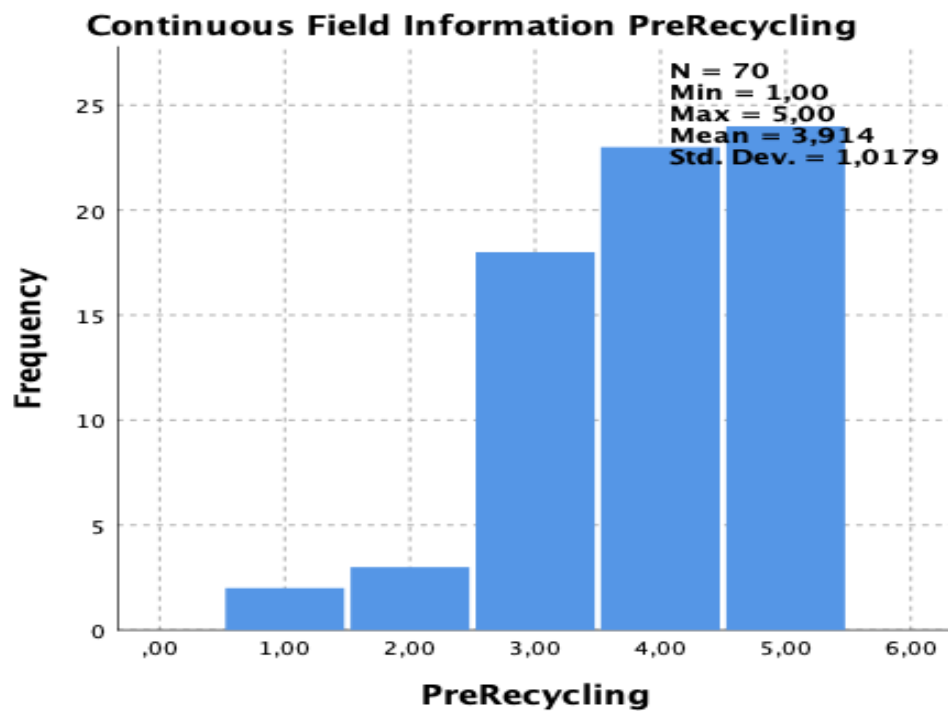
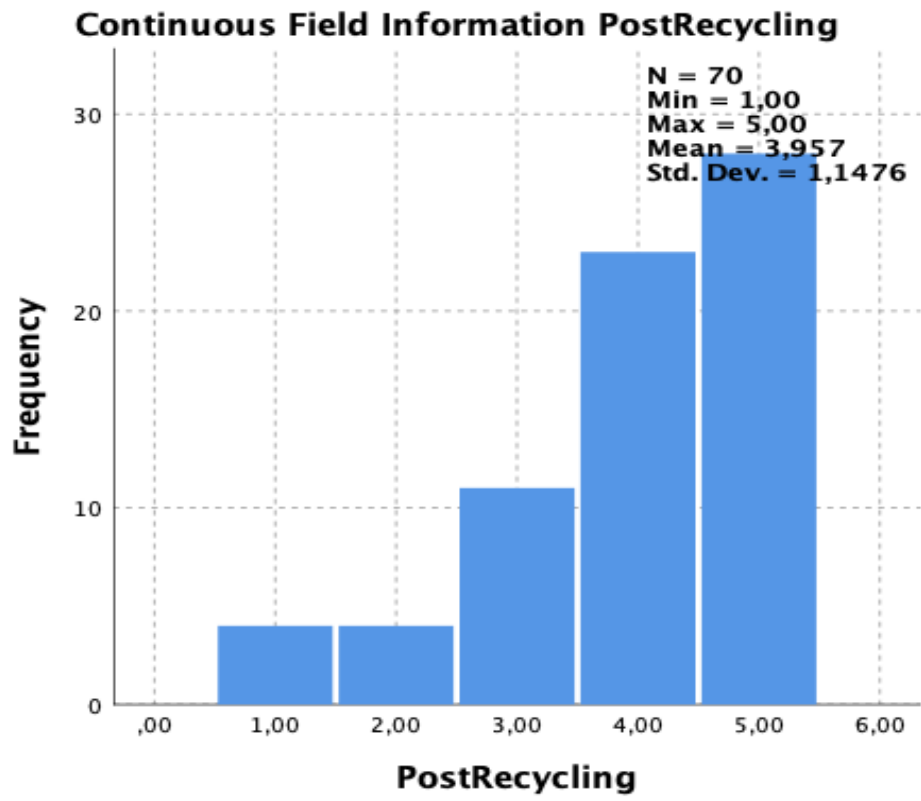


Figure 37. Distribution of the Answers in the Pre-MOOC survey regarding Participants Efforts to Recycle in their Daily Lives



*Figure 38.* Distribution of the Answers in the Post-MOOC survey regarding Participants Efforts to Recycle in their Daily Lives

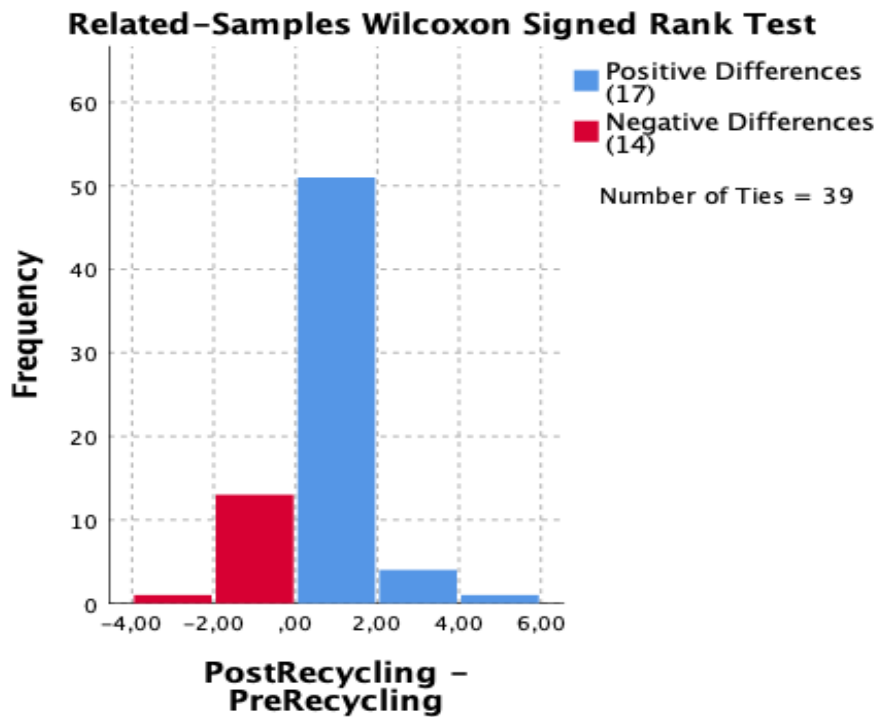


Figure 39. Wilcoxon Signed Rank Test Regarding the Participants Efforts to Recycle in their Daily Lives

Table 116

Descriptive Statistics for Participants Efforts to Recycle in their Daily Lives– Pre and Post

	N	Mean	Std. Deviation	Minimum	Maximum
PreRecycling	70	3,9143	1,01785	1,00	5,00
PostRecycling	70	3,9571	1,14760	1,00	5,00

Table 117

Wilcoxon Signed Rank Test for Participants Efforts to Recycle in their Daily Lives

	N	Mean Rank	Sum of Ranks
PostRecycling - PreRecycling	Negative Ranks	14 <sup>a</sup>	231,50
	Positive Ranks	17 <sup>b</sup>	264,50
	Ties	39 <sup>c</sup>	

- a. PostRecycling < PreRecycling
- b. PostRecycling > PreRecycling
- c. PostRecycling = PreRecycling

Table 118

*Wilcoxon Signed Rank Result for Participants Efforts to Recycle in their Daily Lives*

	<b>PostRecycling – PreRecycling</b>
<b>Z</b>	-,337 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,736

Table 119

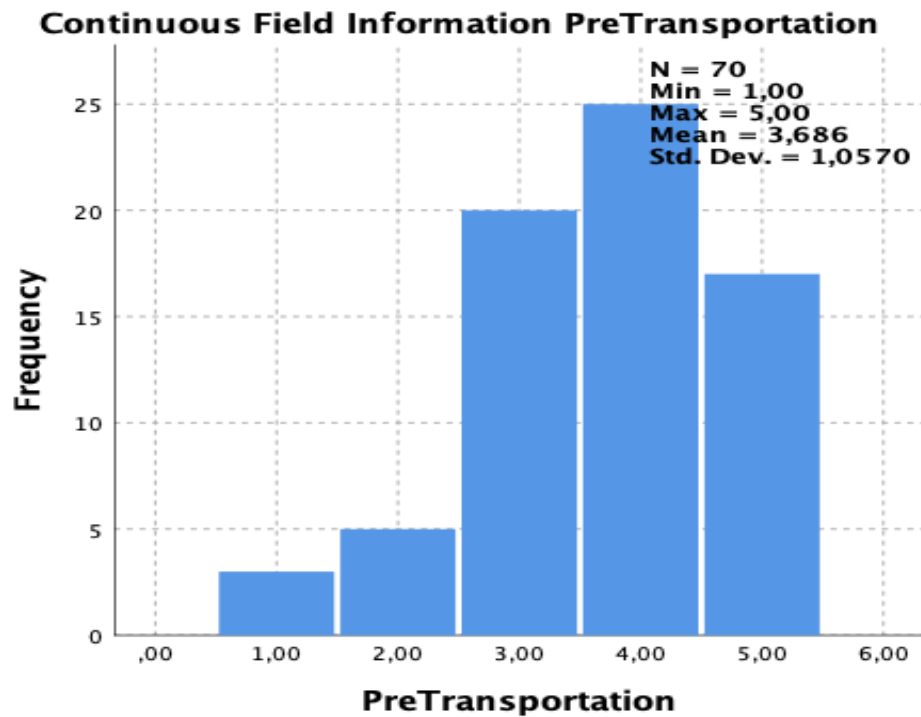
*Participants Efforts to Recycle in their Daily Lives Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreRecycling and PostRecycling equals 0.	Related-Samples Wilcoxon Signed Rank Test	,736	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there wasn't a rise or downfall in participant's answer regarding their efforts to recycle in their daily lives.

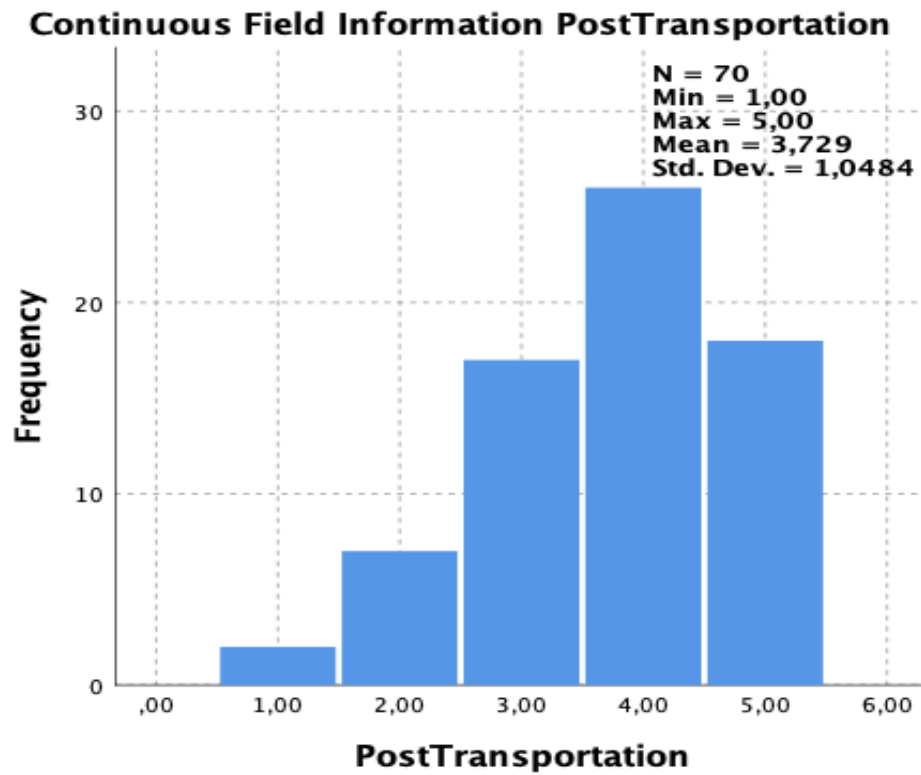
## Pre-Transportation vs. Post Transportation

Participants were asked to rate their efforts to avoid using cars for transportation, opting to either use public transportation or a bike to move around. The results comparing their answers before and after they participated in the MOOC are presented below.



*Figure 40.* Distribution of the Answers in the Pre-MOOC survey regarding Participants Efforts to avoid using Cars for Transportation in their Daily Lives





*Figure 41.* Distribution of the Answers in the Post-MOOC survey regarding Participants Efforts to avoid using Cars for Transportation in their Daily Lives

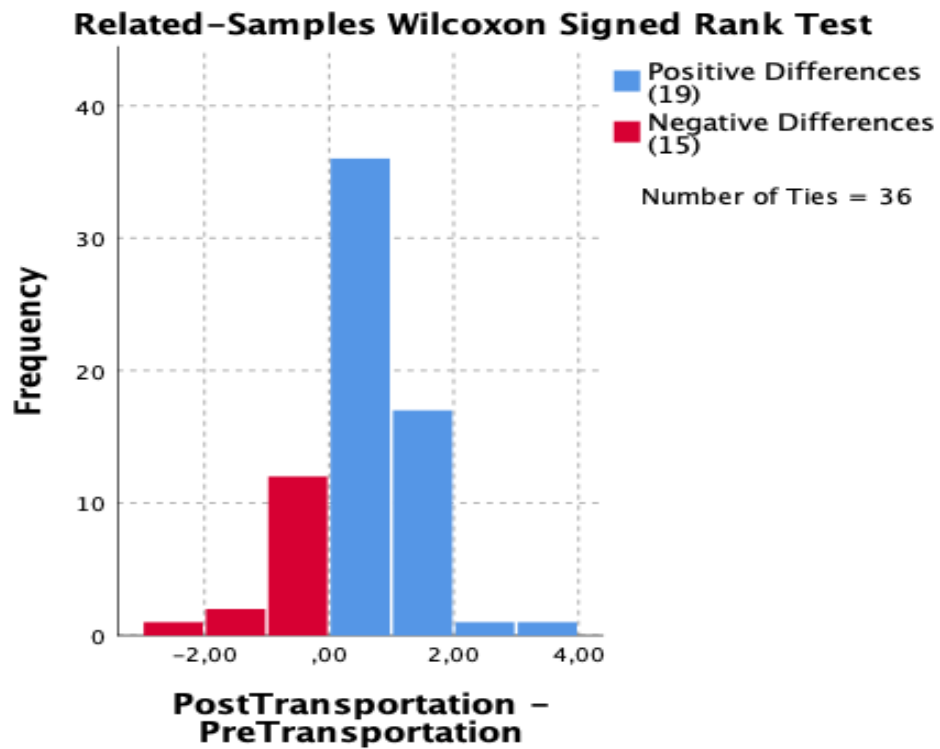


Figure 42. Wilcoxon Signed Rank Test Regarding the Participants Efforts to avoid using Cars for Transportation in their Daily Lives

Table 120

*Descriptive Statistics for Participants Efforts to avoid using Cars for Transportation in their Daily Lives– Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreTransportation	70	3,6857	1,05697	1,00	5,00
PostTransportation	70	3,7286	1,04841	1,00	5,00

Table 121

*Wilcoxon Signed Rank Test for Participants Efforts to avoid using Cars for Transportation in their Daily Lives*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostTransportation	- Negative Ranks	15 <sup>a</sup>	18,37	275,50
PreTransportation	Positive Ranks	19 <sup>b</sup>	16,82	319,50
	Ties	36 <sup>c</sup>		
	Total	70		

- a. PostTransportation < PreTransportation
- b. PostTransportation > PreTransportation
- c. PostTransportation = PreTransportation

Table 122

*Wilcoxon Signed Rank Result for Participants Efforts to avoid using Cars for Transportation in their Daily Lives*

<b>PostTransportation – PreTransportation</b>	
Z	-,408 <sup>b</sup>
Asymp. Sig. (2-tailed)	,684

Table 123

*Participants Efforts to avoid using Cars for Transportation in their Daily Lives Hypothesis*

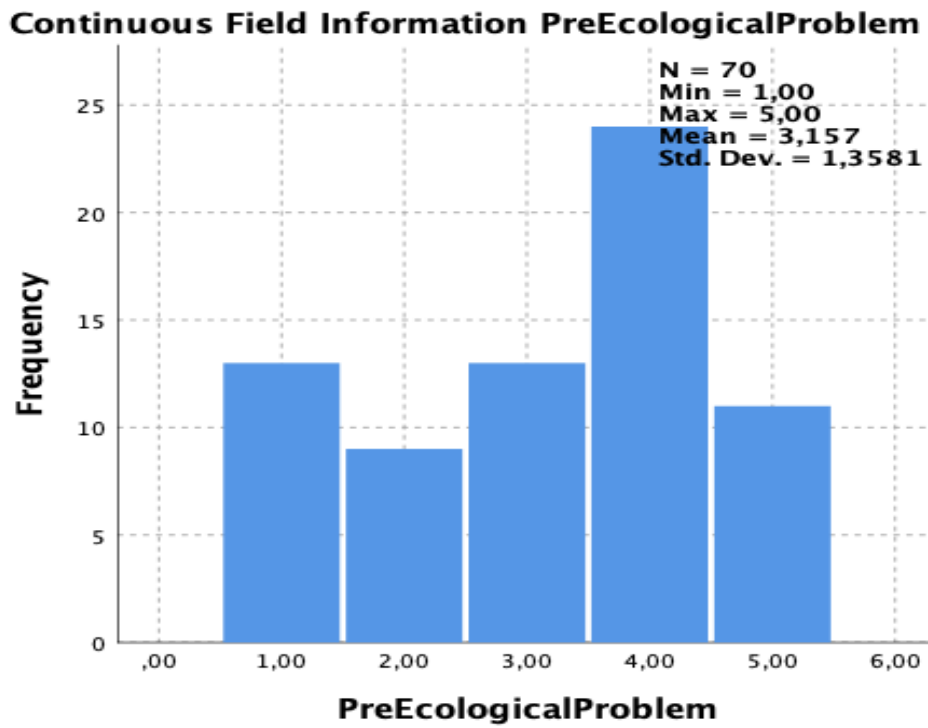
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
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The median of differences between PreTransportation and PostTransportation equals 0.	Related-Samples Wilcoxon Signed Rank Test	,684	Retain the null hypothesis.
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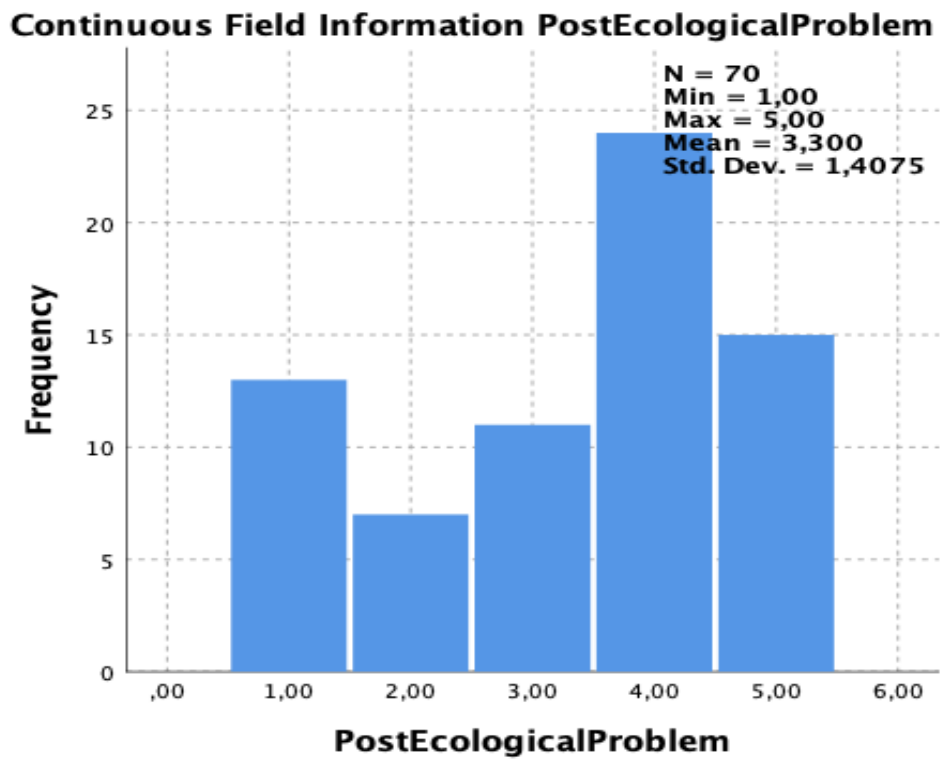
The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there wasn't a rise or downfall in participant's answer regarding their efforts to avoid using cars for transportation.

### **Pre-Ecological Problem vs. Post Ecological Problem**

Participants were requested to rate if they considered that the challenges for the sustainable development were of Ecological nature. The results of the comparison between what they answered before and after the MOOC are presented below.



*Figure 43.* Distribution of the Answers in the Pre-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Ecological Nature



*Figure 44.* Distribution of the Answers in the Post-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Ecological Nature

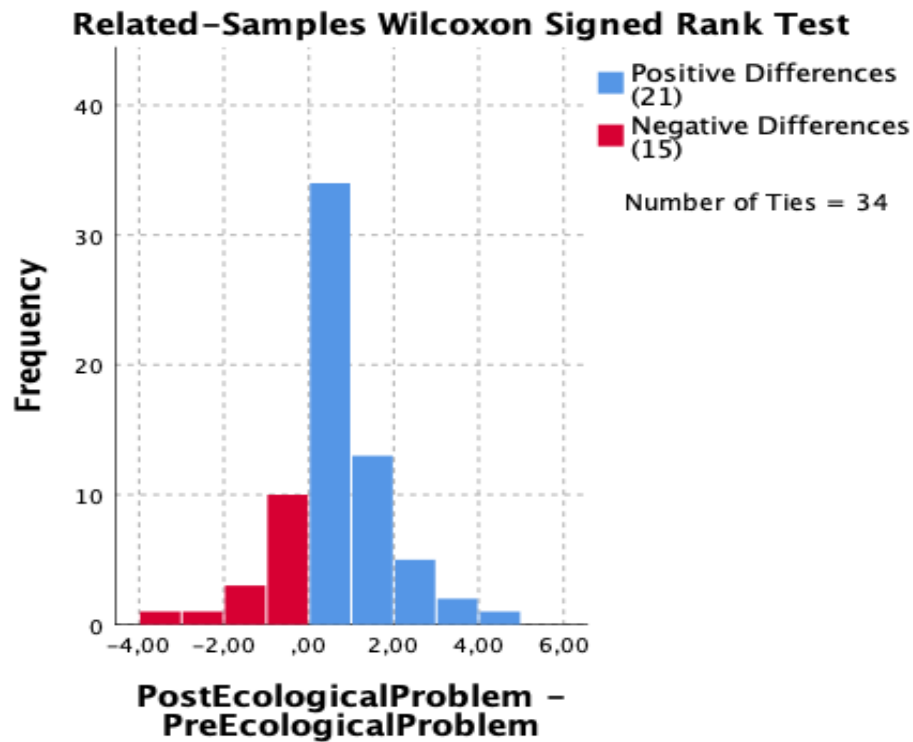


Figure 45. Wilcoxon Signed Rank Test Regarding the Participants Perspective if the challenges for Sustainable Development are of Ecological Nature

Table 124

*Descriptive Statistics for Participants Perspective if the challenges for Sustainable Development are of Ecological Nature– Pre and Pos*

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	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>
PreEcological Problem	70	3,1571	1,35813	1,00

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PostEcological Problem	70	3,3000	1,40754	1,00
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Table 125

*Wilcoxon Signed Rank Test for Participants Perspective if the challenges for Sustainable Development are of Ecological Nature*

		N	Mean Rank	Sum of Ranks
PostEcological	– Negative Ranks	15 <sup>a</sup>	18,07	271,00
PreEcological	Positive Ranks	21 <sup>b</sup>	18,81	395,00
	Ties	34 <sup>c</sup>		
Total		70		

- a. PostEcological < PreEcological
- b. PostEcological > PreEcological
- c. PostEcological = PreEcological

Table 126

*Wilcoxon Signed Rank Result for Participants Perspective if the challenges for Sustainable Development are of Ecological Nature*

	PostEcological – PreEcological
<b>Z</b>	-1,007 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,314

Table 127

*Participants Perspective if the challenges for Sustainable Development are of Ecological Nature Hypothesis*

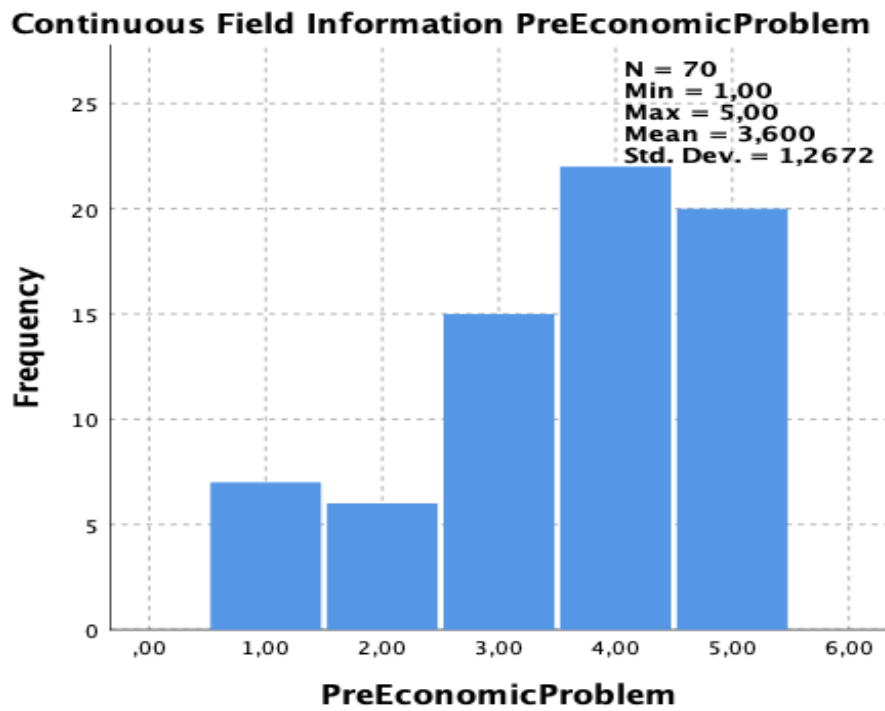


<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreEcologicalProblem and PostEcologicalProblem equals 0.	Related-Samples Wilcoxon Signed Rank Test	,314	Retain the null hypothesis

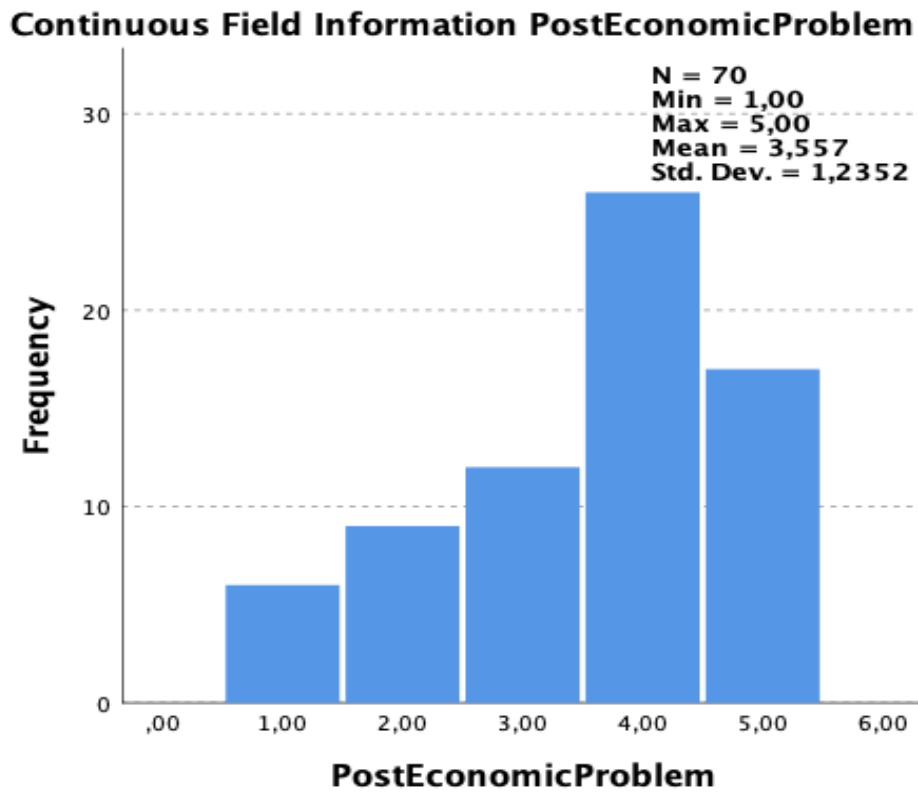
The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there was not a rise or downfall in participant's answer regarding their perspective if the challenge was of ecological nature.

#### **Pre-Economic Problem vs. Post Economic Problem**

Participants were requested to rate if they considered that the challenges for the sustainable development were of Economic nature. The results of the comparison between what they answered before and after the MOOC are presented below.



*Figure 46.* Distribution of the Answers in the Pre-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Economic Nature



*Figure 47.* Distribution of the Answers in the Post-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Economic Nature

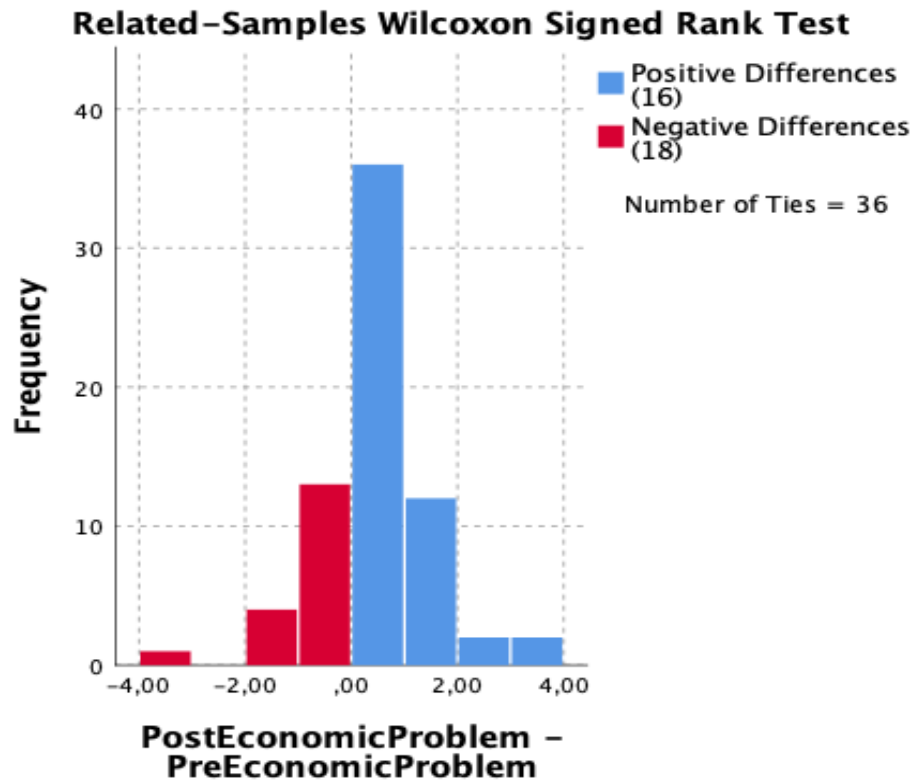


Figure 48. Wilcoxon Signed Rank Test Regarding the Participants Perspective if the challenges for Sustainable Development are of Economic Nature

Table 128

*Descriptive Statistics for Participants Perspective if the challenges for Sustainable Development are of Economic Nature – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreEconomic Problem	70	3,6000	1,26720	1,00	5,00
PostEconomic Problem	70	3,5571	1,23518	1,00	5,00

Table 129

*Wilcoxon Signed Rank Test for Participants Perspective if the challenges for Sustainable Development are of Economic Nature*

		N	Mean Rank	Sum of Ranks
PostEconomic	– Negative Ranks	18 <sup>a</sup>	17,61	317,00
PreEconomic	Positive Ranks	16 <sup>b</sup>	17,38	278,00
	Ties	36 <sup>c</sup>		
	Total	70		

a. PostEconomic < PreEconomic

b. PostEconomic > PreEconomic

c. PostEconomic = PreEconomic

Table 130

*Wilcoxon Signed Rank Result for Participants Perspective if the challenges for Sustainable Development are of Economic Nature*

	PostEconomic – PreEconomic
Z	-,351 <sup>b</sup>
Asymp. Sig. (2-tailed)	,726

Table 131

*Participants Perspective if the challenges for Sustainable Development are of Economic Nature Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PreEconomicProblem and PostEconomicProblem equals 0.	Related-Samples Wilcoxon Signed Rank Test	,726	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what participants answered before and after the MOOC. Thus, we can observe that there wasn't a rise or downfall in participant's answer regarding their perspective if the challenge was of economic nature.

### Pre-Social Problem vs. Post Social Problem

Participants were requested to rate if they considered that the challenges for the sustainable development were of Social nature. The results of the comparison between what they answered before and after the MOOC are presented below.

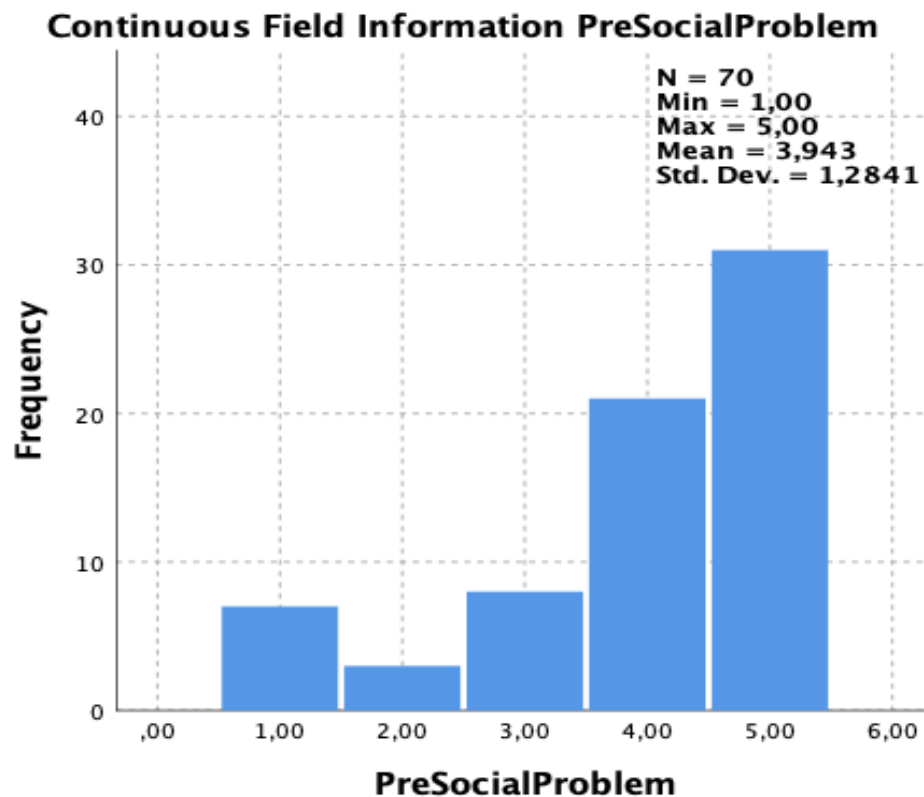


Figure 49. Distribution of the Answers in the Pre-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Social Nature

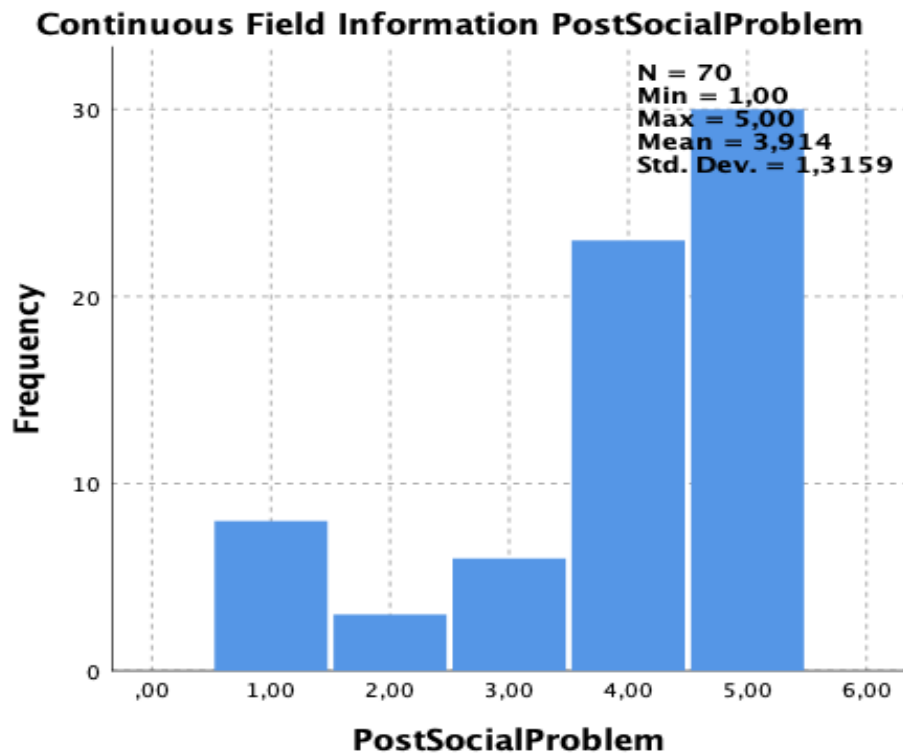


Figure 50. Distribution of the Answers in the Post-MOOC survey regarding Participants Perspective if the challenges for Sustainable Development are of Social Nature

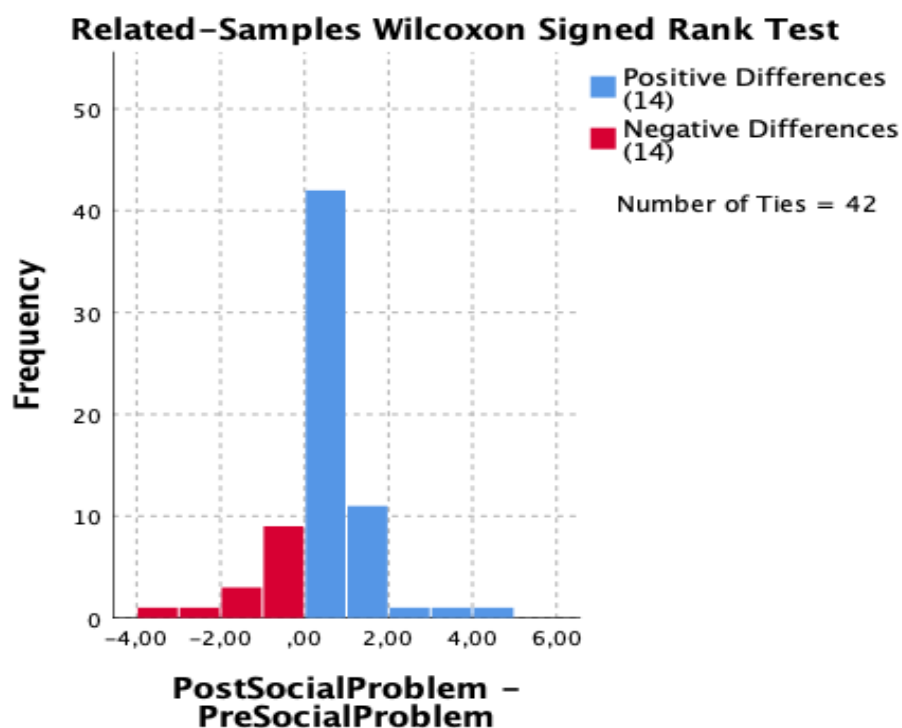


Figure 51. Wilcoxon Signed Rank Test Regarding the Participants Perspective if the challenges for Sustainable Development are of Social Nature

Table 132

*Descriptive Statistics for Participants Perspective if the challenges for Sustainable Development are of Social Nature – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreSocial Problem	70	3,9429	1,28408	1,00	5,00
PostSocial Problem	70	3,9143	1,31593	1,00	5,00

Table 133

*Wilcoxon Signed Rank Test for Participants Perspective if the challenges for Sustainable Development are of Social Nature*

	<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
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<b>PostSocial</b>	<b>– Negative Ranks</b>	14 <sup>a</sup>	15,36	215,00
<b>PreSocial</b>	<b>Positive Ranks</b>	14 <sup>b</sup>	13,64	191,00
	<b>Ties</b>	42 <sup>c</sup>		
	<b>Total</b>	70		

- a. PostSocial Problem < PreSocial Problem
- b. PostSocial Problem > PreSocial Problem
- c. PostSocial Problem = PreSocial Problem

Table 134

*Wilcoxon Signed Rank Result for Participants Perspective if the challenges for Sustainable Development are of Social Nature*

<b>PostSocial Problem – PreSocial Problem</b>	
Z	-,286 <sup>b</sup>
Asymp. Sig. (2-tailed)	,775

Table 135

*Participants Perspective if the challenges for Sustainable Development are of Social Nature Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreSocialProblem and PostSocialProblem equals 0.	Related-Samples Wilcoxon Signed Rank Test	,775	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change from what

participants answered before and after the MOOC. Thus, we can observe that there wasn't a rise or downfall in participant's answer regarding their perspective if the challenge was of social nature.

### **End of Course Survey Results**

Finally, the results obtained from the last instrument in survey format will now be presented. After participants completed the MOOC, they were requested to answer a final survey. This End of the Course survey was designed in such a way that it would be possible to compare if the participant's answers changed significantly before and after they partook in the course, focusing specially on the theme of whether their expectations were met or not.

This end of the course survey was running in all MOOCs and not only the MOOCs that are the subject of analysis in this research. However, just like with the case of the initial demographic survey, results obtained from all MOOCs will be presented first, with the objective of giving context about the feedback that was received for all MOOCs in general. After presenting the results obtained from all the courses, the results obtained from the specific sample that is the objective of this thesis will be presented.

Finally, the Wilcoxon Signed Rank Test will be run to compare the answers specific participants gave in the initial demographic survey and the end of the course survey. The results of these tests in order to determine if there was a significant change or not in the way they replied to the reagents will be presented in order to finish the quantitative portion of results of the present study.

### **Whole Sample Results from the End of the Course Survey**

Table 136

*MOOC the participants signed up to*

<b>Title of the MOOC</b>	<b>Number of participants</b>	<b>Percentage</b>
<b>Energy Saving</b>	50	20.41%
Electric Energy Distribution	24	9.80%
Electric Energy: Basic concepts and principles	27	11.02%
<b>Energy: Past, Present and Future</b>	9	3.67%
<b>Conventional and Clean Energies and Their Technology</b>	20	8.16%
The new electric industry in Mexico	9	3.67%
<b>The Mexican Energy Reform and its Opportunities</b>	4	1.63%
Carbon Markets	28	11.43%
<b>Energy Markets: Business Opportunities</b>	19	7.76%
Smart Grid	43	17.55%
Electric Energy Transmissions	12	4.90%
<b>Total</b>	245	100%

Table 137

*This MOOC satisfied the training needs that led me to enroll*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	0.41%
I disagree	12	4.90%

I neither agree nor disagree	0	0%
I agree	101	41.22%
I strongly agree	131	53.47%
Total	245	100%

Table 138

*This MOOC satisfied my needs for my professional development*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	3	1.22%
I disagree	6	2.45%
I neither agree nor disagree	0	0%
I agree	110	44.90%
I strongly agree	126	51.43%
Total	245	100%

Table 139

*After taking it, I am convinced this MOOC will help me get a better job in the future*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	0.41%
I disagree	26	10.61%
I neither agree nor disagree	0	0%
I agree	128	52.24%
I strongly agree	90	36.73%

Total	245	100%
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Table 140

*This MOOC allowed me to network and create professional relationships with people that have the same interests I do*

Answer	Number of participants	Percentage
I strongly disagree	16	6.53%
I disagree	54	22.04%
I neither agree nor disagree	0	0%
I agree	124	50.61%
I strongly agree	51	20.82%
Total	245	100%

Table 141

*I believe this MOOC positively affected my academic needs*

Answer	Number of participants	Percentage
I strongly disagree	2	0.82%
I disagree	8	3.27%
I neither agree nor disagree	0	0%
I agree	119	48.57%
I strongly agree	116	47.35%
Total	245	100%

Table 142

*I believe I had the necessary perseverance to finish this MOOC successfully*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	2	0.82%
I disagree	12	4.90%
I neither agree nor disagree	0	0%
I agree	115	46.94%
I strongly agree	116	47.35%
Total	245	100%

Table 143

*I believe I had the required abilities (studying, ICT skills) to finish this course successfully*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	0.41%
I disagree	6	2.45%
I neither agree nor disagree	0	0%
I agree	106	43.27%
I strongly agree	132	53.88%
Total	245	100%

Table 144

*After completing this MOOC, I believe I developed my competences even more regarding digital tools that helped me complete this MOOC (understanding of how to use the website,*

*email, and Microsoft Office)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	3	1.22%
I disagree	30	12.24%
I neither agree nor disagree	0	0%
I agree	130	53.06%
I strongly agree	82	33.47%
Total	245	100%

Table 145

*After taking the course, I believe I developed the required competences to deal with the technological platform where the MOOC took place*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	12	4.90%
I neither agree nor disagree	0	0%
I agree	127	51.84%
I strongly agree	106	43.27%
Total	245	100%

Table 146

*After taking this course, I believe I developed the required competences to search for information that was relevant to the topics of this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
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I strongly disagree	1	0.41%
I disagree	7	2.86%
I neither agree nor disagree	0	0%
I agree	130	53.06%
I strongly agree	107	43.67%
Total	245	100%

Table 147

*After taking this course, I was able to use my social media for academic purposes*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	4	1.63%
I disagree	38	15.51%
I neither agree nor disagree	0	0%
I agree	129	52.65%
I strongly agree	74	30.20%
Total	245	100%

Table 148

*After taking this course, I believe I acquired the basic knowledge that was present in the material that was provided in this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	0.41%
I disagree	1	0.41%
I neither agree nor disagree	0	0%



I agree	119	48.57%
I strongly agree	124	50.61%
Total	245	100%

Table 149

*After taking this course, I believe I developed hands on experience in the energy field*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	4	1.63%
I disagree	25	10.20%
I neither agree nor disagree	0	0%
I agree	136	55.51%
I strongly agree	80	32.65%
Total	245	100%

Table 150

*After taking this course, I consider that my knowledge acquired exceeds the knowledge I had at the beginning of the course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	3	1.22%
I disagree	15	6.12%
I neither agree nor disagree	0	0%
I agree	129	52.65%
I strongly agree	98	40.00%

Total	245	100%
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Table 151

*After taking this course, I consider my obtained knowledge will allow me to solve challenges related to at least one subject of the course I enrolled in*

Answer	Number of participants	Percentage
I strongly disagree	1	0.41%
I disagree	5	2.04%
I neither agree nor disagree	0	0%
I agree	139	56.73%
I strongly agree	100	40.82%
Total	245	100%

Table 152

*After taking this course, I consider that my obtained knowledge will allow me to provide innovative solutions to problems related to at least one subject of the course I enrolled in*

Answer	Number of participants	Percentage
I strongly disagree	1	0.41%
I disagree	14	5.71%
I neither agree nor disagree	0	0%
I agree	129	52.65%
I strongly agree	101	41.22%
Total	245	100%

Table 153

*How likely are you to recommend this course to family or colleagues?*

*(0 being definitely not, 10 being highly likely)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
0	2	0.82%
1	0	0%
2	4	1.63%
3	1	0.41%
4	3	1.22%
5	10	4.08%
6	9	3.67%
7	36	14.69%
8	55	22.45%
9	35	14.29%
10	90	36.73%
Total	245	100%

After answering this last question, participants were required to explain the reason behind the grade they given. They were also requested to give three reasons as to why they thought they were able to finish the course successfully. The answers obtained from the participants regarding these open questions will be presented in the qualitative part of this chapter.

Table 154

*Are you willing to be contacted and interviewed for research purposes?*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
Yes, I have no problem being contacted.	160	65.31%
No, I would rather not be contacted	85	34.69%
Total	245	100%

Thus, concludes the results obtained overall for the End of Course survey. Now, the results obtained for the specific sample that is of interest for this research will now be presented. This specific sample is composed uniquely by participants who enrolled in any of the five courses which were selected to be part of this study: Energy Saving, Energy: Past, Present and Future, Conventional and Clean Energies and Their Technology, The Mexican Energy Reform and its Opportunities and Energy Markets: Business Opportunities.

### **Selected Sample Results from the End of the Course Survey**

Table 155

*MOOC the participants had signed up to*

<b>Title of the MOOC</b>	<b>Number of participants</b>	<b>Percentage</b>
Energy Saving	25	39.68%
Energy: Past, Present and Future	6	9.52%
Conventional and Clean Energies and Their Technology	10	15.87%

The Mexican Energy Reform and its Opportunities	12	19.05%
Energy Markets: Business Opportunities	10	15.87%
<b>Total</b>	<b>63</b>	<b>100%</b>

As shown by the previous table, only 63 participants that belong to the selected sample answered the end of the course survey. These participants answered all four instruments and a comparison between what they answered in the initial and the final survey will be presented later. The results obtained directly from this specific sample for the End of Course survey will now be presented.

Table 156

*This MOOC satisfied the training needs that led me to enroll*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	3.17%
I neither agree nor disagree	0	0%
I agree	31	49.21%
I strongly agree	30	47.62%
<b>Total</b>	<b>63</b>	<b>100%</b>

Table 157

*This MOOC satisfied my needs for my professional development*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.59%
I neither agree nor disagree	0	0%
I agree	35	55.56%
I strongly agree	27	42.86%
Total	63	100%

Table 158

*After taking it, I am convinced this MOOC will help me get a better job in the future*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	5	7.94%
I neither agree nor disagree	0	0%
I agree	38	60.32%
I strongly agree	20	31.75%
Total	63	100%

Table 159

*This MOOC allowed me to network with professional relationships that have the same interests I do*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	4	6.35%
I disagree	15	23.81%

I neither agree nor disagree	0	0%
I agree	36	57.14%
I strongly agree	8	12.70%
Total	63	100%

Table 160

*I believe this MOOC positively affected my academic needs*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	1.59%
I disagree	2	3.17%
I neither agree nor disagree	0	0%
I agree	39	61.90%
I strongly agree	21	33.33%
Total	63	100%

Table 161

*I believe I had the necessary perseverance to finish this MOOC successfully*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	3	4.76%
I neither agree nor disagree	0	0%
I agree	35	55.56%
I strongly agree	25	39.68%

Total	63	100%
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Table 162

*I believe I had the required abilities (studying, ICT skills) to finish this course successfully*

Answer	Number of participants	Percentage
I strongly disagree	0	0%
I disagree	2	3.17%
I neither agree nor disagree	0	0%
I agree	27	42.86%
I strongly agree	34	53.97%
Total	63	100%

Table 163

*After completing this MOOC, I believe I developed my competences even more regarding digital tools that helped me complete this MOOC (understanding of how to use the website, email, and Microsoft Office)*

Answer	Number of participants	Percentage
I strongly disagree	0	0%
I disagree	7	11.11%
I neither agree nor disagree	0	0%
I agree	38	60.32%
I strongly agree	18	28.57%
Total	63	100%



Table 164

*After taking the course, I believe I developed the required competences to deal with the technological platform where the MOOC took place*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	3	4.76%
I neither agree nor disagree	0	0%
I agree	36	57.14%
I strongly agree	24	38.10%
Total	63	100%

Table 165

*After taking this course, I believe I developed the required competences to search for information that was relevant to the topics of this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	2	3.17%
I neither agree nor disagree	0	0%
I agree	37	58.73%
I strongly agree	24	38.10%
Total	63	100%

Table 166

*After taking this course, I was able to use my social media for academic purposes*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	1	1.59%
I disagree	7	11.11%
I neither agree nor disagree	0	0%
I agree	38	60.32%
I strongly agree	17	26.98%
Total	63	100%

Table 167

*After taking this course, I believe I acquired the basic knowledge that was present in the material that was provided in this course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	1	1.59%
I neither agree nor disagree	0	0%
I agree	30	47.62%
I strongly agree	32	50.79%
Total	63	100%

Table 168

*After taking this course, I believe I developed hands on experience in the energy field*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%

I disagree	7	11.11%
I neither agree nor disagree	0	0%
I agree	41	65.08%
I strongly agree	15	23.81%
Total	63	100%

Table 169

*After taking this course, I consider that my knowledge acquired exceeds the knowledge I had at the beginning of the course*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	5	7.94%
I neither agree nor disagree	0	0%
I agree	35	55.56%
I strongly agree	23	36.51%
Total	63	100%

Table 170

*After taking this course, I consider my obtained knowledge will allow me to solve challenges related to at least one subject of the course I enrolled in*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%

I disagree	2	3.17%
I neither agree nor disagree	0	0%
I agree	36	57.14%
I strongly agree	25	39.68%
Total	63	100%

Table 171

*After taking this course, I consider that my obtained knowledge will allow me to provide innovative solutions to problems related to at least one subject of the course I enrolled in*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
I strongly disagree	0	0%
I disagree	3	4.76%
I neither agree nor disagree	0	0%
I agree	39	61.90%
I strongly agree	21	33.33%
Total	63	100%

Table 172

*How likely would you recommend this course to family or colleagues?*

*(0 being definitely not, 10 being highly likely)*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
0	0	0%
1	0	0%
2	0	0%

3	1	1.59%
4	0	0%
5	4	6.35%
6	1	1.59%
7	10	15.87%
8	13	20.63%
9	10	15.87%
10	24	38.10%
Total	63	100%

As mentioned before, the answers obtained from the participants regarding the open questions of this survey will be presented in the qualitative part of this chapter.

Table 173

*Are you willing to be contacted and interviewed for research purposes?*

<b>Answer</b>	<b>Number of participants</b>	<b>Percentage</b>
Yes, I have no problem being contacted.	44	69.84%
No, I would rather not be contacted	19	30.1%
Total	63	100%

Thus, concludes the results obtained overall for the End of Course survey for the specific sample that was selected for this research. Next, the Wilcoxon Signed Rank Test will

be run in order to compare what participants answered at the initial demographic survey and the end of the course survey. The results obtained from this study will be presented below.

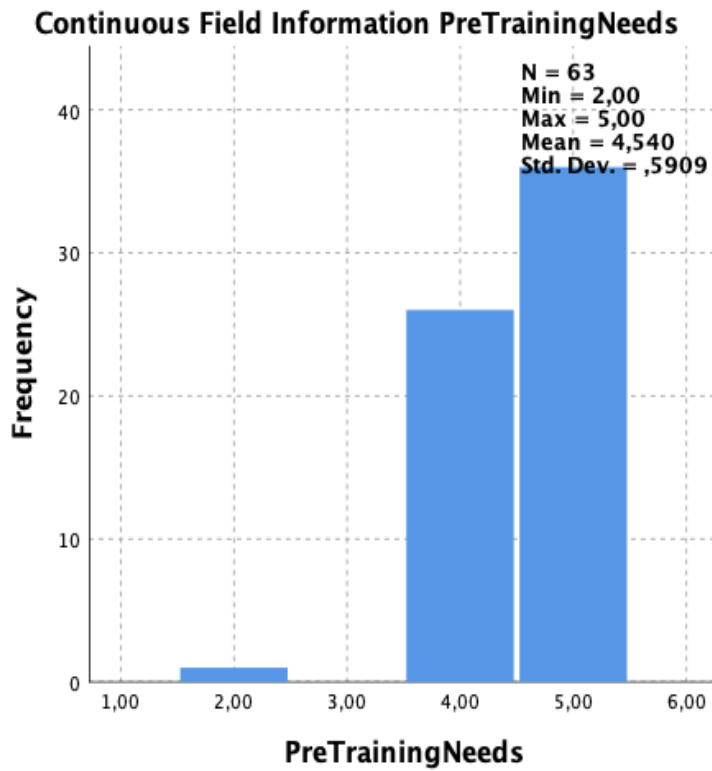
### **Initial and End of Course Pre and Post Survey Results**

Just like with the case of the Pre and Post Education for Sustainable Development surveys, a Related-Sample Wilcoxon Signed Rank Test was run to compare and contrast the answers provided by the participants who answered both the initial demographic survey and the end of course survey, which is the case of 63 participants.

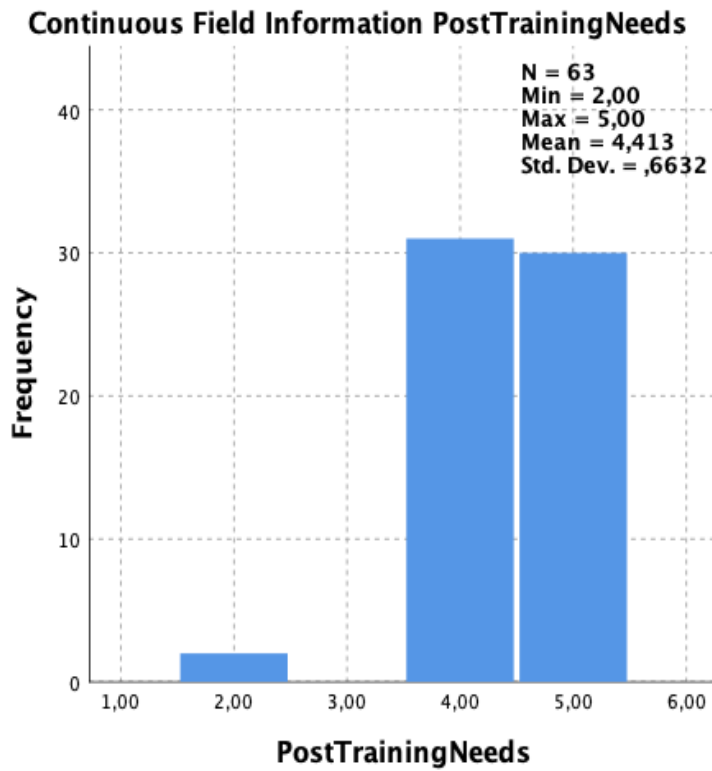
The results obtained will be presented in the following section. First, the frequencies and the differences obtained from each test are illustrated below. Next, a brief descriptive statistics table will be followed by two tables that present the results that were obtained from the Wilcoxon Signed Rank Test for each variable. Finally, the null hypothesis result will be analyzed for each case, followed by a brief description of what the result means.

### **Pre-Training Needs vs. Post Training Needs**

Participants were requested to rate at the beginning of the course if they expected the course to fulfill the training needs that motivated them to enroll to the MOOC in the first place. After the completed the MOOC, participants were asked to rate if their expectation was fulfilled or not. A comparison between these replies was run in order to determine if there was a significant change between their expectations and their final opinion after participating in the MOOC, they enrolled in.



*Figure 52.* Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their Training Needs



*Figure 53.* Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their Training Needs



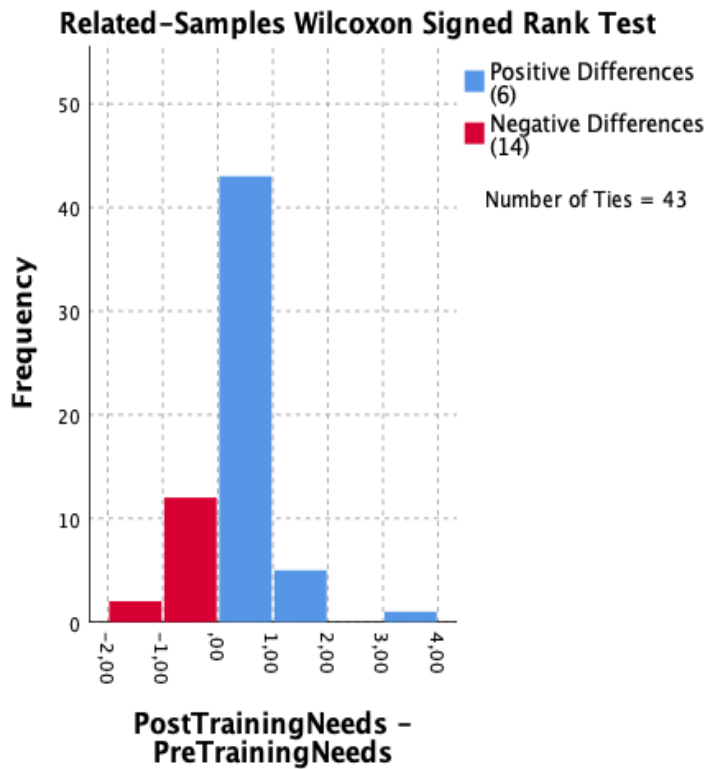


Figure 54. Wilcoxon Signed Rank Test Results regarding the Training Needs of the Participants

Table 174

*Descriptive Statistics for Participant's Training Needs – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreTrainingNeeds	63	4,5392	,59094	2,00	5,00
PostTrainingNeeds	63	4,4127	,66320	2,00	5,00

Table 175

*Wilcoxon Signed Rank Test for “Training Needs of the Participants” Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostTrainingNeeds- PreTrainingNeeds	Negative Ranks	14 <sup>a</sup>	10,36	145,00
	Positive Ranks	6 <sup>b</sup>	10,83	65,00
	Ties	43 <sup>c</sup>		
	Total	63		

a. PostTrainingNeeds < PreTrainingNeeds

b. PostTrainingNeeds > PreTrainingNeeds

c. PostTrainingNeeds = PreTrainingNeeds

Table 176

*Wilcoxon Signed Rank Result for “Training Needs of the Participants” Variable*

<b>PostTrainingNeeds - PreTrainingNeeds</b>	
Z	-1,612 <sup>b</sup>
Asymp. Sig. (2-tailed)	,107

Table 177

*Training Needs of the Participants Hypothesis*

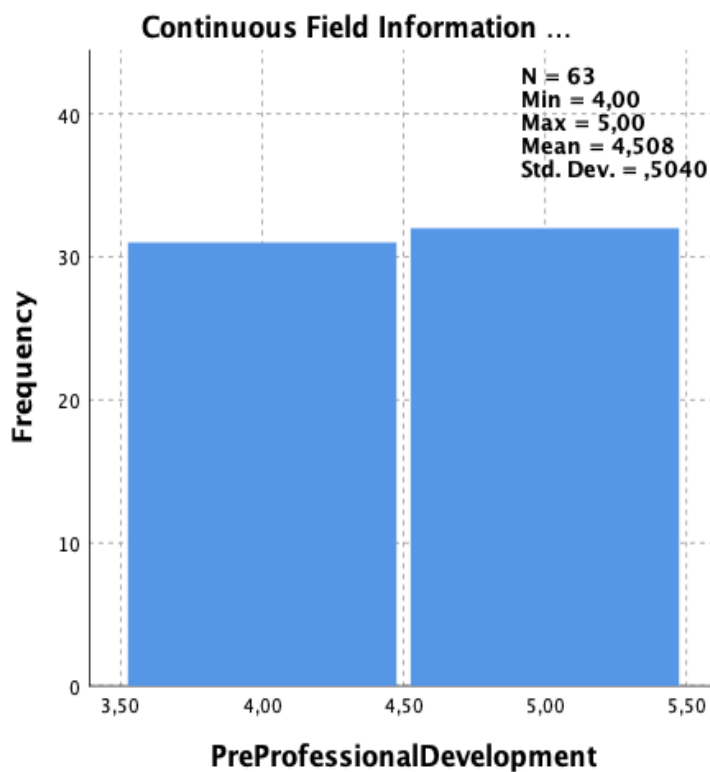
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreTrainingNeeds and PostTrainingNeeds equals 0.	Related-Samples Wilcoxon Signed Rank Test	,107	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change in the participant's

answers between the initial and the end of the course surveys, which means that users graded high expectations and high levels of satisfaction regarding the training they obtained from participating in the MOOC.

### **PreProfessionalDevelopment vs PostProfessionalDevelopment**

Participants were requested to rate at the beginning of the course if they expected the course to have a positive impact in their professional development. After they completed the MOOC, participants were asked to rate if their expectation was fulfilled or not. The results are presented below.



*Figure 55.* Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their Professional Development

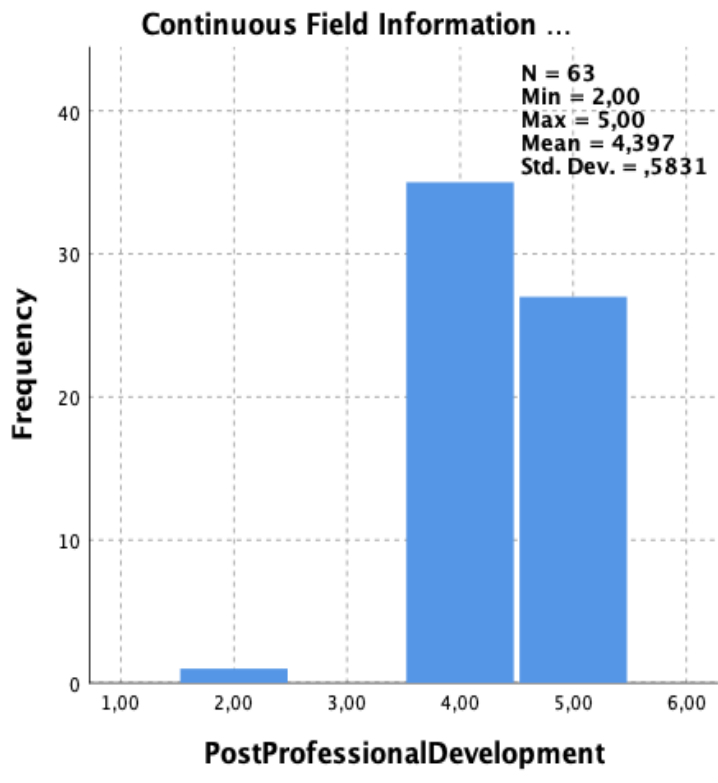


Figure 56. Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their Professional Development

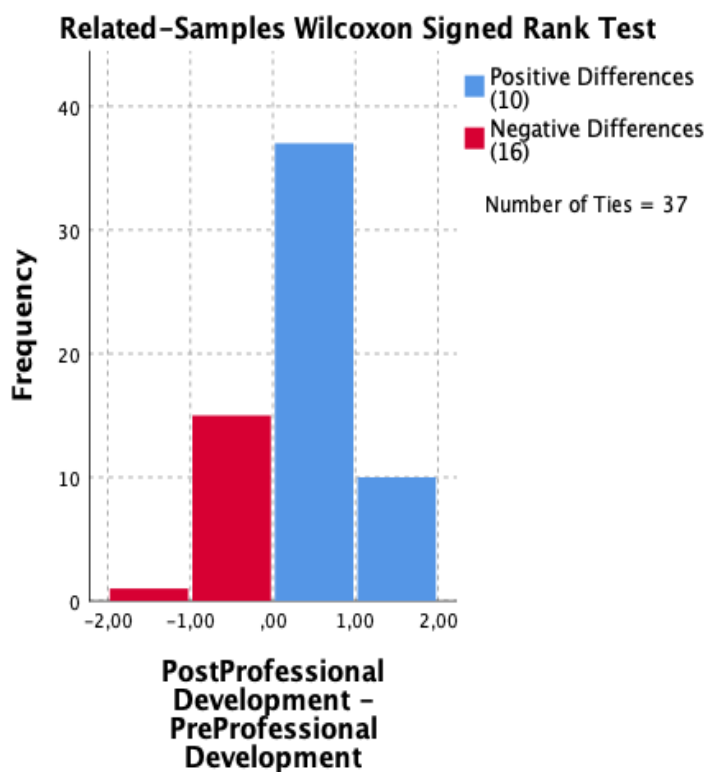


Figure 57. Wilcoxon Signed Rank Test Results regarding the Professional Development of the Participants

Table 178

*Descriptive Statistics for Participant's Professional Development – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreProfessionalDevelopment	63	4,5079	,50395	4,00	5,00
PostProfessionalDevelopment	63	4,3968	,58309	2,00	5,00

Table 179

*Wilcoxon Signed Rank Test for "Participants Professional Development" Variable*

		N	Mean Rank	Sum of Ranks
PostProfessionalDevelopment- PreProfessionalDevelopment	Negative Ranks	16 <sup>a</sup>	13,81	221,00
	Positive Ranks	10 <sup>b</sup>	13,00	130,00

Ties	37 <sup>c</sup>
<b>Total</b>	<b>63</b>

- a. PostProfessionalDevelopment < PreProfessionalDevelopment
- b. PostProfessionalDevelopment > PreProfessionalDevelopment
- c. PostProfessionalDevelopment = PreProfessionalDevelopment

Table 180

*Wilcoxon Signed Rank Result for “Participants Professional Development” Variable*

<b>PostProfessionalDevelopment - PreProfessionalDevelopment</b>	
Z	-1,300 <sup>b</sup>
Asymp. Sig. (2-tailed)	,194

Table 181

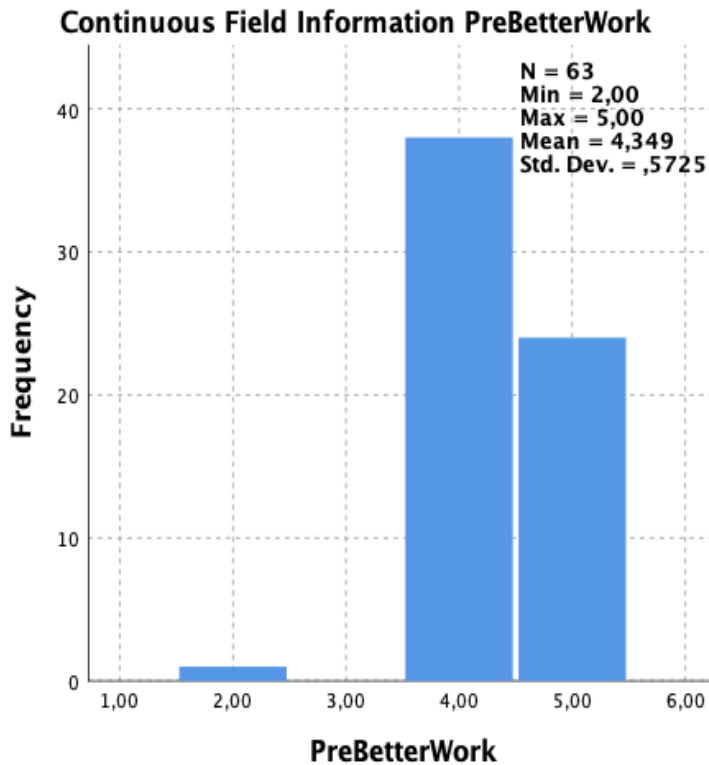
*Training Needs of the Participants Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreProfessionalDevelopment and PostProfessionalDevelopment equals 0.	Related-Samples Wilcoxon Signed Rank Test	,194	Retain the null hypothesis.

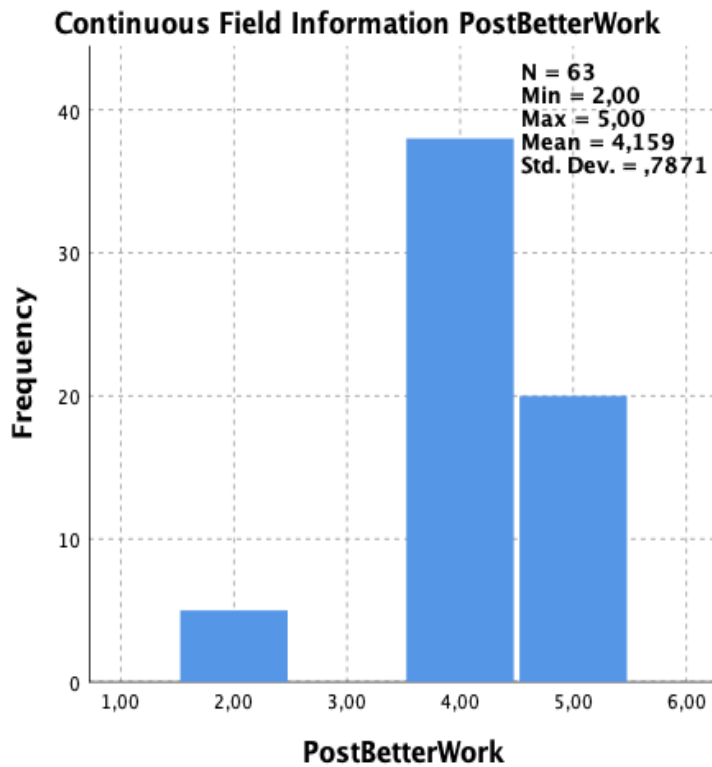
The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change in the participant's answers between the initial and the end of the course surveys, which means that users graded high expectations and high levels of satisfaction regarding the professional development they obtained from participating in the MOOC.

## Pre Better Work vs. Post Better Work

Participants were requested to rate at the beginning of the course if they expected the course to help them get a better job after they completed the course. After they completed the MOOC, participants were asked to rate if their expectation was fulfilled or not. The results are presented below.



*Figure 58.* Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their possibility of getting a better job after taking the course



*Figure 59.* Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their possibility of getting a better job after taking the course



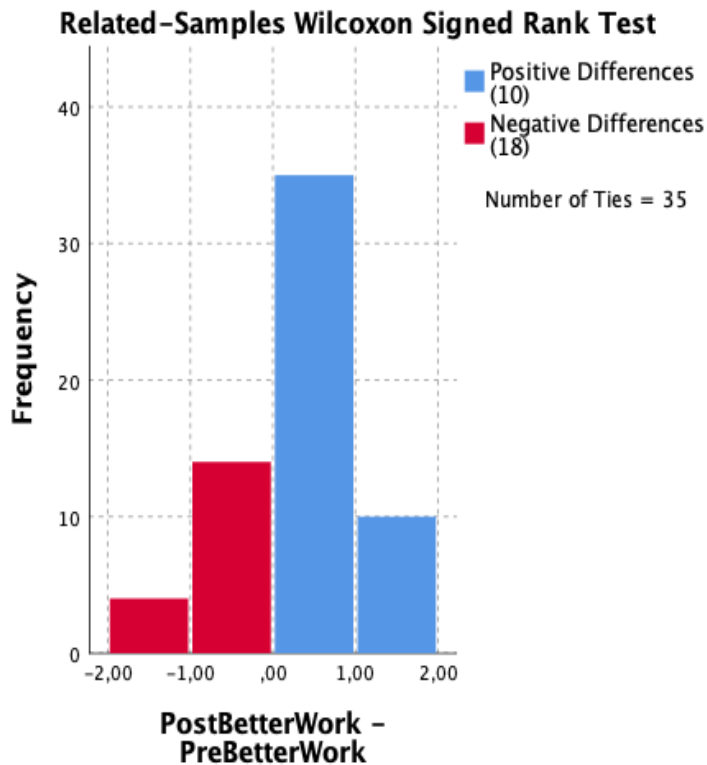


Figure 60. Wilcoxon Signed Rank Test Results regarding their possibility of getting a better job after taking the course

Table 182

*Descriptive Statistics for Participant's Expectations for Getting a Better Work Opportunity after the MOOC– Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreBetterWork	63	4,3492	,57245	2,00	5,00
PostBetterWork	63	4,1587	,78712	2,00	5,00

Table 183

*Wilcoxon Signed Rank Test for "Participant's Expectations for Getting a Better Work Opportunity after the MOOC" Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostBetterWork-	<b>Negative Ranks</b>	18 <sup>a</sup>	15,61	281,00
PreBetterWork	<b>Positive Ranks</b>	10 <sup>b</sup>	12,50	125,00
	<b>Ties</b>	35 <sup>c</sup>		
	<b>Total</b>	63		

- a. PostBetterWork < PreBetterWork
- b. PostBetterWork > PreBetterWork
- c. PostBetterWork = PreBetterWork

Table 184

*Wilcoxon Signed Rank Result for “Participant’s Expectations for Getting a Better Work Opportunity after the MOOC” Variable*

	<b>PostBetterWork - PreBetterWork</b>
Z	-1,926 <sup>b</sup>
Asymp. Sig. (2-tailed)	,054

Table 185

*Training Needs of the Participants Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreBetterWork and PostBetterWork equals 0.	Related-Samples Wilcoxon Signed Rank Test	,054	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *wasn't* a significant change in the participant’s answers between the initial and the end of the course surveys, which means that users graded

high expectations and high levels of satisfaction regarding the possibility of finding a better job after participating in the MOOC.

### Pre Professional Networking vs Post Professional Networking

Participants were requested to rate at the beginning of the course if they expected the course to give them opportunities of making network connections with professionals who had similar interests to their own. After they completed the MOOC, participants were asked to rate if their expectation was fulfilled or not. The results are presented below.

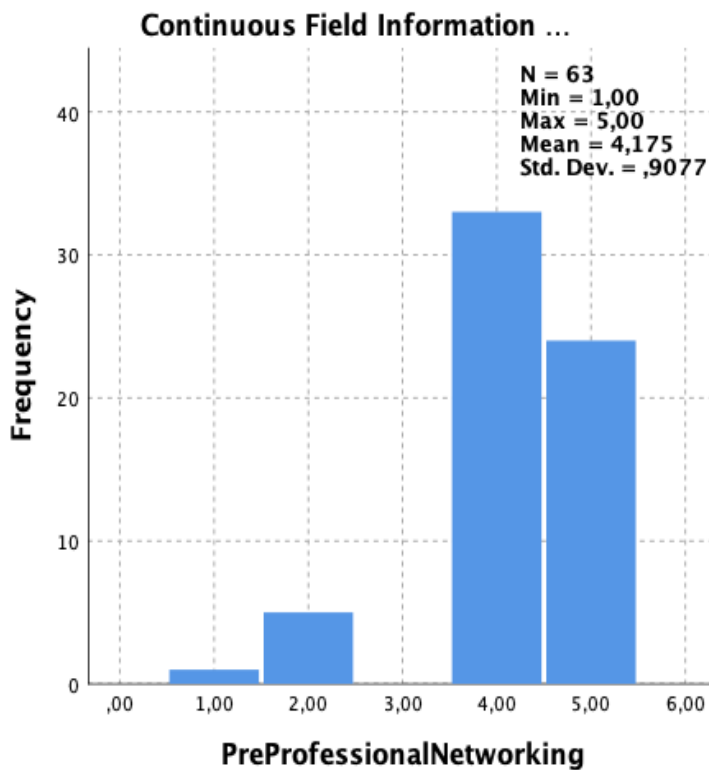
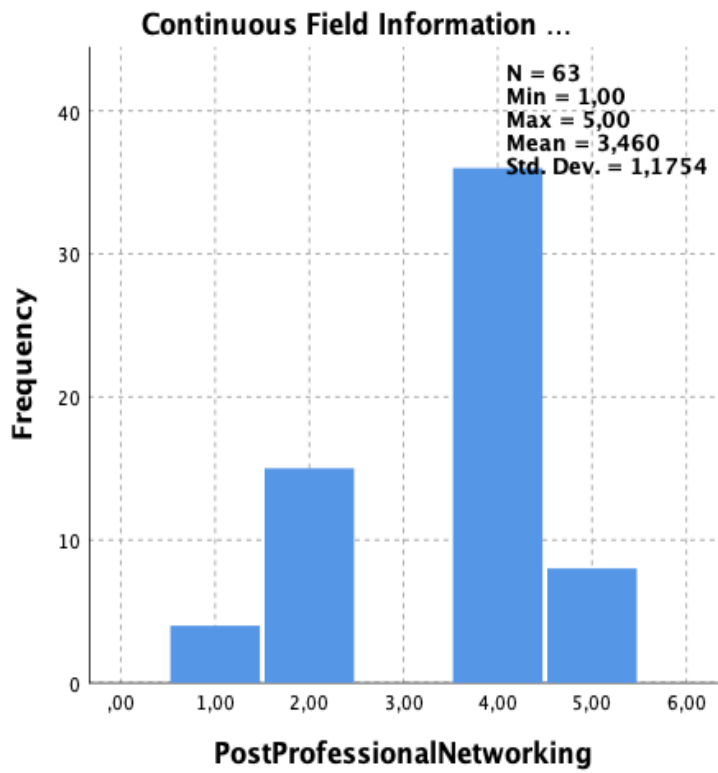


Figure 61. Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their possibility of making professional networking in the course



*Figure 62.* Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their possibility of making professional networking in the course

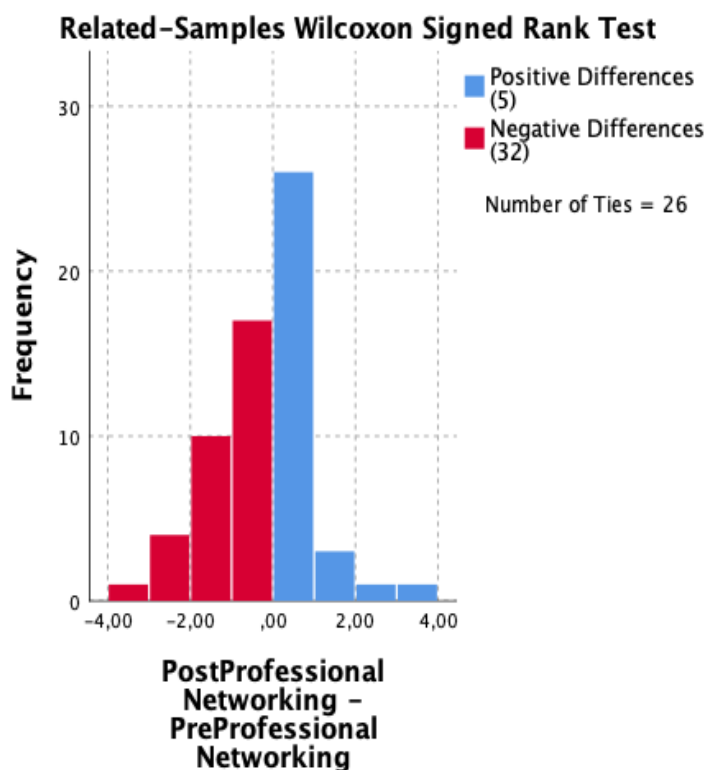


Figure 63. Wilcoxon Signed Rank Test Results regarding their possibility of making professional networking in the course

Table 186

Descriptive Statistics for Participant's Expectations about their possibility of making professional networking in the course– Pre and Post

	N	Mean	Std. Deviation	Minimum	Maximum
PreProfessionalNetworking	63	4,1746	,90767	1,00	5,00
PostProfessionalNetworking	63	3,4603	1,17536	1,00	5,00

Table 187

Wilcoxon Signed Rank Test for "Participant's Possibility for making professional networking in the course" Variable

		N	Mean Rank	Sum of Ranks
PostProfessionalNetworking	Negative Ranks	32 <sup>a</sup>	19,11	611,50
-PreProfessionalNetworking	Positive Ranks	5 <sup>b</sup>	18,30	91,50
	Ties	26 <sup>c</sup>		
	Total	63		

- a. PostProfessionalNetworking < PreProfessionalNetworking
- b. PostProfessionalNetworking > PreProfessionalNetworking
- c. PostProfessionalNetworking = PreProfessionalNetworking

Table 188

*Wilcoxon Signed Rank Result for “Participant’s Possibility for making professional networking in the course” Variable*

	PostProfessionalNetworking - PreProfessionalNetworking
<b>Z</b>	-4,013 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,000

Table 189

*Training Needs of the Participants Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PreProfessionalNetworking and PostProfessionalNetworking equals 0.	Related-Samples Wilcoxon Signed Rank Test	,000	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we retain the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can

see that users answered with 32 negative differences comparing their replies from their expectations and their level of satisfaction. This means that although users might've set very high expectations on being able to network with professional during the course, this expectation wasn't fulfilled for a lot of participants.

### Pre Academic Formation vs. Post Academic Formation

Participants were requested to rate at the beginning of the course if they expected the course to help them have a better academic formation after completing the course. After they completed the MOOC, participants were asked to rate if their expectation was fulfilled or not.

The results are presented below.

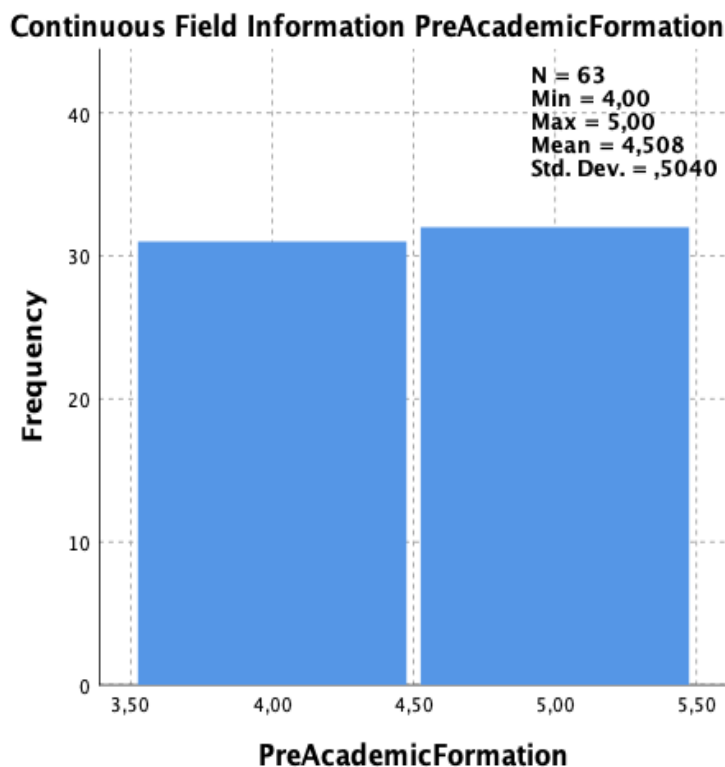


Figure 64. Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their academic formation growth

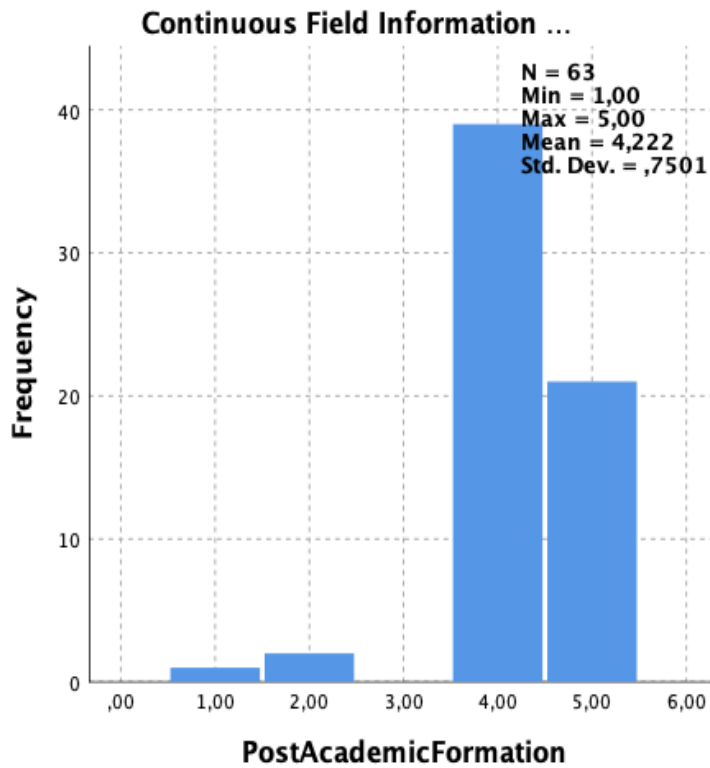


Figure 65. Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their academic formation growth



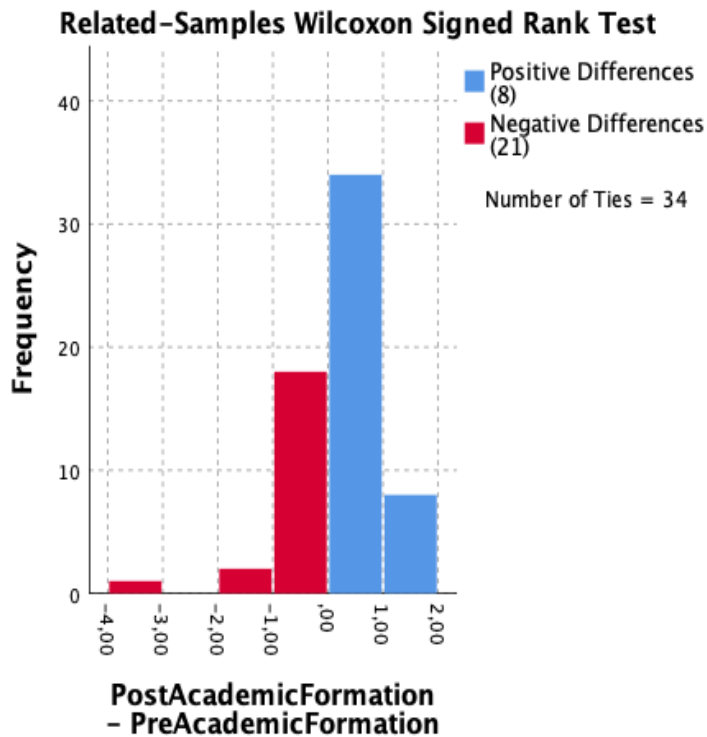


Figure 66. Wilcoxon Signed Rank Test Results regarding participants academic formation

Table 190

*Descriptive Statistics for Participants Academic Formation– Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreAcademic Formation	63	4,5079	,50395	4,00	5,00
PostAcademic Formation	63	4,2222	,75015	1,00	5,00

Table 191

*Wilcoxon Signed Rank Test for “Participants Academic Formation” Variable*

	<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostAcademic Formation- Negative Ranks	21 <sup>a</sup>	15,57	327,00
PreAcademic Formation Positive Ranks	8 <sup>b</sup>	13,50	108,00
Ties	34 <sup>c</sup>		
Total	63		

- a. PostAcademic Formation < PreAcademic Formation
- b. PostAcademic Formation > PreAcademic Formation
- c. PostAcademic Formation = PreAcademic Formation

Table 192

*Wilcoxon Signed Rank Result for “Participants Academic Formation” Variable*

PostAcademicFormation – PreAcademicFormation	
Z	-2,601 <sup>b</sup>
Asymp. Sig. (2-tailed)	,009

Table 193

*Participants Academic Formation Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PreAcademicFormation and PostAcademicFormation equals 0.	Related-Samples Wilcoxon Signed Rank Test	,009	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we retain the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can see that users answered with 21 negative differences comparing their replies from their expectations and their level of satisfaction. At the initial survey, all users answered with very high expectations, however a lot of these expectations were not met at the end of the course.

## PrePerseverance vs. PostPerseverance

Participants were requested to rate at the beginning of the course if they thought they had enough perseverance to finish the course they signed up to successfully. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.

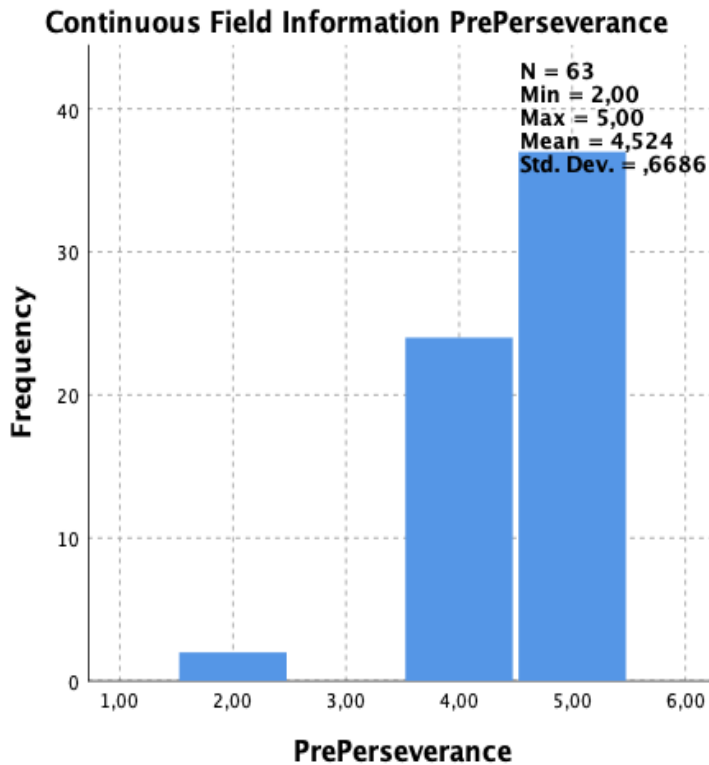
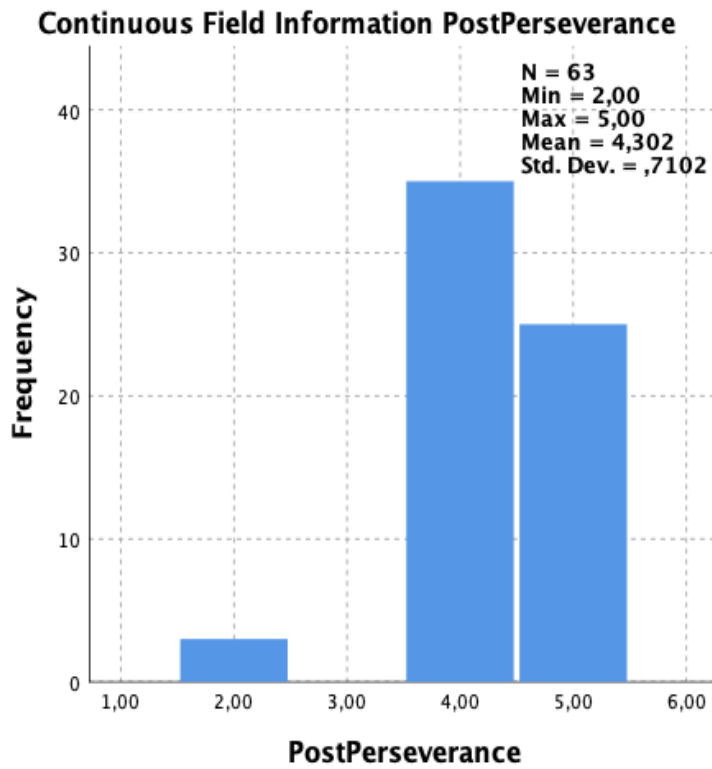


Figure 67. Distribution of the Answers in the Initial Demographic survey regarding Participant's Expectations regarding their perseverance helping them finish the MOOC



*Figure 68.* Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding their perseverance helping them finish the MOOC

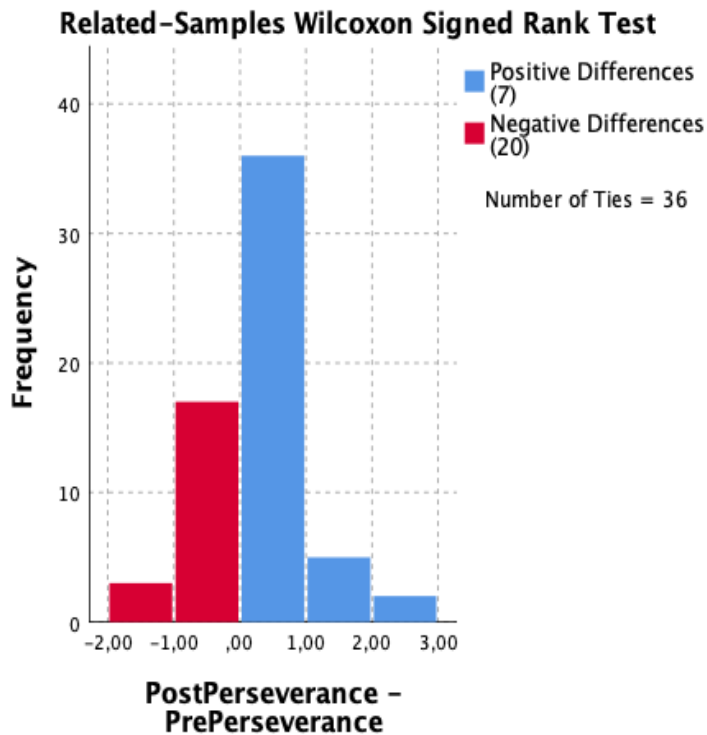


Figure 69. Wilcoxon Signed Rank Test Results regarding participants perseverance helping them finish the MOOC

Table 194

*Descriptive Statistics for Participants Perseverance– Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PrePerseverance	63	4,5238	,66858	2,00	5,00
PostPerseverance	63	4,3016	,71018	2,00	5,00

Table 195

*Wilcoxon Signed Rank Test for “Participants Perseverance” Variable*

	N	Mean Rank	Sum of Ranks
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PostPerseverance	- Negative Ranks	20 <sup>a</sup>	13,53	270,50
PrePerseverance	Positive Ranks	7 <sup>b</sup>	15,36	107,50
	Ties	36 <sup>c</sup>		
	Total	63		

a. PostPerseverance < PrePerseverance

b. PostPerseverance > PrePerseverance

c. PostPerseverance = PrePerseverance

Table 196

*Wilcoxon Signed Rank Result for “Participants Perseverance” Variable*

PostPerseverance – PrePerseverance	
Z	-2,098 <sup>b</sup>
Asymp. Sig. (2-tailed)	,036

Table 197

*Participants Academic Formation Hypothesis*

Null Hypothesis	Test	Sig.	Decision
The median of differences between PrePerseverance and PostPerseverance equals 0.	Related-Samples Wilcoxon Signed Rank Test	,036	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we retain the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can see that users answered with 20 negative differences.

## Pre ICT Skills vs. Post ICT Skills

Participants were requested to rate at the beginning of the course if they thought they had enough ICT skills to complete the MOOC successfully. These ICT skills were defined as word processing, the use of spreadsheets, databases, creation of presentations and use of search engines. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.

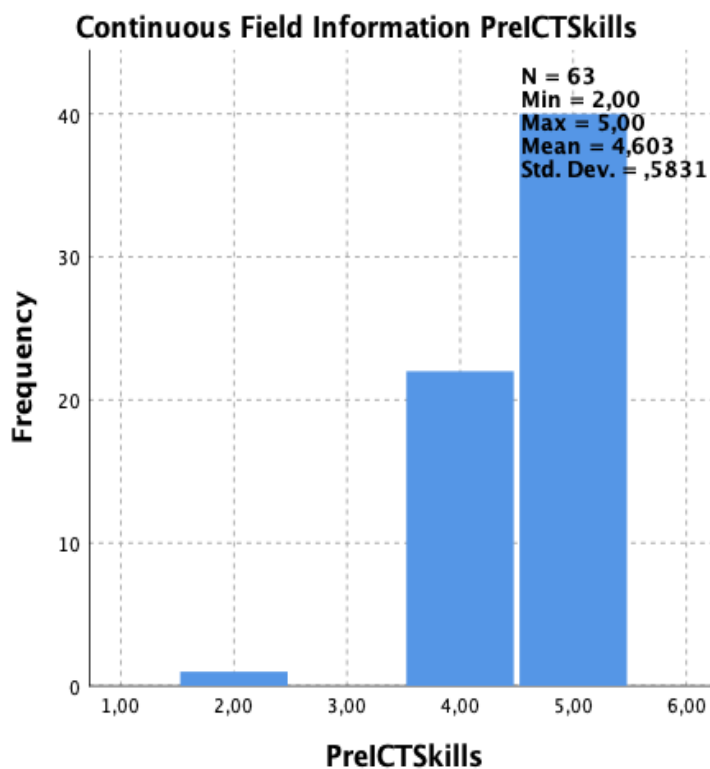
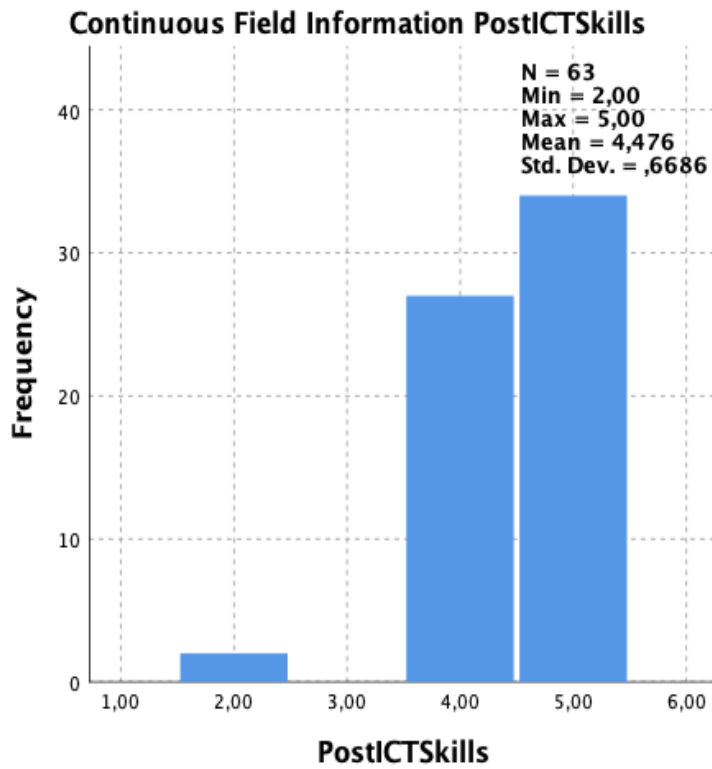


Figure 70. Distribution of the Answers in the Initial Demographic survey regarding Users ICT Skills



*Figure 71.* Distribution of the Answers in the End of the Course survey regarding Participant's Satisfaction regarding Users ICT Skills



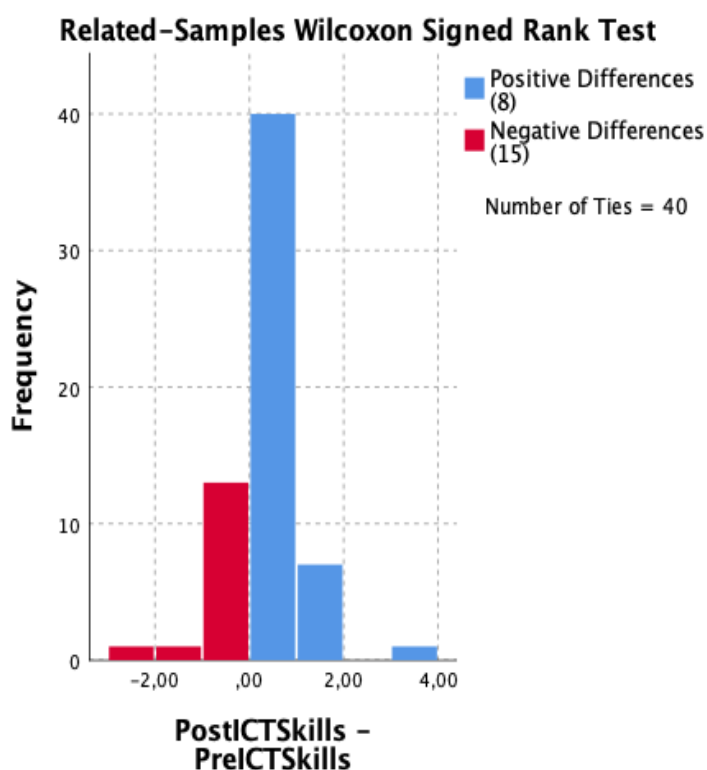


Figure 72. Wilcoxon Signed Rank Test Results regarding Users ICT Skills

Table 198

*Descriptive Statistics for Users ICT Skills – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreICTSkills	63	4,6032	,58309	2,00	5,00
PostICTSkills	63	4,4762	,66858	2,00	5,00

Table 199

*Wilcoxon Signed Rank Test for “Users ICT Skills” Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostICTSkills	- Negative Ranks	15 <sup>a</sup>	12,00	180,00
PreICTSkills	Positive Ranks	8 <sup>b</sup>	12,00	96,00
	Ties	40 <sup>c</sup>		
	Total	63		

- a. PostICTSkills < PreICTSkills
- b. PostICTSkills > PreICTSkills
- c. PostICTSkills = PreICTSkills

Table 200

*Wilcoxon Signed Rank Result for “Users ICT Skills” Variable*

	<b>PostICTSkills – PreICTSkills</b>
<b>Z</b>	-1,389 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,165

Table 201

*Users ICT Skills Hypothesis*

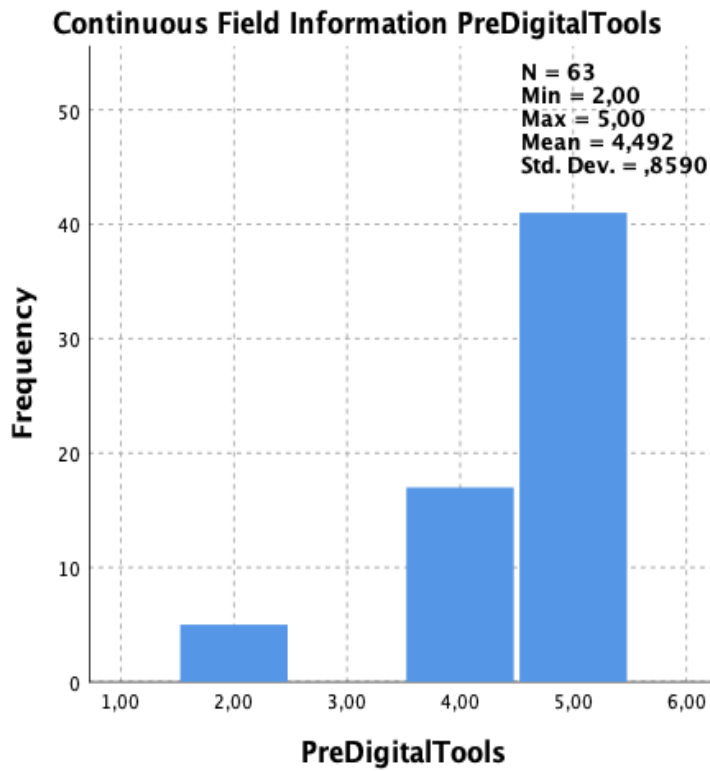
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreICTSkills and PostICTSkills equals 0.	Related-Samples Wilcoxon Signed Rank Test	,165	Reject the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we reject the null hypothesis, meaning that there *wasn't* a significant change in the participant's answers between the initial and the end of the course surveys. Observing the result, we can see there were 40 ties between the pre and post results.

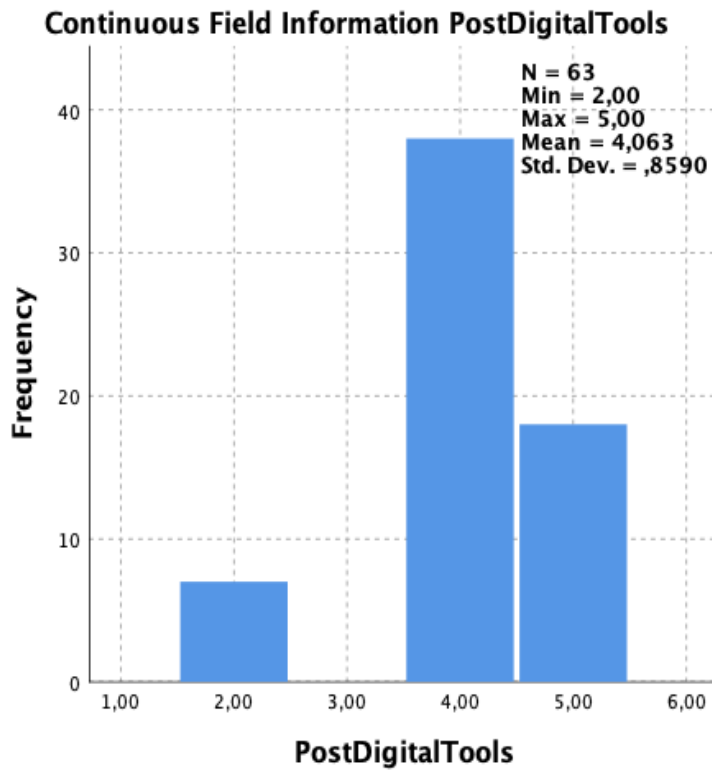
### **Pre-Digital Tools vs. Post Digital Tools**

Participants were requested to rate at the beginning of the course if they thought they had enough knowledge regarding digital tools to finish the course they signed up to

successfully. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.



*Figure 73.* Distribution of the Answers in the Initial Demographic survey regarding Users Digital Tools Knowledge



*Figure 74.* Distribution of the Answers in the End of the Course survey regarding Users Digital Tools Knowledge after the MOOC

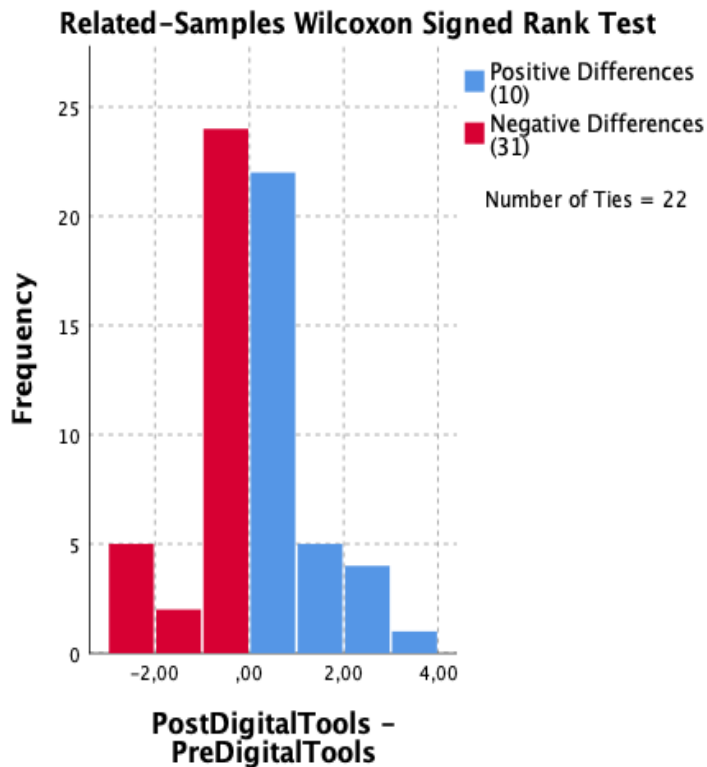


Figure 75. Wilcoxon Signed Rank Test Results regarding Users Digital Tools Knowledge

Table 202

Descriptive Statistics for Users Digital Tools Knowledge – Pre and Post

	N	Mean	Std. Deviation	Minimum	Maximum
PreDigitalTools	63	4,4921	,85898	2,00	5,00
PostDigitalTools	63	4,0635	,85898	2,00	5,00

Table 203

Wilcoxon Signed Rank Test for “Users Digital Tools Knowledge” Variable

	N	Mean Rank	Sum of Ranks
PostDigitalTools - Negative Ranks	31 <sup>a</sup>	19,92	617,50
PreDigitalTools Positive Ranks	10 <sup>b</sup>	24,35	243,50
Ties	22 <sup>c</sup>		
Total	63		

- a. PostDigitalTools < PreDigitalTools
- b. PostDigitalTools > PreDigitalTools
- c. PostDigitalTools = PreDigitalTools

Table 204

*Wilcoxon Signed Rank Result for “Users Digital Tools Knowledge” Variable*

<b>PostDigitalTools – PreDigitalTools</b>	
Z	-2,536 <sup>b</sup>
Asymp. Sig. (2-tailed)	,011

Table 205

*Users Digital Tools Knowledge Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreDigitalTools and PostDigitalTools equals 0.	Related-Samples Wilcoxon Signed Rank Test	,011	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can see there were 31 negative differences when comparing what participants replied in the initial and the end of course surveys.

## PreTechnological Platform vs. PostTechnological Platform

Participants were requested to rate at the beginning of the course if they thought they had enough knowledge regarding technological platforms to finish the course they signed up to successfully. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.

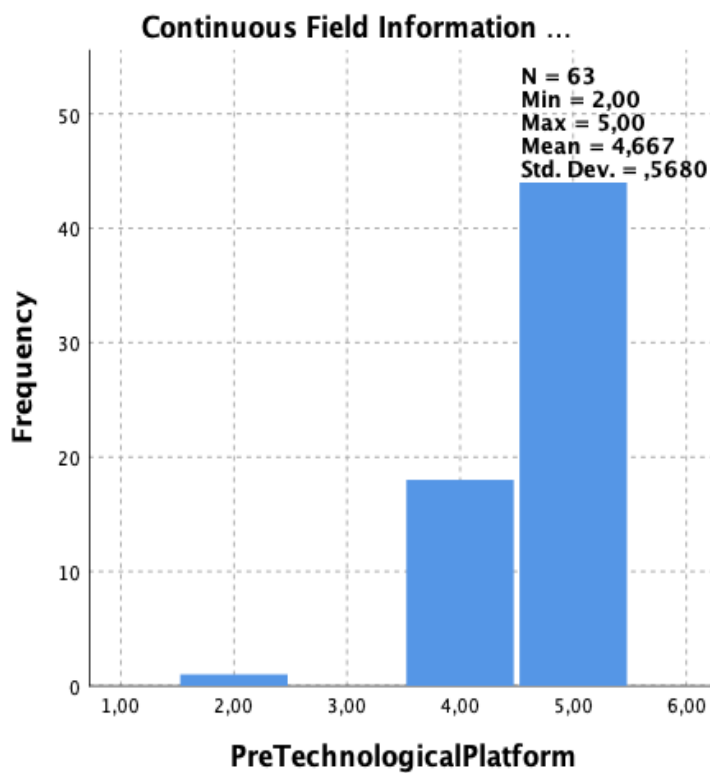


Figure 76. Distribution of the Answers in the Initial Demographic survey regarding Users Knowledge Regarding Technological Platforms

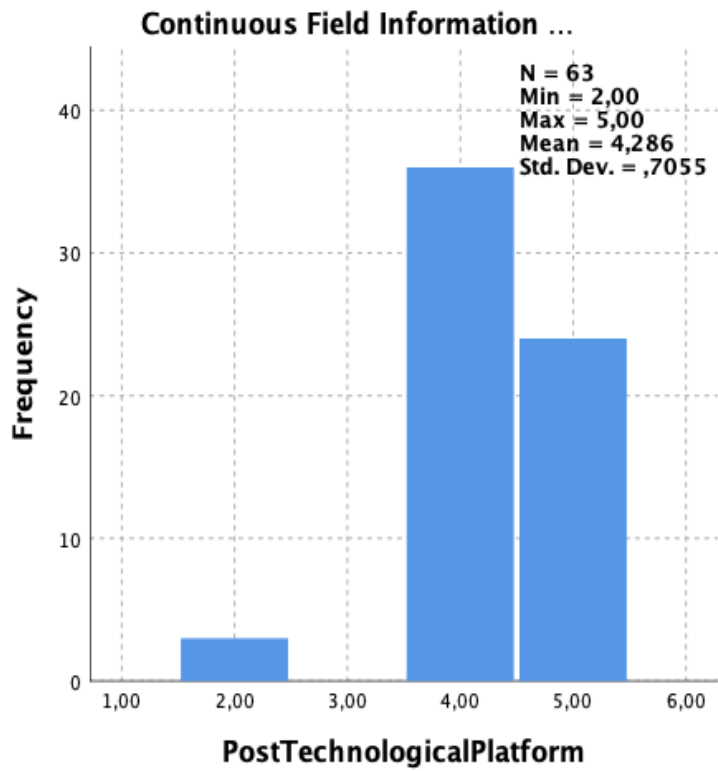


Figure 77. Distribution of the Answers in the End of the Course survey regarding Users Knowledge Regarding Technological Platforms



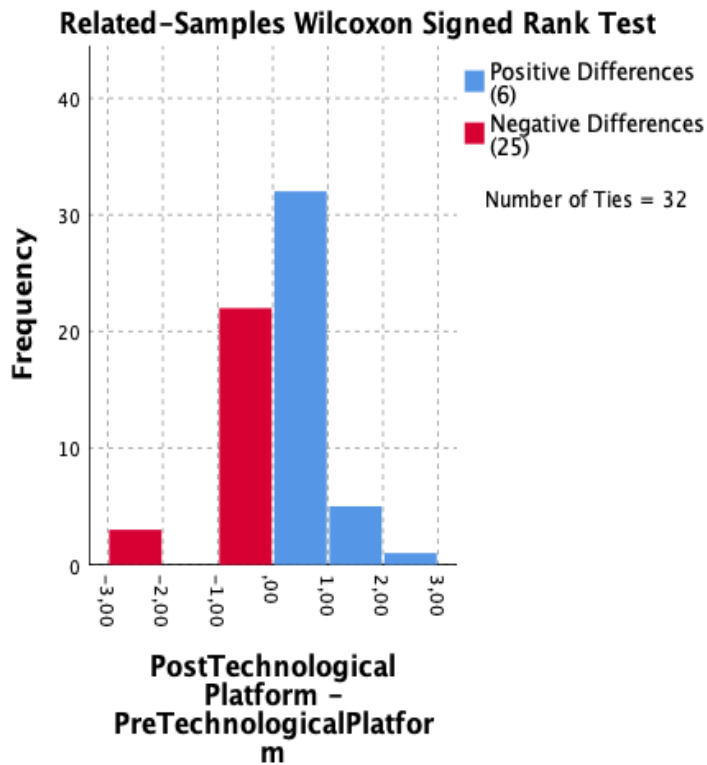


Figure 78. Wilcoxon Signed Rank Test Results regarding Users Knowledge Regarding Technological Platforms

Table 206

Descriptive Statistics for Users Knowledge Regarding Technological Platforms– Pre and Post

	N	Mean	Std. Deviation	Minimum	Maximum
PreTechnological Platform	63	4,6667	,56796	2,00	5,00
PostTechnological Platform	63	4,2857	,70548	2,00	5,00

Table 207

Wilcoxon Signed Rank Test for “Users Knowledge Regarding Technological Platforms” Variable

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostTechnological Platform	Negative Ranks	25 <sup>a</sup>	15,92	398,00
PreTechnological Platform	- Positive Ranks	6 <sup>b</sup>	16,33	98,00
	Ties	32 <sup>c</sup>		
	Total	63		

- a. PostTechnological Platform < PreTechnological Platform
- b. PostTechnological Platform > PreTechnological Platform
- c. PostTechnological Platform = PreTechnological Platform

Table 208

*Wilcoxon Signed Rank Result for “Users Knowledge Regarding Technological Platforms”*

*Variable*

<b>PostTechnological Platform – PreTechnological Platform</b>	
Z	-3,202 <sup>b</sup>
Asymp. Sig. (2-tailed)	,001

Table 209

*Users Digital Tools Knowledge Hypothesis*

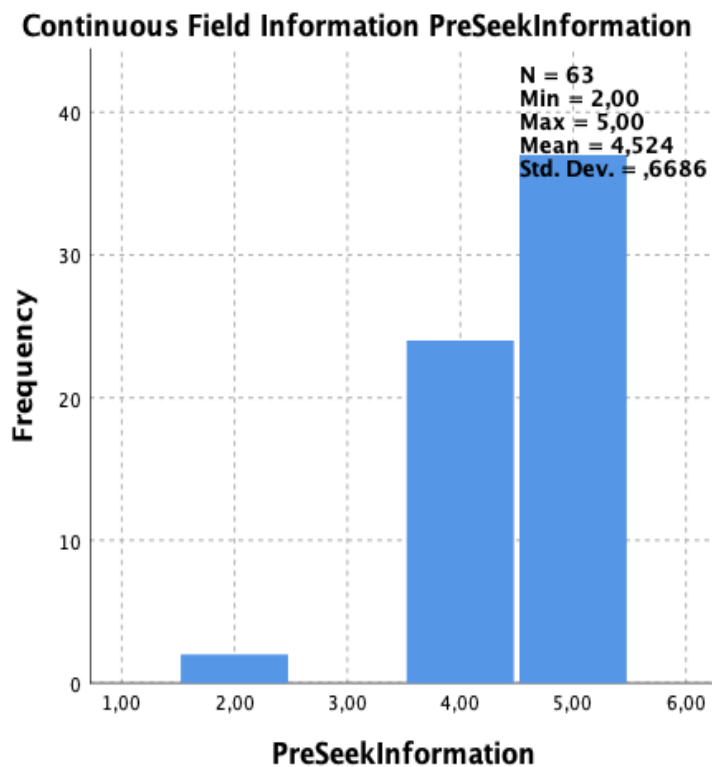
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreTechnologicalPlatform and PostTechnologicalPlatform equals 0.	Related-Samples Wilcoxon Signed Rank Test	,001	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can

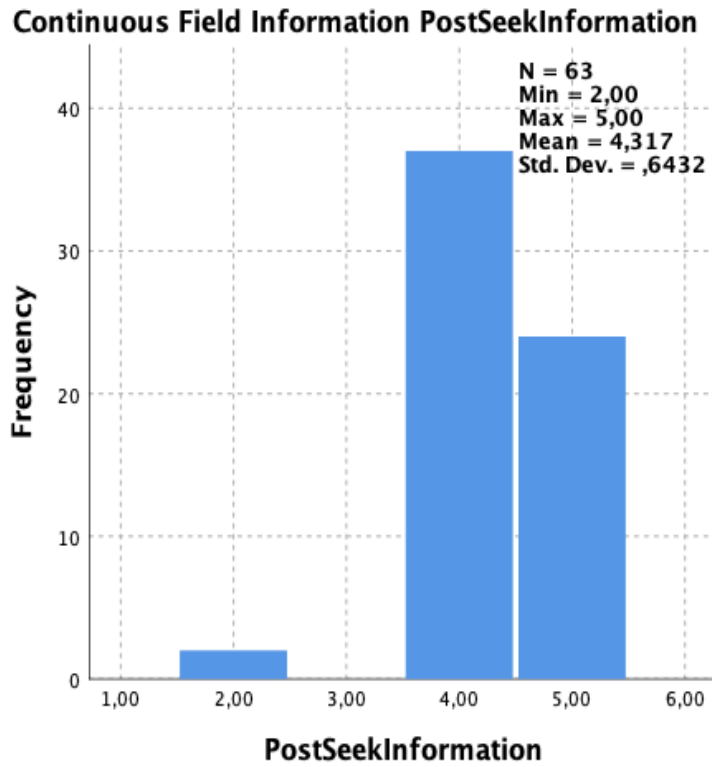
see there were 25 negative differences when comparing what participants replied in the initial and the end of course surveys.

### **PreSeek Information vs. PostSeek Information**

Participants were requested to rate at the beginning of the course if they thought they had enough experience and skills to seek information that was relevant to a topic in the course they enrolled in. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.



*Figure 79.* Distribution of the Answers in the Initial Demographic survey regarding Users Experience Seeking Information



*Figure 80.* Distribution of the Answers in the End of the Course survey regarding Users Experience Seeking Information

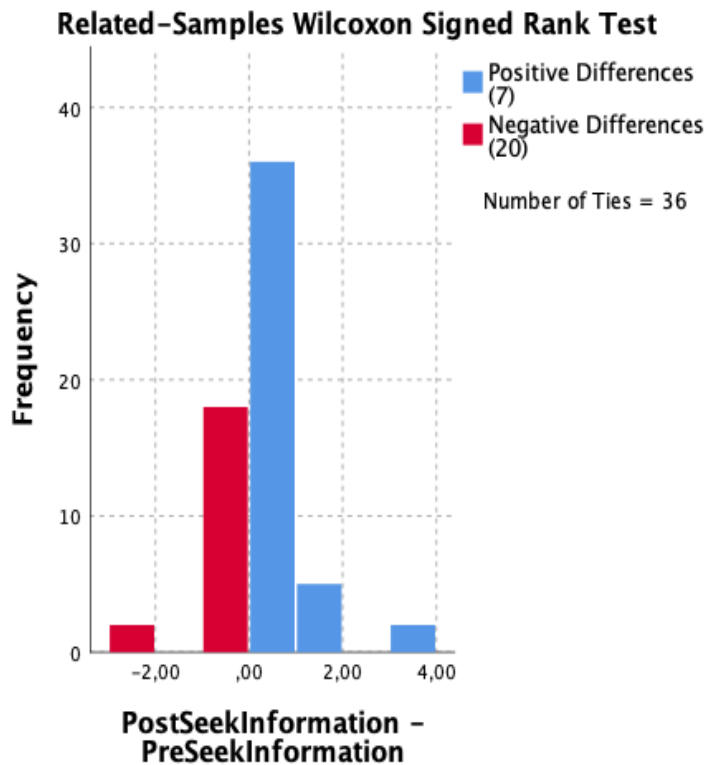


Figure 81. Wilcoxon Signed Rank Test Results regarding Users Experience Seeking Information

Table 210

*Descriptive Statistics for Users Experience Seeking Information – Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreSeek Information	63	4,5238	,66858	2,00	5,00
PostSeek Information	63	4,3175	,64321	2,00	5,00

Table 211

*Wilcoxon Signed Rank Test for “Users Experience Seeking Information” Variable*

	<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostSeekInformation - Negative Ranks	20 <sup>a</sup>	13,35	267,00
PreSeekInformation Positive Ranks	7 <sup>b</sup>	15,86	111,00
Ties	36 <sup>c</sup>		
Total	63		

- a. PostSeek Information < PreSeek Information
- b. PostSeek Information > PreSeek Information
- c. PostSeek Information = PreSeek Information

Table 212

*Wilcoxon Signed Rank Result for “Users Experience Seeking Information” Variable*

<b>PostSeek Information – PreSeek Information</b>	
<b>Z</b>	-2,029 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,042

Table 213

*Users Experience Seeking Information Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreSeekInformation and PostSeekInformation equals 0.	Related-Samples Wilcoxon Signed Rank Test	,042	Reject the null hypothesis.

The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can see there were 20 negative differences when comparing what participants replied in the initial and the end of course surveys.

## PreSocial Media vs. PostSocial Media

Participants were requested to rate at the beginning of the course if they thought they would be able to use their social media for the course they enrolled in. After participants finished the MOOC, users were requested to rate if their expectations were fulfilled or not. The results are presented below.

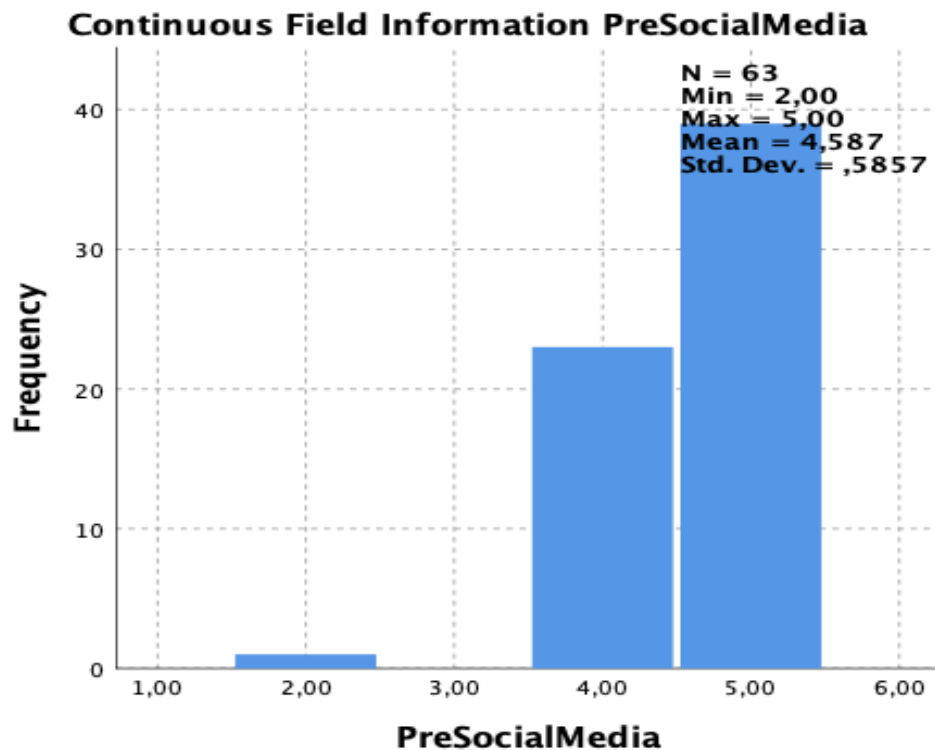
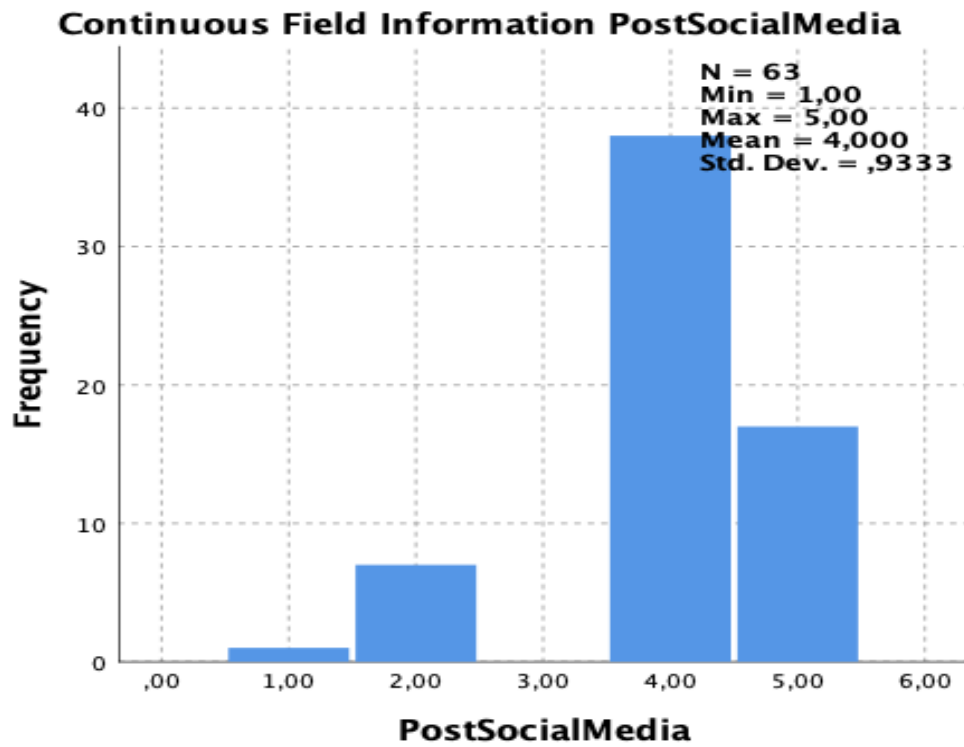


Figure 82. Distribution of the Answers in the Initial Demographic survey regarding Participant's Use of Social Media for the course



*Figure 83.* Distribution of the Answers in the End of the Course survey regarding Participant's Use of Social Media for the course



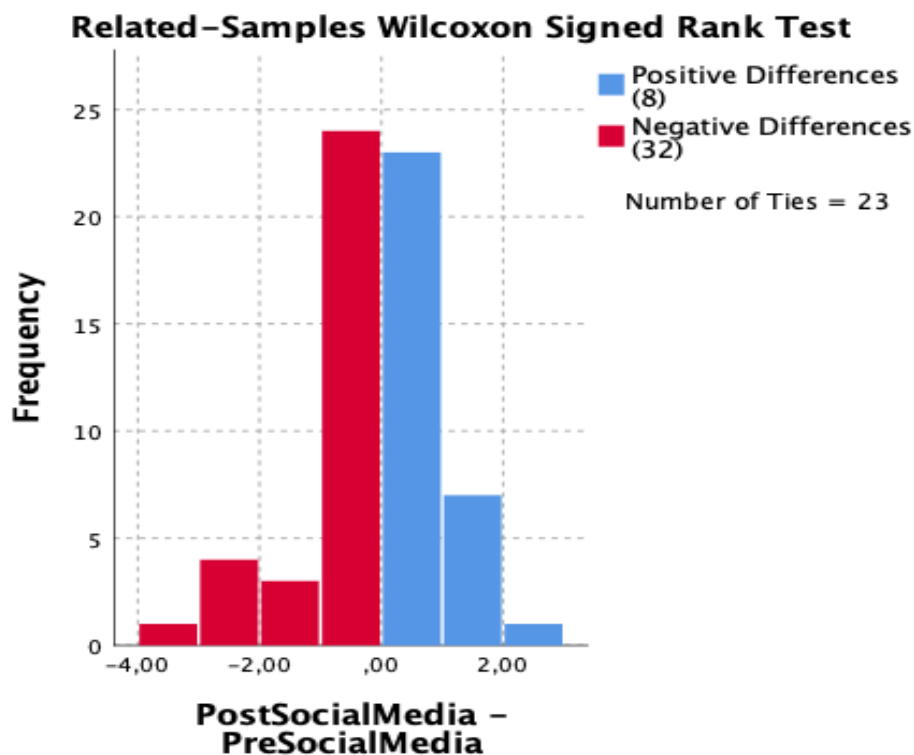


Figure 84. Wilcoxon Signed Rank Test Results regarding Participant’s Use of Social Media for the course

Table 214

*Descriptive Statistics for Participant’s Use of Social Media for the course– Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreSocial Media	63	4,5873	,58571	2,00	5,00
PostSocial Media	63	4,0000	,93326	1,00	5,00

Table 215

*Wilcoxon Signed Rank Test for “Participant’s Use of Social Media for the course” Variable*

	N	Mean Rank	Sum of Ranks
PostSocial Media - Negative Ranks	32 <sup>a</sup>	21,08	674,50
PostSocial Media Positive Ranks	8 <sup>b</sup>	18,19	145,50
Ties	23 <sup>c</sup>		
Total	63		

- a. PostSocial Media < PreSocial Media
- b. PostSocial Media > PreSocial Media
- c. PostSocial Media = PreSocial Media

Table 216

*Wilcoxon Signed Rank Result for “Participant’s Use of Social Media for the course”*

*Variable*

	<b>PostSocial Media – PreSocial Media</b>
Z	-3,774 <sup>b</sup>
Asymp. Sig. (2-tailed)	,000

Table 217

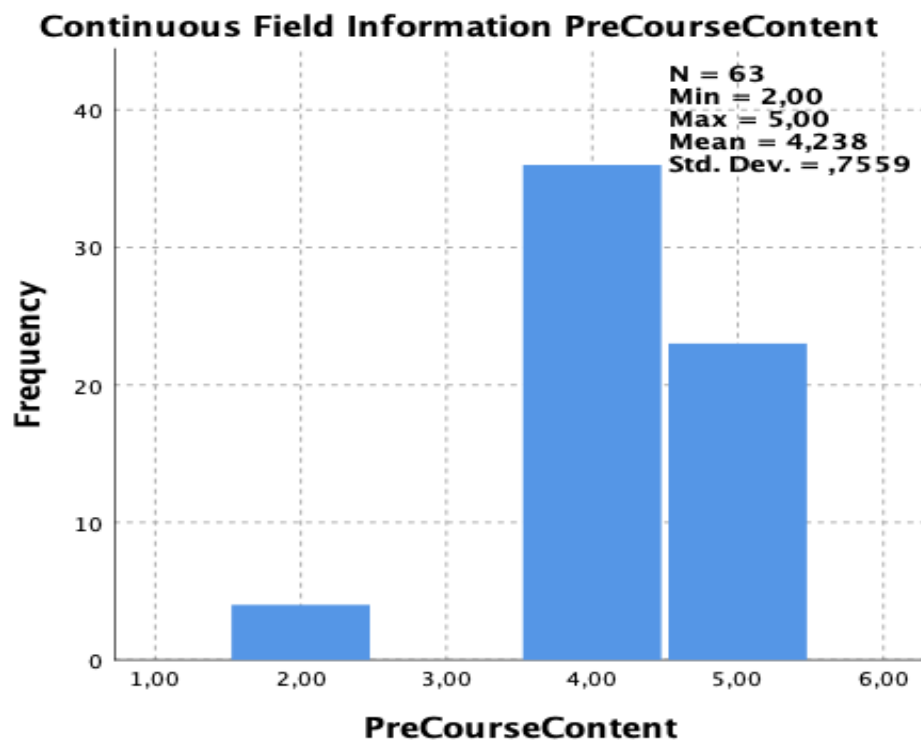
*Participant’s Use of Social Media for the course Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreSocialMedia and PostSocialMedia equals 0.	Related-Samples Wilcoxon Signed Rank Test	,000	Reject the null hypothesis.

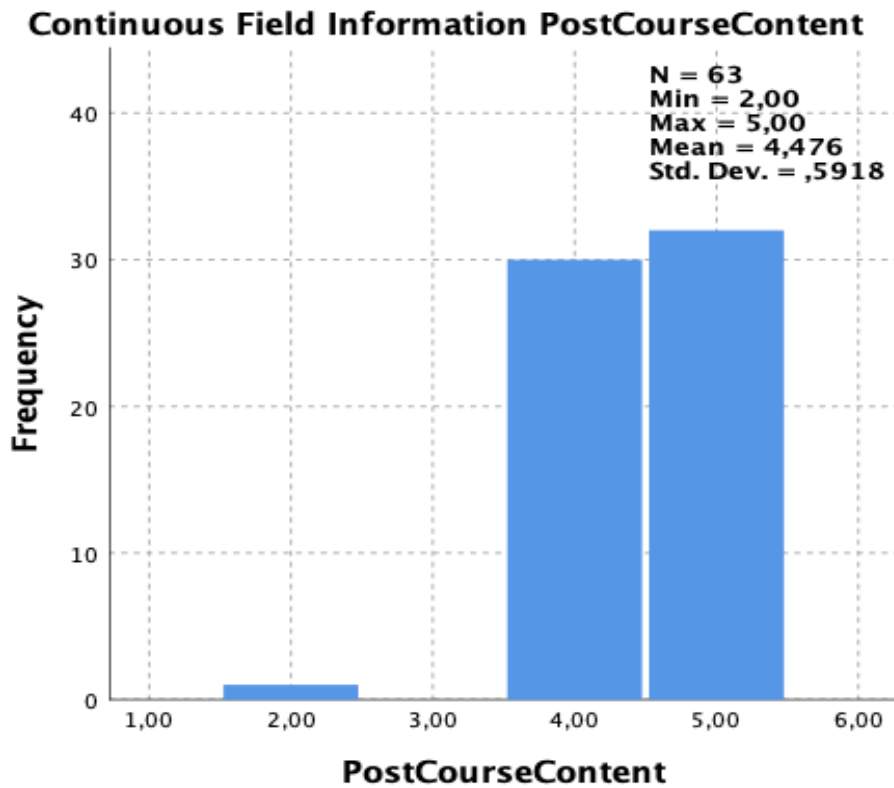
The significance level is .050, and the result obtained is lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant’s answers between the initial and the end of the course surveys. Observing the result, we can see there were 32 negative differences when comparing what participants replied in the initial and the end of course surveys.

## PreCourse Content vs. PostCourse Content

Participants were requested to reply in the initial survey if they considered they already understood generally the topics that were present in the course they enrolled in. After they completed the MOOC, they had to rate if they had understood the course content they were provided. A comparison of what they answered before and after the course is presented below.



*Figure 85.* Distribution of the Answers in the Initial Demographic survey regarding Participant's familiarity with the course content



*Figure 86.* Distribution of the Answers in the End of the Course survey regarding Participant's familiarity with the course content

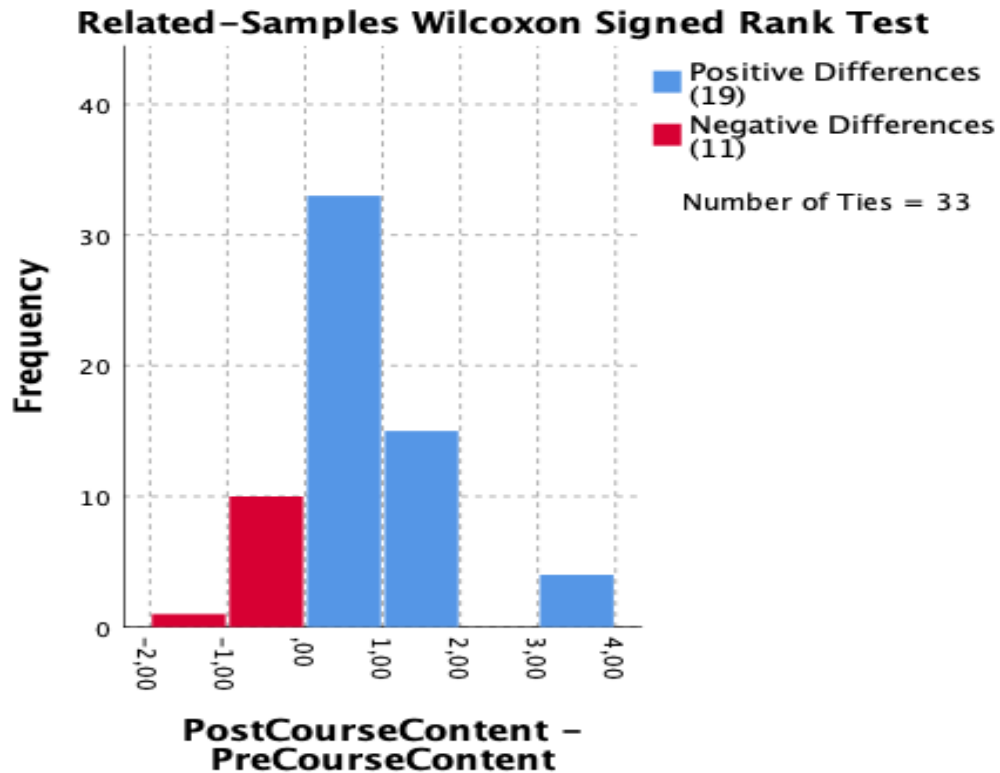


Figure 87. Wilcoxon Signed Rank Test Results regarding Participant’s familiarity with the course content

Table 218

*Descriptive Statistics for Participant’s familiarity with the course content – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
<b>PreCourse Content</b>	63	4,2381	,75593	2,00	5,00
<b>PostCourse Content</b>	63	4,4762	,59180	2,00	5,00

Table 219

*Wilcoxon Signed Rank Test for “Participant’s familiarity with the course content” Variable*

	N	Mean Rank	Sum of Ranks
PostCourse Content - Negative Ranks	11 <sup>a</sup>	14,18	156,00
PreCourse Content Positive Ranks	19 <sup>b</sup>	16,26	309,00
Ties	33 <sup>c</sup>		

- a. PostCourse Content < PreCourse Content
- b. PostCourse Content > PreCourse Content
- c. PostCourse Content = PreCourse Content

Table 220

*Wilcoxon Signed Rank Result for “Participant’s familiarity with the course content”*

*Variable*

<b>PostCourse Content – PreCourse Content</b>	
Z	-1,695 <sup>b</sup>
Asymp. Sig. (2-tailed)	,090

Table 221

*Participant’s familiarity with the course content Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreCourseContent and PostCourseContent equals 0.	Related-Samples Wilcoxon Signed Rank Test	,090	Retain the null hypothesis.

The significance level is .050, and the result obtained is higher than that. Thus, we retain the null hypothesis, meaning that there *was not* a significant change in the participant’s answers between the initial and the end of the course surveys. From the graphs, we can observe that more participants rated their knowledge on the topic of the MOOC to be higher after they completed the course.

## PreHands On Experience vs. PostHands On Experience

Participants were asked in the initial demographic survey to rate if they had previous hands on experience in activates regarding energy. After participants finished the MOOC, users were asked again if they had hands on experience regarding the energy field. The results obtained from these questions are presented below.

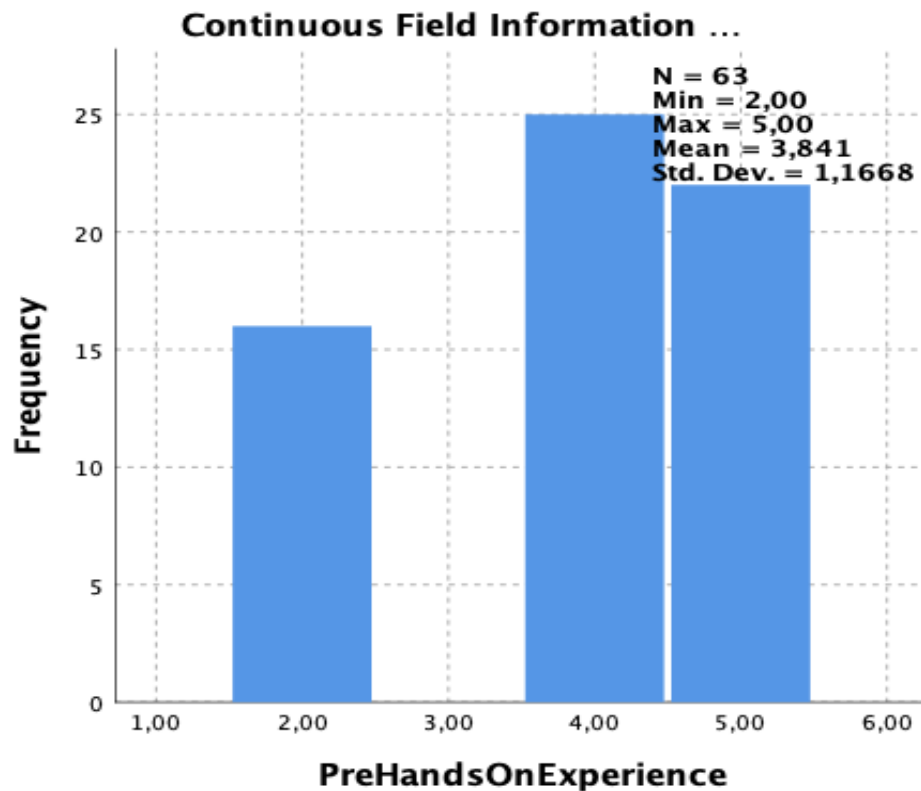
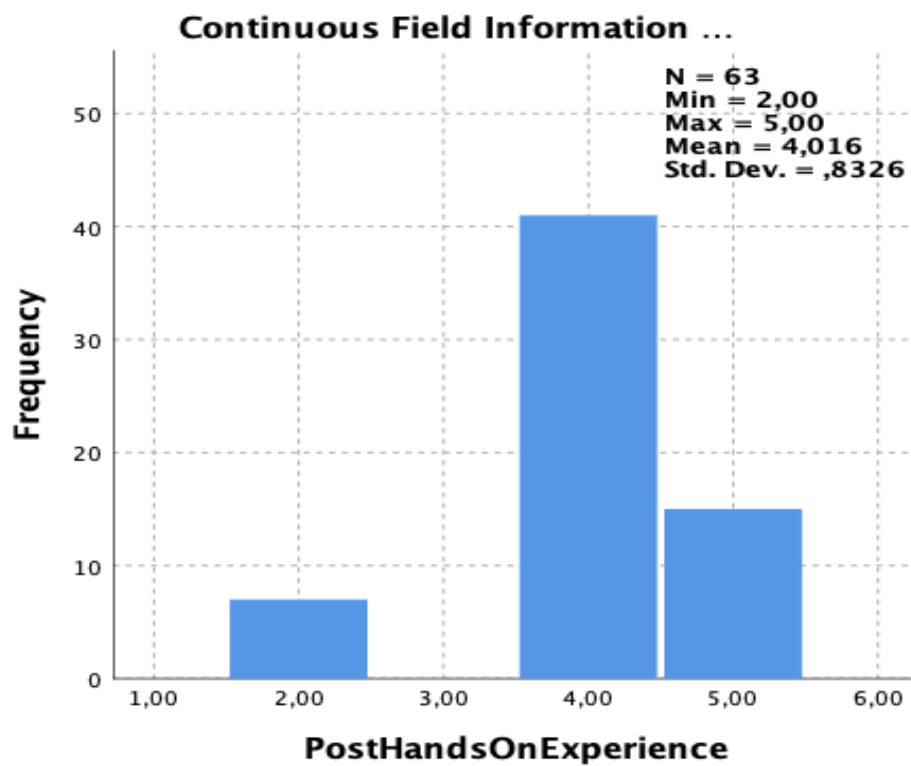


Figure 88. Distribution of the Answers in the Initial Demographic survey regarding Participant's Previous Hands on Experience in the Energy Field



*Figure 89.* Distribution of the Answers in the End of the Course survey regarding Participant's Previous Hands on Experience in the Energy Field



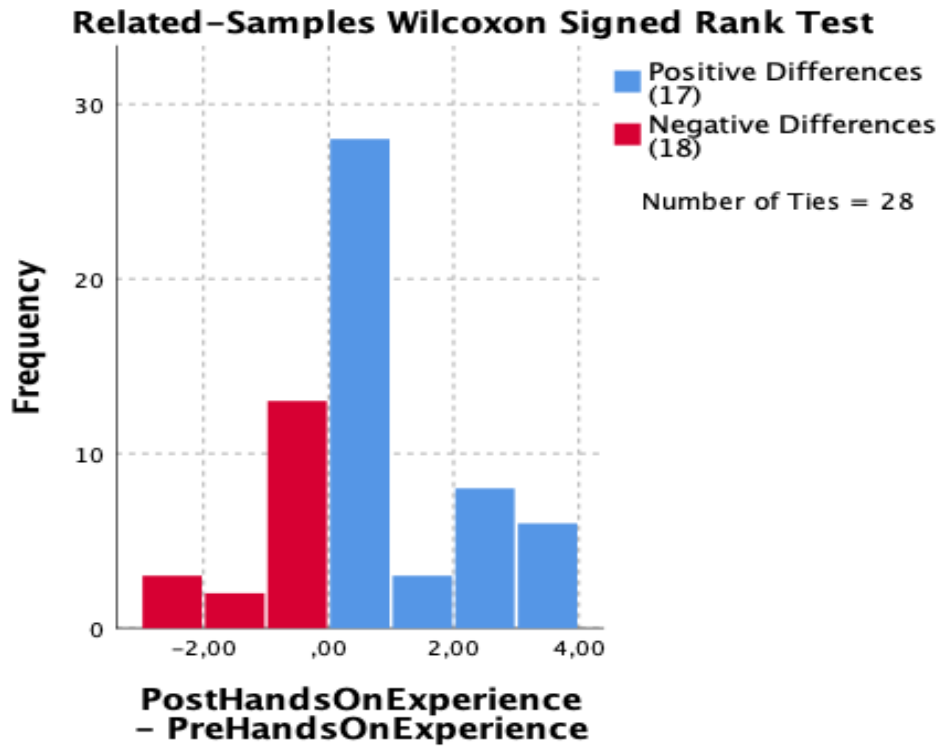


Figure 90. Wilcoxon Signed Rank Test Results regarding Participant’s Previous Hands on Experience in the Energy Field

Table 222

*Descriptive Statistics for Participant’s Previous Hands on Experience in the Energy Field—Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreHands On Experience	63	3,8413	1,16683	2,00	5,00
PostHands On Experience	63	4,0159	,83264	2,00	5,00

Table 223

*Wilcoxon Signed Rank Test for “Participant’s Previous Hands on Experience in the Energy Field” Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostHands On Experience -PreHands On Experience	Negative Ranks	18 <sup>a</sup>	13,69	246,50
	Positive Ranks	17 <sup>b</sup>	22,56	383,50
	Ties	28 <sup>c</sup>		
	Total	63		

- a. PostHands On Experience < PreHands on Experience
- b. PostHands On Experience > PreHands on Experience
- c. PostHands On Experience = PreHands on Experience

Table 224

*Wilcoxon Signed Rank Result for “Participant’s Previous Hands on Experience in the Energy Field” Variable*

<b>PostCourse Content – PreCourse Content</b>	
Z	-1,141 <sup>b</sup>
Asymp. Sig. (2-tailed)	,254

Table 225

*Participant’s Previous Hands on Experience in the Energy Field Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreHandsOnExperience and PostHandsOnExperience equals 0.	Related-Samples Wilcoxon Signed Rank Test	,254	Retain the null hypothesis.

The significance level is .050, and the result obtained was much higher than that. Thus, we retain the null hypothesis, meaning that there *was not* a significant change in the participant’s answers between the initial and the end of the course surveys. From these results,

we can deduce that participant's hands on experiences did not grow nor diminish after participating in the online course they signed up to.

### **PreLearning vs. PostLearning**

Participants were requested to express in the initial survey if they considered their current knowledge (before taking the course) surpassed at least 50% of the topics that were enlisted in the MOOC they enrolled in. After participants completed the MOOC, users were requested to rate if the new knowledge they had acquired was higher than the knowledge they had at the beginning of the course. The results obtained from these questions are presented below.

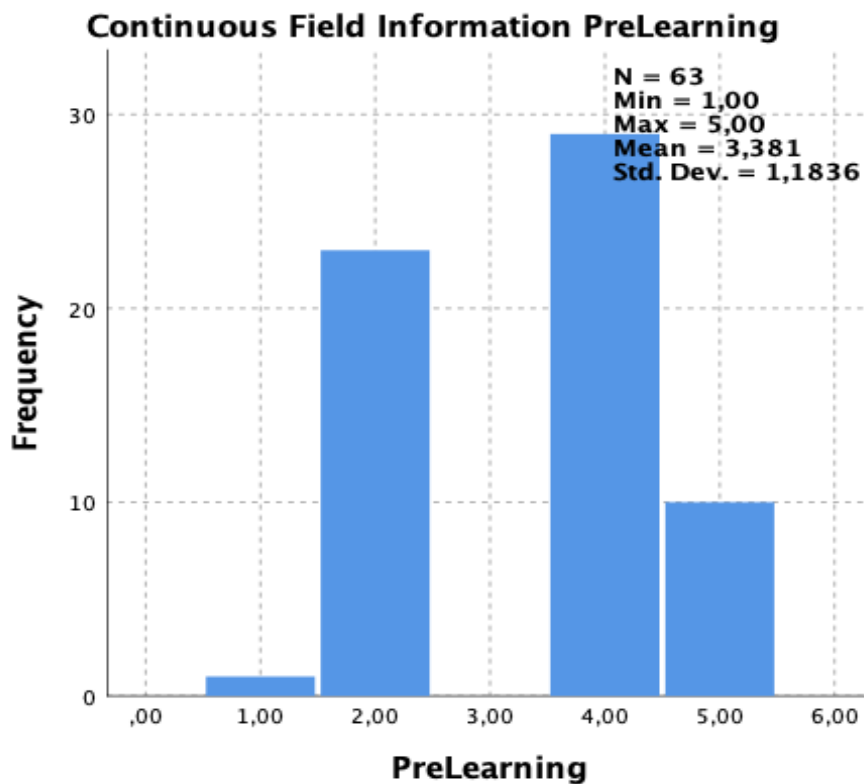


Figure 91. Distribution of the Answers in the Initial Demographic survey regarding Participant's Previous Knowledge regarding the MOOC's topics

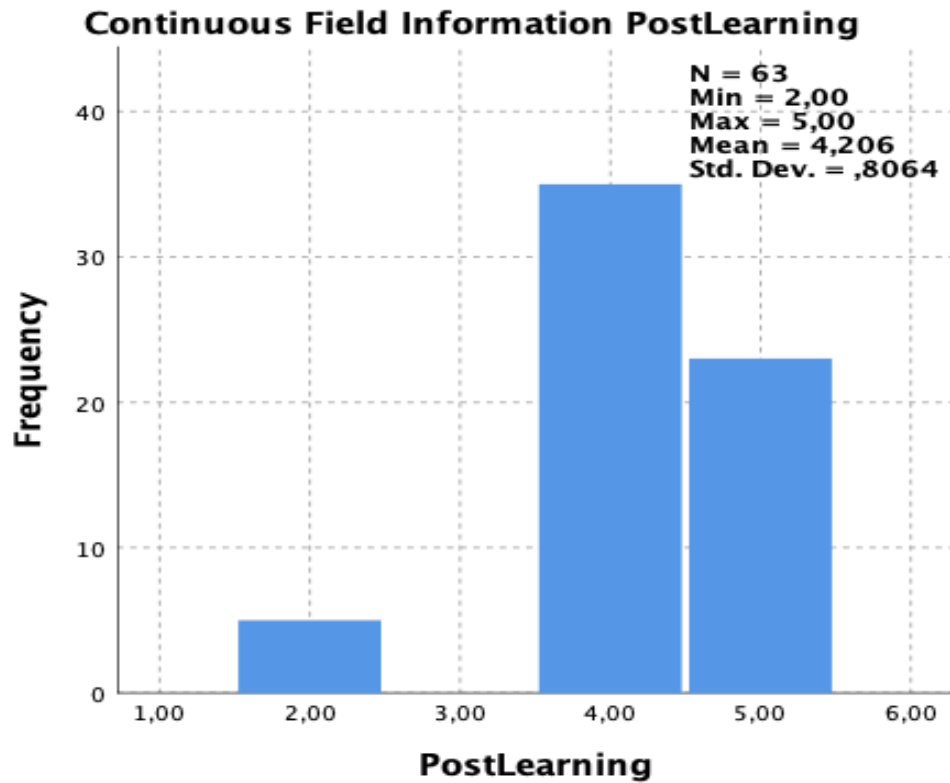


Figure 92. Distribution of the Answers in the End of the Course survey regarding Participant's New Knowledge about the MOOC's content

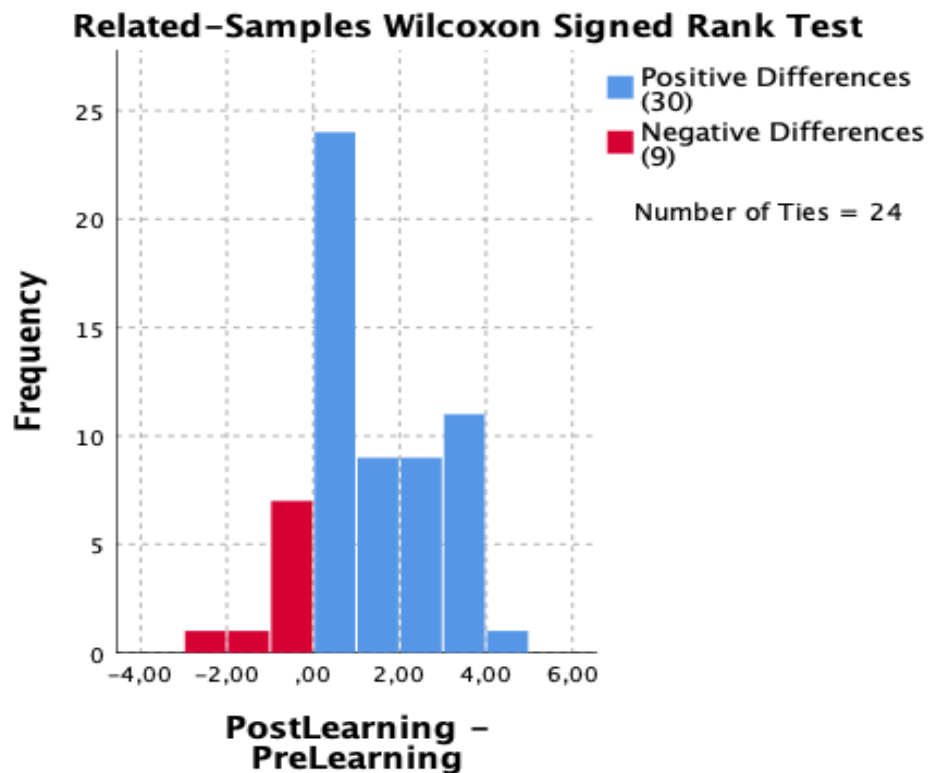


Figure 93. Wilcoxon Signed Rank Test Results regarding Participant's Knowledge Before and After the MOOC

Table 226

Descriptive Statistics for Participant's Knowledge Before and After the MOOC– Pre and Post

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreLearning	63	3,3810	1,18361	1,00	5,00
PostLearning	63	4,2063	,80640	2,00	5,00

Table 227

*Wilcoxon Signed Rank Test for “Participant’s Knowledge Before and After the MOOC”*

*Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostLearning	- Negative Ranks	9 <sup>a</sup>	12,61	113,50
PreLearning	Positive Ranks	30 <sup>b</sup>	22,22	666,50
	Ties	24 <sup>c</sup>		
	<b>Total</b>	<b>63</b>		

a. PostLearning < PreLearning

b. PostLearning > PreLearning

c. PostLearning = PreLearning

Table 228

*Wilcoxon Signed Rank Result for “Participant’s Knowledge Before and After the MOOC”*

*Variable*

		<b>PostLearning – PreLearning</b>
Z		-3,913 <sup>b</sup>
Asymp. Sig. (2-tailed)		,000

Table 229

*Participant’s Knowledge Before and After the MOOC Hypothesis*

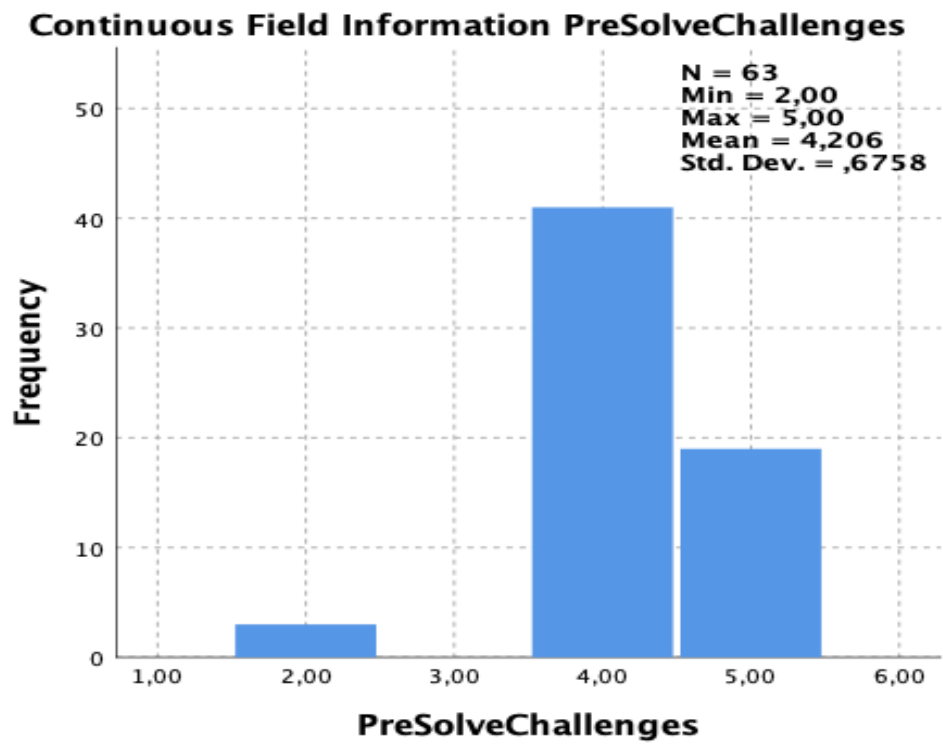
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreLearning and PostLearning equals 0.	Related-Samples Wilcoxon Signed Rank Test	,000	Reject the null hypothesis.

The significance level is .050, and the result obtained was lower than that. Thus, we reject the null hypothesis, meaning that there *was* a significant change in the participant's answers between the initial and the end of the course surveys.

From these results, we can deduce that participant's knowledge about the topics of the MOOC did not exceed 50% a lot, and comparing the knowledge they had before and after they MOOC, most participants considered they had acquired new valuable knowledge regarding the topic of the course they had signed up to.

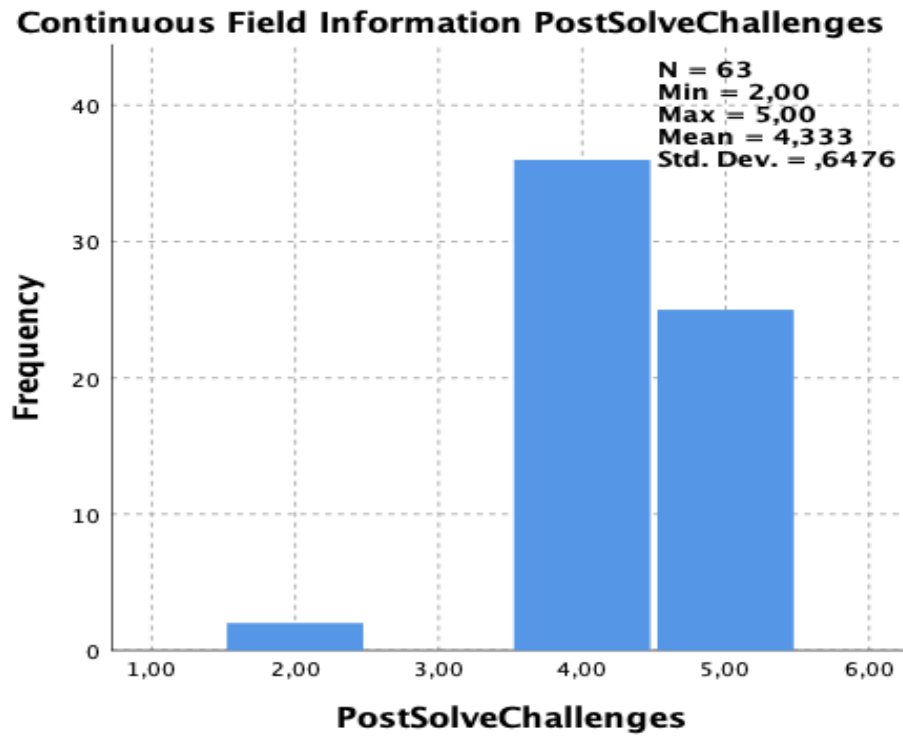
### **PreSolve Challenges vs. PostSolve Challenges**

Participants were asked in the initial demographic survey to evaluate if their current knowledge would allow them to solve challenges related to at least one topic presented in the course they signed up to. After evaluating their challenge solving skills before the MOOC, users were asked to rate themselves again. The comparison of the answer's users provided before and after participating in the course are presented below.



*Figure 94.* Distribution of the Answers in the Initial Demographic survey regarding Participant's Abilities to Solve Challenges





*Figure 95.* Distribution of the Answers in the End of the Course survey regarding Participant's Abilities to Solve Challenges

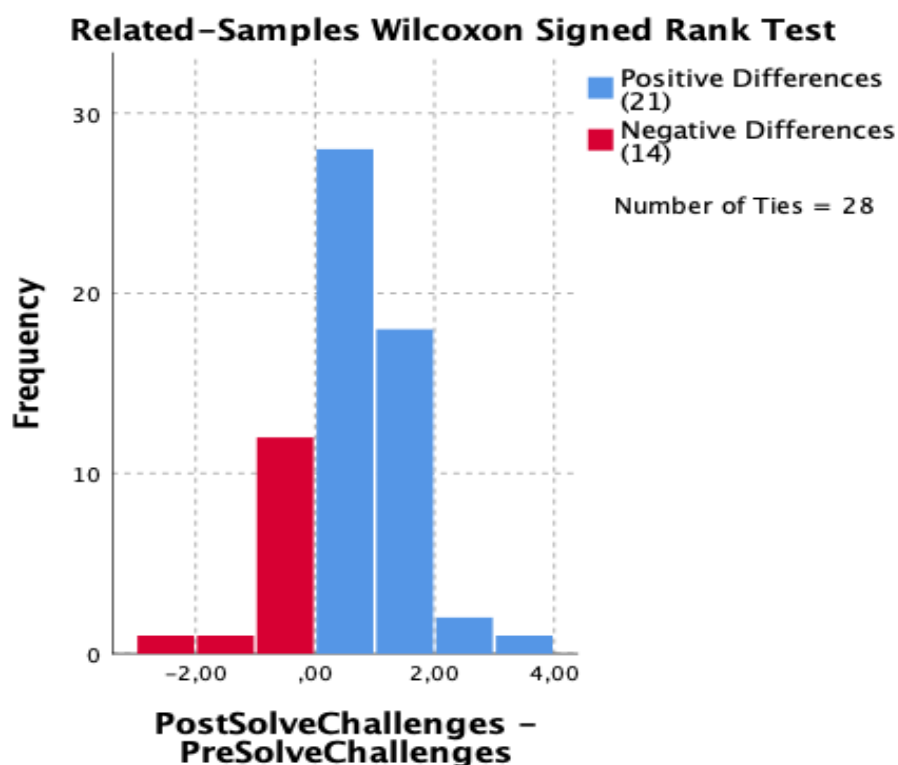


Figure 96. Wilcoxon Signed Rank Test Results regarding Participant’s Abilities to Solve Challenges

Table 230

*Descriptive Statistics for Participant’s Abilities to Solve Challenges– Pre and Post*

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
PreSolve Challenges	63	4,2063	,67582	2,00	5,00
PostSolve Challenges	63	4,3333	,64758	2,00	5,00

Table 231

*Wilcoxon Signed Rank Test for “Participant’s Abilities to Solve Challenges” Variable*

	<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostSolve Challenges - Negative Ranks	14 <sup>a</sup>	18,04	252,50
PreSolve Challenges Positive Ranks	21 <sup>b</sup>	17,98	377,50
Ties	28 <sup>c</sup>		

- a. PostSolve Challenges < PreSolve Challenges
- b. PostSolve Challenges > PreSolve Challenges
- c. PostSolve Challenges = PreSolve Challenges

Table 232

*Wilcoxon Signed Rank Result for “Participant’s Abilities to Solve Challenges” Variable*

<b>PostSolve Challenges – PreSolve Challenges</b>	
<b>Z</b>	-1,111 <sup>b</sup>
<b>Asymp. Sig. (2-tailed)</b>	,267

Table 233

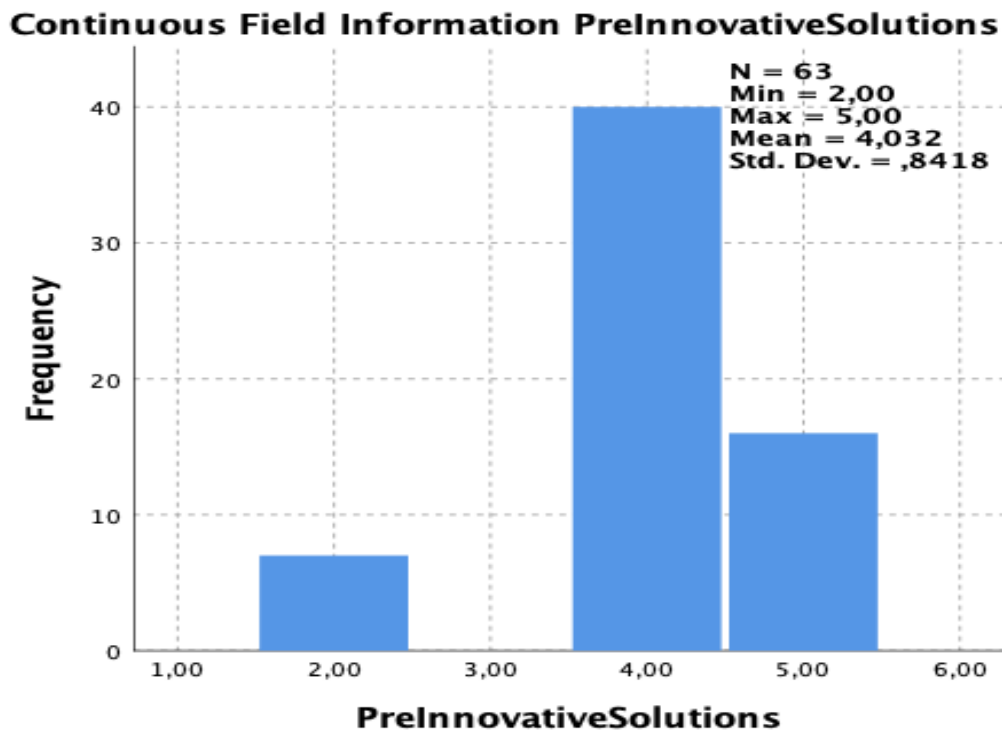
*Participant’s Abilities to Solve Challenges Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreSolveChallenges and PostSolveChallenges equals 0.	Related-Samples Wilcoxon Signed Rank Test	,267	Retain the null hypothesis.

The significance level is .050, and the result obtained was much higher than that. Thus, we retain the null hypothesis, meaning that there *was not* a significant change in the participant’s answers between the initial and the end of the course surveys. From these results, we can deduce that participant’s confidence levels regarding their abilities to solve challenges didn’t change significantly before and after taking the course. Just by observing the graphs of the results that were obtained, it is possible to observe that the replies had a similar tendency before and after the users completed the MOOC.

## Pre Innovative Solutions vs. Post Innovative Solutions

In the initial demographic survey, users were requested to rate if they considered they would be able to come up with innovative solutions to problems related to at least one subject that was present in the course they signed up to. Once they completed the MOOC, participants were requested to rate again their ability to come up with innovative solutions to problems related to the theme of the course they signed up to. The comparison of the rating users provided before and after participating in the course are presented below.



*Figure 97.* Distribution of the Answers in the Initial Demographic survey regarding Participant's Ability to Provide Innovative Solutions

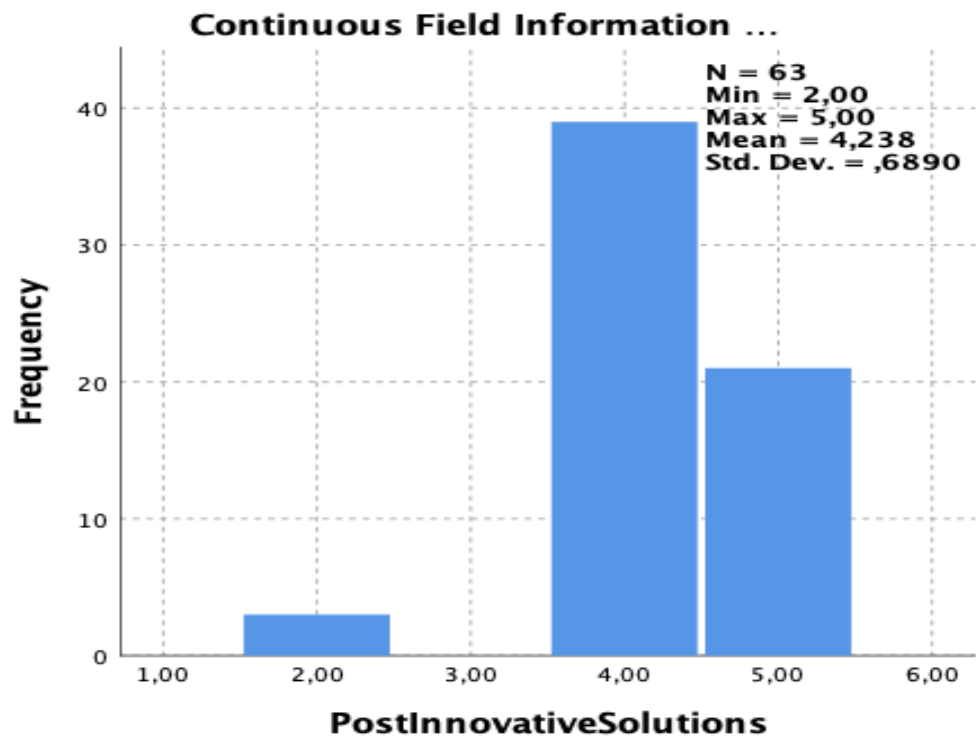


Figure 98. Distribution of the Answers in the End of the Course survey regarding Participant's Ability to Provide Innovative Solutions

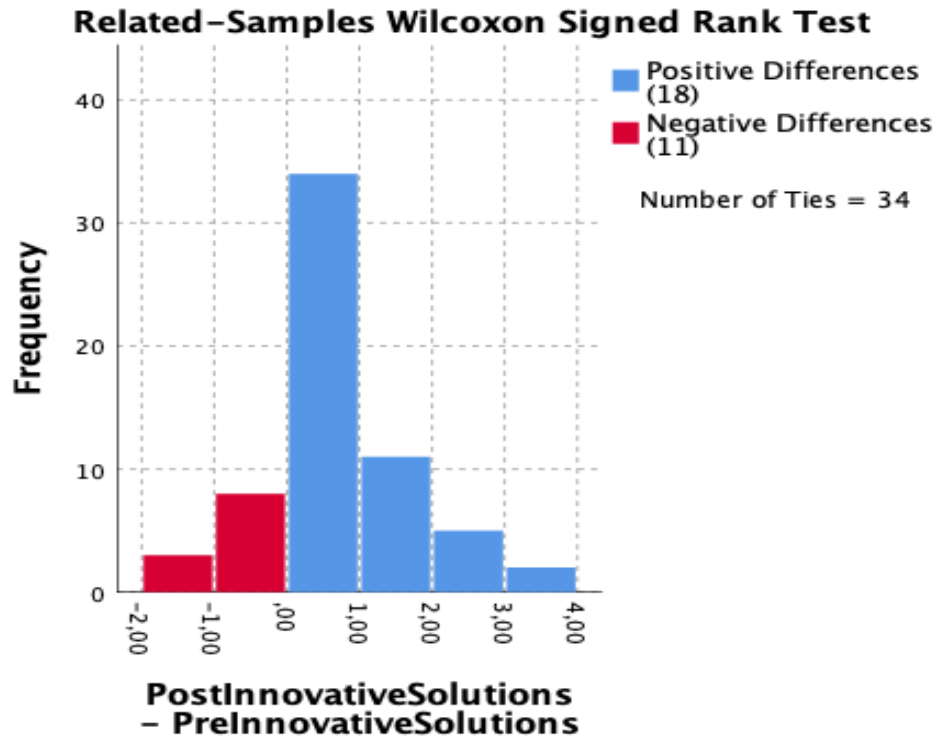


Figure 99. Wilcoxon Signed Rank Test Results regarding Participant’s Ability to Provide Innovative Solutions

Table 234

*Descriptive Statistics for Participant’s Ability to Provide Innovative Solutions – Pre and Post*

	N	Mean	Std. Deviation	Minimum	Maximum
PreInnovative Solutions	63	4,0317	,84182	2,00	5,00
PostInnovative Solutions	63	4,2381	,68895	2,00	5,00

Table 235

*Wilcoxon Signed Rank Test for “Participant’s Ability to Provide Innovative Solutions”*

*Variable*

		<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>
PostInnovative Solutions - Negative Ranks		11 <sup>a</sup>	13,68	150,50
PreInnovative Solutions Positive Ranks		18 <sup>b</sup>	15,81	284,50
	Ties	34 <sup>c</sup>		
	Total	63		

- a. PostInnovative Solutions < PreInnovative Solutions
- b. PostInnovative Solutions > PreInnovative Solutions
- c. PostInnovative Solutions = PreInnovative Solutions

Table 236

*Wilcoxon Signed Rank Result for “Participant’s Ability to Provide Innovative Solutions”*

*Variable*

	<b>PostInnovative Solutions – PreInnovative Solutions</b>
Z	-1,504 <sup>b</sup>
Asymp. Sig. (2-tailed)	,133

Table 237

*Participant’s Ability to Provide Innovative Solutions Hypothesis*

<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
The median of differences between PreInnovativeSolutions and PostInnovativeSolutions equals 0.	Related-Samples Wilcoxon Signed Rank Test	,133	Retain the null hypothesis.

The significance level is .050, and the result obtained was higher than that. Thus, we retain the null hypothesis, meaning that there *was not* a significant change in the participant’s

answers between the initial and the end of the course surveys. From these results, we can deduce that participant's confidence levels regarding their abilities to provide innovative solutions to problems did not change significantly before and after taking the course.

Just by observing the graphs of the results that were obtained before and after, it is possible to perceive that the replies had a similar tendency before and after the users completed the MOOC.

## **Qualitative Results**

### **Categories that arose from the interviews**

In total, 16 interviews were conducted. Eight of the participants who concluded the MOOC successfully answered a series of questions about their experience with the course and provided some insight about their perspective and advice for teaching about sustainable development in the future. Another eight participants answered a similar interview, although the main focus of the questions was centered in the reasons as to why they didn't conclude the course all the way. A script of the questions presented during the semi structured interview can be found in Appendix 3.

The interviews were translated, transcribed, and coded in the Qualitative Analysis Program MaxQDA 2020.

As a result, after finishing the coding of the interviews, the following map of the codes that arose from the analysis of the interviews conducted was created.



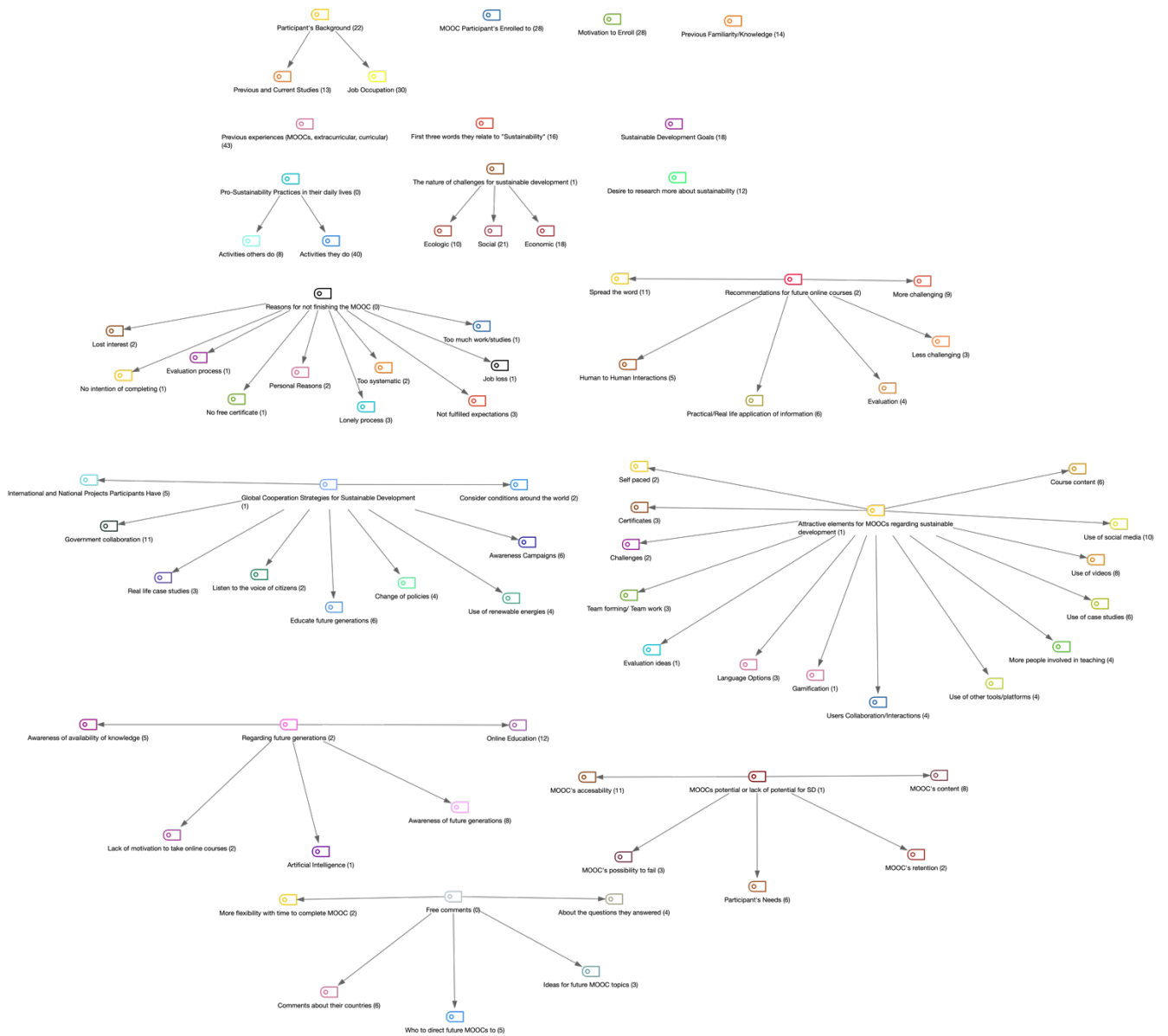
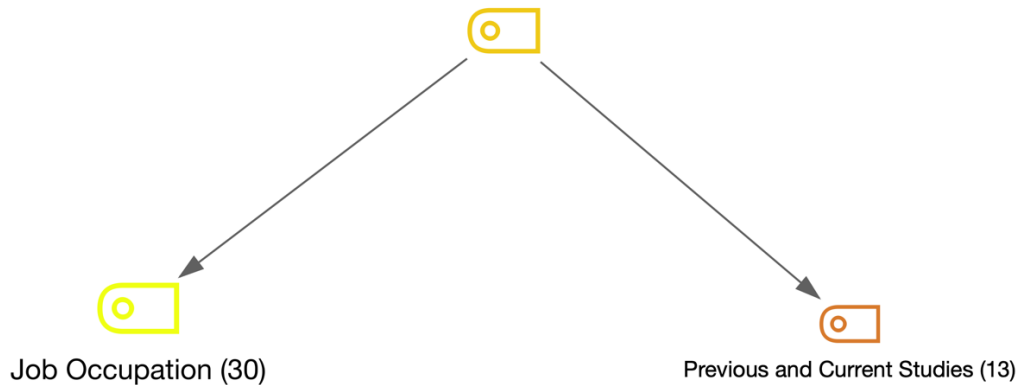


Figure 100. All codes and sub codes that arose from the interviews that were conducted  
 The following section will describe the codes, along with their subcategories.

## Participant's Background (22)



*Figure 101.* Participant's Background

For this specific code, any time the participants commented about their background, their country, their field of work or their previous and current studies, their comments were coded under this category.

## MOOCs Participants Enrolled to (28)



*Figure 102.* MOOCs Participants Enrolled to

Participants were requested to mention which MOOC they enrolled to and the way in which they found out that the MOOC was available online. Whenever they made comments about the content of the MOOC they participated in, their comments were also filed under this category.

## Motivation to enroll (28)



*Figure 103.* Motivation to enroll

This was one of the main lines of questioning during the interviews that were conducted. Participants were requested to share their main motivations for enrolling in the massive open online course in the first place. Whenever the participants made a comment about their intentions behind their enrollment, those portions of the interview were filed under this category.

## Previous Familiarity/Knowledge (14)



*Figure 104.* Previous Familiarity and Knowledge of the Participants

In order to comprehend at a deeper level the experience of the participants before, during, and after the MOOC, participants were requested to share if, before taking the course, they had already obtained some sort of training regarding the main topic of the course they signed up to.

Whenever participants made a comment about their level of familiarity or knowledge regarding the MOOC's content or topic that they had before taking the course, their comments were filed under this category, even when participants admitted that they had never taken any sort of course or training that had familiarized them with the topic of the MOOC they signed up to.

## Previous experiences (MOOCs, curricular and extracurricular) (43)



*Figure 105.* Previous experiences the participants had with curricular, extracurricular and MOOCs that touched upon the subject of sustainable development

Participants were requested to answer if they had had any previous experience in curricular or extracurricular activities that had touched upon the subject of sustainable development. Because some of the participants explained they had previous studies when it came to sustainability, they were requested to talk about the curricular classes in their programs.

Users were also requested to express if they had any previous experiences when it came to Massive Open Online Courses. In case they did, they were requested to talk about the main topic of the courses they signed up to.

## First three words they relate to "sustainability" (16)



*Figure 106.* First three words participants related to “sustainability”

With the hope of observing if there were some patterns in the way participants related the word sustainability to other terms, users were requested to say the first three words that popped into their head whenever they heard the word “sustainability”.

A word cloud with the results obtained for this category are presented in Figure X.

## Sustainable Development Goals (18)



*Figure 107.* Comments the participants did about sustainable development goals

Users were asked if they knew about UNESCO’s Sustainable Development Goals. In case they did, they were requested to explain how they got familiarized with them and if they had ever applied them in their job or studying environments.

# Pro-Sustainability Activities in Daily Life

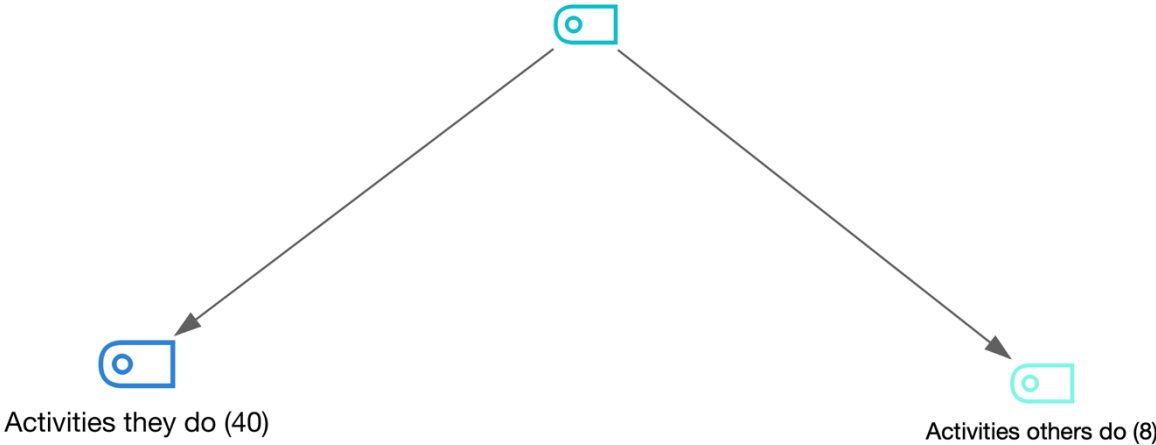


Figure 108. Pro-sustainable activities participants do or see others do in their daily lives

Participants were requested to share if they considered they partook in pro-sustainability activities in their daily lives. In case they did, they were requested to give examples of said activities. Users were also prompted to share in case they observed other people in their social circles partake in pro-sustainable activities, and to explain what those activities were.

# Nature of challenges for sustainable development

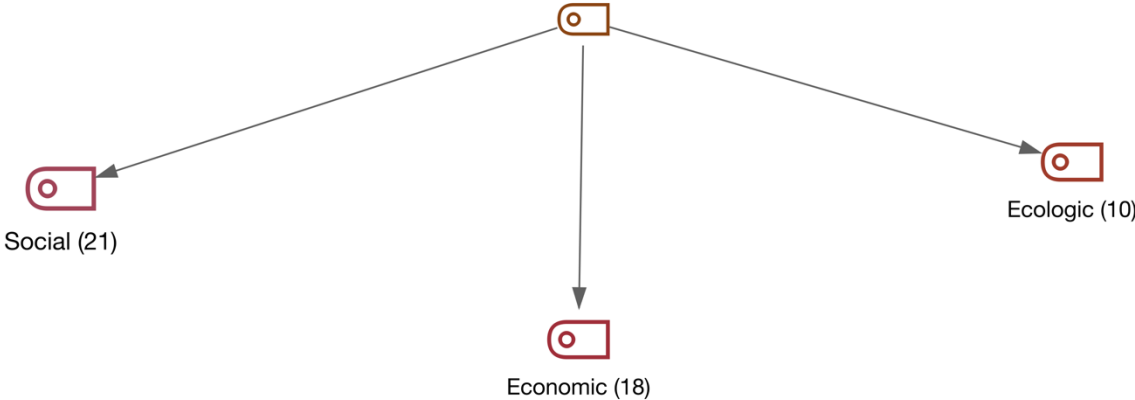


Figure 109. Participant’s Perspective about the nature of the challenges sustainable development faces

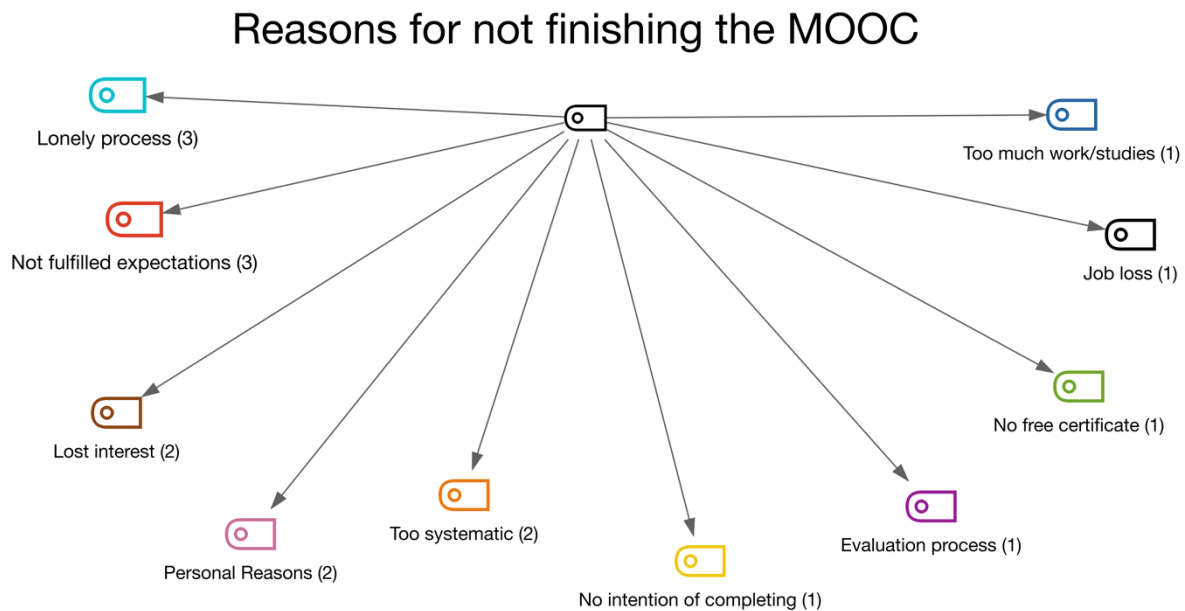
During some point of the interview, users were requested to share their take on the nature of the challenges that sustainable development had to face in order to help secure a sustainable future for everyone. Whenever participants made comments from a social, economic or ecological perspective, their comments were coded under this category.

## Desire to research more about sustainability (12)



*Figure 110.* About the desire or the lack of desire to research more about sustainability after the course

Participants who concluded the MOOC successfully were asked if they had the urge to research more about sustainability after they had completed the MOOC. Regardless if they did, or they did not, their comments regarding the topic of looking for more information after the course were coded under this category.

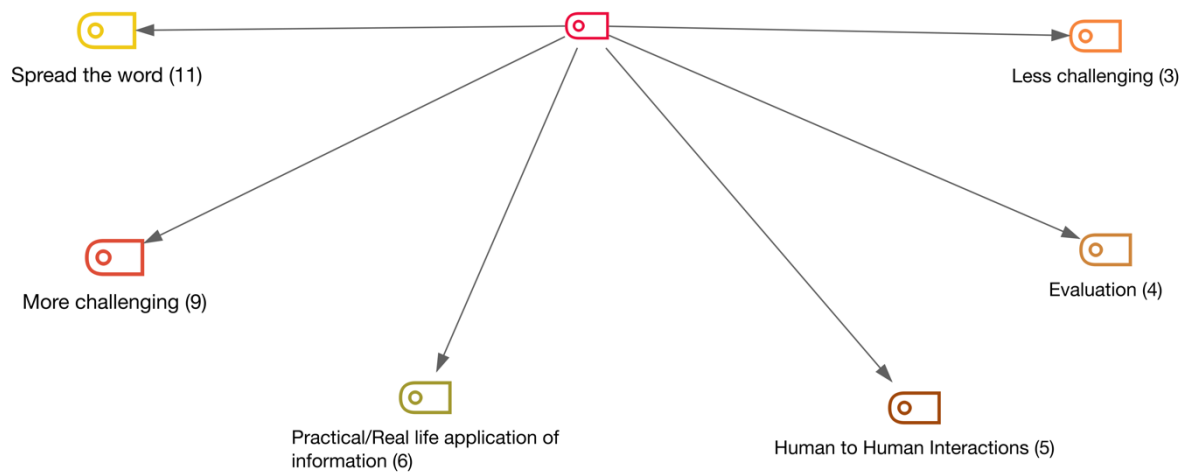


*Figure 111.* Reasons Participants didn't finish the MOOC they enrolled to

Participants who didn't finish the MOOC were requested to elaborate on the reasons they had for not finishing the MOOC. All subcategories that arose were directly created after transcribing the interviews and observing the content of the reasons as to why the participants deserted the MOOC.

Whenever participants made a comment related to their reasons for not finishing the course, those portions of the interview were coded under this category.

## Recommendations for future MOOCs

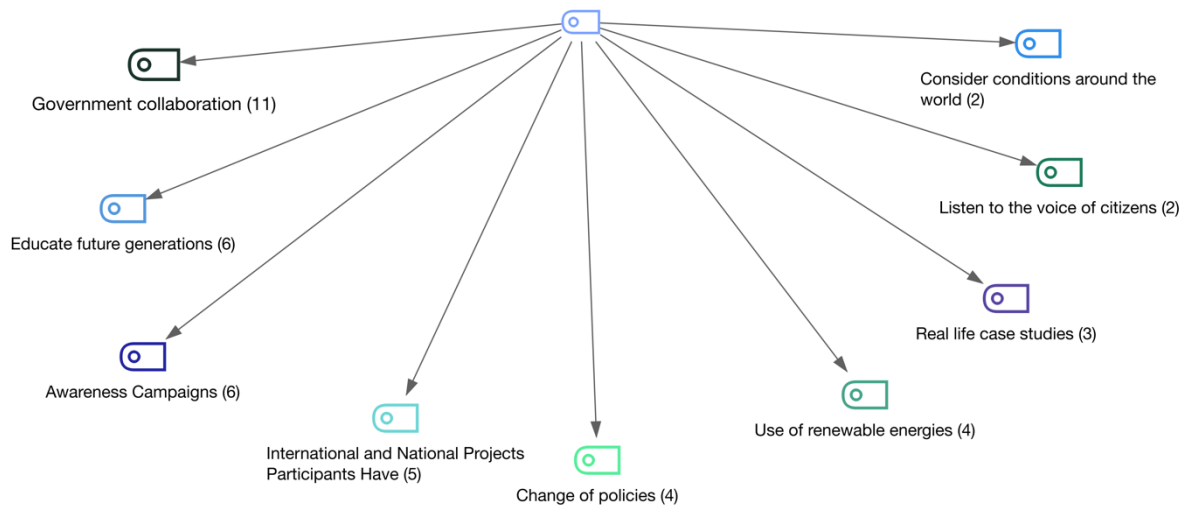


*Figure 112.* Recommendations Participants did for future MOOCs

During the last portion of the interview, users were requested to share any recommendations that came to mind for courses that would be designed and run in the future. The subcategories that arose from this line of questioning were created after observing the content and feedback that was received from the participants.

Whenever users touched upon the subject of things they would like to be taken in consideration for future courses, their comments were filed under this category.

## Global Cooperation Strategies for Sustainable Development



*Figure 113.* Global Cooperation Strategies for Sustainable Development Participants Recommended

This category arose while the interviews took place. Originally, it had not been expected to receive feedback from users that were from other countries. However, after listening about the background of the users, it was possible to observe that users were from various nationalities, and thus, they were requested to share ideas for strategies in order to cooperate in a big international scale to promote the education for sustainable development.

The subcategories that were defined arose after the interviews took place and the content of the suggestions the participants was analyzed thoroughly with the MaxQDA tool.



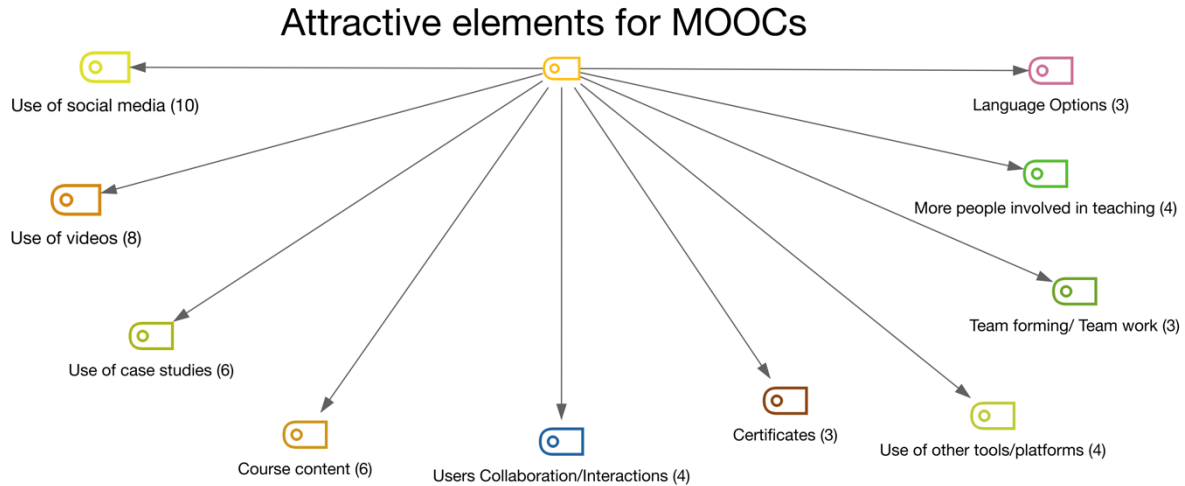


Figure 114. Elements that the participants found attractive from MOOCs

Because all participants had enrolled in a massive open online course, they were requested to explain what elements were attractive or motivational for them in order to commit themselves to enrolling. The subcategories were defined after the content of their comments were analyzed.

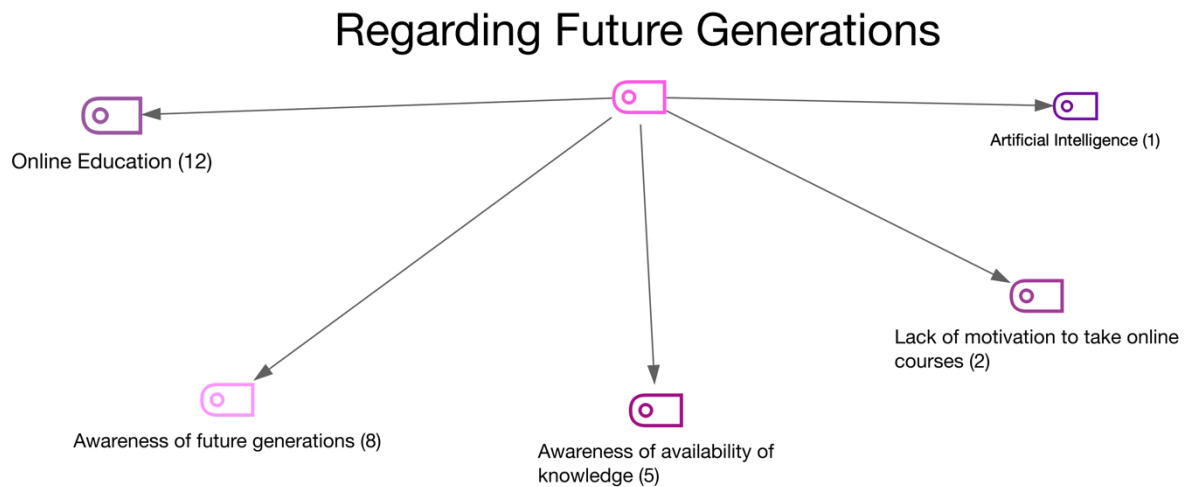
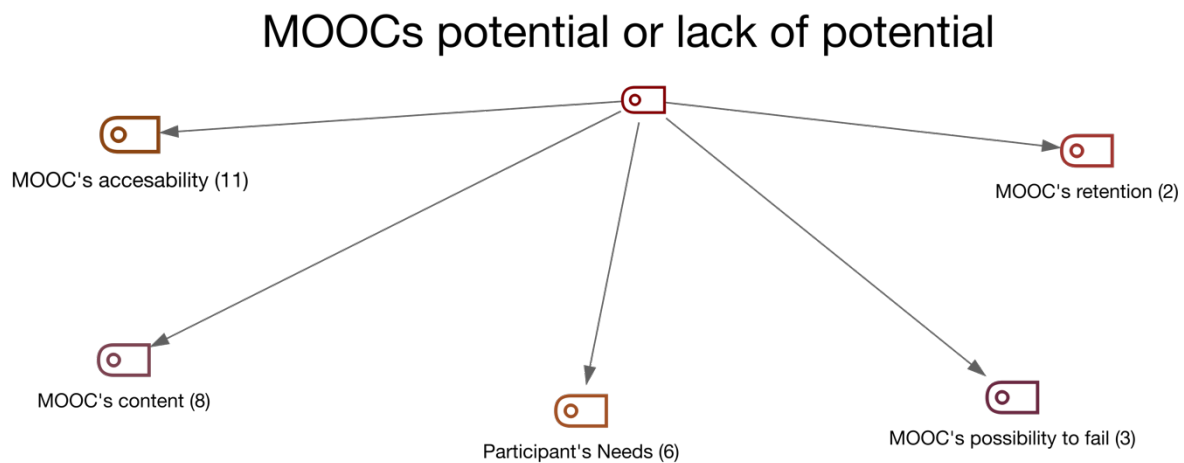


Figure 115. Thoughts participants had regarding future generations

Users were requested to share their point of view regarding future, younger generations, especially when it came to online learning. Participants were questioned about

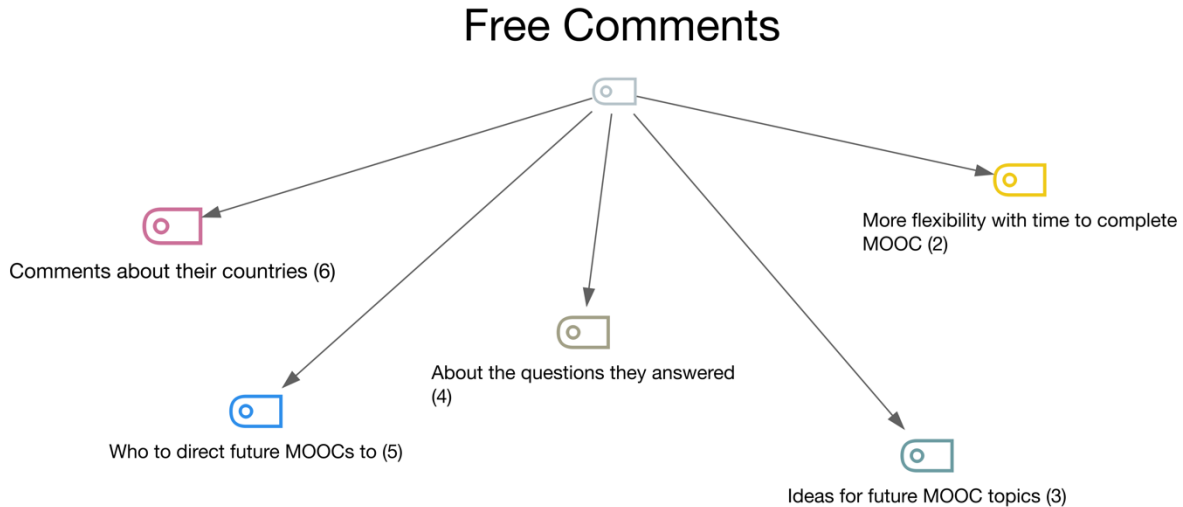
massive open online courses and their impact in future generations, specifically, if they thought that future generations would use MOOCs. All comments that derived from this line of questioning were filed under this category.



*Figure 116.* Participants thoughts about MOOC’s potential or lack of potential to teach about sustainable development

As a final line of questioning, participants were requested to share their thoughts about MOOC’s potential to become a useful and successful tool to teach about education for sustainable development in the future. Participants were requested to share their posture and to explain the reasoning behind their answer.

The subcategories that developed were defined after analyzing the content of the suggestions and comments the participants made.



*Figure 117.* Free comments and various subcategories that arose

This final category was created in order to showcase some comments that were made by the users that didn't really fall in any of the previous categories, but that were considered valuable information or feedback that should be taken in consideration for the analysis. Important feedback regarding the questions that they answered, circumstances of their countries, ideas about future MOOCs and suggestions for the timing and organization of future courses were filed under this category.

## **Results obtained from the interviews**

### **Answers by participants who answered both pre and post instruments**

The next section will showcase quotes obtained from interviews that were conducted to the first eight participants that were interviewed. These participants were users who had successfully finished the MOOC they enrolled to. For privacy reasons, their real names have been modified and they have been assigned a code name, starting with the letter A and finishing with the letter H.

The results obtained for each category that was defined and illustrated previously will be presented in the following tables.

Table 238

*About the Participant's Background – Users who finished the MOOC*

Code	Coded segments
Participant's Background	<p>I am currently a tenured teacher in the University of Guayaquil, and I am working to earn my Ph.D. and my second university degree. Interview Participant A: 2</p> <p>Good afternoon, my name is Participant E (redacted). I am from La Paz, Bolivia. Interview Participant E: 2</p> <p>I am from Puebla, Mexico. I am 42 years old. Interview Participant G: 2 - 7</p> <p>My name is Participant H. I am from Ecuador. Interview Participant H: 2</p>
Previous and Current Studies	<p>Regarding my formation, my university degree was in mathematical physics, I earned my master's degree in Teaching about Physics, which is what I teach about the most at the university I currently work in. And, as I mentioned before, I am working to earn my Ph.D with the Dakota State University through an online approach. I am, at the same time, studying my college degree for Renewable Energies. The Ph.D I am enrolled in is related to one of the lines of research that the university I work for focuses a lot, which is Sustainable Development. Interview Participant A: 4</p> <p>I studied economy back in college and my current job is that of an economist who specializes in environment economy. Interview Participant B: 4</p> <p>I am a college student. I am studying chemical engineering and I am currently finishing my seventh semester in the University of Pachuca. I reside in Hidalgo, Mexico, but I was born in Michoacan. I am 21 years old. Interview Participant D: 2</p> <p>I am an engineer in telecommunications and currently work as the main manager in a small business that was created quite recently. It started in October of 2018 and it focuses on themes related to energy efficiency, renewable energies, and themes related to the environment. Before starting this small business, I worked in two other businesses that were from Spain who also focused in themes related to sustainable energy and the environment.</p>

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Interview Participant E: 3 - 4

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Job Occupation

I work in the department of industrial engineering of the university. I am a full-time teacher; I give classes about applied physics and I help run the laboratory in our department. I also give classes about the theme of electricity. Currently, I am giving a class about electronic energy in telecommunications.

Interview Participant A: 3

I currently work as the director of operations in Green Momentum, which focuses in the analysis of public policies, conditions in the market, and technological development of our country in order to train current talents and develop innovative solutions that might prove sustainable in the future.

Because my job as a director is to try and help my team develop better abilities for the future, I try to send out emails urging them to sign up to courses and trying to keep track of the newest courses available that might be of interest for the younger generations.

Interview Participant B: 5 - 56

I work in the development of teaching material focused in sustainability. I also give classes and run workshops in order to certify people to teach about the importance of clean water and to each about the environment.

I also work as a consultant for various businesses in order to guarantee that their practices are pro-sustainability.

I give classes in a local university about sustainability, and I believe that is one of the most pro-sustainability a person can do, raise awareness about this topic with future generations.

Interview Participant C: 3 - 4 - 23

I am an engineer in telecommunications and currently work as the main manager in a small business that was created quite recently. It started in October of 2018 and it focuses on themes related to energy efficiency, renewable energies, and themes related to the environment.

Interview Participant E: 3

I am currently a Consultant in Energy and Climate Change. My job is to carry out market intelligence tasks, as well as public policy recommendations for the public and private sector. In energy matters, I specialize in renewable energies and enablers in the Mexican electricity market.

It is also part of my job to keep up to date with the evaluation of these issues, especially in cases where it relates to clean electric energy.

Interview Participant F: 2- 29

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Table 239

*MOOC Participants Enrolled to – Users who finished the MOOC*

Code	Coded segments
MOOC Participants Enrolled to	<p>The course I took was about Clean Energies. Interview Participant A: 6</p> <p>I remember the name of the course, it was: Energy Markets in Mexico: Opportunities for Business. I took the course, completed all of it and I even paid for the official certificate of the course. I wanted the official certificate because I strongly believe it will be a great asset for my curriculum. Interview Participant B: 13 - 15</p> <p>Yes, I remember the course I signed up to. The title of it was "Energy Savings" or something like that. I found out about this course because I am subscribed in the platform of EdX and I asked to be notified whenever there were new courses that touched upon the subject of energy saving or sustainability. So, I got an email address about there being a new course, and I decided to sign up to it. Interview Participant C: 6 - 7</p> <p>I was enrolled in three courses: Conventional and Clean Energies and their Technology, Electric Energy and Energy Saving. I took these three courses in order to earn the credit of a subject I am taking in my program titled: Electric Engineering I found out about these MOOCs because 2 years ago, a professor told us about online platforms and made us subscribe to a course in order to earn the credit of his topic. Interview Participant D: 4 - 5</p> <p>I remember the course I signed up, it was the "Energy Saving" course, in the platform EdX. I found out about this course through a friend, who works in a business who uses the EdX platform a lot in order to give training to their employees. My friend recommended this course to me because he knew that I was looking for courses that talked about Energy Saving. I had been seeking more traditional "in person" courses, but I had been unable to find a lot of options. So, my friend, knowing I was</p>

seeking to learn about this topic, recommended this online course to me.

Interview Participant E: 6 - 7 - 8

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Table 240

*Participant's Motivation to Enroll – Users who finished the MOOC*

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Code	Coded segments
Motivation	<p>I took it because the courses are generally online and they allow you to open and work on them in your own pace, at your own time. You are free to access them very early in the morning, or during your specific break or lunch hour in the afternoon... or even very late at night, just before going to sleep. This was important to me, because as I mentioned before, I am currently working in a tenure track, fighting to earn my Ph.D. and also finishing my second university degree at the same time. So, having the flexibility to enroll and take the course at my own pace was a very strong motivation.</p> <p>I was interested in the topic of the course because I am currently working on studying themes regarding renewable energy and I have to show samples or evidence that I enrolled in activities which are related to this topic. These activities can be seminars, congresses, or online courses. So, for my work, this was a valuable opportunity for me, since it would make my list of evidences that I was keeping up with the newest trends of this topic longer.</p> <p>In my case, I had the need to earn knowledge about this topic and seeing how this can be related to my own research project proved useful.</p> <p>Interview Participant A: 7 - 8 - 75</p> <p>The title caught my attention. The fact that they mentioned my country in the title definitely was a key factor that pulled me in.</p> <p>I took the course, completed all of it and I even paid for the official certificate of the course. I wanted the official certificate because I strongly believe it will be a great asset for my curriculum.</p> <p>Because my job as a director is to try and help my team develop better abilities for the future, I try to send out emails urging them to sign up to courses and trying to keep track of the newest courses available that might be of interest for the younger generations.</p> <p>Interview Participant B: 15 - 56</p>

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One big motivation that helped me decide to sign up to this course was that the university that created the course is very well known in my country, it is considered one of the most prestigious and expensive universities in Latin America. So, I truly thought that the opportunity of taking a course that was designed by the team of this university was something I needed to try.

Another reason I was motivated to sign up to this course was because it was directly related to my field of work. As I mentioned before, I design teaching material that focuses on sustainability. And energy is a very important element for this topic. So, I thought it would be wise to deepen my knowledge regarding this topic.

I dedicate myself a hundred percent to creating teaching material that touches upon the topic of sustainability, that is my line of work. My personal business is about this, so I find it really necessary that I involve myself in curricular and extracurricular activities that teach about this subject so that I can keep updated on the newest trends.

Interview Participant C: 9 – 10 - 13

The main motivation for enrolling was because my professor said that it was a requirement in order to earn full marks in his class. And well... more than enrolling because I really wanted to, I was sort of forced to.

Interview Participant D: 6

There were a lot of reasons I was motivated to enroll in this course. The first one that comes to mind is that I am currently studying to earn my PhD and the main topic of my research is regarding sustainable development. This PhD is about Geography and Tourism, but I am the one who decided in the topic of sustainable development for my thesis.

On the other hand, the university where I work from, they request to receive evidence and reports every now and then, demonstrating that the professors are making a continuous effort to train themselves with the newest information available out there. So, when I took this course, I knew that in the end I would be able to add it to my report as part of my curriculum.

I also felt motivated because the course itself was free, and the certificate at the end had an accessible price for me.

The information would've been valuable to me and I knew that it would be well received in my job. Seemed like a two birds one stone kind of situation.

Interview Participant H: 7 – 8 - 10 - 11



*Participant's Previous Familiarity or Knowledge of the MOOC Topic – Users who finished the MOOC*

<b>Code</b>	<b>Coded segments</b>
Previous Familiarity Knowledge	<p>I did take one course previously that touched upon the topic of sustainable development, it was a course that was being promoted by the government of Argentina. This course was also certified by the UN. I also have experience learning about SDGs, but not in a MOOC but it was a course that I took in person, here in Mexico City, that was run by the World Energy Council.</p> <p>I have participated in a lot of courses that I took in person which were more focused on the energy sector, but of course, because of the context that they apply, one way or another they bring up the topic of sustainability.</p> <p>When I specialized in environmental economics, I had to take one class that touched upon the topic of sustainability. I think the title of the class was: sustainable development or something of the sort. So yes, I had previous curricular formation regarding this topic. Interview Participant B: 17 – 20 – 21 - 23</p> <p>This was my second MOOC I enrolled in that touched upon the subject of energy saving.</p> <p>Yes, I have participated in workshops, seminars, curricular activities and extracurricular activities that involve the theme of sustainability. Interview Participant C: 8 - 12</p> <p>Before signing up to the course, I was very knowledgeable about the subject. A lot of the topics that were touched upon are things that I work with daily in my work activities. I studied all my life on this topic and now I work in things related to it. Interview Participant F: 8</p> <p>Let's say I was already familiarized, but I wouldn't consider myself an expert in the field. Specially with the topic related to the energy reform in Mexico, which was one of the main elements that was brought up a lot during the course I signed up to. Interview Participant G: 9</p>

Table 242

*Participant's Previous Experiences – Users who finished the MOOC*

<b>Code</b>	<b>Coded segments</b>
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Previous experiences (MOOCs, extracurricular, curricular)

No, I had previously signed up to some courses in the EdX platform, but they were from the University of Valencia and they were about Physics, Mechanics, Qualitative Analysis and Statistics. This was the first MOOC I signed up to that touched upon the theme of sustainability.

Interview Participant A: 12

I had previously taken some courses in EdX, but they were all courses focused in a more global approach.

I did take one course previously that touched upon the topic of sustainable development, it was a course that was being promoted by the government of Argentina. This course was also certified by the UN.

Interview Participant B: 11 - 17

I had then, taken curricular classes upon the topic and, as I mentioned before, two years ago I got involved with online courses because one of my professors made it a requirement in order to pass his class. I took three courses this semester because that was the imposed requirement in order to earn full marks in his course. I had no extracurricular or seminars that touched upon the subject, but I guess I see a lot of it in class formally already, it's not necessarily a bad thing.

Interview Participant D: 8

Regarding my level of familiarity with the main theme of the course, I had taken some graduate programs in order to learn about the topic. I had also taken some courses in person regarding the topic, so it wasn't like I had zero knowledge about the subject. I would say I was moderately knowledgeable about the course content when I signed up.

Interview Participant E: 11

However, I admit that I have already taken several online courses in the EdX platform that touch upon similar subjects.

I had taken several courses before. One of them was specifically about sustainable development and the other one was for project directing.

I have participated in some workshops, and I do my best to attend to big conferences that touch upon the subject of Renewable Energies, because that is something that is related to the topic of my business.

Interview Participant G: 5 - 11 - 13

No, this was my first MOOC ever. I hadn't enrolled in a MOOC before.

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I had taken some courses in person, both in curricular and extracurricular scenarios. In June of 2018 I went to Bali, where I took a summer course regarding tourism and sustainability  
 Interview Participant H: 13 - 15

Table 243

*First words related to “sustainability” – Users who finished the MOOC*

<b>Code</b>	<b>Coded segments</b>
First three words they relate to "Sustainability"	Environment, Natural resources, and Sustainable Conducts Interview Participant A: 18
	Environment, Well-being, and Growth. Interview Participant B: 25
	Responsibility, Economy, and Natural Resources Interview Participant C: 15
	Saving, Environment, Energy Interview Participant D: 10
	Balance, Conservation, Future Interview Participant E: 13
	Prosperity, Economy, and Citizenship Interview Participant F: 13
	Responsibility, Growth, Harmony Interview Participant G: 15
	Environment, Community, Society Interview Participant H: 17

Table 244

*About Sustainable Development Goals – Users who finished the MOOC*

<b>Code</b>	<b>Coded segments</b>
Sustainable Development Goals	In our university, the line of research about sustainability has touched upon this topic a little bit. I would not say I am an expert on the topic, but I do know that some of the goals that have been defined include taking care of the environment, reduce poverty and the responsible use of natural resources. I also think that they should touch up on more

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about sustainable conducts of the people, try to motivate the people around the world to take better care of the environment or stuff like that.

Interview Participant A: 20

I also have experience learning about SDGs, but not in a MOOC but it was a course that I took in person, here in Mexico City, that was run by the World Energy Council.

Interview Participant B: 20

Based on the 17 objectives, I developed some graphics that show the titles and the main objectives of each objective. Each participant, which are normally 17, are given information about one objective each and they have to research and explain the objective they were assigned to their peers. They also have to talk about which objective is related to the objective they were assigned, so they start talking about ways to collaborate or come up with new ideas to accomplish the objectives that were settled. They also talk about applying the objective that they were assigned to their daily life or relate it to their profession or their studies. All of these with the objective of demonstrating that the 17 objectives can be applied to everyone and that we need to raise awareness about what they are and how to achieve them.

Interview Participant C: 19

When I started my career as a professor in 2015, I learned about the Objectives for the Millennium. I was studying for my master's and one of my classes was titled "Cooperation for Development" and it was in this class where I was first presented with the SDGs. I did my best to learn about these objectives a lot, in order to train my students about this topic as well. I would say it was a two-way street. Not only am I trying to share this knowledge with my students, but they are giving me an opportunity to compromise more with the objectives and put them to action in my personal and professional life.

For example, if they are going to teach about the sustainable development goals, maybe they should enlist the goals that are defined but also enlist all the positive changes and the positive impacts that have already taken place. Why? Because I think that it is key to give users a sense of hope, a sense that these goals are reachable, that they are not just thought up by people who want to see a better world but that are not putting in any effort to see these changes happen. In other words, we need to present users with real life scenarios that will help them feel inspired, motivated and that their goals are not out of reach.

Interview Participant H: 19 - 31

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Code	Coded segments
<p>Pro-Sustainability Practices in their daily lives</p> <p>Activities others do</p>	<p>Currently, in our country, which is Ecuador, anything related to the topic of recycling and stuff like that is not something we see a lot in our communities.</p> <p>Normally, users just place the garbage in a single bag, they don't divide the trash.</p> <p>In the area where I live, there are some persons who have taken the role of "chamberos", which means they go through the trash and try to divide water bottles, plastics, glass and so on so that they can sell them and make a profit out of that.</p> <p>Not all my neighbors take the time to try and divide their trash like I do.</p> <p>Interview Participant A: 22- 23 - 26 - 28</p> <p>For example, me as an economist, I would think that the most important drive and way in which you can help take actions that are pro-sustainable, would be to observe your spending patterns, keep an eye out of what you are consuming, how often, and how much.</p> <p>Interview Participant B: 28</p> <p>After living this period of having no trash picked up, more people became aware of the topic and they realized that if they separated their trash properly, then it would make things easier for the people that pick up the trash. And ever since, more awareness has raised and more people in my community have taken it upon themselves to divide the trash at home.</p> <p>Interview Participant E: 22</p> <p>One of my friends also stopped using one use only plastics at her bakery and I admire her for that.</p> <p>Interview Participant H: 25</p>
<p>Pro-Sustainability Practices in their daily lives</p> <p>Activities they do</p>	<p>In my case, however, we try to help by other means. For example, I try my best to keep the use of electricity and water as low as possible in my personal home.</p> <p>Regarding waste, we are trying to start recycling campaigns.</p> <p>Because I know that they will go through my trash, I try to help out by trying to divide the garbage and putting the water bottles or glass bottles in their own garbage bag. I also do this because I rather they don't go through my trash and contaminate the environment by opening mixed up garbage bags.</p>

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But I teach in my home that it is worth the extra effort. It is our attempt to cooperate to the main goal, somewhat. A better environment for everyone.

Interview Participant A: 24 – 25 – 27 - 29

I try to keep track of my consuming patterns and I try to avoid waste as much as I can. I also keep track of what the materials are in the purchases I make, and I try to look for the most environment friendly options when I am able to.

I also make little actions in my everyday life, like attempt to bring an Eco bag when I go the supermarket. I also use a bicycle to make my way to work. I don't buy things I don't need, and I avoid consuming things that are not necessary for my well-being.

But if I had to name it, I believe that the most important activity I do is try to raise awareness of the topic and educate others about the financial impact that their decisions make and how the environment policies play a role in our economic sector.

I promoted the MOOC I enrolled in by using my social media to share the signup page with my friends and family, to try and share the knowledge with others.

Interview Participant B: 29 - 32

There are not a lot of them, but for example, we have stopped using a gas boiler at home and instead use one that charges with solar energy. It has really helped us save on gas.

There are centers around here where you collect and turn in divided garbage, and you get a little money back. So, we do that. We also use rainwater to keep our garden, so whenever the rain falls, we do our best to collect all the rain water possible.

Speaking about water, there are some strict rules in my home regarding the use of water when we shower. We close the water when we are putting on soap or shampoo.

We don't use the car a lot, I try to transport myself through public transport mainly.

We use rechargeable batteries to avoid buying batteries over and over again.

We also try to save electricity by turning off the lights when we leave a room. And we have changed all of our light bulbs to the energy saving ones, which has reflected in a positive way in our electricity bill.

Interview Participant D: 14 – 16 – 17 – 18 – 19 – 20 - 21

At home, I live only with my mother, we recycle absolutely everything. We divide PET bottles, glass, and paper. We give the divided things to someone who wants to take them to a recycle center and earn a little money from that, so we are also helping someone out, albeit slightly.

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Another activity I do is that I always carry a reusable thermos with me everywhere to refill it with water. I don't want to purchase water bottles every time I get thirsty, so I always carry my thermos around with me. To be honest, I sometimes lose them. For example, this year (2019) I have already lost three. (laughter) But I do my best to not forget them and to always take it with me. I also have a metallic and bamboo straw in order to avoid using plastic ones.

And in my professional life, here in the university, we have started a campaign to talk about good practices that they could start applying to their everyday life and I have been very active in cooperating with other professors who are interested in the topic as well.

I strongly believe that my role as a professor and as a team member with the other university staff also counts as a pro-sustainable activity, because I am doing my best to educate future generations about the importance of recycling and other activities that in the long run, if applied by lots of people, will have a positive impact for the environment.

Interview Participant H: 21 – 22 – 23 - 24

Table 246

*Nature of the Challenges for Sustainable Development – Users who finished the MOOC*

Code	Coded segments
The nature of challenges for sustainable development	<p>In the case of my country, Ecuador, the basic needs of a person can't sometimes be covered by the very low income we have when we get paid and that includes the use of electricity. Someone who doesn't have a strong job or position might struggle to pay their electricity bill, because the prices go up, especially during the summer. So, people decided not to invest in electronic kitchens and relied on gas mostly to cover their day to day cooking needs.</p> <p>However, because the demand for gas rose so much, the government considered taking away the economical help they provided users to cover their gas bills to promote that people stopped using gas so much. In the end, they decided to not act upon it, because it would mean a political struggle and the society might riot or get angry with the political party in charge during the time, and that would mean that they would earn less votes the next time elections came up.</p> <p>So, as we can see, the two elements of social and economics are present in this case, but I do believe that society plays a more active role. I think that we should start working on educating people more about ecological approaches, campaigns that raise awareness and to present the society with possibilities so that they can be self-conscious about their role.</p>

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Interview Participant A: 34 - 38

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The nature of challenges for sustainable development  
Ecologic

Finally, I do think that the ecology plays a role as well, because depending on the type of environment and flora and fauna, each country faces different challenges. But I would say that compared to the other two, ecological nature would be the one with least impact on the challenges we have to face.

Interview Participant E: 28

If I had to pick one to focus on first, I would pick the ecological nature. The reason for this is because, in the end, we owe everything to the environment. In the end, we need clean water to drink, no matter how rich we are or how close our societies are. We need to take care of the ecosystems around us, we need to raise awareness about the importance of the environments that surround us.

Interview Participant H: 28

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The nature of challenges for sustainable development  
Social

I mainly think it is a social problem. People are not being taught about the importance of trying to be part of the solution. They are not aware about the impact they might have if they started taking care about the resources and the environment around them.

There was a social campaign that was run recently in my community, where we tried to raise awareness about the importance of saving energy. However, because the demand for gas rose so much, the government considered taking away the economical help they provided users to cover their gas bills to promote that people stopped using gas so much. In the end, they decided to not act upon it, because it would mean a political struggle and the society might riot or get angry with the political party in charge during the time, and that would mean that they would earn less votes the next time elections came up.

Interview Participant A: 31 - 33 – 35 - 36

I also believe that there is a lack of sensibilization for current generations about thinking in long term planation. Nowadays, people have a tendency to only worry about their needs and don't really stop to put themselves in the shoes of other human beings who might not be born yet, but that will probably struggle to try and keep a good quality of life, especially if we keep being careless about what we consume and what we build.

Thus, the government must get involved at some point. Because they have to provide their citizens with the tools so that we can co-create new models, new designs, not only in public policies, but in the development of infrastructure that is planning for long term solutions for everyone.

Both the societies and their governments need to cooperate in order to start these practices, in order to fight back towards the challenges that permit sustainable development to take place.

Interview Participant B: 39 - 40 - 41



However, I think that the issues are greatly involved with society, because in the end all of us are involved. Sometimes, we like to point at the government and say that it is all their fault, when in reality one as their person can decide to start making changes in their daily lives.

Interview Participant D: 24

However, if I had to list them by order of priority, I would have to say that first and foremost, it is a social problem. Society is not aware and conscious about the importance of sustainable development. We need to work in educating people about this topic.

And in order to educate young ones about this topic, we need to invest in resources, courses, teachers and research.

Interview Participant E: 25 - 26

However, if I had to point one as the one with more impact and importance, it would have to be the social approach and nature. A large part of the problems that sustainable development faces are related to environmental awareness and education in the population, since if it were to a greater or more homogeneous degree around the world, the ecological problems could possibly be less as a result of more decision-making procedures and public awareness. So yes, I definitely think society plays a heavier role.

Interview Participant F: 25

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The nature of challenges for sustainable development  
Economic

I also consider that economically, our country is having some hardships that make them unable to invest in educating future generations about this topic, since they have to resolve other crisis before that.

In the case of my country, Ecuador, the basic needs of a person can't sometimes be covered by the very low income we have when we get paid and that includes the use of electricity. Someone who doesn't have a strong job or position might struggle to pay their electricity bill, because the prices go up, especially during the summer. So, people decided not to invest in electronic kitchens and relied on gas mostly to cover their day to day cooking needs.

However, because the demand for gas rose so much, the government considered taking away they economical help they provided users to cover their gas bills to promote that people stopped using gas so much.

So, as we can see, the two elements of social and economics are present in this case, but I do believe that society plays a more active role.

Interview Participant A: 32 – 34 - 35 - 37

I believe the problem arose hundreds of years of a broken system that have been replicated and applied over and over again. An economic system that focuses mainly on consumism and not on the impact that these sorts of practices have in the long-term run.

I strongly think that there is a lot of misinformation out there that makes people believe that in order to create infrastructure and movements that

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might be pro-sustainability, that immediately means that the solution is going to be expensive. There would be actually economic gains for the population because of how much we would save if we implemented measures that took better advantage of renewable energies, for example. The cost of doing nothing actually ends up being more expensive in the long run.

Interview Participant B: 38 - 42

I strongly believe that the challenges rely greatly in Economics. Money makes the world turn. Until it proves profitable to be sustainable in their bank accounts, it is highly unlikely that big businesses will care.

Interview Participant G: 24 - 26

Table 247

*Desire to research more about sustainability – Users who finished the MOOC*

Code	Coded segments
Desire to research more about sustainability	<p>Yes. I believe that sustainable development is a topic that involves a lot of different types of people and jobs, and even though the course I enrolled in touched a little bit about this subject, it is a topic that is relevant and active worldwide right now, so I was curious enough to research a little but more about it and I am glad I did.</p> <p>Interview Participant A: 40</p> <p>I think that the course helped me raise my awareness and made me start keeping an eye out for any news that would come up in my Newsfeed regarding the efforts that are taking place around the world to make sustainable development become the norm and not necessarily the exception. I do think that if someone offered to teach me more about the topic, I would definitely sign up.</p> <p>Interview Participant D: 26</p> <p>Of course, I was interested in looking for more information. Thanks to the course, I realized that there was still a lot of things I knew nothing about, which means that I have to start educating myself more on the topic, definitely.</p> <p>As I explained before, my personal business is one of the very few in Bolivia who is centralizing their main objectives of working as a consulting force in order to recommend more sustainable approaches to other entities. And in order to give the best counseling available, we need to have the best information at our reach, to educate ourselves and the staff.</p> <p>It is our future we are talking about too. We need to take care of our planet, which has given us everything we need in order to survive. I</p>

think we need to really do our part in making a change for the better in the long run.

Interview Participant E: 31 – 32 – 33 - 34

Definitely felt the need to look for more information regarding this topic.

Professionally, it is a career, or, better said, one of the careers or specialties with the most impact in this near future.

It is also part of my job to keep up to date with the evaluation of these issues, especially in cases where it relates to clean electric energy.

Additionally, part of the responsibility that the informed communities may have is to viralize or retransmit what has been learned to other less informed sectors in order to maintain a constant awareness campaign, at least in my opinion. So, I always look forward to actualizing my current knowledge, so that I have better information to share with others in the long run.

Interview Participant F: 27 - 28 – 29 - 30

I didn't really feel an urge to research or learn much more about the topic of the course. I felt like my knowledge was good enough for my needs.

Interview Participant G: 28

Table 248

*Recommendations for future online courses – Users who finished the MOOC*

Code	Coded segments
Recommendations for future online courses	<p>I consider that it is key to make a study to determine the profile of the end user of the course. In other words, to take in consideration who the course is being developed for.</p> <p>So, I believe that it is very important that before designing the course, the people behind it are able to decide who their public is and try to provide an interesting and challenging level depending on who they are designing for.</p> <p>Interview Participant A: 42 - 45</p>
Spread the word	<p>First of all, I think that a big area of opportunity online courses is to even notify people that they exist. There are a lot of people out there who just assume that if it's an online course they might charge you for them, and they don't realize that they can sign up for free and then pay for the certificate if they are really committed and want the evidence.</p> <p>But I really do think that the people creating the courses should do a better job at telling the world about these courses.</p>

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And if social media is used, then more people will get to know about the courses and the diffusion and use of them would increase as well.

I think that my last comment is to reinforce what I already mentioned before: I think the course as very good, but the area that it lacks is to share its existence with more people.

Interview Participant D: 28 – 30 - 39 - 46

Definitely, I think that they need to promote their courses more. I didn't find out about these online courses because of an ad or social media, I found it because of a friend. I got lucky. And also, he only mentioned it to me because I shared with him my wish to learn more about the topic in the first place. But I bet that there are a lot of people out there who would really benefit from courses like this and yet they are not aware that they can access them for free because there is no diffusion about the topic.

Finally, to share the fact that these courses exist in the first place is my main recommendation, spread the word that there are courses out there.

Some years ago, when I was in college, I had absolutely no idea that this type of tools existed. I, gratefully, found out about them after I started working, but I believe that was in great part because of my luck. So now, I urge that they tell the world that their courses are out there.

I believe that MOOCs also have a big area of opportunities, little factors they need to work on. For example, I believe that their strategy to spread knowledge is limited to only people that are signed up to the platform and that actually enroll in a class. I think that maybe they could share infographics or other more summarized and flashy ways to share information, like pictures or videos, that can become easily shareable and that can also motivate a normal person that normally doesn't sign up to courses online to feel inclined to give this specific course a chance. In other words, they need to work on the way they promote themselves and what they can offer.

Interview Participant F: 34- 35 – 36 – 37- 51

I think that the platform is already amazing. If anything, I would recommend that they spread the word about the available courses more. Motivate people to enroll.

Interview Participant G: 30

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Human to Human  
Interactions

Another factor that I believe would help to make the online courses more engaging and better would be to give more activities where participants have to collaborate or engage in conversation or debate. Otherwise, the whole process of taking the course feels very systematic and even robotic. Adding a bit of human to human

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interaction might help warm things up and keep the engagement flowing.

Interview Participant C: 32

If more people enroll, then the conversations in the open forums would be more engaging and fun.

Interview Participant G: 31

Yes, and I also think that they should add more interactions between users, so that everyone can share their sustainable practices in their daily lives, to share information and receive positive feedback between them

Interview Participant H: 33

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Practical/Real life application of information

I think that the MOOC I enrolled in was very good, it helped me realize that my consumption of gas through electricity was very high, and after I did research about this topic, I found out that the gas company was actually over charging me. So, I think that to keep using information about real life and more practical things that anyone can relate to is valuable, because, honestly, who doesn't have to pay for gas?

To include tips that you can apply in your daily life would be really interesting. Maybe some random trivia or facts that maybe you can share with your friends and family later on, too.

Interview Participant C: 29 - 31

I think that the most attractive options to capture the attention of the users would be to use real life cases, to present which have been the challenges out there and what solutions have been applied and the results that they had. I don't know how to explain this, but I definitely think that the best approach would be to teach with examples.

Interview Participant E: 41

It would also fun to see real life information, like for example what it takes to create a PET bottle and how long it actually takes for the bottle to stop affecting our environment or some interesting trivia like that to raise awareness of the impact that it has when we buy things in certain presentation formats.

Interview Participant G: 39

I would say that the best recommendation would be to use real, successful and recent cases that can be applied in the learning process to familiarize participants to the topic of the course.

And that the course gave me functional and practical tips for my everyday life that didn't require me spending a ton of money in order to make more sustainable choices.

Interview Participant H: 30 - 38

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Evaluation	<p>I also believe that one of the reasons I didn't enjoy the MOOC I enrolled in was the format that they presented in order to evaluate if we were learning or not. The routine was the same for every topic of the course: Read this document, watch this video and then answer a couple of multiple answer questions. This system was ridiculously easy, at least in my case. Sometimes I didn't even need to read the document or watch the whole video in order to answer the multiple-choice questions and get them right.</p> <p>A more ambitious evaluating process would help me feel more engaged and with a sense of accomplishment.</p> <p>Interview Participant B: 45 - 47</p>
Less challenging	<p>However, I am sure there are other people who are not in the same academic level who might struggle if they try to tackle this kind of course without any previous formation in the topic.</p> <p>Interview Participant A: 44</p> <p>There were some portions of the MOOC that I found to be a little bit too hard, for example, there were some math formulas we had to use in order to calculate how much energy we were spending or something of the sort. And honestly, math is not my strongest point. So, they just gave me a very complicated formula I couldn't really understand. So maybe adding some examples or a step by step explanation of how to use the formula, might be useful for future implementations.</p> <p>Interview Participant C: 30</p> <p>On the other hand, I think that they should segment better the profile of the participants that join. In my case, I was a little familiarized with the topic, but there are other people out there who are experts on the topic, or who might have never heard about it and that need a slower introduction to the material. If the courses took in consideration the different types of users, I think that it could become a better experience for the learners.</p> <p>Interview Participant E: 39</p>
More challenging	<p>For example, I work with university students and I am currently working hard to earn my Ph.D. in a topic related to energy, it would be more attractive if the MOOC I signed up to had more advanced and higher level of difficulty so that I would actually learn about things I was not aware of before I signed up.</p> <p>So, I believe that it is very important that before designing the course, the people behind it are able to decide who their public is and try to provide an interesting and challenging level depending on who they are designing for.</p> <p>I also believe that another key point that would help MOOCs become a more relevant education tool would be if they constantly</p>

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give you the chance to prove to yourself that you are learning something.

Interview Participant A: 43 – 45 - 71

Sincerely, I think that the course I enrolled to wasn't good. The level was very basic for me, so it was a little bit boring. It felt more like a chore than an actual learning process.

I also believe that one of the reasons I didn't enjoy the MOOC I enrolled in was the format that they presented in order to evaluate if we were learning or not. The routine was the same for every topic of the course: Read this document, watch this video and then answer a couple of multiple answer questions. This system was ridiculously easy, at least in my case. Sometimes I didn't even need to read the document or watch the whole video in order to answer the multiple-choice questions and get them right.

And so, I strongly believe that a recommendation I would give for future designing and running of courses like this would be to set the bar higher, to actually do a little more research and share with the public more complex and challenging information to process, think, and learn.

A more ambitious evaluating process would help me feel more engaged and with a sense of accomplishment.

Interview Participant B: 44 – 45 - 46 - 47

On the other hand, I think that they should segment better the profile of the participants that join. In my case, I was a little familiarized with the topic, but there are other people out there who are experts on the topic, or who might have never heard about it and that need a slower introduction to the material. If the courses took in consideration the different types of users, I think that it could become a better experience for the learners.

Interview Participant E: 39

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Table 249

*Global Cooperation Strategies for Sustainable Development – Users who finished the MOOC*

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<b>Code</b>	<b>Coded segments</b>
Global Cooperation Strategies for Sustainable Development	And finally, an attractive element that I would enjoy would be if somehow, they involved international collaboration to the mix. Interview Participant E: 43

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<p>International and National Projects Participants Have</p>	<p>Luckily, we have had the opportunity to collaborate with the German government regarding these themes, and we have also established contact with the development department of the United States of America.</p> <p>We have also collaborated with different government entities in Mexico, for example, we have worked with the government of Jalisco, Puebla, Queretaro and others.</p> <p>We are currently working in an international project regarding Chile, Brazil, Uruguay and Mexico.</p> <p>Interview Participant B: 6 – 7 - 8</p> <p>Government collaboration between countries who have a more developed technology and strategies that spread the word about the use of sustainable development with countries who maybe are just starting off in this topic.</p> <p>Interview Participant E: 55</p> <p>Technical and economic cooperation through international treaties would be great.</p> <p>Interview Participant F: 41</p>
<p>Real life case studies</p>	<p>In my case, it was interesting to see the efforts to educate about this topic in other countries, in this case, the country of Mexico, and how the case studies they used during the course were applied to their own cities but reflected scenarios that have also presented themselves in my country, Ecuador. It helped me realize that I could help my country if I took in consideration the approaches that they were using in Mexico to educate about sustainable development.</p> <p>Interview Participant A: 77</p> <p>One way in which I think it could prove beneficial to share what is happening in our efforts to come up with worldwide collaborations would be to use the Internet as a platform to share news about the topic. Share real life situations online and ask for participants to share this website or forum with their friends and family. Make talking about this subject something normal. Not treat it only as a school only topic, because it really isn't. It's affecting all of our lives.</p> <p>Interview Participant C: 37</p> <p>I think that the most attractive options to capture the attention of the users would be to use real life cases, to present which have been the challenges out there and what solutions have been applied and the results that they had. I don't know how to explain this, but I definitely think that the best approach would be to teach with examples.</p> <p>Interview Participant E: 41</p>



Government collaboration	<p>However, I do believe that some governments that are currently in charge are not giving it the importance that they should. And maybe, the voices of the citizens and their concerns should be listened to more in order to change this.</p> <p>Another key point, I believe, involves us educating future generations about this topic. The government should promote this type of education and practices in the society they work for.</p> <p>There should be international collaboration, making governments compromise and agree on ways to promote the education for sustainable development agenda.</p> <p>Maybe the government should make it mandatory that some workers in businesses take online courses regarding education for sustainable development, at least just to help raise awareness.</p> <p>Interview Participant A: 49 – 52 - 53 - 86</p>
	<p>Thus, the government must get involved at some point. Because they have to provide their citizens with the tools so that we can co-create new models, new designs, not only in public policies, but in the development of infrastructure that is planning for long term solutions for everyone.</p> <p>Both the societies and their governments need to cooperate in order to start these practices, in order to fight back towards the challenges that permit sustainable development to take place.</p> <p>Interview Participant B: 40</p>
	<p>I think political policies are key in order to start cooperation strategies worldwide that touch upon the topic of education for sustainable development. Each government needs to sit down and analyze the situation their country is in, in order to start implementing the changes and the collaborations that will be key in making changes in our societies.</p> <p>Interview Participant C: 35</p>
	<p>For me personally, I think that the countries who are more advanced in technology can create collaborations in order to share their findings and technology with less developed countries.</p> <p>Interview Participant D: 32</p>
	<p>To invest in local talent who might be willing to share their own discoveries or inventions that have a sustainable approach would be amazing too, but that would require the government to get involved and to be willing to actually invest some money in these efforts.</p> <p>Interview Participant F: 42</p>
Educate future generations	<p>Another key point, I believe, involves us educating future generations about this topic. The government should promote this type of education and practices in the society they work for.</p>

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There should be international collaboration, making governments compromise and agree on ways to promote the education for sustainable development agenda.

Meanwhile, maybe we could start a project by starting such cases of collaboration to teach about sustainable development in universities. We should start a collaboration between universities, where we share the resources that we have created upon this topic and compare cases in which they are having success or what is working in different societies of the world, so that they can start applying in their own societies.

Interview Participant A: 52 - 53 - 54

I also believe that there is a lack of sensibilization for current generations about thinking in long term planation. Nowadays, people have a tendency to only worry about their needs and don't really stop to put themselves in the shoes of other human beings who might not be born yet, but that will probably struggle to try and keep a good quality of life, especially if we keep being careless about what we consume and what we build.

Interview Participant B: 39

One way in which I think it could prove beneficial to difuse what is happening in our efforts to come up with worldwide collaborations would be to use the Internet as a platform to share news about the topic. Share real life situations online and ask for participants to share this website or forum with their friends and family. Make talking about this subject something normal. Not treat it only as a school only topic, because it really isn't. It's affecting all of our lives.

Interview Participant C: 37

I think that international treaties between countries who set the goal of educating more about these topics would be a good strategy.

Interview Participant H: 40

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Listen to the voice  
of citizens

However, I do believe that some governments that are currently in charge are not giving it the importance that they should. And maybe, the voices of the citizens and their concerns should be listened to more in order to change this.

Interview Participant A: 49

To invest in local talent who might be willing to share their own discoveries or inventions that have a sustainable approach would be amazing too, but that would require the government to get involved and to be willing to actually invest some money in these efforts.

Interview Participant F: 42

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Change of policies	<p>In my country, some people have suggested using thermo-energy, which I think would be great. However, all the volcanoes and things related to the nature are protected by old laws who are not updated and aware that we could find a use for that thermal energy, so I believe that revising old laws and trying to promote the use of renewable energies worldwide could really make a difference in the long run.</p>
	Interview Participant A: 51
	<p>Thus, the government must get involved at some point. Because they have to provide their citizens with the tools so that we can co-create new models, new designs, not only in public policies, but in the development of infrastructure that is planning for long term solutions for everyone.</p>
	Interview Participant B: 40
	<p>I think political policies are key in order to start cooperation strategies worldwide that touch upon the topic of education for sustainable development. Each government needs to sit down and analyze the situation their country is in, in order to start implementing the changes and the collaborations that will be key in making changes in our societies.</p>
	Interview Participant C: 35
	<p>I also think that we should start implementing new policies that promote the use of renewable energies globally, in order to start lowering the level of pollution around the world.</p>
	Interview Participant D: 33
Use of renewable energies	<p>There are some projects were people are proposing starting to replace the old ways to earn energy with better and renewable approaches.</p>
	<p>In my country, some people have suggested using thermo-energy, which I think would be great. However, all the volcanoes and things related to the nature are protected by old laws who are not updated and aware that we could find a use for that thermal energy, so I believe that revising old laws and trying to promote the use of renewable energies worldwide could really make a difference in the long run.</p>
	Interview Participant A: 50 - 51
Awareness Campaigns	<p>Regarding strategies to cooperate, from what I have seen, there are some people who have taken it upon themselves to start going in cleaning campaigns, especially regarding the oceans, which is a nice and important action to take.</p>
	Interview Participant A: 48

There is a need to raise awareness about what we are doing and how we are doing it. There might be efforts going on in our neighborhood, and we are not even aware of that. We need to raise awareness about the efforts that are being made and try to come up with ways in which we can keep people informed about them and give them the chance to collaborate in case they feel inclined to do so.

Interview Participant C: 36

Also, to make awareness campaigns that can motivate the society of all countries feel inclined to educate themselves on the topic

Interview Participant E: 56

Also, to raise awareness of younger generations through slogans or campaigns that might go "viral" would be a good strategy, too.

Interview Participant F: 43

I would also recommend some awareness campaign with young people, in order to teach them that even little actions, like trying to take a quick shower instead of just spending two hours in that process, could really help shape things in the future.

Interview Participant H: 41

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Conditions around the world	<p>Yes, it really is a struggle globally. Even though there are some countries who have started already trying to fight back, we can see that other countries are facing terrible levels of pollution and that is taking a toll in the quality of life of millions of people, all around the globe.</p> <p>Interview Participant A: 47</p>
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Table 250

*Attractive elements of MOOCs – Users who finished the MOOC*

Code	Coded segments
Attractive elements of MOOCs	<p>To be able to apply the knowledge that you obtained in the online course in your practical life is very satisfying, and it helped me raise awareness about the importance of the topic of sustainable development.</p> <p>Interview Participant A: 76</p>
Challenges	<p>I also think that a novelty or interesting approach would be to include some sort of social challenge in the course. For example, asking for users to upload three pictures where they are recycling, or using a reusable straw or other various fun activities that are pro sustainability, and then make them challenge their friends and</p>

	<p>families and sharing the results of that. Start a chain through fun and interactive challenges, that would be really interesting to see.</p> <p>Interview Participant H: 36</p>
Language Options	<p>Also, the few courses that I have seen that touch upon this subject have mainly been in English, so to be able to make content available in more than one language, so that it is also accessible to non-English speakers, would be great.</p> <p>Interview Participant F: 33</p> <p>I would also recommend that in any online website where they are sharing all of these efforts for the international cooperation, they make the content available in all the languages that all involved parties use. That is to say, sure, a lot of people can read and understand English and that is one of the reasons there is a lot of content out there that is in English... but I would feel more inclined to know that there will be Spanish, French, Italian or whatever language it is that they need to adapt so that even people that don't know English can be notified and can also become part of the solution.</p> <p>Interview Participant H: 43</p>
Team forming/ Teamwork	<p>Maybe if we could develop a system in which we can see the personality type of other participants and create teams or groups that can commit to collaborating through the course, that could help make the courses not feel like such a lonely process. Teamwork has always had a positive impact in my interaction with my students, and it would be really interesting to see that applied in online platforms as well.</p> <p>Interview Participant C: 46</p>
Evaluation ideas	<p>I took an online course through the UNAM university and you had to reply questions as you were watching the video in real time, and it didn't matter at what time you saw the video, if you wanted to, you could watch it at 3 am in the morning. But that way, they evaluated if you were paying attention to the video in real time and that affected your grade, you could only run the video once per participant and that meant that you had to be really paying attention, because your final score was affected by it. I think that evaluating the engagement and adding more practices like this, instead of just a standard multiple-choice question can be entertaining and challenging.</p> <p>Interview Participant C: 44</p>
Non attractive/Not recommended options	<p>I wouldn't recommend implementing very fancy and complicated things, like the use of virtual reality. Sometimes, you need other type of equipment so that such things can run successfully, and not everyone has access to that.</p>

Interview Participant C: 41	
Gamification	<p>For me, learning through gamification has been successful when dealing with my students, it seems to keep them engaged.</p> <p>Interview Participant C: 40</p>
Users Collaboration/ Interactions	<p>Another factor that I believe would help to make the online courses more engaging and better would be to give more activities where participants have to collaborate or engage in conversation or debate. Otherwise, the whole process of taking the course feels very systematic and even robotic. Adding a bit of human to human interaction might help warm things up and keep the engagement flowing.</p> <p>Interview Participant C: 32</p> <p>So, if we could receive guidance from experts in other countries, who have more experience and who can share with us the best advice and knowledge, that would be amazing. If you add in the factor that people could be from different countries and that gives it a more international view, I would find that to be very engaging and attractive as a user.</p> <p>Interview Participant E: 45</p>
Use of other tools/platforms	<p>One thing I really enjoyed in one course I took online, was that they gave me access to a tool that allowed me to see the tendencies around the world. Using other platforms or tools, such as the tool that was created by IRENA (International Renewable Energy Agency) really made me feel motivated and interested, because I realized that if I learned how to use this tool, I could apply it in other fields of my daily life, including my research. I found that so engaging and fun, I actually asked my whole team to take the course as well, and we all considered as a group that the teaching of how to use a specific tool was really useful and great.</p> <p>Interview Participant B: 52</p> <p>I also think that somehow MOOCs are meant to intertwine with social media more. Everyone is on social media nowadays. It would be neat that part of the course involved people making posts on Facebook that educate their friends and family about certain trivia, even if they are not the ones taking the course.</p> <p>I believe that MOOCs also have a big area of opportunities, little factors they need to work on. For example, I believe that their strategy to spread knowledge is limited to only people that are signed up to the platform and that actually enroll in a class. I think that maybe they could share infographics or other more summarized and flashy ways to share information, like pictures or videos, that can become easily shareable and that can also motivate a normal person that normally doesn't sign up to courses online to</p>

feel inclined to give this specific course a chance. In other words, they need to work on the way they promote themselves and what they can offer.

Interview Participant F: 39 - 51

The use of a tool in order to make people calculate the impact they have thanks to the lifestyle they have could be fun and an intuitive way to make participants more self-aware about the importance and impact of their role in society.

Interview Participant G: 33

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More people involved in teaching

Something I didn't enjoy about the course I signed up to, was that there was only one professor. It was the same guy over and over again in every single video. I found that to be frustrating and boring. If there were other people involved, maybe have other teachers who are expert in the theme share their perspective or their knowledge would help to keep things interesting and engaging.

Interview Participant B: 51

If big entities, universities or organizations collaborated to create new courses, I believe that there would be more interest in the participants to enroll and participate in such a course. In other words, have more professors involved in the teaching process, allowing experts to share the expertise of their field.

Interview Participant C: 33

This way, anyone can educate themselves with teachers and professors who were hired by the best universities in the continent. And that is amazing, that we can have access to the advice and the experience of such talented individuals that otherwise, we might have never met.

Interview Participant F: 50

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Use of case studies

In my case, it was interesting to see the efforts to educate about this topic in other countries, in this case, the country of Mexico, and how the case studies they used during the course were applied to their own cities but reflected scenarios that have also presented themselves in my country, Ecuador. It helped me realize that I could help my country if I took in consideration the approaches that they were using in Mexico to educate about sustainable development.

Interview Participant A: 77

I am currently trying to find courses that are more practical and use of real-life case studies, so that I can observe what is happening around the world regarding the themes I am interested in.

Interview Participant B: 50

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I think that applying real life cases in the course would be an amazing approach to raise awareness and also teach about this subject. Specially if the cases are landed in geographic locations that the participants can relate to.

Interview Participant C: 42

I think that real life cases, or case studies that maybe you can relate to because you can see it applied in your daily life would be something really nice that could make people become more invested in the topic.

Interview Participant D: 37

I would also like to hear about real life cases and solutions, specially to analyze the international advances that have been made worldwide regarding sustainable development.

Interview Participant F: 38

This way, anyone can educate themselves with teachers and professors who were hired by the best universities in the continent. And that is amazing, that we can have access to the advice and the experience of such talented individuals that otherwise, we might have never met.

Interview Participant F: 50

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Use of videos

The use of videos is also something I find interesting, because it helps the information to be shared with more interaction than just a wall of text. So, use of videos would be great.

And something very important that keeps me engaged or interested in a MOOC I signed up to, is that they use videos as part of their explanations.

Interview Participant A: 58 - 70

Regarding the use of video, I must confess that I find the use of videos to be great. I really think that the use of videos in online courses is amazing and I would have to say that if I got a say in future courses, I would specially request that they keep adding videos to the courses.

Interview Participant C: 43

I personally really like that they use videos. However, if the videos are too long, I find it harder to concentrate after a while, so maybe try to make the videos interesting or cut down into smaller segments.

Interview Participant E: 42

I think that the use of videos is always enjoyable.

Interview Participant F: 37

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Something that I really liked was the use of videos, as well.

Interview Participant H: 37

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Use of social  
media

I also think that involving social media in fun and interesting way would be an approach that could help younger generations get involved.

Interview Participant A: 57

I promoted the MOOC I enrolled in by using my social media to share the signup page with my friends and family, to try and share the knowledge with others.

Interview Participant B: 32

The use of social media I believe would also make future generations feel interested. Maybe we could challenge students to make Snapchats or TikToks related to the topic and if we get lucky, one might go viral and start a movement. You never know with young generations nowadays.

Interview Participant C: 45

But mostly, I think that a big area of opportunity would be to get social media involved with these courses, and make participants use their Instagram or Facebook accounts to share what they are learning in their online class. Nowadays, everyone has a Facebook, so it wouldn't leave anyone out of the fun.

And if social media is used, then more people will get to know about the courses and the diffusion and use of them would increase as well.

Interview Participant D: 38 - 39

I also think that somehow MOOCs are meant to intertwine with social media more. Everyone is on social media nowadays. It would be neat that part of the course involved people making posts on Facebook that educate their friends and family about certain trivia, even if they are not the ones taking the course.

I believe that MOOCs also have a big area of opportunities, little factors they need to work on. For example, I believe that their strategy to spread knowledge is limited to only people that are signed up to the platform and that actually enroll in a class. I think that maybe they could share infographics or other more summarized and flashy ways to share information, like pictures or videos, that can become easily shareable and that can also motivate a normal person that normally doesn't sign up to courses online to feel inclined to give this specific course a chance. In other words, they need to work on the way they promote themselves and what they can offer.

Interview Participant F: 39 - 51

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Course content	<p>I think that it would be very useful if from the very start, the MOOC clarified the type of profile their course was designed for. In other words, that even before you sign up, you are aware about the level of complexity or challenges that you will be facing. Interview Participant A: 56</p> <p>The most important thing for me is the content. The tool that is used to share the content is also important, of course. But the core of the course is the content. Interview Participant B: 49</p> <p>To include tips that you can apply in your daily life would be really interesting. Maybe some random trivia or facts that maybe you can share with your friends and family later on, too. Interview Participant C: 31</p> <p>In my opinion, I consider there to be too few MOOCs that touch upon the topic of sustainable development and it would be really interesting to see MOOCs that decide to create content that focus specifically on that. Interview Participant F: 32</p> <p>I would really find it amazing if they found a way to transmit knowledge in a more visual way. I am a visual learner, so I think I would be very fond of the idea to see the content be shared in a more visual and maybe even graphic oriented way instead of just text after text. Interview Participant G: 38</p>
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Table 251

*Regarding Future Generations – Users who finished the MOOC*

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<b>Code</b>	<b>Coded segments</b>
Regarding future generations  Awareness of availability of knowledge	<p>But future generations, I think that they should become more aware of just how lucky they are, they should open their eyes and understand that they are in the best moment to be alive in order to educate themselves about any type of knowledge they want. Literally any question is just a google search away. And if they put in the extra effort, they can really take courses that were designed by top tier universities around the world. I believe that if the right promotion is made and younger people realize about the potential, future generations will definitely take better advantage of courses online. Interview Participant B: 57</p>

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Future generations have to realize that this is one of the most important topics they can learn about. It is as simple as planting the seeds in order to secure a better learning, growing and living environment for everyone in the future. They need to be made aware of the importance of this subject.

Interview Participant E: 49

Future generations should raise their awareness about the importance of their role and take factors in consideration that have an impact on their purchases or way of life.

Interview Participant F: 47

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Lack of motivation to take online courses

When I discovered MOOCs, I was surprised. I felt excited. I planned on taking thousands of courses. However, the people I work with... their average age is around 25. And I have noticed that there are two different types of personalities when it comes to online courses. Either they are like me and get super excited and motivated to complete as many courses as possible, because the knowledge is accessible and out there, and then there are other users who really struggle to feel motivated to even open the website in the first place.

Interview Participant B: 55

Sadly, I have seen that a lot of my students not really aware of the number of courses and opportunities that are available online. I strongly believe that if we raise awareness of all the information, they can have access to, we can get the ball rolling and get younger generations more involved with online learning.

Interview Participant C: 51

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Artificial Intelligence

A trend that I see in the future is that machine learning will help robots and other type of digital intelligence help students learn about diverse topics, which means that students won't have to rely on the one professor in order to advance in their studies. I truly believe that in the future, education will be more accessible because of this, and I would not be surprised if online courses became a very important trend in the field of education in the future.

Interview Participant A: 62 - 63

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Awareness of future generations

As we know, population is growing, and people are not being careful about the use of natural resources. So, I believe that future generations will not only want to learn about sustainable development, but their quality of life will be directly affected by the lack of it in case the societies don't start educating and acting now.

We should work in cultivating and raising awareness about the importance of sustainable development for everyone.

Interview Participant A: 61 - 64

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Obviously, the decisions that were taken in the past are no longer working for the generations of the present. And I think that we definitely need to start thinking of the generations of the future.

Interview Participant B: 61

We need to start working in making future generations worry about it and start looking for solutions for the future.

Interview Participant D: 35

Future generations have to realize that this is one of the most important topics they can learn about. It is as simple as planting the seeds in order to secure a better learning, growing and living environment for everyone in the future. They need to be made aware of the importance of this subject.

Interview Participant E: 49

Future generations should raise their awareness about the importance of their role and take factors in consideration that have an impact on their purchases or way of life.

Interview Participant F: 47

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Online Education

I consider that the long-distance education trend is evolving and taking up speed, especially because nowadays there are a lot of young people who don't have easy access to universities or courses in their proximity. Being able to log in online and be part of a program or a course is very attractive and with the passing of time, technology and the use of the Internet is becoming more and more accessible for others.

I would not be surprised if online courses became a very important trend in the field of education in the future.

And if the easier way to contact and promote this is online, I think a lot of efforts should be directed towards online platforms.

Interview Participant A: 60 - 63 - 65

I think that future generations should definitely dive deep into the MOOC world and explore all the resources and information that is available to them for free in various online platforms.

Interview Participant B: 54

I strongly believe that online education will become stronger in the future generations.

There are a lot of benefits to taking classes or courses online. I even consider that it is a sustainable activity to do, because you don't need to transport yourself anywhere, you have access to everything in the digital platform, so you don't need to waste paper or print out stuff. I strongly believe that there are many benefits to online education and with the passing of time, more and more people will start using it in our country. (Mexico)

Interview Participant C: 48 - 50

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Of course, I believe that future generations will take a lot of courses online. Actually, I strongly believe that whole world will be developing a lot in the next 50 years or so. I think that the tendency will be that more and more people will start using online learning as the norm.  
Interview Participant E: 47

Table 252

*MOOCs potential or lack of potential to teach about sustainable development – Users who finished the MOOC*

Code	Coded segments
MOOC's potential	<p>I believe that online education will become one of the most relevant and important approaches to educate young ones in the near future. Interview Participant F: 45</p>
MOOC's accessibility	<p>Yes, I believe MOOCs have a lot of potential to teach about this topic. As I mentioned before, I believe that MOOCs are a sustainable approach themselves. People can access it as long as they have Interview Participant C: 53</p> <p>Yes, I think future generations will take a lot of online courses. Even now, a lot of the classes and materials I go to can be accessed online. A lot of my professors even ask me to hand in my homework online, everything is turning digital. Even libraries are going online. With each passing day, the Internet is becoming more and more the best resource for information. So yes, I strongly believe that online courses will have a strong impact, especially because they are easy to access. All you need is wifi. Interview Participant D: 41</p> <p>Of course, I believe that future generations will take a lot of courses online. Actually, I strongly believe that whole world will be developing a lot in the next 50 years or so. I think that the tendency will be that more and more people will start using online learning as the norm. Definitely. MOOCs have a lot of transformative potential. I strongly believe they will play a vital role in teaching about sustainable development. Because they give access to information to people who are actively seeking new ways to learn about this topic, like is my case, I feel grateful that they have the potential to share this content with others easily.</p>

And not easily, they are free. So that opens up the door so that anyone who really has a strong interest in the topic can access the information with just an email account, which is fascinating to me.

Interview Participant E: 47–51- 52 -53

Future generations will, besides having access to all the new knowledge that is being generated today, a higher level of compromise with the environment, in my opinion. I believe MOOCs have great potential in teaching about this because all you need is a computer, a smartphone and access to the Internet in order to get access to high level of education material free of charge, unless you want the certificate, of course.

This way, anyone can educate themselves with teachers and professors who were hired by the best universities in the continent. And that is amazing, that we can have access to the advice and the experience of such talented individuals that otherwise, we might have never met.

Interview Participant F: 46 - 49 - 50

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MOOC's  
possibility to fail

However, I believe it is important to take notice that not all courses are going to be the best option for all the potential participants.

Interview Participant A: 82

Something that I think might maybe represent a challenge for MOOCs to be successful is that the participants need to have a certain level of commitment and discipline. In my case, it works because I take it seriously and really organize my agenda to attend to my online courses. But I completely understand that there are some people out there who have a hard time having this sort of practice.

Interview Participant C: 56

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Participant's Needs

I consider that it depends on the person who took the course, and what their needs are.

I also believe that they are attending the needs of participants to learn more about relevant topics that will have a positive impact in their daily lives.

We need to listen to the needs of the users, in order to give them the content they need in order to fulfill their education needs on the subject they wish to study.

Interview Participant A: 74 - 81 - 83

I strongly believe that as long as the MOOCs come up with topics that are engaging, transversal, and they try to develop topic in different levels so that different types of profiles can sign up and earn new knowledge, they should be successful in getting more people involved and interested in the topic of sustainable development.

Interview Participant B: 59

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I think MOOCs have a lot of potential, but we should remember that what defines if someone will enroll or not is based mainly because of their needs. Sure, there are some people that learn because they want to, like is my case, but there are other cases where users need a course because they have to prove that they know about a specific topic, their employees requires from them to prove that they are active in their learning process, or sometimes even a student might enroll simply because their homeroom teacher told them that the course was part of the program in their class. Everyone has different needs and purposes for enrolling, and I think that MOOCs should really concentrate in the participant's needs in order to be successful.

Interview Participant H: 47

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MOOC's retention In the end, it all comes down to the content and the ability the designers of the course have to keep people interested in the course.

Interview Participant A: 68

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MOOC's content I consider that the online courses, depending on their content, will have potential to educate about this topic or not. Content is everything for me. And something very important that keeps me engaged or interested in a MOOC I signed up to, is that they use videos as part of their explanations. That sense of growth and that the content is worth the effort are the key elements that I consider could help MOOCs become an important tool to educate about sustainable development.

I believe that MOOCs are developing very well. They are presenting topics that are relevant to the challenges that we are facing worldwide nowadays, and that can be useful for future generations as well, because these courses are archived and saved online for posterity.

Interview Participant A: 67 – 69 – 70 -72 - 80

I strongly believe that as long as the MOOCs come up with topics that are engaging, transversal, and they try to develop topic in different levels so that different types of profiles can sign up and earn new knowledge, they should be successful in getting more people involved and interested in the topic of sustainable development.

Interview Participant B: 59

I also think that MOOCs can help guide participants with notes or charts, some sort of accessible data that summarizes the main topics of the course and that can be accessible to any participant, allowing the knowledge to be shared easily.

Interview Participant C: 54

I think that the topic of sustainable development is transversal. It must be touched upon, no matter what one studies or what they work in.

Interview Participant E: 48

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Table 253

*Free comments – Users who finished the MOOC*

Code	Coded segments
Comments about their countries	<p>I believe that Mexico arrived late to the party when it comes to online courses and education. Interview Participant C: 49</p> <p>Sadly, in Mexico I think that we are way behind when it comes to raising awareness about sustainable development. Interview Participant D: 34</p> <p>I really believe that the topic of renewable energy has a lot of potential, especially in my country, Bolivia. There are not a lot of businesses out there who take this element into consideration, and I strongly believe that the first ones that do in my country will have a lot to show for it in the future. Recently, in Bolivia there was a problem in January 2019 where a lot of waste caused problems for the trash collectors, and they stopped picking up the trash for three to four weeks. This situation caused health hazards for the community. In my country, there is not a lot of information out there on this topic, Bolivia is in diapers when it comes to sustainable development. Interview Participant E: 10 -21 - 44</p> <p>In my city, all plastic bags are biodegradable, and all plastic bags are prohibited. Straws are not made out of plastic, but of paper. So, I think that if the governments started enforcing their communities to join these types of practices, we would start seeing a positive impact in our planet. Interview Participant H: 42</p>
Who to direct future MOOCs to	<p>Something I believe is lacking is to educate at the level of businesses, because those are the people that are out there making a difference or not in today's world. Maybe the government should make it mandatory that some workers in businesses take online courses regarding education for sustainable development, at least just to help raise awareness. Interview Participant A: 85 - 86</p> <p>Maybe we should start a network online, where we can debate and discuss about the future and the best ideas and approaches for future courses. And then, design courses for those participants who are really passionate about the topic. Interview Participant C: 58</p>



However, I also think that it is key that they start planning out better who they are going to create the courses for. Maybe they could make different types of courses depending on the area that the participants are studying, or their age group. Maybe they should think about focusing better on different options and profiles in the potential participants.

For example, a course that is thought out for children would be a really cool idea.

Interview Participant D: 42 - 43

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Ideas for future MOOC topics

I personally have been pondering about how to educate about sustainable development in middle school level, with younger people. I believe that if they made a course directed towards adults who teach children or younger people, a lot of benefit, for present and future generations, would take place.

Interview Participant A: 84

Also, an idea for a future MOOC that I think could be interesting if we want to raise awareness about the importance of sustainable development would involve creating a new MOOC that only touches upon the topic of sustainable development from a more basic and easy to understand point of view, rather than attempting to land it in such a specific market or field like is the case of energy.

Interview Participant G: 32

I would be super interested in seeing a future course that focuses in tourism and sustainability.

Interview Participant H: 49

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About the questions they answered

The questions you presented were very stimulating.

Interview Participant A: 79

Yes, and that is one of the reasons I was really looking forward to collaborating with you through this interview, because I strongly believe that it is an important topic that needs to be promoted more. So, I truly appreciate that your questions were greatly directed about future MOOC designs and new and interesting ways to try to keep participants engaged, it means that you guys in education are really trying to make things better and that is great.

Interview Participant B: 35 - 62

I would be very interested to read the results from your thesis, your questions were very interesting, and I would really appreciate if you share the product of your research with me.

Interview Participant G: 44

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## Results obtained from the interviews that were conducted

### Answers by participants who answered only the pre instruments

The next section will showcase quotes obtained from interviews that were conducted to the first eight participants that were interviewed. These participants were users who had successfully finished the MOOC they enrolled to. For privacy reasons, their real names have been modified and they have been assigned a code name, starting with the later J and finishing with the letter P.

The results obtained for each category that was defined and illustrated previously will be presented in the following tables.

Table 254

#### *About the Participant's Background – Users who didn't finish the MOOC*

Code	Coded segments
Participant's Background	I am from Uruguay and I am a college professor. Interview Participant J : 5
	Hello, nice to meet you. My name is Participant K. (redacted) I was born and live in Panama. Interview Participant K: 3
	My name is Participant M. (redacted) I am from Argentina. Interview Participant M: 3
	Hello, nice to meet you. My name is Participant N. (redacted) I am from Peru. Interview Participant N: 3
	Hello, nice to meet you. My name is Participant O. (redacted) I live in Salamanca, Spain. I am a full-time professor at a university here in Salamanca. I am also a researcher. Interview Participant O: 3
Previous and Current Studies	I just finished high school. I am currently a college student. Interview Participant I : 3
	I studied my Master's in Business Management around five years ago.

Interview Participant K: 5

I studied a technical career in natural sciences.

Interview Participant L: 4

I studied as an engineer back in college and my current occupation is that of a full-time job with a business that specializes in renewable energy.

Interview Participant N: 4

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Job Occupation	<p>I teach art, architecture and design. I also have my own business, but I have just started off, so I would say it is still a work in progress.</p> <p>Interview Participant J : 5</p> <p>I am currently working full time for a business that specializes in administrative planning, with a specialization in financial advice.</p> <p>Interview Participant K: 4</p> <p>I am currently unemployed.</p> <p>Interview Participant L: 5</p> <p>I studied natural sciences back in college and I own my own business. My main occupation is doing consultation jobs with schools and high schools about their green activities, so that they can say they are "doing their part" when it comes to "saving the planet", per say.</p> <p>Interview Participant M: 4</p>
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Table 255

*MOOC Participants Enrolled to – Users who didn't finish the MOOC*

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<b>Code</b>	<b>Coded segments</b>
MOOC Participants Enrolled to	<p>I remember I enrolled to a MOOC that taught about Energy Savings.</p> <p>I found out about this MOOC thanks to a Youtube Ad. It was a short video that ran before my favorite youtubers videos, so I figured there was no harm in trying it out.</p> <p>Interview Participant I : 5 - 6</p> <p>I remember that the course I signed up to was about conventional energies and their technology. I was trying to teach myself more about the topic of clean energies.</p> <p>I completely forget how I first found out about the MOOC, but I believe that maybe a colleague or someone in the university suggested it to me</p>

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Interview Participant J : 7- 8

To be honest, I don't really remember what course I signed up to.

Interview Participant L: 7

I saw an article about these online courses that were being provided by a well-known private university in Mexico.

I was interested in joining one of these courses because the topic was somewhat related to my field of work: Energy Savings.

Interview Participant M: 6 - 7

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Table 256

*Participant's Motivation to Enroll – Users who didn't finish the MOOC*

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Code	Coded segments
Motivation	<p>The main reason I enrolled was curiosity. I had never enrolled in a MOOC before, and I figured that the topic was very broad and useful, no matter what you decided to do with your life, so I decided to give it a go. Also, it is somewhat related to my college degree I am trying to earn, and I thought that earning a certificate from a private university that is well known in my country, even if it was online, could maybe help me get a better job in the long run.</p> <p>I was also excited to interact with other people online who would like to learn about this topic.</p> <p>I felt pretty confident when I signed up, to be honest. I really thought it would be a fun way to pass the time and that I had every ability in order to finish the course successfully, but that ended up not being the case.</p> <p>Interview Participant I : 7 – 8 - 9</p> <p>The main reason I decided to enroll was because I was interested in teaching my students about the newest ways to generate energy that had a bit of a green approach, for the future. So, in order to teach them about it, I first had to learn about it myself.</p> <p>Interview Participant J : 9</p> <p>I decided to enroll because I wanted to see if the course could provide me with any valuable insight that might've helped me do my job better.</p> <p>Interview Participant K: 12</p> <p>I was also very interested in getting an official certificate that said that I had taken a course that was designed and run by a</p>

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private university that is well known, because I could've added that in my curriculum. I really do believe that it could've helped me and my business a lot if I showed credentials from a private university from Mexico.

Interview Participant M: 8

I signed up because a colleague from work recommended it to me, he saw that they were offering these courses from an online post somewhere. It seemed like the topic was very related to my field of work and I was looking forward at the opportunity of sharing my knowledge with other people and even make some contacts that could help create maybe international job collaborations or something of the sort. In other words, I was looking forward to making some social networking and doing my job better in the long run thanks to this course.

Interview Participant N: 7

I first heard about the MOOCs during one of my online classes for my master's degree. The teacher that gave us the class mentioned that we would receive bonus points if we signed up to one of the MOOCs that the private university was offering, and we proved that we had at least taken 80% of the MOOC before the semester ended. They offered us 5 extra points over our final grade, and that was my main motivation to sign up to the MOOC, if I'm being honest. Not to learn or because the topics were super interesting to me, but rather, because I just wanted to have those five extra points in case, I needed them. Just to be on the safe side, you know?

Interview Participant P: 15

Table 257

*Participant's Previous Familiarity or Knowledge of the MOOC Topic – Users who didn't finish the MOOC*

Code	Coded segments
Previous Familiarity Knowledge	<p>I had never taken an online class before. Interview Participant I : 11</p> <p>I would say that I know a little bit about the topic of the course, because I have collaborated with businesses that deal with the energy market before. So even though I was no expert, I did have a little bit of hands on experience from work.</p>

Table 258

*Participant's Previous Experiences – Users who didn't finish the MOOC*

Code	Coded segments
Previous experiences (MOOCs, extracurricular, curricular)	<p>I had never taken an online class before.</p> <p>I had some introductory classes on college that touched upon the subject of sustainable development, but very briefly. When it came to energy savings, which was the topic of the course I signed up to, I would say I just knew the basic stuff. Like turn off the light when you leave the room and stuff like that. Interview Participant I : 11 - 12</p> <p>This was my first time participating in an online course, and I must admit that it was... different from what I expected. I thought that I would have a real professor, not just some videos that I could play anytime. It was a different experience.</p> <p>Regarding having experiences in any curricular activities, I would say no. I studied design and architecture, so we never really talked about clean energies back in the day. This is a somewhat new topic that has arisen. Interview Participant J : 11 - 12</p> <p>Yes, I have participated in at least five online courses before this one.</p> <p>I had a couple of courses in my master's degree that touched upon the topic of sustainable development.</p> <p>For extracurricular activities, I would say no, I didn't have any extracurricular classes that touched on the subject. I barely have time for extracurricular activities nowadays. Interview Participant K: 15 -17- 18</p> <p>I have taken at least ten online courses before.</p> <p>I have taken part in at least three seminars that are about renewable and clean energies, and my whole college was centered in this topic, so I would say I have both curricular and extracurricular experiences that are related to sustainable development. Interview Participant N: 11</p>

Table 259

*First words related to “sustainability” – Users who didn’t finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
First three words they relate to "Sustainability"	Future, Green, Health Interview Participant I : 14
	clean energies, future, renewable Interview Participant J : 18
	Green, Growth, Finances Interview Participant K: 20
	Growth, Future, Green Interview Participant L: 22
	Job, Opportunity, well being Interview Participant M: 13
	Business, Job, Future Interview Participant N: 13
	Wealth, Family, Future Interview Participant O: 14
	Energy, Green, Future Interview Participant P: 17

Table 260

*About Sustainable Development Goals – Users who didn’t finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
Sustainable Development Goals	I have heard about them a little in my classes, I am aware that they exist, but I know about them superficially. Wouldn't say I am an expert on them. Interview Participant I : 16
	Can't say I have heard of them, no. Interview Participant J : 20
	Yes, a lot of companies nowadays use them as a sort of guide to plan their activities and their development. Because they are somewhat related to my field of work, I am familiarized with them. Interview Participant K: 22

Yes, very familiar. One of the seminars I had participated in before was specifically about these goals and how to achieve them. I am well aware of the goals and objectives UNESCO is aiming for in 2030.

Interview Participant N: 15

I am no expert in the topic, but I have definitely heard about them before and have heard about them in conferences and short sessions with other fellow professors who try to implement them in their classes.

Interview Participant O: 16

Table 261

*Pro-Sustainable Practices in their daily lives – Users who didn't finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
Activities they do	<p>I try to, but I can't do a lot, really. In my college dorm, we try to separate the garbage, but people don't really follow the guidelines, so it gets a little frustrating. And I don't own a car, I try to use public transport the most, to save the planet from a lot of car fumes. Interview Participant I : 18 - 20</p> <p>I try to divide the trash at home. Interview Participant K: 24</p> <p>The very nature of my job is to raise awareness about the importance of sustainability. I believe that just by getting my job done, I am helping promote the education about this topic with younger generations who will shape our future someday. I also attempt to save water and electricity at home. Interview Participant M: 18 - 19</p> <p>I think my field of work is very pro-sustainability in general. Our main focus is to help people get involved with clean and renewable energies, so I think that my day to day job is my pro-sustainable activity in my daily life. Interview Participant N: 17</p> <p>I try to walk to school or my office, I reduce the use of electricity in my home and I am very picky when it comes to trying to make sure I don't waste water. Interview Participant P: 22</p>



Table 262

*Nature of the Challenges for Sustainable Development – Users who didn't finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
Ecologic	<p>Ecological. We can maybe change our societies and the way we run money in our world, but there are things that are out of our control, like ecological factors of the area where we live. So, I think that first we need to learn about the environment we are getting ourselves involved in before suggesting things just from the top of our heads. We need to understand mother Earth first.</p> <p>Interview Participant J : 24</p>
Social	<p>I would have to lean more towards a social nature. It all begins with us, and there is a lack of awareness and responsibility from the people in general. We need to educate ourselves in order to motivate future generations to take sustainability as an important factor in their daily lives.</p> <p>Interview Participant N: 19</p> <p>I would lean more towards a social nature. In the end, if it the society the ones who define which actions, or lack of actions, will shape our future.</p> <p>Interview Participant O: 20</p> <p>I would say mainly social. We need to educate people more about this topic.</p> <p>Interview Participant P: 24</p>
Economic	<p>I think it is mainly an economic problem. If people with a lot of money considered that "going green" would mean they would earn more money in the long run, then they would probably make the necessary changes to make their practices more sustainable. But because money is their main motivation, they don't really make the necessary changes. So, if they received an economic incentive, I do think we would see more changes in the world.</p> <p>Interview Participant I : 22</p> <p>Definitely economic nature. We need to invest more money in these kinds of efforts. Without money, it all becomes just good wishes for the world and nothing more than that.</p> <p>Interview Participant K: 26</p>

Table 263

*Reasons for not finishing the MOOC – Users who did not finish the MOOC*

Code	Coded segments
Lost interest	<p>Well... truth to be told, at the beginning I was afraid my online class would be super hard and that I would need those five extra points for my final grade. But I soon realized that if I did the activities exactly as the instructions suggested I should, I would get almost full marks in every single activity and as long as I got a 90 or more, I was more than satisfied. In the end, I finished the class with a 98 and I figured that was good enough, so I never really finished the course because I never needed the 5 extra points I had been promised.</p> <p>Interview Participant P: 26</p>
No intention of completing	<p>My intention from the start, even when I signed up, wasn't to get a certificate or even complete the MOOC. As I mentioned before, it was a visiting professor who first introduced me to the courses, and I decided I just wanted to check quickly if there was any content in these courses that could be applied in my own courses or classes. I just wanted to check the kind of material and approaches that were used in the online course, and if I could learn a little bit about energy in the process, that was great. But it wasn't my main objective.</p> <p>Interview Participant O: 23</p>
Evaluation process	<p>In the course, there was an activity where we had to review the work of other people who were taking the course, kind of like a peer review sort of thing. Now, I admit that maybe I am not the best expert in the topic, but I do have some hands-on experience that comes from my daily job. And it was very shocking to me that the person that ended up grading me decided to give me half marks when my answer was relatively extensive and in detail to the question. I felt frustrated that I was being graded by an anonymous person online who probably knows less about the topic than I do, and that that would affect my general score in the course even though I had done my best trying to complete the activity I was given. I tried to send an email and see if the professor or the people behind the MOOC could help me get a second opinion or help my grade get better from that activity, but after several days I got an email saying that it would be a longer process and honestly, my time is precious. So, I decided to just leave the MOOC unfinished. So if I had to summarize it, I would say that I was not very pleased with an evaluation activity that involved me being graded by strangers</p>

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online who could affect my grade in such a way that it would entail a lot of extra work for me to get that fixed. I decided to quit instead.  
Interview Participant N: 22

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No free certificate

The main reason I signed up to the course in the first place was because I was very interested in getting myself an official certificate that proved that I had taken a course by a very well-known private university in Mexico. If we had to phrase it somehow, it was all about status, and knowledge, of course. But the certificate was very important to me. However, after I finished enrolling, I read the fine print and realized that I could take the course for free, but that I would get charged in order to have my certificate given. I felt very disappointed, because the whole point of MOOCs is, according to my knowledge, that they are free and accessible and all of that. But after I learned that they would need to charge me as an "extra" in order to get the certificate, I decided to not take the course after all. My main goal was not going to be fulfilled even if I finished the course correctly unless I paid, and they were charging in American dollars. The whole situation was a big no-no for me and that was the main reason I didn't end up taking the course.  
Interview Participant M: 22

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Personal Reasons

Well, when I first signed up to the course, I had a stable job and income. However, things took a turn for the worse and eventually I lost my job. I went through a personal crisis, which made finding a new job the number one priority. My wife had cancer and I needed to earn money in order to pay for her treatment. It made all unnecessary activities, like an online course I had signed up to a couple of weeks before, become less important to me. I decided to put my family first.  
I needed to focus in more urgent matters in my personal life. The course, I thought, was an extra thing. And I couldn't deal with any extra burdens or HomeWorks.  
Interview Participant L: 15 - 18

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Lonely process

It felt a little void just to take the course by myself.  
And I am aware that there were sections in the course where you could write in message boards and stuff like that, but it felt a little bit like writing a letter to someone who would never reply.  
I checked the message boards in my class and maybe two or three people had gathered the courage to share a short paragraph or two, but there were almost no replies to their comments, and I figured it was just not worth the effort.  
Interview Participant J : 28 – 29 - 30

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Too systematic

Most of the activities were done mostly by me and the professor was in fact just a teacher that had recorded some videos who knows how long ago, and that was it. It felt very robotic, like there was no real

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	<p>human interaction behind all of this. And in the end, that was the reason I decided to quit the course. It felt too mechanical and I am more of a social learner. It wasn't the right fit for me.</p> <p>As I mentioned before, it felt all very robotic. Like a pre-established system or program that was already scripted.</p> <p>Interview Participant J : 16 - 26</p>
Not fulfilled expectations	<p>When I enrolled to the course, I had some expectations. I thought that I would get to interact with other online students and an online professor. But... I didn't.</p> <p>It felt like my presence or my logging in didn't make a difference at all, and in the end, I guess it didn't, because after the second week I didn't log in again and I think nothing really happened.</p> <p>Interview Participant J : 15 – 27</p> <p>However, once I saw the titles for the class modules, I realized that it was a MOOC on a very basic level compared to my level of knowledge. Thus, I concluded that the course would now provide me with any valuable new knowledge, and I decided to invest my time in other activities that would.</p> <p>Interview Participant K: 29</p>
Too much work/studies	<p>The main reason I left the course unfinished because I tried to do too many things. When I first signed up to the course, I was in the summer where I had just graduated High School and was waiting for college to start. I signed to the course out of a whim, thinking that I might as well keep myself entertained with something productive while I waited for my first college semester to start. And things started calm enough. I did a couple of lessons for a couple of weeks, but then college started, and I got overwhelmed with schoolwork and I was just unable to finish. It was absolutely necessary for me to focus on my curricular studies rather than any extra studies.</p> <p>Interview Participant I : 24</p>
Job loss	<p>Well, when I first signed up to the course, I had a stable job and income. However, things took a turn for the worse and eventually I lost my job. I went through a personal crisis, which made finding a new job the number one priority. My wife had cancer and I needed to earn money in order to pay for her treatment. It made all unnecessary activities, like an online course I has signed up to a couple of weeks before, become less important to me. I decided to put my family first.</p> <p>Interview Participant L: 15</p>

Table 264

*Recommendations for future online courses – Users who didn't finish the MOOC*

Code	Coded segments
Spread the word	<p>But I definitely think we need to share more that the courses are out there. There are a lot of people that are not informed that they could take free courses online if they wanted to. So, we need to spread the word, definitely.</p> <p>Interview Participant J : 42</p>
Human to Human Interactions	<p>Make it more interactive! Make the participants reach out and start a real conversation. I think that if I had felt a little more engaged with other users, I might've given the course a try.</p> <p>Interview Participant J : 32</p> <p>Also, maybe it would be a good idea to do a little background check on each participant and to group them by their level of knowledge depending on the field they are in. That way, people that are on the same level can collaborate and even do some networking, and then circumstances like the one I had to go through wouldn't repeat themselves, because I would feel confident that at least one person that is on the same level of knowledge as me is going to be grading or checking my activities, rather than a random stranger who probably doesn't know a lot about the topic in the first place.</p> <p>Interview Participant N: 25</p>
Evaluation	<p>Yes. I would recommend that the tests they design become less repetitive or boring. It was a little boring to always just reply to tests that were multiple choice options. I think that they could've spiced it up a little with different ways to evaluate our knowledge.</p> <p>Interview Participant I : 26</p> <p>Work in the way you evaluate the knowledge of the people that sign up.</p> <p>Interview Participant N: 24</p>
More challenging	<p>I think it would be great if they created online courses that were a little more challenging. I definitely feel like the courses offered were very basic and that was the main reason I felt like they might be more a waste of time, for me personally, than anything else.</p> <p>Interview Participant K: 31</p>

Table 265

*Global Cooperation Strategies for Sustainable Development – Users who didn't finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
Use of renewable energies	I would recommend that the companies around the world should start using more renewable energy sources to make their craft. They should set an example to smaller companies that are just starting off, too. Interview Participant I : 28
Conditions around the world	I think we need first to understand the world that we are facing right now. So, I would say, first invest on research and find out all the information that is valuable so that it can be shared with the rest of the world through awareness campaigns. Interview Participant J : 34

Table 266

*Attractive elements of MOOCs – Users who did not finish the MOOC*

<b>Code</b>	<b>Coded segments</b>
Self-paced	I love online courses because I have the freedom to organize my own time in order to participate in the classes and do the activities, even if I have a full-time job. Interview Participant N: 10  I do have experiences with other online courses. I like to take courses that allow me to advance at my own pace, considering I am pretty busy every now and then. Interview Participant O: 9
Certificates	It would be great if they informed about the certificates or lack of certificates from the start. I would love to see online courses that offered free certificates if you complete the course, even if they are not very fancy. Maybe they can offer a fancier version of the certificate for a price if it is necessary. But at least, if they offered a free version, that would help motivate me to enroll and actually finish the course. Interview Participant M: 24 – 25
Challenges	Also, to be challenged more would make the whole ordeal more interesting. Maybe set up challenges weekly and make

	<p>everyone share the results of their challenges, that would be great. I would like that a lot. Interview Participant K: 34</p>
Language Options	<p>I think that when the material is offered in more than one language, it really opens up the opportunity of making international collaborations more accesible and natural. I would most definitely recommend that future courses are presented at least in English and Spanish, that way it would be easier to connect with other participants around the globe. Interview Participant O: 27</p>
Team forming/Teamwork	<p>If it involved more teamwork-oriented activities, that would be great. It is always fun to interact with people with different backgrounds and learn from them. Having participants collaborate more would've made me feel like it was worth a shot, but I saw that the course was very linear and that was a big turn off for me. Interview Participant K: 33</p> <p>Maybe more teamwork activities would be nice. An actual chance to interact with other people who are interested in the topic of the course could prove useful and interesting. Interview Participant N: 27</p>
Users Collaboration/ Interactions	<p>I was also excited to interact with other people online who would like to learn about this topic. Interview Participant I : 8</p> <p>Also, maybe it would be a good idea to do a little background check on each participant and to group them by their level of knowledge depending on the field they are in. That way, people that are on the same level con collaborate and even do some networking, and then circumstances like the one I had to go through wouldn't repeat themselves, because I would feel confident that at least one person that is on the same level of knowledge as me is going to be grading or checking my activities, rather than a random stranger who probably doesn't know a lot about the topic in the first place. Interview Participant N: 25</p>
More people involved in teaching	<p>In the course I enrolled in, it was always the same old guy giving the classes through video format. It would be fun if they changed it up a little and maybe got more people to teach us about a topic, instead of just having the same person talk over and over again Interview Participant I : 35</p>

Use of videos	<p>I would definitely recommend interactive videos, like the kind where you click between two options and that develops a different script depending on what you chose. I would love that. Interview Participant J: 36</p> <p>Make more videos for the courses instead of putting just giant walls of text to teach about a topic. It keeps it more fun and easier for us as users to keep engaged. Interview Participant P: 32</p>
Use of social media	<p>Also, to use more social media somehow. Maybe even open up chat rooms or stuff, so that you are able to interact with the teacher or other students easier. Interview Participant J : 37</p>
Course content	<p>I also think that the content got a little boring after a while because the format was always: read this, watch this video, answer these questions. I would much rather get to learn with different formats every now and then to change it up a little. Interview Participant I : 36</p>

Table 267

*Regarding Future Generations – Users who didn't finish the MOOC*

Code	Coded segments
Regarding future generations	<p>Yes, I think that future generations will take more online courses. Even in my college classes nowadays, a lot of our activities and interactions are online between classmates, even though we have to go to class in person. I think that in a couple of years, online classes will have a bigger impact in future generations. Interview Participant I : 30</p> <p>I definitely think that kids nowadays are more used to interacting and learning online than my generation ever did. So yes, I do think future generations will take more courses online. Interview Participant J : 39</p>
Awareness of availability of knowledge	<p>I think that future generations need to raise awareness of the amount of knowledge that is available to them only by a click away. A lot of the younger generations spend a lot of time entertaining themselves with the internet, rather than seeing it as a tool to learn more. I strongly believe we have to help them see the potential of the internet as a huge library of knowledge besides it being their "meme machine", if you know what I mean. Interview Participant O: 29</p>



Awareness of future generations	We need to raise awareness of future generations, that is for sure. Interview Participant O: 21
Online Education	<p>Yes, I think that future generations will take more online courses. Even in my college classes nowadays, a lot of our activities and interactions are online between classmates, even though we have to go to class in person. I think that in a couple of years, online classes will have a bigger impact in future generations. Interview Participant I : 30</p> <p>I definitely think that kids nowadays are more used to interacting and learning online than my generation ever did. So yes, I do think future generations will take more courses online. Interview Participant J : 39</p> <p>I think that it is still long ways into the future, because first we have to make computers and internet more accesible all around the world in order to claim that there will be a strong rise of the use of online courses, but I definitely think that future generations will find more benefits and use of online courses than my generation ever did. Interview Participant N: 29</p>

Table 268

*MOOCs potential or lack of potential to teach about sustainable development – Users who did not finish the MOOC*

Code	Coded segments
MOOC's accessibility	I think the cool thing about MOOCs is that they are easy to access. Interview Participant J : 41
MOOC's possibility to fail	Maybe the biggest issue with MOOCs is that they are sometimes repetitive and boring. Interview Participant I : 32
Participant's Needs	Also, maybe it would be a good idea to do a little background check on each participant and to group them by their level of knowledge depending on the field they are in. That way, people that are on the same level con collaborate and even do some networking, and then circumstances like the one I had to go through wouldn't repeat themselves, because I would feel confident that at least one person that is on the same level of knowledge as me is going to be grading or checking my activities,

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	rather than a random stranger who probably doesn't know a lot about the topic in the first place. Interview Participant N: 25
MOOC's retention	If maybe the MOOC I enrolled in had been more interactive with other human beings and I had felt like it was worth putting some more time on it, even though college was being super hard, I might've finished the course. But I just found it too boring, it was difficult for me to feel motivated to log back in on my account. Interview Participant I : 33

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Table 269

*Free comments – Users who did not finish the MOOC*

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<b>Code</b>	<b>Coded segments</b>
More flexibility with time to complete MOOC	<p>I think that if they added a model of course in which they understand that sometimes college students will get overwhelmed by schoolwork, and for that reason they might get a longer period of time to finish the course, that would be great. If I had gotten maybe two more weeks given to finish the course, I might've gone back to the course to finish it. After all, I was halfway done. But the course period was strict with their timing and when I was able to log back in, the course was no longer accessible. So maybe they should be a little more flexible with the amount of time they leave a course online. Interview Participant I : 38</p> <p>I would definitely recommend that they would be a little more flexible with the time they offer their online courses. For example, once I had gotten a stable job again, I wanted to go back to the course and start from where I had left off. But I couldn't. If I wanted to rejoin the course, I would need to start from week one and I couldn't bring myself to do that. I definitely just wanted the possibility of starting from where I left off without losing all my previous progress, but that was not possible. That was the main reason I decided to not go back to the course. Interview Participant L: 20</p>

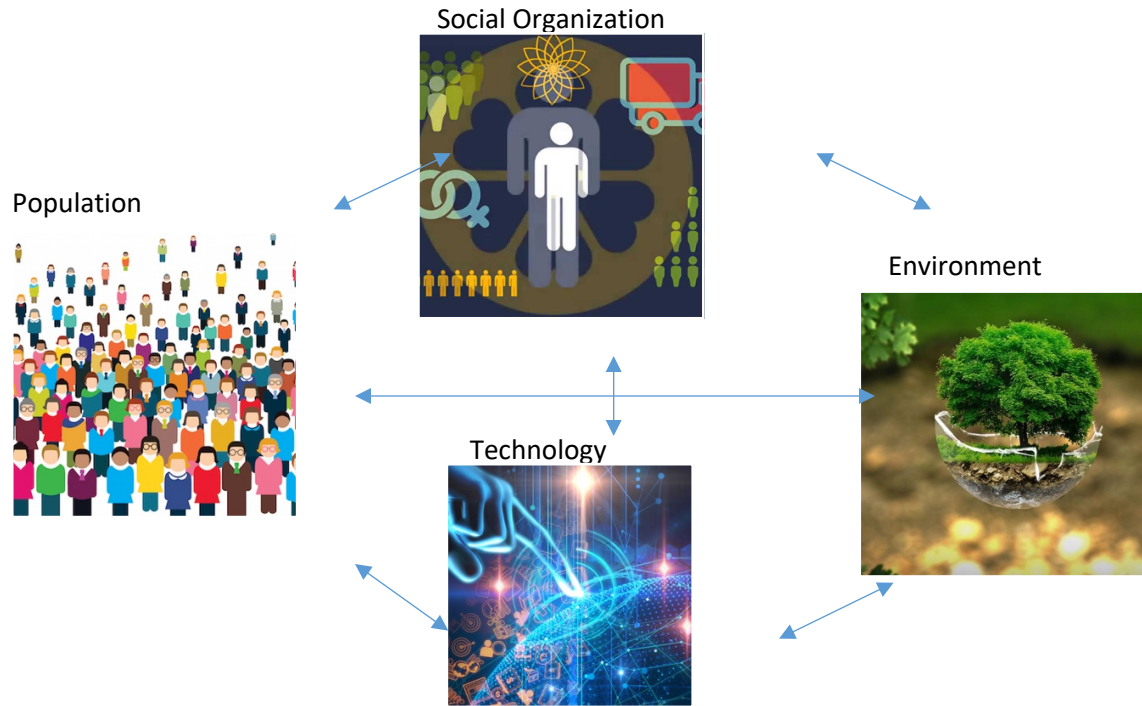
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In order to highlight some of the most interesting findings obtained from the thorough qualitative analysis from the conducted surveys, it is interesting to observe that even though all three natures were mentioned or highlighted as important perspectives to be taken in consideration when confronting the challenges that sustainable development faces for the

future, the most mentioned nature was that of a social challenge, something that was more commonly referred to by both participants who completed the MOOC and participants who didn't complete the MOOC.

The fact that society was the most quoted perspective and nature of the challenges that progress for sustainable development faces, agrees with the perspective that was presented by Duarte et al. (2006) when they claimed that the constant changes in our environment due to pollution has been demonstrated through history, particularly by the disappearance of whole civilizations because of climate change and environmental degradation who failed to adapt and make changes in their society to more sustainable approaches.

Duarte et al (2006) also claim that the social impact or consequences of global change is ultimately what will result from the interactions between changes in the biophysical environment and changes in the specific social environment. After observing the patterns on what the participants expressed when detailing why they considered society to play the most active role in order to secure a sustainable future for everyone, keywords such as technology, environment, population and organization were constantly brought up by the participants. These keywords were also presented by Duarte et al (2006) in their social ecosystem map, which will be presented in the following figure.



*Figure 118.* Social Ecosystem (Duarte et al, 2007)

As observed by the previous figure, social intervention and organization is both influential and heavily influenced by the environment, the technology at hand and the behavior of the population. Thus, we can conclude that there will be different needs and potentials in each society, since there will be different circumstances in each situation.

The second nature that was most mentioned by the participants was the economic approach and perspective, since they consider that money and budget limitations play an important role in securing a sustainable future in the long run. After analyzing the reason as to why participants selected economic nature as the most influential of the challenges that sustainable development must face, a pattern was observed.

More than just money, users who relied on the power of economy as the biggest factor that needs to change or adapt in order to secure a sustainable future also brought up the topic of infrastructure and planification in the cities. If the government or authorities from the start

clarified that any building being built needs to take in consideration the way a city will grow 100 years into the future, then the expenses of adapting the building or even having it tore down in order to make way for new infrastructure plans that don't necessarily think in the long term either, will then help save money and time, some of the most valuable assets that are available, helping people invest in a more responsible way.

Duarte et al (2007) make a point of stating that social actions reflect in the economy as well, not to mention that the environment and the ecological factors of the environment being treated also play an important role in the development of a strategy that might secure a sustainable future, which was also expressed by most of the participants, whose first response was that all three natures: economic, social and ecologic, were important to factor in when thinking about making sustainable development the new normal.

Of course, the importance that each individual play when securing a sustainable way of life was mentioned by the participants as well, echoing what most advocates of sustainable development recognize when accepting that there is a need for changes in human values, attitudes and behaviors in order to achieve a sustainable transition. These transitions can have three different sets of benchmark goals such as (a) the short-term goals of the Millennial Declaration, (b) the two-generation goals (2030) of the Sustainable Development Goals, and (c) the long-term (beyond 2030) goals of the Great Transition. These three visions of sustainable development articulate widespread views, concrete goals, and specific indicators, yet provide different temporal perspectives and pose different challenges, which need to be faced (Leiserowitz, Kates & Parris, 2006)

Another interesting and important aspect that was obtained from the perspective of the users through the analysis of the interviews that were conducted was if they considered MOOCs to have the potential to teach about sustainable development in a successful way or

not in the future. Most of the users claimed that they believed in the potential of the MOOCs greatly, stating that they thought that future generations would most definitely use more online courses than they ever will, but there were some recommendations that were stated more than once about different and better approaches that might guarantee a better experience for the people enrolled in the course.

An example was, that before allowing the participant to enroll to the course, first they should make a background check of the level of expertise that the user has about the topic, in order to assure that the level of complexity corresponds to the level of education of the individual. In other words, factor in more the characteristics of the end user and adapt the content to their needs and aspirations for new knowledge.

Ver & Steffens (2015) mentioned in their research that we are observing a gradual shift from the teacher-oriented learning to student-oriented learning, which seems to be what a lot of participants would like to see reflected in future MOOC designs. Another recommendation that was brought up a lot by participants was the need to feel that they could communicate in a more personal or deeper level with their comrades or their online professors.

This suggestion has been brought up before when conducting focus groups with experts in the topic of MOOCs, who consider alternative forms of online courses, such as Small Private Online Courses (SPOCs) to have a higher rate of completion and satisfaction for the users (Ver & Steffens, 2015).

Something that was useful to delve upon through the process of the interviews had to do with the previous experiences the users had. Regardless of if they finished the MOOC or not, there was a pattern in which participants who had previously had a curricular or extracurricular experience where they had learned about sustainability, they recommended

that other persons should enroll in that type of experience in order to spread awareness. This type of recommendation was also presented in the research of Murray & Murray (2007) where participants think that activities that delved in the topic of sustainability should be integrated in their courses, or that they should be offered to all students at their university, since sustainability issues are too important to exclude.

On the topic of sustainability, an analysis of the first three words that popped into the participant's heads whenever they heard the word "sustainability" was run through MaxQDA. The result from said analysis culminated in the following word cloud. If the word in question was repeated more than once, then that word will appear bigger in the word cloud.



*Figure 119.* First words participants relate to the word "sustainability"

As observed in the past figure, the main words that were mentioned included the topic of future, environment, growth, green and responsibility. It was interesting to observe that

the patterns were similar between both sample of participants, even if they didn't finish the MOOC.

### **Research Questions Answered**

The main research question for the present document stated the following: To what extent do people's attitude and perception on sustainability change after completing one of the MOOCs in the context of non-formal learning?

The results can be observed in the patterns that were revealed after comparing and contrasting the results obtained from the pre and post surveys and comparing the changes in the answered provided by the participants who answered all instruments. Based on the results obtained, participants considered they understood the topic of sustainability better after participating in the MOOC, also stating that they perceived a better understanding of the topics related to the MOOC content. They also changed their perception about the Sustainable Development Goals, since a lot of the users admitted they were not familiarized with them at all at the beginning, and then, after taking the course, they became more perceptive of the different approaches and efforts that schools and social groups around them have been making in order to reach the goals by 2030. This was observed not only by the results reflected in the survey results, but was a topic that users delved upon in more detail when answering the interview.

Another interesting change in the participant's perception was that, after participating in the MOOC, they considered that they had a better understanding on how to deal and learn through digital interventions, some of them even admitting through the interview process (as well as in the results from the survey) that they had signed up to more extracurricular activities that involved the understanding and application of sustainability in their daily lives.



However, we could also observe that there was no significant change in their curricular experiences before and after the MOOC, which is understandable, since some users who claimed that they were studying a major or a graduate program that was related to the topic wouldn't change their answer after taking the online course, and the participants who specialized in other fields would've had a very short time to enroll themselves in a program that involves more sustainable approaches during the time they were signed up to the MOOC, which was a period of around a month.

An interesting result that was observed from analyzing the results obtained from the survey was that daily practices in the user's lives that they considered pro-sustainability did not have a significant change before and after participating in the MOOC. It is important to point out that the results obtained even before the users took the first class of the MOOC already showed that most participants graded their pro-sustainable daily activities to be over 90% average successful in their daily lives. Thus, users didn't see a change in their efforts to lead a more sustainable lifestyle, avoid the waste of water, attempt to recycle or use other means of transportation than using a car. It seems that their daily efforts and practices were already set before they started taking the MOOC, and their resolve and effort to keep these practices in their day to day remained the same, regardless of if they completed the MOOC or not. Thus, from the results obtained, it can be stated that their perception was broadened and that they felt a positive impact in their knowledge regarding the topic of sustainability, but their attitude from the start showed strong patterns of adapting pro-sustainable activities in their daily lives, and that remained the same before and after their participated in the course. This can also be reflected from the cited excerpts in table 235 and 251 which reflect the activities the participants conduct in their daily lives regarding pro-sustainable approaches.

Subordinate questions that were presented for this research included the impacts that the MOOC had in participants who completed and didn't complete the course. In order to answer these questions, it is key to observe the motivations and reasons the users signed up to the courses in the first place.

Most users signed up to the courses because they were interested in gaining knowledge that they might apply in their future field of work or study. After analyzing the results obtained from the conducted interviews, we can observe that the main motivations behind the users who completed the MOOC and who didn't were similar (Tables 230 and 246) although the experiences were different between these two groups.

It is also important to take note that a lot of users who completed the MOOC also expressed an interest to research more on the topic of sustainability after they completed their studies. Citations of the participants who expressed if they felt the desire to research more about this topic or not can be read in Table 237.

Users who didn't complete the MOOCs cited various reasons for their lack of completion of the course (Table 253), including: loss of interest, no intention of completing the course in the first place, not feeling comfortable with the evaluation process of the course, the realization that if they wanted to get a certificate it would be necessary for them to pay an extra price for it, personal reasons that included the sickness of a loved one, the feeling that the MOOC platform was a very linear, systematic and lonely process to learn, the realization that the expectations that they had set in the course were not being fulfilled, being overwhelmed by too much work or pressure in their studies, and in one particular case, the loss of a job which forced the participant to focus their time, energy and resources in trying to secure another job instead of completing a course which wasn't even mandatory.

As a final subordinate question, it was a valuable and important asset to question the participants about what recommendations they would give for future MOOC designs, especially if these are centered to teach about sustainability. Main suggestions can be found in Table 238 and 254. These suggestions make an important emphasis on the need to spread the word about the availability of the courses, since a lot of users consider that very few persons are aware that they can sign up to free courses online. They also suggested the implementation of more human to human interactions, instead of relying the evaluation process to simply be a revision of the material and a series of multiple-choice questions, which might prove to be a little too systematic or robotic for the users.

Participants also had suggestions regarding the content that might be designed in future implementations, especially when it came to the application of real-life cases or information that the participants can relate to or apply directly in their day to day life. They also had suggestions of either making the content of the course more or less challenging, depending on the end goal of the person who will enroll to the course.

Tables 240 and 256 reflect which elements from the MOOC platforms the participants found attractive or motivating to enroll. Main suggestions included the possibility of having access to courses that offer more than one language option, the possibility to create teams or promote teamwork through the online activities, the use of gamification and the possibility to explore other tools and platforms that might enrich the experience of the participants beyond the MOOC platform.

Other attractive elements that were mentioned by the users included the possibility to have more than one professor teach the course, in order to add variety and the experience of other experts in the field, as well as the use of case studies that have been applied in real life in order to promote a sense of reality to the information that is being presented to the

participants. Finally, it was constantly expressed by the users that they thoroughly enjoy the use of videos in the MOOCs they enroll to, although they did recommend exploring the possibility of developing more interactive videos, such as adding questions or different “paths” that the participants can explore about the information they are learning depending on the choices they might make. They also brought up the topic of social media and commented some ideas about social challenges or approaches that might get younger generations involved, since they enjoy using social media so much.

This concludes the section where the results obtained from the interviews were presented. In the following chapter, a summary of the main findings and suggestions for the future will be presented, along with the closing thoughts about this research and the potential for future research projects.

## **Chapter 5. Final Discussion and Future Research**

In the following chapter, the main findings from this research will be presented in a summary format, making a triangulation process between the results that were obtained from all the instruments that were applied for this thesis and a final reflection on what these results entail and how they open the door for future research endeavors.

The first revelation that caused an important impact and changed the narrative of this research was reflected in the participants who enrolled to the courses. As previously mentioned, when the courses were designed, it was thought that the participants in question who would sign up and take the courses would mainly be users who were Mexican and who spoke Spanish. However, the reach that the courses had exceeded all expectations, and participants enrolled from 30 different countries, the biggest number of users pertaining to Latin America.

Following Mexico, who had 445 people enrolled, Colombia, with 198 users, and Peru, with 114 participants, had the highest amount of enrollments total. Another interesting factor was the age of the users. It was expected that most participants would be between 18 and 50 years old. However, in the final sample, we could see that the reach of the courses motivated even younger participants to join, and there were over 165 users over the age of 50 who decide to enroll in one of the available courses.

One prediction that ended up becoming reality was the fact that the designers of the courses expected that the people who would enroll would mostly be people who were at a full-time job as their main occupation. In the end, that was the highest given response, gaining 45.43%, in total 586 participants out of 1290, who claimed that their main occupation was

working in a full-time job most of their time. However, something that wasn't expected and that was a gratifying surprise was that the second most common answer was that the people enrolled were college students, with the third most selected option being that the person enrolling was the owner of their own business.

This was also reflected in the interviews that were conducted after the courses had ended. At least 2 of the persons interviewed were the owners of businesses that were somehow related to educating or applying sustainable actions in a bigger scale, and one of the participants interviewed was a college student who considered that the MOOC was an interesting and accessible tool that could help them understand on a deeper level the topics that were related to their studies.

Something interesting to note was that more than 50% of the users who enrolled had never participated in a MOOC before, and thus, this was the first experience with a Massive Open Online Course. However, out of the 224 users who had participated in at least three MOOCs or more before enrolling to one of these offered courses, there was a higher number of users who finished the course successfully compared to first timers.

When this topic was brought up during the personal interviews, one of the participants who hadn't finished the MOOC explained that, having never taken a MOOC before, he had generated a series of expectations that in the end were not met, and that that was the main reason he had decided in the end to leave the course unfinished. Another reason that was later mentioned by other users who didn't finish the course was the lack of self-regulation practices from their part, along with a certain level of frustration from feeling that the learning process was too systematic and that they were not really interacting either with the teachers, or other students as much as they would've liked.

This brings us to a topic that was of major influence and importance for the users to enroll to the courses in the first place, their main motivations for joining the MOOC. Out of the demographic surveys that were conducted, we can see from the initial survey that they three biggest reasons people felt motivated to enroll included the fact that the topic of the course was related to their field of work, with the second most cited reason being the fact that the users hoped that after taking the course, they would be offered better jobs or a higher position because of their new knowledge. The third reason users decided to enroll to the courses involved the fact that the topic of the course was related to their academic program or their current studies, which was the case for at least three of the participants who were interviewed who had finished the MOOC completely and successfully.

When talking about the level of compromise and the end goal that the users had set for themselves when signing up to the courses, around 62% had the intention of learning from all the available lessons and completing all activities and exams even though in the end they did not plan to pay the extra fee in order to obtain the official certificate that they had, in fact, enrolled and finished the MOOC successfully. However, 31.71% of the users did have the intention to pay for the certificate, since they considered that having evidence that they had completed the course successfully would prove useful and valuable for their resumes.

However, there was a specific case of a user who had the full intention of earning a certificate who enrolled to the course and finished at least half of the classes before realizing that the certificate would only be delivered if she paid an extra fee. This participant, feeling that the need to pay was not justified, decided instead to leave the course unfinished and gave feedback about how she considered that it would be more beneficial, both for the participants and for the course developers, to offer a less fancy certificate for free in order to motivate users to finish at least a certain number of activities or quizzes. Understanding why the users

signed up to the courses and what were their expectations was an important step of this research, because it gave a series of patterns in the data gathered that gave an idea of what the users wanted to gain from the experience.

Next, came the process of analyzing the answers that were provided by the participants regarding their perspective and level of knowledge about sustainable development. Out of the 152 answers that were obtained, more than 20% of the users claimed that they didn't really feel familiar with the term "sustainability" and that they wanted to learn more about it through the course they signed up to. Participants were also requested to enlist any activities they partook in their daily lives that could be considered "pro sustainability", along with their point of view about the challenges that sustainable development faces and which entities have a bigger responsibility to assure a sustainable future for everyone.

After analyzing all of the answers that were provided to the pre-MOOC instruments, a comparison took place with a specific sample of users who finished the MOOCs and who also answered the instruments in their post-MOOC format. The interesting point of analysis for this comparison was to determine if there was a significant change or not before and after the MOOC intervention in the expectations and thoughts that the participants had before and after the course. Because four survey instruments were applied, first the results from the demographic surveys will be enlisted by the variables that did and didn't show a significant change before and after the course that were measured thanks to the demographic surveys.

The variables that did have a significant change before and after the course include:

- The participant's expectations about their possibility to establish professional networking through the MOOC platform



- The participant's expectations about how the MOOC would have a positive impact in their academic formation
- The participant's self-perspective about if they had enough perseverance to finish the MOOC all the way to the end or not
- The self-perceived level of the participant's ICT skills being enough to complete all MOOC activities successfully
- The self-perceived level of the participant's understanding and use of digital tools in order to complete all MOOC activities successfully
- The self-perceived level of the participant's understanding of the technological platform they were working with in order to complete all MOOC activities successfully
- The self-perceived talent of seeking information that the users considered they had in order to complete all MOOC activities successfully
- The level of domain over social media by the participants in order to involve their own personal social media in the process of promoting and solving activities in the MOOC they signed up to
- Participant's level of knowledge about the course content before and after the course

As observed by previous lists, most of the expectations by the users were fulfilled, except when it came to the user's possibility of establishing professional networking opportunities in the MOOC platform, since the forums and spaces that they were provided in order to start a conversation or share personal information were barely promoted or used.

Users felt that the process of taking the course was very linear and self-paced, so they didn't really feel like they interacted much with the other participants during their learning process. Participants also were disappointed about the reach of the MOOC content, since many of the users who had signed up with the intention of using the MOOC as a way to positively impact their academic formation soon realized that the level of complexity didn't fulfill their expectations.

As a recommendation constantly cited during the interviews, users mentioned they would like to get a gist of the level of complexity or expertise of the course before they sign up, maybe even in the form of a brief trailer, so that they can assess if the content is at a level that they consider valuable for their formation.

Finally, many of the user's self-perceived level of talent when it came to solving MOOC activities had significant changes, including their level of perseverance, their ICT skills, their usage of digital tools, their understanding of technological platforms, seeking relevant information and their usage of social media. From the results obtained, it can be perceived that participants had a higher level of confidence of their skills after they finished the course successfully, and thus, they worked in fortifying these skills during their enrollment to the course. Now, the variables that didn't show a significant change before and after the course from the demographic surveys will now be presented.

The variables that did not have a significant change before and after the MOOC intervention include:

- The expectation users had about how the MOOC would positively affect their training needs
- The expectation users had about how the MOOC would positively affect their professional development

- The expectation users had about how the MOOC would positively affect their possibilities of getting a better job after taking the course
- The level of general understanding the users thought they had about the course content
- The level of experience users had with hands on experiences that involved the energy field in any way
- Participant's self-assessed ability to solve challenges that could be presented in MOOC activities
- Participant's self-assessed ability to provide innovative solutions to problems they might be posed during the MOOC activities

As observed from the previous list, many of the user's expectations about the impact the MOOC would have in their personal development were fulfilled, including how much users expected to see a positive influence in their training needs, their professional development, and their possibilities of finding a better job after they took the course.

Some factors were participants didn't perceive any important self-changes included their level of ability to solve challenges or provide innovative solutions during the MOOC activities. It would seem that the users considered that their level of skill remained the same before and after taking the course. Finally, it didn't seem like users perceived any significant changes to the amount of hands on experiences in the energy field they had while they participated in the online course.

Now, here is a list of variables that proved to have a significant change before and after the course from the surveys whose main topic was about sustainable development:

- The level of understanding the users had of the MOOC content

- The user's understanding of the term "sustainability"
- The user's awareness of the Sustainable Development Goals by UNESCO
- The amount of digital interventions the participants have taken part in that somehow were related to sustainability
- The amount of extracurricular activities that the participants have taken part in that were somehow related to sustainability

From the previous list, we can see that there was a significant change in the level of understanding and knowledge the users had about the MOOC content and the term "sustainability". There was also a significant rise in the level of knowledge users had about UNESCO's Sustainable Development Goals. Finally, there was an increase in the amount of digital and extracurricular activities the users had experienced before and after taking the course.

The variables that did not have a significant change before and after the MOOC intervention include:

- The amount of curricular interventions that the participants have participated in that involve the topic of sustainability
- Users efforts to have a sustainable lifestyle
- Users efforts to reduce waste
- Users efforts to recycle
- Users efforts to use other means of transportation other than a personal car
- User's perspective that sustainable development faces challenges of ecological nature

- User's perspective that sustainable development faces challenges of economic nature
- User's perspective that sustainable development faces challenges of social nature

As observed by the previous list, participant's opinion about the nature of the challenges that sustainable development needs to face didn't really change significantly before and after taking the course. Neither did the amount of effort or self-perceived level of compromise when it came to promote or do pro-sustainable activities in their daily lives.

This is an interesting point, since from both the initial and the end of course survey, we can observe that all participants graded that they partook in these sustainable activities with a success rate of over 90%. However, when they were questioned about why they rated themselves so high in the survey, many users who were interviewed admitted that they felt like they needed to rate with a five out of five their efforts to try and recycle in their house, even if maybe they didn't really recycle every single day.

Thus, as a recommendation post-experiment, it would be recommended to change this portion of the survey (the list of pro-sustainable activities in their daily lives) with another sort of question, since there seemed to be a pattern in which users just rated themselves very highly when it came to pro-sustainable activities without really stopping to reflect upon the topic in a deeper level.

As a suggestion for future runs, it would be recommended to leave an open question in this section of the survey, asking users to express in detail any pro-sustainable activities they might partake in in their daily lives. This way, users will have to reflect and write in their own personal way the activities that they do. As a follow up question, users will be requested to enlist all pro-sustainable activities that they might not do in the present, but that they definitely wish to implement in their day to day in the future. This way, if they think that

recycling is important but maybe they haven't found a way to implement it in their daily lives yet, users will have a space where they can share their desire to add this to their daily activities.

As a final question for this line of questioning, it is suggested to add a new question too: What pro-sustainable activities do you see others do? This question has the objective of making participants reflect on what they see in their environment and maybe promote that they consider joining the efforts.

These adaptations and changes for future runs of these surveys are suggested after complementing the lack of significant data that was obtained from the surveys with some questions that were added to the semi structured interviews that took place afterwards. Very valuable input was obtained from said interviews, and thus, a suggestion to open up the possibility of hearing the participant's voices in a more direct way through the surveys is proposed.

Now that we are reaching the end of this document, some valuable input that was obtained from the interviews that were conducted will now be enlisted. First, from the sixteen interviews that were conducted, it was possible to assess and analyze the answers provided by the two kinds of participants that were interviewed: those who finished the MOOC and those who didn't. However, upon further analysis of the content of said interviews, we can observe that the level of self-awareness about the importance of sustainability was very high in both groups, regardless of if they finished the MOOC or not.

Actually, one of the most important findings that were done after revising the content of the interviews that were conducted to the users who didn't finish the MOOC, it is clear to see that not finishing the MOOC doesn't necessarily mean that the experience was a failure or that the user's objectives were not met.

Hearing the voice of the participants, it was possible to discover that many participants, from the very start, knew that their end goal wasn't to reach the end of the course. Of the few cases (three out of eight) of users who had the intention of taking the course all the way to the end, but then didn't, it was possible to see that there were other external factors in their personal life that affected deeply in their decision to stop with the course, with only one of them deserting the course because they considered that the content and the evaluation process definitely didn't match up to their expectations.

Another interesting finding from the interviews that took place was that most users considered that there was mostly a need for changes in the social environment in order to help sustainable development beat the challenges that it faces nowadays in order to become the norm. Most interviewed participants considered that the change had to come from social approaches, since the persons in a community define if the practices in the community are going to have a sustainable approach or not.

The second most cited nature of action that was requested and recommended by the participants was the economic approach. Quoting one of the interviewees, "Money makes the world go round". More than three times, economic factors were cited as limitations or potential factors that could refrain sustainable development to become more prominent in the future. Ecological factors were cited less, but one of the participants, user H, explained that "If I had to pick one to focus on first, I would pick the ecological nature. The reason for this is because, in the end, we owe everything to the environment. We need clean water to drink, no matter how rich we are or how close our societies are. We need to take care of the ecosystems around us, we need to raise awareness about the importance of the environments that surround us."

Listening to the perspective that participants had about the challenges and best strategies to promote sustainable development for the future was an enriching experience, especially when participants shared their desire to keep learning and educating themselves on the topic even after they had finished the course they enrolled in. However, maybe the most valuable feedback obtained from the interviews involves the recommendations that the participants gave for any future MOOCs that might be developed.

First, many users made comments about defining the profile of the end user, mainly because they perceived that the end user that was promoted for these MOOCs was “too broad”. “Any user who has finished high school” was not very clear about the level of expertise or complexity that the courses would present, and more than one user felt that they wanted the course to be “harder” or “easier”. Thus, the suggestion to define a more specific end user and to promote the course to the population that would be interested in the level of complexity that was defined for the course beforehand was a suggestion that was constantly mentioned by participants, both those who finished the MOOC and those who didn’t.

A second suggestion that was made constantly by the participants was to promote the courses more, to invest in advertisement and to spread the word about their existence. Many of the people interviewed considered that there was not enough promotion of the courses, and they strongly believed that more users would sign up and participate if only they knew that they could have free access to these online courses.

Other important suggestions by the participants was the promotion of more human-to-human interactions or opening spaces and possibilities for the students of the course to be able to communicate with their peers beyond a “message board that nobody uses”. Promoting activities that promote team building or teamwork were also recommended, since more than one user admitted that taking the course was a very “lonely” process for them, since it was



mostly them, text and some videos. Inviting users to also explore or learn to use other tools or platforms was a suggestion that was recommended a lot, since a lot of the participants who were interviewed had already experienced other type of MOOCs that promoted the use of tools that were available in websites that were outside the platform of the course. Also, the use of case studies or real life cases was recommended, since it made the users feel more connected to the information, especially if the information could be applied to their own personal lives, like was the case of the Energy Savings course, in which users could learn to measure their electricity waste in a deeper and personal level, a skill that one of the users who was interviewed admitted was “life changing” and “very valuable” in their experience.

Users also requested that more than one professor teach the lessons, since it became a little bit too repetitive to have one person give all the lessons every single week. Users were interested in hearing the voices of other experts in the field. They even suggested that making collaborations with other universities or even countries might’ve made the course content more entertaining and interesting for their learning process.

As a final suggestion that was requested more than once, users suggested the implementation of social media more like a natural tool in the course content rather than just an “invitation” to tweet or mention in their Facebook status that they had finished a lesson. Implementing social media challenges that might be related to the course topic would be considered innovative and interesting, especially for the younger users.

And finally, in the topic about future generations, all participants that were interviewed agreed that courses online, such as the MOOC they participated in, will definitely become a tool to educate future generations with more and more impact in the future. All users considered that online courses have the “potential” to teach about sustainable development,

and that there is a very high level of importance to raise awareness about the importance of sustainable development to promote a “better future” for everyone.

With the hope to help reach this goal, a series of future research endeavors that will be explored as a result of culminating this initial research include exploring findings of the study that were not anticipated, such as a more international perspective about sustainable development and ways in which future generations can be introduced about this topic in a fun and interactive way through digital interventions. Some unanswered aspects of the research questions that were posed, such as the impact of the MOOCs in the participant’s daily live activities that are considered pro-sustainable will be explored at a deeper level, making changes in the instrument that was applied and seeking to listen to the voices of the end users in more detail, rather than trying to measure them with a Likert scale.

Because one of the limitations of this research was the amount of time that was used in order to gather the data that was analyzed, there is a possibility to analyze and compare the results obtained from this time period with other runs of the courses that have already taken place or that will take place in the future. Finally, re-assessing and expanding theory, framework and study designs about the topic of education for sustainable development in online platforms is suggested as a line of future research, with the purpose of applying the suggestions and recommendations that were obtained from this research with the hope of noticing a favorable outcome in the users experience and level of understanding and awareness about sustainability for the future.

And thus, concludes the present research. I conclude this thesis with the following quote from Frederich Niecks (1889), who phrased perfectly the way I feel about the effort and work that culminated in this document.

“If my narrative does not succeed in engaging your interest, in stimulating your curiosity, and in now and then sending a thrill of excitement through you, I have failed to do justice to the noble subject of my choice”

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## Appendices

### Appendix 1. Pre-Survey

1. ¿Cuál es tu correo electrónico? (El que usaste para inscribirte a este curso)

2. *Considero que mi entendimiento de sustentabilidad es a nivel de experto.*

Totalmente en desacuerdo

En desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

3. *Antes de tomar este curso ¿qué tan familiarizado estás con el tema principal de este curso?*

Soy nuevo con el tema

Estoy relativamente familiarizado

Estoy familiarizado

Estoy muy familiarizado

Soy un experto en el tema

4. *Estoy familiarizado con las Metas de Desarrollo Sostenible de la UNESCO*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

*5. Anteriormente he tomado cursos en línea en donde el desarrollo sostenible es un tema que ha sido tratado.*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

*6. Anteriormente he tomado seminarios en donde el desarrollo sostenible es un tema que ha sido tratado*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

7. Anteriormente he tomado cursos presenciales en donde el desarrollo sostenible es un tema que ha sido tratado

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

8. ¿Qué actividades sostenibles desempeñas en tu vida diaria?

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Considero que mi estilo de vida es altamente sostenible

Ajusto conscientemente mi estilo de vida personal para reducir el desperdicio lo más que puedo

Procuro reciclar en casa

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Procuró sustituir el uso de un  
vehículo con caminatas o el uso  
de una bicicleta

9. *¿Cuál es tu perspectiva sobre el problema del desarrollo sostenible?*

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Considero que el desarrollo sostenible  
es un problema ecológico

Considero que el desarrollo sostenible  
es un problema económico

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Considero que el desarrollo sostenible  
es un problema social

10. Enlista en orden de prioridad quién tiene la influencia más significativa sobre la sostenibilidad en una sociedad. Siendo 1 la que tiene más prioridad y 4 la que tiene menos prioridad.

Gobierno

Negocios

Academia

Ciudadanos

11. Evalúa las siguientes fuentes de energía y califica de acuerdo a su importancia para la sociedad a futuro.

Muy poco importante	Poco importante	Neutral	Importante	Muy importante
---------------------	-----------------	---------	------------	----------------

Petróleo

Gas

natural

Carbón

Nuclear

Solar

Eólica

12. ¿Aceptarías ser contactado para realizar una entrevista con fines de investigación?

No acepto

Acepto

## **Appendix 2. Post-Survey**

1. ¿Cuál es tu correo electrónico? (El que usaste para inscribirte a este curso)

2. *Considero que mi entendimiento de sustentabilidad es a nivel de experto.*

Totalmente en desacuerdo

En desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo



3. *Este curso me motivó a investigar más sobre el desarrollo sostenible.*

- Totalmente en desacuerdo
- Desacuerdo
- Neutral
- De acuerdo
- Totalmente de acuerdo

4. *Estoy familiarizado con las Metas de Desarrollo Sostenible de la UNESCO*

- Totalmente en desacuerdo
- Desacuerdo
- Neutral
- De acuerdo
- Totalmente de acuerdo

5. *Anteriormente he tomado cursos en línea en donde el desarrollo sostenible es un tema que ha sido tratado.*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

*6. Anteriormente he tomado seminarios en donde el desarrollo sostenible es un tema que ha sido tratado*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

*7. Anteriormente he tomado cursos presenciales en donde el desarrollo sostenible es un tema que ha sido tratado*

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

8. *¿Qué actividades sostenibles desempeñas en tu vida diaria?*

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Considero que mi estilo de vida es altamente sostenible

Ajusto conscientemente mi estilo de vida personal para reducir el desperdicio lo más que puedo

Procuró reciclar en casa

Procuró sustituir el uso de un vehículo con caminatas o el uso de una bicicleta

9. *¿Cuál es tu perspectiva sobre el problema del desarrollo sostenible?*

Opciones:

Totalmente en desacuerdo

Desacuerdo

Neutral

De acuerdo

Totalmente de acuerdo

Considero que el desarrollo sostenible  
es un problema ecológico

Considero que el desarrollo sostenible  
es un problema económico

Considero que el desarrollo sostenible  
es un problema social

10. Enlista en orden de prioridad quién tiene la influencia más significativa sobre la sostenibilidad en una sociedad. Siendo 1 la que tiene más prioridad y 4 la que tiene menos prioridad.

Gobierno

Negocios

Academia

Ciudadanos

11. Evalúa las siguientes fuentes de energía y califica de acuerdo a su importancia para la sociedad a futuro.

Muy poco importante	Poco importante	Neutral	Importante	Muy importante
---------------------	-----------------	---------	------------	----------------

Petróleo

Gas

natural

Carbón

Nuclear

Solar

Eólica

12. ¿Aceptarías ser contactado para realizar una entrevista con fines de investigación?

No acepto

Acepto

## **Appendix 3. Semistructured Interview Script**

### **Parte 1. Perfil del Sujeto Entrevistado**

1. Pláticame un poco sobre ti. ¿A qué te dedicas?

2. ¿Recuerdas en qué MOOC te inscribiste?

(preguntas derivadas de esta)

- ¿Cómo te enteraste del MOOC?

- ¿Qué fue lo que te motivó a inscribirte?

- ¿Qué tan familiarizado estabas con el tema central del MOOC antes de tomarlo?

3. Antes de este MOOC, ¿habías participado en un curso en línea donde se tratara la temática del desarrollo sostenible?

(preguntas dervidas de esta)

- ¿Habías participado en algún seminario o actividad extracurricular que tratara la temática de desarrollo sostenible?

¿ Habías participado en alguna clase curricular que tratara la temática de desarrollo sostenible?

### **Parte 2. Sobre la Sustentabilidad y las Actitudes de los Participantes**

4. Por favor, dime las primeras 3 palabras que relacionas con "sustentabilidad"

5. ¿Estás familiarizado con las Metas del Desarrollo Sostenible de la UNESCO?

- Dependiendo de su respuesta, explicarles qué son o preguntarles de dónde habían escuchado sobre ellas.

6. ¿Consideras que haces muchas actividad pro-sustentabilidad en tu vida cotidiana?

- Dependiendo de su respuesta, preguntar por qué

- ¿Podrías darme algunos ejemplos?

7. Sobre el problema del desarrollo sostenible.... ¿acaso crees que es un problema...?

- ecológico

- económico

- social

¿Porqué?

8. Después de cursar el MOOC, ¿te interesó buscar más información o aprender más sobre el desarrollo sostenible? ¿Por qué?

### **Parte 3. Mejoras en MOOCs, Estrategias del Futuro para Educación Para el Desarrollo Sostenible**

9. ¿Qué mejoras consideras se deberían hacer en cursos masivos en línea para educar sobre el desarrollo sostenible?

10. ¿Consideras que es un problema global? ¿Qué estrategias de cooperación internacional consideras serían valiosas para la difusión del desarrollo sostenible?

11. ¿Qué elementos serían llamativos para ti para educar sobre la educación para el desarrollo sostenible en cursos masivos en línea?

- gamificación
- realidad virtual
- casos de la vida real
- colaboración internacional
- videos
- uso de redes sociales
- retos

12. ¿Crees que futuras generaciones tomarán muchos cursos en línea? ¿Crees que la temática de Desarrollo Sostenible será importante para futuras generaciones?

13. ¿Crees que los MOOCs tienen el potencial transformador para educar sobre el desarrollo sostenible? ¿Porque? Si los MOOCs no te convencen, ¿qué otras medidas consideras serían valiosas?

14. Después de cursar el MOOC de energía, ¿consideras que pasaste por un proceso de sensibilización sobre el tema del desarrollo sostenible? ¿Porque?

15. Muchas gracias por tu tiempo. Si tienes algún otro comentario sobre posibles mejoras en MOOCs para la educación sobre el desarrollo sostenible, siéntete con la libertad de compartirlos conmigo en este momento.



#### Appendix 4. Interview Participant A

1	I: Please tell me about yourself. Let's start by asking you your name and what you dedicate yourself to.
2	PA: Good afternoon. My name is Participant A. (redacted) I am currently a tenured teacher in the University of Guayaquil and I am working to earn my Ph.D. and my second university degree. I don't know if this is relevant or not, but the theme of my thesis is about the field of energy techniques.
3	I work in the department of industrial engineering of the university. I am a full time teacher, I give classes about applied physics and I help run the laboratory in our department. I also give classes about the theme of electricity. Currently, I am giving a class about electronic energy in telecommunications.
4	Regarding my formation, my university degree was in mathematical physics, I earned my Master's degree in Teaching about Physics, which is what I teach about the most at the university I currently work in. And, as I mentioned before, I am working to earn my Ph.D with the Dakota State University through an online approach. I am, at the same time, studying my college degree for Renewable Energies. The Ph.D I am enrolled in is related to one of the lines of research that the university I work for focuses a lot, which is Sustainable Development.
5	I: Thank you for your answer. Do you remember which MOOC you signed up to? How did you find out about this MOOC? How familiarized were you with the main topic of the course before you enrolled in it? Was there a specific motivation as to why you signed up to it in the first place?
6	PA: The course I took was about Clean Energies.
7	I took it because the courses are generally online and they allow you to open and work on them in your own pace, at your own time. You are free to access them very early in the morning, or during your specific break or lunch hour in the afternoon... or even very late at night, just before going to sleep. This was important to me, because as I mentioned before, I am currently working in a tenure track, fighting to earn my Ph.D and also finishing my second university degree at the same time. So having the flexibility to enroll and take the course at my own pace was a very strong motivation.
8	I was interested in the topic of the course because I am currently working on studying themes regarding renewable energy and I have to show samples or evidence that I enrolled in activities which are related to this topic. These activities can be seminars, congresses, or online courses. So for my work, this was a valuable opportunity for me, since it would make my list of evidences that I was keeping up with the newest trends of this topic longer.
9	I had previously participated in some MOOCs, so I had signed up to the EdX platform and requested that I would be notified whenever new courses that touched upon the theme of clean or renewable energies were uploaded to the platform. I saw that the Tecnológico de Monterrey University had uploaded a series of MOOCs that touched upon the theme of energy and I decided to enroll in the one that focused more in Clean

	Energies, because it was the course most relevant to my area of research and formation.
10	I finished the course successfully. I truly believe they gave me all the tools and all the information I needed to accomplish this.
11	I: Before this MOOC, had you ever enrolled in an online course that touched upon the topic of sustainable development?
12	PA: No, I had previously signed up to some courses in the EdX platform, but they were from the University of Valencia and they were about Physics, Mechanics, Qualitative Analysis and Statistics. This was the first MOOC I signed up to that touched upon the theme of sustainability.
13	I: Had you participated in a seminar, or any extracurricular or curricular experiences that touched upon the theme of sustainability before?
14	PA: Previously, no. I hadn't taken any seminars or extracurricular activities related to sustainable development.
15	However, I would say that in my curricular formation, since I am about to earn my second university degree in Renewable Energies, I have started to touch upon this subject a little bit.
16	Also, as mentioned before, this was my first MOOC related to sustainability directly, so I guess that before this MOOC the answer was no, but now that I have finished it, the answer is yes
17	I: Please tell me the first three words you relate to "sustainability"
18	PA: Environment, Natural resources, and Sustainable Conducts
19	I: Are you familiarized with UNESCO's Sustainability Development Goals?
20	PA: In our university, the line of research about sustainability has touched upon this topic a little bit. I wouldn't say I am an expert on the topic, but I do know that some of the goals that have been defined include taking care of the environment, reduce poverty and the responsible use of natural resources. I also think that they should touch up on more about sustainable conducts of the people, try to motivate the people around the world to take better care of the environment or stuff like that.
21	I: Do you consider you make a lot of pro-sustainable activities in your daily life? Why? Could you please give me some examples?
22	PA: Currently, in our country, which is Ecuador, anything related to the topic of recycling and stuff like that is not something we see a lot in our communities.
23	Normally, users just place the garbage in a single bag, they don't divide the trash.
24	In my case, however, we try to help by other means. For example, I try my best to keep the use of electricity and water as low as possible in my personal home.
25	Regarding waste, we are trying to start recycling campaigns.

26	In the area where I live, there are some persons who have taken the role of "chamberos", which means they go through the trash and try to divide water bottles, plastics, glass and so on so that they can sell them and make a profit out of that.
27	Because I know that they will go through my trash, I try to help out by trying to divide the garbage and putting the water bottles or glass bottles in their own garbage bag. I also do this because I rather they don't go through my trash and contaminate the environment by opening mixed up garbage bags.
28	Not all my neighbors take the time to try and divide their trash like I do.
29	But I teach in my home that it is worth the extra effort. It is our attempt to cooperate to the main goal, somewhat. A better environment for everyone.
30	I: Regarding the topic about the challenges that exist for the sustainable development, do you consider these challenges to be of ecological, economic or social nature? Why?
31	PA: I mainly think it is a social problem. People are not being taught about the importance of trying to be part of the solution. They are not aware about the impact they might have if they started taking care about the resources and the environment around them.
32	I also consider that economically, our country is having some hardships that make them unable to invest in educating future generations about this topic, since they have to resolve other crisis before that.
33	There was a social campaign that was run recently in my community, where we tried to raise awareness about the importance of saving energy.
34	In the case of my country, Ecuador, the basic needs of a person can't sometimes be covered by the very low income we have when we get paid and that includes the use of electricity. Someone who doesn't have a strong job or position might struggle to pay their electricity bill, because the prices go up, specially during the summer. So, people decided not to invest in electronic kitchens and relied on gas mostly to cover their day to day cooking needs.
35	However, because the demand for gas rose so much, the government considered taking away the economical help they provided users to cover their gas bills to promote that people stopped using gas so much.
36	In the end, they decided to not act upon it, because it would mean a political struggle and the society might riot or get angry with the political party in charge during the time, and that would mean that they would earn less votes the next time elections came up.
37	So, as we can see, the two elements of social and economics are present in this case, but I do believe that society plays a more active role.
38	I think that we should start working on educating people more about ecological approaches, campaigns that raise awareness and to present the society with possibilities so that they can be self-conscious about their role.

39	I: After participating in the MOOC, where you interested in researching more about the topic of sustainable development? Why?
40	PA: Yes. I believe that sustainable development is a topic that involves a lot of different types of people and jobs, and even though the course I enrolled in touched a little bit about this subject, it is a topic that is relevant and active worldwide right now, so I was curious enough to research a little but more about it and I am glad I did.
41	I: What would you suggest for future online courses that would want to touch upon the topic of sustainable development?
42	PA: I consider that it is key to make a study to determine the profile of the end user of the course. In other words, to take in consideration who the course is being developed for.
43	For example, I work with university students and I am currently working hard to earn my Ph.D in a topic related to energy, it would be more attractive if the MOOC I signed up to had more advanced and higher level of difficulty so that I would actually learn about things I was not aware of before I signed up.
44	However, I am sure there are other people who are not in the same academic level who might struggle if they try to tackle this kind of course without any previous formation in the topic.
45	So I believe that it is very important that before designing the course, the people behind it are able to decide who their public is and try to provide an interesting and challenging level depending on who they are designing for.
46	I: Would you consider that the challenges for the sustainable development are global? What strategies to internationally cooperate would you consider to be valuable for raising awareness about the importance of sustainable development?
47	PA: Yes, it really is a struggle globally. Even though there are some countries who have started already trying to fight back, we can see that other countries are facing terrible levels of pollution and that is taking a toll in the quality of life of millions of people, all around the globe.
48	Regarding strategies to cooperate, from what I have seen, there are some people who have taken it upon themselves to start going in cleaning campaigns, specially regarding the oceans, which is a nice and important action to take.
49	However, I do believe that some governments that are currently in charge are not giving it the importance that they should. And maybe, the voices of the citizens and their concerns should be listened to more in order to change this.
50	There are some projects where people are proposing starting to replace the old ways to earn energy with better and renewable approaches.
51	In my country, some people have suggested using thermo-energy, which I think would be great. However, all the volcanoes and things related to the nature are protected by old laws who are not updated and aware that we could find a use for that thermal

	energy, so I believe that revising old laws and trying to promote the use of renewable energies worldwide could really make a difference in the long run.
52	Another key point, I believe, involves us educating future generations about this topic. The government should promote this type of education and practices in the society they work for.
53	There should be international collaboration, making governments compromise and agree on ways to promote the education for sustainable development agenda.
54	Meanwhile, maybe we could start a project by starting such cases of collaboration to teach about sustainable development in universities. We should start a collaboration between universities, where we share the resources that we have created upon this topic, and compare cases in which they are having success or what is working in different societies of the world, so that they can start applying in their own societies.
55	I: What elements would be striking or attractive for you to find in massive open online courses that touch upon the topic of education for sustainable development?
56	PA: I think that it would be very useful if from the very start, the MOOC clarified the type of profile their course was designed for. In other words, that even before you sign up, you are aware about the level of complexity or challenges that you will be facing.
57	I also think that involving social media in fun and interesting way would be an approach that could help younger generations get involved.
58	The use of videos is also something I find interesting, because it helps the information to be shared with more interaction than just a wall of text. So use of videos would be great.
59	I: Do you believe future generations will take a lot of courses online? Do you believe the topic of sustainable development will be important to future generations?
60	PA: I consider that the long distance education trend is evolving and taking up speed, specially because nowadays there are a lot of young people who don't have easy access to universities or courses in their proximity. Being able to log in online and be part of a program or a course is very attractive and with the passing of time, technology and the use of the Internet is becoming more and more accesible for others.
61	As we know, population is growing and people are not being careful about the use of natural resources. So I believe that future generations will not only want to learn about sustainable development, but their quality of life will be directly affected by the lack of it in case the societies don't start educating and acting now.
62	A trend that I see in the future is that machine learning will help robots and other type of digital intelligence help students learn about diverse topics, which means that students won't have to rely on the one professor in order to advance in their studies. I truly believe that in the future, education will be more accesible because of this, and

63	I would not be surprised if online courses became a very important trend in the field of education in the future.
64	We should work in cultivating and raising awareness about the importance of sustainable development for everyone.
65	And if the easier way to contact and promote this is online, I think a lot of efforts should be directed towards online platforms.
66	I: Do you believe that MOOCs have the transformative power to educate about sustainable development? Why? In case MOOCs don't convince you as a useful approach, which other approaches would you consider valuable?
67	PA: I consider that the online courses, depending on their content, will have potential to educate about this topic or not.
68	In the end, it all comes down to the content and the ability the designers of the course have to keep people interested in the course.
69	Content is everything for me.
70	And something very important that keeps me engaged or interested in a MOOC I signed up to, is that they use videos as part of their explanations.
71	I also believe that another key point that would help MOOCs become a more relevant education tool would be if they constantly give you the chance to prove to yourself that you are learning something.
72	That sense of growth and that the content is worth the effort are the key elements that I consider could help MOOCs become an important tool to educate about sustainable development.
73	I: After taking this course, do you consider you went through a process of sensibilization regarding the topic of sustainable development? Why?
74	PA: I consider that it depends on the person who took the course, and what their needs are.
75	In my case, I had the need to earn knowledge about this topic and seeing how this can be related to my own research project proved useful.
76	To be able to apply the knowledge that you obtained in the online course in your practical life is very satisfying, and it helped me raise awareness about the importance of the topic of sustainable development.
77	In my case, it was interesting to see the efforts to educate about this topic in other countries, in this case, the country of Mexico, and how the case studies they used during the course were applied to their own cities but reflected scenarios that have also presented themselves in my country, Ecuador. It helped me realize that I could help my country if I took in consideration the approaches that they were using in Mexico to educate about sustainable development.

78	I: Thank you for your time. If you have any other comments you would like to share with me, feel free to say them now.
79	PA: The questions you presented were very stimulating.
80	I believe that MOOCs are developing very well. They are presenting topics that are relevant to the challenges that we are facing worldwide nowadays, and that can be useful for future generations as well, because these courses are archived and saved online for posterity.
81	I also believe that they are attending the needs of participants to learn more about relevant topics that will have a positive impact in their daily lives.
82	However, I believe it is important to take notice that not all courses are going to be the best option for all the potential participants.
83	We need to listen to the needs of the users, in order to give them the content they need in order to fulfill their education needs on the subject they wish to study.
84	I personally have been pondering about how to educate about sustainable development in middle school level, with younger people. I believe that if they made a course directed towards adults who teach children or younger people, a lot of benefit, for present and future generations, would take place.
85	Something I believe is lacking is to educate at the level of businesses, because those are the people that are out there making a difference or not in today's world.
86	Maybe the government should make it mandatory that some workers in businesses take online courses regarding education for sustainable development, at least just to help raise awareness.
87	Those would be all my comments. Thank you for your questions and good luck with your thesis!

## Appendix 5. Interview Participant B

1	I: Hello, thank you for taking the time to take this interview. My first question is related to you. Could you please share with me about who you are and what you work on... what country you're from... any information that you might consider relevant so that I can understand your background.
2	PB: My name is Participant B. (redacted)
3	I was born and currently live in Mexico City.
4	I studied economy back in college and my current job is that of an economist who specializes in environment economy.
5	I currently work as the director of operations in GreenMomentum, which focuses in the analysis of public policies, conditions in the market, and technological development of our country in order to train current talents and develop innovative solutions that might prove sustainable in the future.

6	Luckily, we have had the opportunity to collaborate with the German government regarding these themes, and we have also established contact with the development department of the United States of America.
7	We have also collaborated with different government entities in Mexico, for example, we have worked with the government of Jalisco, Puebla, Queretaro and others.
8	We are currently working in an international project regarding Chile, Brazil, Uruguay and Mexico.
9	I am 34 years old... I am single. I like watching soccer matches.
10	I: Now that I have a notion about who you are, I have a better understanding of your background. My next question would be; do you remember which course you signed up to? How did you find out about it?
11	PB: I had previously taken some courses in EdX but they were all courses focused in a more global approach.
12	I hadn't seen a course applied specifically for my country, Mexico. And then, I saw that this MOOC was added to the platform.
13	I remember the name of the course, it was: Energy Markets in Mexico: Opportunities for Business.
14	The title caught my attention. The fact that they mentioned my country in the title definitely was a key factor that pulled me in.
15	I took the course, completed all of it and I even paid for the official certificate of the course. I wanted the official certificate because I strongly believe it will be a great asset for my curriculum.
16	I: You mentioned you had previously taken some courses in the EdX platform. Was there any of these courses the topic of education for sustainable development?
17	PB: I did take one course previously that touched upon the topic of sustainable development, it was a course that was being promoted by the government of Argentina. This course was also certified by the UN.
18	This online course taught about the Objectives for the Sustainable Development, the objective at the end was to make you a promotor of these objectives.
19	The intention of this course was to help the participants familiarize with all the objectives that have been defined, along with their structure and their goals for the year 2030.
20	I also have experience learning about SDGs, but not in a MOOC but it was a course that I took in person, here in Mexico city, that was run by the World Energy Council.



21	I have participated in a lot of courses that I took in person which were more focused on the energy sector, but of course, because of the context that they apply, one way or another they bring up the topic of sustainability.
22	I: I understand. Did you have any curricular formation that touched upon this subject?
23	PB: When I specialized in environmental economics, I had to take one class that touched upon the topic of sustainability. I think the title of the class was: sustainable development or something of the sort. So yes, I had previous curricular formation regarding this topic.
24	I: Okay. Talking about sustainable, could you please tell me the first three words you relate to "sustainability"?
25	PB: Environment, Well being, and Growth.
26	I: Perfect. Next question, do you think you make actions in your daily life which would be considered pro-sustainability? If you do, can you share some examples with me?
27	PB: Well... a lot of people might say they do. But not everyone really understands what categorizes as such, you know?
28	For example, me as an economist, I would think that the most important drive and way in which you can help take actions that are pro-sustainable, would be to observe your spending patterns, keep an eye out of what you are consuming, how often, and how much.
29	I try to keep track of my consuming patterns and I try to avoid waste as much as I can. I also keep track of what the materials are in the purchases I make, and I try to look for the most environment friendly options when I am able to.
30	I also make little actions in my everyday life, like attempt to bring an ecobag when I go the supermarket. I also use a bicycle to make my way to work. I don't buy things I don't need and I avoid consuming things that are not necessary for my well being.
31	But if I had to name it, I believe that the most important activity I do is try to raise awareness of the topic, and educate others about the financial impact that their decisions make and how the environment policies play a role in our economic sector.
32	I promoted the MOOC I enrolled in by using my social media to share the signup page with my friends and family, to try and share the knowledge with others.
33	But honestly, not a lot of people cared. Not in my social circle, at least.
34	I: Yes, we are all doing our best to promote awareness about this topic.
35	PB: Yes, and that is one of the reasons I was really looking forward to collaborating with you through this interview, because I strongly believe that it is an important topic that needs to be promoted more.

36	I: Speaking about the problem we are trying to solve, we are aware that sustainable development is the approach for solving a lot of real life problems that are originating from a lack of innovative solutions to promote sustainability. I am curious about your perspective. Are the challenges for sustainable development of economic, social or ecological nature?
37	PB: If we analyze the goals for the year 2030 defined by the UNESCO, there are 17 objectives. But I honestly think that these goals are not the solution.
38	I believe the problem arose hundreds of years of a broken system that have been replicated and applied over and over again. An economic system that focuses mainly on consumism and not on the impact that these sort of practices have in the long term run.
39	I also believe that there is a lack of sensibilization for current generations about thinking in long term planation. Nowadays, people have a tendency to only worry about their needs and don't really stop to put themseles in the shoes of other human beings who might not be born yet, but that will probably struggle to try and keep a good quality of life, specially if we keep being careless about what we consume and what we build.
40	Thus, the government must get involved at some point. Because they have to provide their citizens with the tools so that we can co-create new models, new designs, not only in public policies, but in the development of infrastructure that is planning for long term solutions for everyone.
41	Both the societies and their governments need to cooperate in order to start these practices, in order to fight back towards the challenges that permit sustainable development to take place.
42	I strongly think that there is a lot of misinformation out there that makes people believe that in order to create infrastructure and movements that might be pro-sustainability, that immediately means that the solution is going to be expensive. There would be actually economic gains for the population because of how much we would save if we implemented measures that took better advantage of renewable energies, for example. The cost of doing nothing actually ends up being more expensive in the long run.
43	I: Thank you so much for your extended answer. Now, landing all of this into the MOOC platform, what would be your reccomend for future planning and runnings of a massive open online course that will focus in teaching and raising awareness about the importance of sustainable development?
44	PB: Sincelery, I think that the course I enrolled to wasn't good. The level was very basic for me, so it was a little bit boring. It felt more like a chore than an actual learning process.
45	I also believe that one of the reasons I didn't enjoy the MOOC I enrolled in was the format that they presented in order to evaluate if we were learning or not. The routine was the same for every topic of the course: Read this document, watch this video

	and then answer a couple of multiple answer questions. This system was ridiculously easy, at least in my case. Sometimes I didn't even need to read the document or watch the whole video in order to answer the multiple choice questions and get them right.
46	And so, I strongly believe that a recommendation I would give for future designing and running of courses like this would be to set the bar higher, to actually do a little more research and share with the public more complex and challenging information to process, think, and learn.
47	A more ambitious evaluating process would help me feel more engaged and with a sense of accomplishment.
48	I: Which elements would you find attractive to be implemented in future online courses?
49	PB: The most important thing for me is the content. The tool that is used to share the content is also important, of course. But the core of the course is the content.
50	I am currently trying to find courses that are more practical and use of real life case studies, so that I can observe what is happening around the world regarding the themes I am interested in.
51	Something I didn't enjoy about the course I signed up to, was that there was only one professor. It was the same guy over and over again in every single video. I found tha to be frustrating and boring. If there were other people involved, maybe have other teachers who are expert in the theme share their perspective or their knowledge would help to keep things interesting and engaging.
52	One thing I really enjoyed in one course I took online, was that they gave me access to a tool that allowed me to see the tendencies around the world. Using other platforms or tools, such as the tool that was created by IRENA (International Renewable Energy Agency) really made me feel motivated and interested, because I realized that if I learned how to use this tool, I could apply it in other fields of my daily life, including my research. I found that so engaging and fun, I actually asked my whole team to take the course as well, and we all considered as a group that the teaching of how to use a specific tool was really useful and great.
53	I: Do you believe future generations will use MOOCs to learn about sustainable development?
54	PB: I think that future generations should definitely dive deep into the MOOC world and explore all the resources and information that is available to them for free in various online platforms.
55	When I discovered MOOCs, I was surprised. I felt excited. I planned on taking thousands of courses. However, the people I work with... their average age is around 25. And I have noticed that there are two different types of personalities when it comes to online courses. Either they are like me and get super excited and motivated to complete as many courses as possible, because the knowledge is accesible and

	out there, and then there are other users who really struggle to feel motivated to even open the website in the first place.
56	Because my job as a director is to try and help my team develop better abilities for the future, I try to send out emails urging them to sign up to courses and trying to keep track of the newest courses available that might be of interest for the younger generations. So, I believe that I have an extra motivation because I must keep updated on what is the newest and the best information out there.
57	But future generations, I think that they should become more aware of just how lucky they are, they should open their eyes and understand that they are in the best moment to be alive in order to educate themselves about any type of knowledge they want. Literally any question is just a google search away. And if they put in the extra effort, they can really take courses that were designed by top tier universities around the world. I believe that if the right promotion is made and younger people realize about the potential, future generations will definitely take better advantage of courses online.
58	I: Do you think MOOCs have the potential to teach about sustainable development in the future?
59	PB: I strongly believe that as long as the MOOCs come up with topics that are engaging, transversal, and they try to develop topic in different levels so that different types of profiles can sign up and earn new knowledge, they should be succesful in getting more people involved and interested in the topic of sustainable development.
60	I: If there are any free comments you would like to tell me, now would be the time.
61	PB: Obviously, the decisions that were taken in the past are no longer working for the generations of the present. And I think that we definitely need to start thinking of the generations of the future. And future generations needs to start thinking of the future future generations. And so on.
62	So I truly appreciate that your questions were greatly directed about future MOOC designs and new and interesting ways to try to keep participants engaged, it means that you guys in education are really trying to make things better and that is great.

## Appendix 6. Interview Participant C

1	I: Could you please tell me a little about yourself? Where are you from and what do you work in?
2	PC: My name is Participant C (redacted), I am mexican, I live in the city of Cuernavaca, in Moreles.
3	I work in the development of teaching material focused in sustainability. I also give classes and run workshops in order to certify people to teach about the importance of clean water and to each about the environment.

4	I also work as a consultant for various businesses in order to gurantee that their practices are pro-sustainability.
5	I: Do you remember which MOOC you signed up to? How did you find out about it? What motived you to enroll in it? How familiar were you with the topic that was being taught in that specific course?
6	PC: Yes, I remember the course I signed up to. The title of it was "Energy Savings" or something like that.
7	I found out about this course because I am subscribed in the platform of EdX and I asked to be notified whenever there were new courses that touched upon the subject of energy saving or sustainability. So I got an email address about there being a new course, and I decided to sign up to it.
8	This was my second MOOC I enrolled in that touched upon the subject of energy saving.
9	One big motivation that helped me decide to sign up to this course was that the university that created the course is very well known in my country, it is considered one of the most prestigious and expensive universities in Latin America. So I truly thought that the opportunity of taking a course that was designed by the team of this university was something I needed to try.
10	Another reason I was motivated to sign up to this course was because it was directly related to my field of work. As I mentioned before, I design teaching material that focuses on sustainability. And energy is a very important element for this topic. So I thought it would be wise to deepen my knowledge regarding this topic.
11	I: Before enrolling in this course, had you participated in any previous workshops, seminars, curricular or extracurricular activities that touched upon the subject of sustainability?
12	PC: Yes, I have participated in workshops, seminars, curricular activities and extracurricular activities that involve the theme of sustainability.
13	I dedicate myself a hundred percent to creating teaching material that touches upon the topic of sustainability, that is my line of work. My personal business is about this, so I find it really necessary that I involve myself in curricular and extracurricular activities that teach about this subject so that I can keep updated on the newest trends.
14	I: Please share with me the first three words that pop into your head when you hear the word "sustainability"
15	PC: Responsibility, Economy, and Natural Resources
16	I: Are you familiarized with UNESCO's Sustainability Development Goals?

17	PC: Yes, of course. I have even developed a course in order to help teachers become familiarized with all 17 objectives.
18	I: Interesting! Can you share with me more about this course?
19	PC: Based on the 17 objectives, I developed some graphics that show the titles and the main objectives of each objective. Each participant, which are normally 17, are given information about one objective each and they have to research and explain the objective they were assigned to their peers. They also have to talk about which objective is related to the objective they were assigned, so they start talking about ways to collaborate or come up with new ideas to accomplish the objectives that were settled. They also talk about applying the objective that they were assigned to their daily life or relate it to their profession or their studies. All of these with the objective of demonstrating that the 17 objectives can be applied to everyone and that we need to raise awareness about what they are and how to achieve them.
20	I: Thank you very much for sharing with me about this workshop. Wish I could take it. Next question, do you consider you participate in a lot of pro-sustainability activities in your daily life? In case you do, could you share some examples with me?
21	PC: My work is 100% related to pro-sustainability, because I work in creating teaching materials that raise awareness about this topic.
22	I also work directly as a consultant, specially with businesses that work in fields related to the use of bodies of water, so clean water campaigns and activities are something I involve myself with constantly.
23	I give classes in a local university about sustainability, and I believe that is one of the most pro-sustainability a person can do, raise awareness about this topic with future generations.
24	I: About the challenges that sustainable development faces, do you consider that they are of ecological, economic or social nature? Why?
25	PC: I think that all three are important perspectives to take in consideration when facing the challenges that we have to tackle in order to secure a sustainable future for everyone.
26	I: If you had to select one of the three as one that has a bigger impact, which one would you choose and why?
27	PC: I think the problem is more of a social problem, because in the end, it is the society that defines how to behave themselves. This affects economical and ecological factors in the long run, but I strongly believe that it all originates in the human beings as a society first.
28	I: Do you have recommendations for future massive open online courses that touch upon the topic of sustainable development?

- 29 PC: I think that the MOOC I enrolled in was very good, it helped me realize that my consumption of gas through electricity was very high, and after I did research about this topic I found out that the gas company was actually over charging me. So I think that to keep using information about real life and more practical things that anyone can relate to is valuable, because, honestly, who doesn't have to pay for gas?
- 30 There were some portions of the MOOC that I found to be a little bit too hard, for example, there were some math formulas we had to use in order to calculate how much energy we were spending or something of the sort. And honestly, math is not my strongest point. So they just gave me a very complicated formula I couldn't really understand. So maybe adding some examples or a step by step explanation of how to use the formula, might be useful for future implementations.
- 31 To include tips that you can apply in your daily life would be really interesting. Maybe some random trivia or facts that maybe you can share with your friends and family later on, too.
- 32 Another factor that I believe would help to make the online courses more engaging and better would be to give more activities where participants have to collaborate or engage in conversation or debate. Otherwise, the whole process of taking the course feels very systematic and even robotic. Adding a bit of human to human interaction might help warm things up and keep the engagement flowing.
- 33 If big entities, universities or organizations collaborated to create new courses, I believe that there would be more interest in the participants to enroll and participate in such a course. In other words, have more professors involved in the teaching process, allowing experts to share the expertise of their field.
- 34 I: Do you consider the challenges that sustainable development are global? What cooperation strategies would you consider valuable in order to raise awareness about the importance of sustainable development?
- 35 PC: I think political policies are key in order to start cooperation strategies worldwide that touch upon the topic of education for sustainable development. Each government needs to sit down and analyze the situation their country is in, in order to start implementing the changes and the collaborations that will be key in making changes in our societies.
- 36 There is a need to raise awareness about what we are doing and how we are doing it. There might be efforts going on in our neighborhood, and we are not even aware of that. We need to raise awareness about the efforts that are being made and try to come up with ways in which we can keep people informed about them, and give them the chance to collaborate in case they feel inclined to do so.
- 37 One way in which I think it could prove beneficial to difuse what is happening in our efforts to come up with worldwide collaborations would be to use the Internet as a platform to share news about the topic. Share real life situations online and ask for participants to share this website or forum with their friends and family.

	Make talking about this subject something normal. Not treat it only as a school only topic, because it really isn't. It's affecting all of our lives.
38	I: Which elements would you consider interesting that should be implemented in future massive open online courses that touch upon the topic of education for sustainable development?
39	PC: I recommend my students to enter the EdX platform and to seek courses that touch upon the topic of energy and sustainability. As I mentioned before, I am a teacher in a local university here.
40	For me, learning through gamification has been successful when dealing with my students, it seems to keep them engaged.
41	I wouldn't recommend implementing very fancy and complicated things, like the use of virtual reality. Sometimes, you need other type of equipment so that such things can run successfully, and not everyone has access to that.
42	I think that applying real life cases in the course would be an amazing approach to raise awareness and also teach about this subject. Specially if the cases are landed in geographic locations that the participants can relate to.
43	Regarding the use of video, I must confess that I find the use of videos to be great. I really think that the use of videos in online courses is amazing and I would have to say that if I got a say in future courses, I would specially request that they keep adding videos to the courses.
44	I took an online course through the UNAM university and you had to reply questions as you were watching the video in real time, and it didn't matter at what time you saw the video, if you wanted to, you could watch it at 3 am in the morning. But that way, they evaluated if you were paying attention to the video in real time and that affected your grade, you could only run the video once per participant and that meant that you had to be really paying attention, because your final score was affected by it. I think that evaluating the engagement and adding more practices like this, instead of just a standard multiple choice question can be entertaining and challenging.
45	The use of social media I believe would also make future generations feel interested. Maybe we could challenge students to make Snapchats or TikToks related to the topic and if we get lucky, one might go viral and start a movement. You never know with young generations nowadays.
46	Maybe if we could develop a system in which we can see the personality type of other participants and create teams or groups that can commit to collaborating through the course, that could help make the courses not feel like such a lonely process. Team work has always had a positive impact in my interaction with my students, and it would be really interesting to see that applied in online platforms as well.



47	I: Do you believe future generations will take a lot of courses online? Do you think education for sustainable development will be an important topic for future generations?
48	PC: I strongly believe that online education will become stronger in the future generations.
49	I believe that Mexico arrived late to the party when it comes to online courses and education.
50	There are a lot of benefits to taking classes or courses online. I even consider that it is a sustainable activity to do, because you don't need to transport yourself anywhere, you have acces to everything in the digital platform so you don't need to waste paper or print out stuff. I strongly believe that there are many benefits to online education and with the passing of time, more and more people will start using it in our country. (Mexico)
51	Sadly, I have seen that a lot of my students not really aware of the amount of courses and opportunities that are available online. I strongly believe that if we raise awareness of all the information they can have access to, we can get the ball rolling and get younger generations more involved with online learning.
52	I: Do you beleive MOOCs have the transformative potential to educate about sustainable development? Why? If MOOCs don't quite convince you, what other approaches would you reccomend?
53	PC: Yes, I believe MOOCs have a lot of potential to teach about this topic. As I mentioned before, I believe that MOOCs are a sustainable approach themselves. People can access it as along as they have an Internet connection.
54	I also think that MOOCs can help guide participants with notes or charts, some sort of accesible data that summarizes the main topics of the course and that can be accesible to any participant, allowing the knowledge to be shared easily.
55	I am an avid MOOC consumer. I make it a weekly ritual to figure out which new courses are available online and I do my best to recommend the best courses to my students.
56	Something that I think might maybe represent a challenge for MOOCs to be succesful is that the participants need to have a certain level of commitment and discipline. In my case, it works because I take it seriously and really organize my agenda to attend to my online courses. But I completely understand that there are some people out there who have a hard time having this sort of practice.
57	I: Thank you so much for your time. If you have any other comments, feel free to share them with me now.
58	PC: Maybe we should start a network online, where we can debate and discuss about the future and the best ideas and approaches for future courses. And then, design courses for those participants who are really passionate about the topic.

59	As I mentioned before, I have a lot of experience when it comes to online courses, so I would be really happy to connect with other participants who enjoy learning online.
60	Also, if you wish to take a look at the contents and type of educational material I have developed in my business, feel free to check out our website: <a href="https://makotisurasc.com.mx">https://makotisurasc.com.mx</a>
61	I: Thank you for your time.

### **Appendix 7. Interview Participant D**

1	I: Could you please tell me a little about yourself? Where are you from and what do you work in?
2	PC: My name is Participant C (redacted), I am mexican, I live in the city of Cuernavaca, in Moreles.
3	I work in the development of teaching material focused in sustainability. I also give classes and run workshops in order to certify people to teach about the importance of clean water and to each about the environment.
4	I also work as a consultant for various businesses in order to gurantee that their practices are pro-sustainability.
5	I: Do you remember which MOOC you signed up to? How did you find out about it? What motivated you to enroll in it? How familiar were you with the topic that was being taught in that specific course?
6	PC: Yes, I remember the course I signed up to. The title of it was "Energy Savings" or something like that.
7	I found out about this course because I am subscribed in the platform of EdX and I asked to be notified whenever there were new courses that touched upon the subject of energy saving or sustainability. So I got an email address about there being a new course, and I decided to sign up to it.
8	This was my second MOOC I enrolled in that touched upon the subject of energy saving.
9	One big motivation that helped me decide to sign up to this course was that the university that created the course is very well known in my country, it is considered one of the most prestigious and expensive universities in Latin America. So I truly thought that the opportunity of taking a course that was designed by the team of this university was something I needed to try.
10	Another reason I was motivated to sign up to this course was because it was directly related to my field of work. As I mentioned before, I design teaching material that focuses on sustainability. And energy is a very important element for this topic. So I thought it would be wise to deepen my knowledge regarding this topic.

11	I: Before enrolling in this course, had you participated in any previous workshops, seminars, curricular or extracurricular activities that touched upon the subject of sustainability?
12	PC: Yes, I have participated in workshops, seminars, curricular activities and extracurricular activities that involve the theme of sustainability.
13	I dedicate myself a hundred percent to creating teaching material that touches upon the topic of sustainability, that is my line of work. My personal business is about this, so I find it really necessary that I involve myself in curricular and extracurricular activities that teach about this subject so that I can keep updated on the newest trends.
14	I: Please share with me the first three words that pop into your head when you hear the word "sustainability"
15	PC: Responsibility, Economy, and Natural Resources
16	I: Are you familiarized with UNESCO's Sustainability Development Goals?
17	PC: Yes, of course. I have even developed a course in order to help teachers become familiarized with all 17 objectives.
18	I: Interesting! Can you share with me more about this course?
19	PC: Based on the 17 objectives, I developed some graphics that show the titles and the main objectives of each objective. Each participant, which are normally 17, are given information about one objective each and they have to research and explain the objective they were assigned to their peers. They also have to talk about which objective is related to the objective they were assigned, so they start talking about ways to collaborate or come up with new ideas to accomplish the objectives that were settled. They also talk about applying the objective that they were assigned to their daily life or relate it to their profession or their studies. All of these with the objective of demonstrating that the 17 objectives can be applied to everyone and that we need to raise awareness about what they are and how to achieve them.
20	I: Thank you very much for sharing with me about this workshop. Wish I could take it. Next question, do you consider you participate in a lot of pro-sustainability activities in your daily life? In case you do, could you share some examples with me?
21	PC: My work is 100% related to pro-sustainability, because I work in creating teaching materials that raise awareness about this topic.
22	I also work directly as a consultant, specially with businesses that work in fields related to the use of bodies of water, so clean water campaigns and activities are something I involve myself with constantly.
23	I give classes in a local university about sustainability, and I believe that is one of the most pro-sustainability a person can do, raise awareness about this topic with future generations.

24	I: About the challenges that sustainable development faces, do you consider that they are of ecological, economic or social nature? Why?
25	PC: I think that all three are important perspectives to take in consideration when facing the challenges that we have to tackle in order to secure a sustainable future for everyone.
26	I: If you had to select one of the three as one that has a bigger impact, which one would you choose and why?
27	PC: I think the problem is more of a social problem, because in the end, it is the society that defines how to behave themselves. This affects economical and ecological factors in the long run, but I strongly believe that it all originates in the human beings as a society first.
28	I: Do you have recommendations for future massive open online courses that touch upon the topic of sustainable development?
29	PC: I think that the MOOC I enrolled in was very good, it helped me realize that my consumption of gas through electricity was very high, and after I did research about this topic I found out that the gas company was actually over charging me. So I think that to keep using information about real life and more practical things that anyone can relate to is valuable, because, honestly, who doesn't have to pay for gas?
30	There were some portions of the MOOC that I found to be a little bit too hard, for example, there were some math formulas we had to use in order to calculate how much energy we were spending or something of the sort. And honestly, math is not my strongest point. So they just gave me a very complicated formula I couldn't really understand. So maybe adding some examples or a step by step explanation of how to use the formula, might be useful for future implementations.
31	To include tips that you can apply in your daily life would be really interesting. Maybe some random trivia or facts that maybe you can share with your friends and family later on, too.
32	Another factor that I believe would help to make the online courses more engaging and better would be to give more activities where participants have to collaborate or engage in conversation or debate. Otherwise, the whole process of taking the course feels very systematic and even robotic. Adding a bit of human to human interaction might help warm things up and keep the engagement flowing.
33	If big entities, universities or organizations collaborated to create new courses, I believe that there would be more interest in the participants to enroll and participate in such a course. In other words, have more professors involved in the teaching process, allowing experts to share the expertise of their field.
34	I: Do you consider the challenges that sustainable development are global? What cooperation strategies would you consider valuable in order to raise awareness about the importance of sustainable development?

- 35 PC: I think political policies are key in order to start cooperation strategies worldwide that touch upon the topic of education for sustainable development. Each government needs to sit down and analyze the situation their country is in, in order to start implementing the changes and the collaborations that will be key in making changes in our societies.
- 36 There is a need to raise awareness about what we are doing and how we are doing it. There might be efforts going on in our neighborhood, and we are not even aware of that. We need to raise awareness about the efforts that are being made and try to come up with ways in which we can keep people informed about them, and give them the chance to collaborate in case they feel inclined to do so.
- 37 One way in which I think it could prove beneficial to difuse what is happening in our efforts to come up with worldwide collaborations would be to use the Internet as a platform to share news about the topic. Share real life situations online and ask for participants to share this website or forum with their friends and family. Make talking about this subject something normal. Not treat it only as a school only topic, because it really isn't. It's affecting all of our lives.
- 38 I: Which elements would you consider interesting that should be implemented in future massive open online courses that touch upon the topic of education for sustainable development?
- 39 PC: I reccommend my students to enter the EdX platform and to seek courses that touch upon the topic of energy and sustainability. As I mentioned before, I am a teacher in a local university here.
- 40 For me, learning through gamification has been succesful when dealing with my students, it seems to keep them engaged.
- 41 I wouldn't reccommend implementing very fancy and complicated things, like the use of virtual reality. Sometimes, you need other type of equipment so that such things can run succesfully, and not everyone has access to that.
- 42 I think that applying real life cases in the course would be an amazing approach to raise awareness and also teach about this subject. Specially if the cases are landed in geographic locations that the participants can relate to.
- 43 Regarding the use of video, I must confess that I find the use of videos to be great. I really think that the use of videos in online courses is amazing and I would have to say that if I got a say in future courses, I would specially request that they keep adding videos to the courses.
- 44 I took an online course through the UNAM university and you had to reply questions as you were watching the vido in real time, and it didn't matter at what time you saw the video, if you wanted to, you could watch it at 3 am in the morning. But that way, they evaluated if you were paying attention to the video in real time and that affected your grade, you could only run the video once per participant and that meant that you had to be really paying attention, because your final score was affected by it. I

	think that evaluating the engagement and adding more practices like this, instead of just a standard multiple choice question can be entertaining and challenging.
45	The use of social media I believe would also make future generations feel interested. Maybe we could challenge students to make Snapchats or TikToks related to the topic and if we get lucky, one might go viral and start a movement. You never know with young generations nowadays.
46	Maybe if we could develop a system in which we can see the personality type of other participants and create teams or groups that can commit to collaborating through the course, that could help make the courses not feel like such a lonely process. Team work has always had a positive impact in my interaction with my students, and it would be really interesting to see that applied in online platforms as well.
47	I: Do you believe future generations will take a lot of courses online? Do you think education for sustainable development will be an important topic for future generations?
48	PC: I strongly believe that online education will become stronger in the future generations.
49	I believe that Mexico arrived late to the party when it comes to online courses and education.
50	There are a lot of benefits to taking classes or courses online. I even consider that it is a sustainable activity to do, because you don't need to transport yourself anywhere, you have acces to everything in the digital platform so you don't need to waste paper or print out stuff. I strongly believe that there are many benefits to online education and with the passing of time, more and more people will start using it in our country. (Mexico)
51	Sadly, I have seen that a lot of my students not really aware of the amount of courses and opportunities that are available online. I strongly believe that if we raise awareness of all the information they can have access to, we can get the ball rolling and get younger generations more involved with online learning.
52	I: Do you beleive MOOCs have the transformative potential to educate about sustainable development? Why? If MOOCs don't quite convince you, what other approaches would you reccomend?
53	PC: Yes, I believe MOOCs have a lot of potential to teach about this topic. As I mentioned before, I believe that MOOCs are a sustainable approach themselves. People can access it as along as they have an Internet connection.
54	I also think that MOOCs can help guide participants with notes or charts, some sort of accesible data that summarizes the main topics of the course and that can be accesible to any participant, allowing the knowledge to be shared easily.

55	I am an avid MOOC consumer. I make it a weekly ritual to figure out which new courses are available online and I do my best to recommend the best courses to my students.
56	Something that I think might maybe represent a challenge for MOOCs to be succesful is that the participants need to have a certain level of commitment and discipline. In my case, it works because I take it seriously and really organize my agenda to attend to my online courses. But I completely understand that there are some people out there who have a hard time having this sort of practice.
57	I: Thank you so much for your time. If you have any other comments, feel free to share them with me now.
58	PC: Maybe we should start a network online, where we can debate and discuss about the future and the best ideas and approaches for future courses. And then, design courses for those participants who are really passionate about the topic.
59	As I mentioned before, I have a lot of experience when it comes to online courses, so I would be really happy to connect with other participants who enjoy learning online.
60	Also, if you wish to take a look at the contents and type of educational material I have developed in my business, feel free to check out our website: <a href="https://makotisurasc.com.mx">https://makotisurasc.com.mx</a>
61	I: Thank you for your time.

### **Appendix 8. Interview Participant E**

1	I: Thank you for agreeing to take this interview. Could you start by sharing with me a little but about yourself? What is your job? Where are you from?
2	PE: Good afternon, my name is Participant E (redacted). I am from La Paz, Bolivia.
3	I am an engineer in telecommunications and currently work as the main manager in a small business that was created quite recently. It started in October of 2018 and it focuses on themes related to energy efficiency, renewable energies, and themes related to the environment.
4	Before starting this small businneses, I worked in two other businesses that were from Spain who also focused in themes related to sustainable energy and the environment.
5	I: Do you remember which MOOC you signed up to? How did you find out about it? What motivated you to enroll? How familiarized were you with the main topic of the course you enrolled in?
6	PE: I remember the course I signed up, it was the "Energy Saving" course, in the platform EdX.

7	I found out about this course through a friend, who works in a business who uses the EdX platform a lot in order to give training to their employees.
8	My friend recommended this course to me because he knew that I was looking for courses that talked about Energy Saving. I had been seeking more traditional "in person" courses, but I had been unable to find a lot of options. So my friend, knowing I was seeking to learn about this topic, recommended this online course to me.
9	I was motivated to sign up because after working in those two businesses in Spain, I really was interested in the topic of renewable energy. Because of my formation, I didn't consider myself a knowledge person in the matter, and I really wanted to better my knowledge so that I could start a business on my own that specialized in this theme.
10	I really believe that the topic of renewable energy has a lot of potential, specially in my country, Bolivia. There are not a lot of businesses out there who take this element into consideration, and I strongly believe that the first ones that do in my country will have a lot to show for it in the future.
11	Regarding my level of familiarity with the main theme of the course, I had taken some graduate programs in order to learn about the topic. I had also taken some courses in person regarding the topic, so it wasn't like I had zero knowledge about the subject. I would say I was moderately knowledgeable about the course content when I signed up.
12	I: Please tell me the first three words you relate to "sustainability"
13	PE: Balance, Conservation, Future
14	Balance, in order to live in balance with the natural resources we have. Conservation in order to administer these goods properly. And future because, if we take in consideration the first two, we are sure to guarantee a future that is sustainable in our world.
15	I: Are you familiarized with UNESCO's Sustainable Development Goals?
16	PE: Yes, I have learned about them in a course I took recently. However, I think that my knowledge about them is very superficial. I wouldn't consider that I know them very well.
17	I: Do you consider that in your daily life you partake in a lot of pro-sustainability activities? If you do, can you give me some examples, please?
18	PE: Yes, there are some activities that I have with my family.
19	At home, we divide trash. We divide them in plastics, glass, cans, batteries and so on. We are very strict in this topic, me, my wife and my young daughter.
20	I am personally aware of the impact that this has in the world as a whole, and I am a strong believer that little actions such as this one, like dividing our trash, causes a



	big impact on the long run, specially if more families start adopting this sort of activity themselves.
21	Recently, in Bolivia there was a problem in January 2019 where a lot of waste caused problems for the trash collectors, and they stopped picking up the trash for three to four weeks. This situation caused health hazards for the community.
22	After living this period of having no trash picked up, more people became aware of the topic and they realized that if they separated their trash properly, then it would make things easier for the people that pick up the trash. And ever since, more awareness has raised and more people in my community have taken it upon themselves to divide the trash at home.
23	I: Thank you for sharing your experience. Regarding Sustainable Development and the challenges it faces in order to become the norm, do you believe these challenges are of ecological, economic or social nature? Why?
24	PE: All three of them, definitely.
25	However, if I had to list them by order of priority, I would have to say that first and foremost, it is a social problem. Society is not aware and conscious about the importance of sustainable development. We need to work in educating people about this topic.
26	And in order to educate young ones about this topic, we need to invest in resources, courses, teachers and research.
27	And that is when I think that it becomes an economic issue; when we have to invest in order to make these changes.
28	Finally, I do think that the ecology plays a role as well, because depending on the type of environment and flora and fauna, each country faces different challenges. But I would say that compared to the other two, ecological nature would be the one with least impact on the challenges we have to face.
29	It is the humans the one who really need to make a change, not mother nature herself.
30	I: After taking this course, were you interested in searching for more information about sustainable development? Why?
31	PE: Of course I was interested in looking for more information.
32	Thanks to the course, I realized that there was still a lot of things I knew nothing about, which means that I have to start educating myself more on the topic, definitely.
33	As I explained before, my personal business is one of the very few in Bolivia who is centralizing their main objectives of working as a consulting force in order to recommend more sustainable approaches to other entities. And in order to give the best counseling available, we need to have the best information at our reach, to educate ourselves and the staff.

34	It is our future we are talking about too. We need to take care of our planet, which has given us everything we need in order to survive. I think we need to really do our part in making a change for the better in the long run.
35	PE: What recommendations would you give to future open massive online courses that plan on teaching about the topic of sustainable development?
36	PE: Definitely, I think that they need to promote their courses more.
37	I didn't find out about this online courses because of an ad or social media, I found it because of a friend. I got lucky. And also, he only mentioned it to me because I shared with him my wish to learn more about the topic in the first place. But I bet that there are a lot of people out there who would really benefit from courses like this and yet they are not aware that they can access them for free because there is no diffusion about the topic.
38	I wouldn't have taken the course had it not been because of my friend.
39	On the other hand, I think that they should segment better the profile of the participants that join. In my case, I was a little familiarized with the topic, but there are other people out there who are experts on the topic, or who might have never heard about it and that need a slower introduction to the material. If the courses took in consideration the different types of users, I think that it could become a better experience for the learners.
40	I: Which would be some attractive elements that should be added to online courses that touch upon the topic of sustainable development?
41	PE: I think that the most attractive options to capture the attention of the users would be to use real life cases, to present which have been the challenges out there and what solutions have been applied and the results that they had. I don't know how to explain this, but I definitely think that the best approach would be to teach with examples.
42	I personally really like that they use videos. However, if the videos are too long, I find it harder to concentrate after a while, so maybe try to make the videos interesting or cut down into smaller segments.
43	And finally, an attractive element that I would definitely enjoy would be if somehow they involved international collaboration to the mix.
44	In my country, there is not a lot of information out there on this topic, Bolivia is in diapers when it comes to sustainable development.
45	So if we could receive guidance from experts in other countries, who have more experience and who can share with us the best advice and knowledge, that would be amazing. If you add in the factor that people could be from different countries and that gives it a more international view, I would find that to be very engaging and attractive as a user.

46	I: Do you believe future generations will take a lot of online courses? Do you believe the topic of Sustainable Development will be important for future generations?
47	PE: Of course I believe that future generations will take a lot of courses online. Actually, I strongly believe that whole world will be developing a lot in the next 50 years or so. I think that the tendency will be that more and more people will start using online learning as the norm.
48	I think that the topic of sustainable development is transversal. It must be touched upon, no matter what one studies or what they work in.
49	Future generations have to realize that this is one of the most important topics they can learn about. It is as simple as planting the seeds in order to secure a better learning, growing and living environment for everyone in the future. They need to be made aware of the importance of this subject.
50	I: Do you think MOOCs have the potential to educate about sustainable development? Why? If MOOCs don't quite convince you or you believe they lack the potential, could you please share with me why and other options you deem better?
51	PE: Definitely. MOOCs have a lot of transformative potential. I strongly believe they will play a vital role in teaching about sustainable development.
52	Because they give access to information to people who are actively seeking new ways to learn about this topic, like is my case, I feel grateful that they have the potential to share this content with others easily.
53	And not easily, they are free. So that opens up the door so that anyone who really has a strong interest in the topic can access the information with just an email account, which is fascinating to me.
54	I: What global cooperation strategies would you consider valuable in order to raise awareness about the importance to educate about sustainable development?
55	PE: Government collaboration between countries who have a more developed technology and strategies that difuse the use of sustainable development with countries who maybe are just starting off in this topic.
56	Also, to make awareness campaigns that can motivate the society of all countries feel inclined to educate themselves on the topic
57	I: Thank you for your time, if you have any last comment, I would be happy to hear it.
58	PE: Thanks to you. I hope my answers were of help. All the best.

## Appendix 9. Interview Participant F

1	I: Tell me a little bit about yourself. What do you work in? Where are you from?
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2	PF: I am currently a Consultant in Energy and Climate Change. My job is to carry out market intelligence tasks, as well as public policy recommendations for the public and private sector. In energy matters, I specialize in renewable energies and enablers in the Mexican electricity market.
3	I am from Oaxaca, Mexico.
4	I: Do you remember which course you signed up to? How did you find out about the MOOC? What motivated you to enroll? How familiarized were you with the main topic of the course before you signed up?
5	PF: I signed up to the energy markets in Mexico course, by Tec de Monterrey.
6	I found out about the course because of EdX. I had asked to be notified whenever new courses regarding energy were uploaded to their platform.
7	The main motivation to enroll, at least for me, was that it was the first course I saw online that taught about energy markets and that they applied it specifically to my country, Mexico.
8	Before signing up to the course, I was very knowledgeable about the subject. A lot of the topics that were touched upon are things that I work with daily in my work activities. I studied all my life on this topic and now I work in things related to it.
9	I: Before this course, had you previously participated in an online course that touched upon the topic of sustainable development? A seminar? Or curricular or extracurricular classes?
10	PF: I am currently enrolled in an online course that teaches about UNESCO's Sustainable Development Goals, but I signed up to it after I completed the energy markets course.
11	I haven't attended any seminar or extracurricular experiences that teach about sustainable development, but a big part of my studies in college touched upon this subject.
12	I: Please tell me the first three words that you relate to the word "sustainability"
13	PF: Prosperity, Economy, and Citizenship
14	I: How familiarized are you with UNESCO's Sustainable Development Goals?
15	PF: I would say I am slightly familiarized with them. As I mentioned before, I am currently taking an online course so that I can get to know them better.
16	I: In your daily life, would you consider you enroll in a lot of pro-sustainability activities? Could you share some examples with me?
17	PF: I consider my pro-sustainability activities to be basic and not remarkable in terms of the magnitude of their impact, but I do make an effort to keep them in my daily routine.

18	Among these activities, there is the efficient and rational use of electricity. I also have an electric kitchen installed in my home.
19	I don't take showers that are longer than 5 minutes and I do my best to turn off the water whenever I am putting on shampoo or soap.
20	I separate the garbage, even though that is not a common thing in my city.
21	I minimize the use of single-use plastics.
22	I avoid unnecessary use of the car.
23	I: Do you consider that the challenges for sustainable development are of ecological, economic or social nature?
24	PF: All three of them, since all three are linked somehow. They impact our way of life and also have an impact in future generations.
25	However, if I had to point one as the one with more impact and importance, it would have to be the social approach and nature. A large part of the problems that sustainable development faces are related to environmental awareness and education in the population, since if it were to a greater or more homogeneous degree around the world, the ecological problems could possibly be less as a result of more decision making procedures and public policy awareness. So yes, I definitely think society plays a heavier role.
26	I: After taking this course, would you say you were more interested in looking for information related to sustainable development? Why?
27	PF: Definitely felt the need to look for more information regarding this topic.
28	Professionally, it is a career, or, better said, one of the careers or specialties with the most impact in this near future.
29	It is also part of my job to keep up to date with the evaluation of these issues, specially in cases where it relates to clean electric energy.
30	Additionally, part of the responsibility that the informed communities may have is to viralize or retransmit what has been learned to other less informed sectors in order to maintain a constant awareness campaign, at least in my opinion. So I always look forward to actualizing my current knowledge, so that I have better information to share with others in the long run.
31	I: What suggestions do you have for future massive open online courses that will touch upon the subject of education for sustainable development?
32	PF: In my opinion, I consider there to be too few MOOCs that touch upon the topic of sustainable development and it would be really interesting to see MOOCs that decide to create content that focus specifically on that.

33	Also, the few courses that I have seen that touch upon this subject have mainly been in English, so to be able to make content available in more than one language, so that it is also accesibe to non-english speakers, would be great.
34	Finally, to share the fact that these courses exist in the first place is my main recommendation, spread the word that there are courses out there.
35	Some years ago, when I was in college, I had absolutely no idea that this type of tools existed. I, gratefully, found out about them after I started working, but I believe that was in great part because of my luck. So now, I urge that they tell the world that their courses are out there.
36	I: I see. What elements would you find attractive in a future MOOC?
37	PF: I think that the use of videos is always enjoyable.
38	I would also like to hear about real life cases and solutions, specially to analyze the international advances that have been made worldwide regarding sustainable development.
39	I also think that somehow MOOCs are meant to intertwine with social media more. Everyone is on social media nowadays. It would be neat that part of the course involved people making posts on Facebook that educate their friends and family about certain trivia, even if they are not the ones taking the course.
40	I: What strategies would you recommend for international collaboration in efforts to raise awareness about this topic?
41	PF: Technical and economic cooperation through international treaties would be great.
42	To invest in local talent who might be willing to share their own discoveries or inventions that have a sustainable approach would be amazing too, but that would require the government to get involved and to be willing to actually invest some money in these efforts.
43	Also, to raise awareness of younger generations through slogans or campaigns that might go "viral" would be a good strategy, too.
44	I: Do you think future generations will be taking a lot of online courses? Do you believe the topic of sustainable development will become importat for future generations?
45	PF: I believe that online education will become one of the most relevant and important approaches to educate young ones in the near future.
46	Future generations will, besides having access to all the new knowledge that is being generated today, a higher level of compromise with the environment, in my opinion.

47	Future generations should raise their awareness about the importance of their role and take factors in consideration that have an impact on their purchases or way of life.
48	I: Do you believe MOOCs have the transformative potential to educate about the topic of sustainable development? Why? If MOOCs don't quite convince you, what other measures would you recommend?
49	PF: I believe MOOCs have great potential in teaching about this because all you need is a computer, a smartphone and access to the Internet in order to get access to high level of education material free of charge, unless you want the certificate, of course.
50	This way, anyone can educate themselves with teachers and professors who were hired by the best universities in the continent. And that is amazing, that we can have access to the advice and the experience of such talented individuals that otherwise, we might have never met.
51	I believe that MOOCs also have a big area of opportunities, little factors they need to work on. For example, I believe that their strategy to spread knowledge is limited to only people that are signed up to the platform and that actually enroll in a class. I think that maybe they could share infographics or other more summarized and flashy ways to share information, like pictures or videos, that can become easily shareable and that can also motivate a normal person that normally doesn't sign up to courses online to feel inclined to give this specific course a chance. In other words, they need to work on the way they promote themselves and what they can offer.
52	I: Thank you very much for your time. If you have any last comments, now would be the time to share them.
53	PF: I think those are all the comments I have for now. You're welcome. Cheers.

### **Appendix 10. Interview Participant G**

1	I: Let us start, then. Can you please share with me a little bit about yourself? Where do you work? Where are you from?
2	PG: I am from Puebla, Mexico.
3	I have my own business that specializes in systems to gather energy from the sun, in other word, solar panels.
4	The nature of my job, or my business, was one of the main motivations for me to sign up to the course in the first place.
5	However, I admit that I have already taken several online courses in the EdX platform that touch upon similar subjects.
6	I studied Administration in College and then I did a Masters in Strategic Planning.

7	I am 42 years old.
8	I: Perfect. So, you mentioned that one of the main reasons you decided to sign up to this course was because the topic was related to your field of work. How familiarized would you say you were with the main topic of the course before you signed up to it?
9	PG: Let's say I was already familiarized, but I wouldn't consider myself an expert in the field. Specially with the topic related to the energy reform in Mexico, which was one of the main elements that was brought up a lot during the course I signed up to.
10	I: Before, had you taken courses online?
11	PG: I had taken several courses before. One of them was specifically about sustainable development and the other one was for project directing.
12	I: And other than digital courses, have you ever had the experience of attending curricular or extracurricular activities that touched upon this subject?
13	PG: I have participated in some workshops, and I do my best to attend to big conferences that touch upon the subject of Renewable Energies, because that is something that is related to the topic of my business.
14	I: Could you please share with me the first three words that pop into your head when you hear the word "sustainability"?
15	PG: Responsibility, Growth, Harmony
16	I: Are you familiarized with UNESCO's Sustainable Development Goals?
17	PG: Yes, vaguely. I have heard about them. I know they are out there. But I don't really remember them or know them deeply, not at all. However these objectives have become a pattern that big businesses use as a compass in order to plan their growth and their activities, so I strongly believe they are important and I will definitely make an effort to familiarize myself with them more in the future.
18	I: Would you consider that in your daily life you make a lot of pro-sustainability activities? Why, or why not? Could you share some examples with me?
19	PG: Yes, I try the basic ones. I attempt to save the electricity at home.
20	I divide the trash at home and take some of the waste in my house to recycle, specially when it comes to batteries.
21	We make an attempt to not waste water in my house. This is very important to me and my family.
22	Because my job is related to the use of renewable energy, I would even dare say that every single day, when I can get my job done, I am helping the future to become more sustainable and more reliable in the use of solar energy.



23	I: Very interesting. Would you say that the challenge in order to raise awareness about sustainable development is of economic, social or ecological nature?
24	PG: I strongly believe that the challenges rely greatly in Economics.
25	I: Could you please explain to me why?
26	PG: Money makes the world turn. Until it proofs profitable to be sustainable in their bank accounts, it is highly unlikely that big businesses will care.
27	I: The course that you enrolled in, did it motivate you to research more about the topic of sustainable development?
28	PG: I didn't really feel an urge to research or learn much more about the topic of the course. I felt like my knowledge was good enough for my needs.
29	I: What recommendations do you have for future massive open online courses?
30	PG: I think that the platform is already amazing. If anything, I would recommend that they spread the word about the available courses more. Motivate people to enroll.
31	If more people enroll, then the conversations in the open forums would be more engaging and fun.
32	Also, an idea for a future MOOC that I think could be interesting if we want to raise awareness about the importance of sustainable development would involve creating a new MOOC that only touches upon the topic of sustainable development from a more basic and easy to understand point of view, rather than attempting to land it in such a specific market or field like is the case of energy.
33	The use of a tool in order to make people calculate the impact they have thanks to the lifestyle they have could be fun and an intuitive way to make participants more self aware about the importance and impact of their role in society.
34	I: What global cooperation strategies would you recommend in order to raise awareness about the importance of sustainable development?
35	PG: I definitely believe that the topic of sustainable development involves the whole planet. The problem resides in every country, in some sort of way.
36	As a strategy, I would recommend treaties and collaborations between governments.
37	I: What attractive elements would you like to see in future online courses?
38	PG: I would really find it amazing if they found a way to transmit knowledge in a more visual way. I am a visual learner, so I think I would be very fond of the idea to see the content be shared in a more visual and maybe even graphic oriented way instead of just text after text.
39	It would also fun to see real life information, like for example what it takes to create a PET bottle and how long it actually takes for the bottle to stop affecting

	our environment or some interesting trivia like that to raise awareness of the impact that it has when we buy things in certain presentation formats.
40	I would also suggest the use of social media to start sharing information.
41	I: Do you believe that future generations will take a lot of online courses in the future? Do you think the topic of sustainable development will be an important topic for future generations?
42	PG: Yes, I definitely believe that future generations will participate more and more in online courses. I believe the future is definitely in online learning.
43	I: That would conclude this interview. Thank you so much for your time. If you have any other comments, please feel free to share it with me now.
44	PG: I would be very interested to read the results from your thesis, your questions were very interesting and I would really appreciate if you share the product of your research with me.
45	I: Of course, I will make a memo to do so when the time arrives, probably around May 2020.
46	PG: Perfect. I look forward to it.

### **Appendix 11. Interview Participant H**

1	I: Hello! Thank you very much for your time. Let us start off the interview learning a little bit more about yourself. What is your job? Where are you from?
2	PH: My name is Participant H. I am from Ecuador.
3	I studied tourism in college and I did a Master's program in Social Sciences with a special focus to social environment sciences.
4	I have worked in a lot of different roles, not only in tourism. I have worked in international relations and national projects in Ecuador.
5	I am currently a professor in the Tourism degree in a university here. I am also a researcher who specializes in environment and pollution research.
6	I: Excellent. How did you find out about this online course? What motivated you to enroll?
7	PH: There were a lot of reasons I was motivated to enroll in this course. The first one that comes to mind is that I am currently studying to earn my PhD and the main topic of my research is regarding sustainable development. This PhD is about Geography and Tourism, but I am the one who decided in the topic of sustainable development for my thesis.
8	On the other hand, the university where I work from, they request to receive evidence and reports every now and then, demonstrating that the professors are making a continuous effort to train themselves with the newest information available

	out there. So, when I took this course, I knew that in the end I would be able to add it to my report as part of my curriculum.
9	The course I took was about Clean Energies and their Technology.
10	I also felt motivated because the course itself was free, and the certificate at the end had an accesible price for me.
11	The information would've been valuable to me and I knew that it would be well received in my job. Seemed like a two birds one stone kind of situation.
12	I: Before taking this online course, had you signed up to another MOOC?
13	PH: No, this was my first MOOC ever. I hadn't enrolled in a MOOC before.
14	I: I understand. What about in person activities? Maybe some curricular or extracurricular activities?
15	PH: Yes! I had taken some courses in person, both in curricular and extracurricular scenarios. In June of 2018 I went to Bali, where I took a summer course regarding tourism and sustainability
16	I: Very interesting! Now, could you please share with me the first three words that pop into your head when you hear the word "sustainability"?
17	PH: Environment, Community, Society
18	I: Are you familiarized with UNESCO's Sustainable Development Goals?
19	PH: Yes, totally. When I started my career as a professor in 2015, I learned about the Objectives for the Millenium. I was studying for my Master's and one of my classes was titled "Cooperation for Development" and it was in this class where I was first presented with the SDGs. I did my best to learn about these objectives a lot, in order to train my students about this topic as well. I would say it was a two way street. Not only am I trying to share this knowledge with my students, but they are giving me an opportunity to compromise more with the objectives and put them to action in my personal and professional life.
20	I: Excellent. Speaking about your personal life, could you please share with me if you consider that you make certain pro sustainable activities in your daily life?
21	PH: Definitely. At home, I live only with my mother, we recycle absolutely everything. We divide PET bottles, glass, and paper. We give the divided things to someone who wants to take them to a recycle center and earn a little money from that, so we are also helping someone out, albeit slightly.
22	Another activity I do is that I always carry a reusable thermos with me everywhere to refill it with water. I don't want to purchase water bottles every time I get thirsty, so I always carry my thermos around with me. To be honest, I sometimes lose them. For example, this year (2019) I have already lost three. (laughter) But I do my best to not forget them and to always take it with me. I also have a metallic and bamboo straw in order to avoid using plastic ones.

23	And in my professional life, here in the university, we have started a campaign to talk about good practices that they could start applying to their everyday life and I have been very active in cooperating with other professors who are interested in the topic as well.
24	I strongly believe that my role as a professor and as a team member with the other university staff also counts as a pro-sustainable activity, because I am doing my best to educate future generations about the importance of recycling and other activities that in the long run, if applied by lots of people, will have a positive impact for the environment.
25	One of my friends also stopped using one use only plastics at her bakery and I admire her for that.
26	I: Would you say that the challenges that sustainable development faces are of economic, social or ecological nature?
27	PH: For me, all three are related. They are all intertwined.
28	However, if I had to pick one to focus on first, I would pick the ecological nature. The reason for this is because, in the end, we owe everything to the environment. In the end, we need clean water to drink, no matter how rich we are or how close our societies are. We need to take care of the ecosystems around us, we need to raise awareness about the importance of the environments that surround us.
29	I: What recommendations would you give future online courses that touch upon the topic of sustainable development?
30	PH: I would say that the best recommendation would be to use real, successful and recent cases that can be applied in the learning process to familiarize participants to the topic of the course.
31	For example, if they are going to teach about the sustainable development goals, maybe they should enlist the goals that are defined but also enlist all the positive changes and the positive impacts that have already taken place. Why? Because I think that it is key to give users a sense of hope, a sense that these goals are reachable, that they are not just thought up by people who want to see a better world but that are not putting in any effort to see these changes happen. In other words, we need to present users with real life scenarios that will help them feel inspired, motivated and that their goals are not out of reach.
32	I: I see
33	PH: Yes, and I also think that they should add more interactions between users, so that everyone can share their sustainable practices in their daily lives, to share information and receive positive feedback between them
34	I: Which would be attractive elements in an online massive open online course for you, personally?

35	PH: Using social media would be an excellent idea. Specially because nowadays, most people, when they are looking at their phones, they are keeping an eye on their social media. So if the courses started using social media more, then definitely the word about these topic and courses would spread.
36	I also think that a novelty or interesting approach would be to include some sort of social challenge in the course. For example, asking for users to upload three pictures where they are recycling, or using a reusable straw or other various fun activites that are pro sustainabiliy, and then make them challenge their friends and families and sharing the results of that. Start a chain through fun and interactive challenges, that would be really interesting to see.
37	Something that I really liked was the use of videos, as well.
38	And that the course gave me functional and practical tips for my everyday life that didn't require me spending a ton of money in order to make more sustainable choices.
39	I: What international cooperation strategies would you recommend in order to raise awareness about sustainable development?
40	PH: I think that international treaties between countries who set the goal of educating more about these topics would be a good strategy.
41	I would also recommend some awareness campaign with young people, in order to teach them that even little actions, like trying to take a quick shower instead of just spending two hours in that process, could really help shape things in the future.
42	In my city, all plastic bags are biodegradable and all plastic bags are prohibited. Straws are not made out of plastic, but of paper. So I think that if the governments started enforcing their communities to join these type of practices, we would start seeing a positive impact in our planet.
43	I would also recommend that in any online website where they are sharing all of these efforts for the international cooperation, they make the content available in all the languages that all involved parties use. That is to say, sure, a lot of people can read and understand english and that is one of the reasons there is a lot of content out there that is in English... but I would feel more inclined to know that there will be spanish, french, italian or whatever language it is that they need to adapt so that even people that don't know english can be notified and can also become part of the solution.
44	I: Do you consider future generations will use massive open online courses more?
45	PH: Yes, I think that future generations will use online courses because of matter of time and cost. Accesability is key.
46	I: Do you believe MOOCs have the transformative potential to teach future generations about sustainable development?

47	PH: I think MOOCs have a lot of potential, but we should remember that what defines if someone will enroll or not is based mainly because of their needs. Sure, there are some people that learn because they want to, like is my case, but there are other cases where users need a course because they have to prove that they know about a specific topic, their employees requires from them to prove that they are active in their learning process, or sometimes even a student might enroll simply because their homeroom teacher told them that the course was part of the program in their class. Everyone has different needs and purposes for enrolling, and I think that MOOCs should really concentrate in the participant's needs in order to be succesful.
48	I: Those would be all the questions. If you have any more ideas or suggestions, feel free to share them with me now.
49	PH: I would be super interested in seeing a future course that focuses in tourism and sustainability.
50	I: Thank you very much for your time. I appreciate it.
51	PH: I am grateful you considered me to be interviewed, I hope my answers will help you with your research. All the best.

## Appendix 12. Interview Participant I

1	I: Hello. Thank you for accepting to take this interview. Let us start by learning a little bit more about you. Could you please tell me about your job or your studies? Where are you from?
2	PI: Hello. My name is Participant I (redacted). I am from Mexico and live in Colima
3	I just finished high school. I am currently a college student.
4	I: Do you remember which MOOC you signed up to? How did you find out about this MOOC? What motivated you to enroll? How familiarized were you with the main topic of the course?
5	PI: I remember I enrolled to a MOOC that taught about Energy Savings.
6	I found out about this MOOC thanks to a Youtube Ad. It was a short video that ran before my favorite youtubers videos, so I figured there was no harm in trying it out.
7	The main reason I enrolled was curiosity. I had never enrolled in a MOOC before, and I figured that the topic was very broad and useful, no matter what you decided to do with your life, so I decided to give it a go. Also, it is somewhat related to my college degree I am trying to earn, and I thought that earning a certificate from a private university that is well known in my country, even if it was online, could maybe help me get a better job in the long run.
8	I was also excited to interact with other people online who would like to learn about this topic.

9	I felt pretty confident when I signed up, to be honest. I really thought it would be a fun way to pass the time and that I had every ability in order to finish the course successfully, But that ended up not being the case.
10	I: Before this MOOC, had you taken any other course online that touched upon the topic of sustainable development? What about curricular or extracurricular activities or classes?
11	PI: I had never taken an online class before.
12	I had some introductory classes on college that touched upon the subject of sustainable development, but very briefly. When it came to energy savings, which was the topic of the course I signed up to, I would say I just knew the basic stuff. Like turn off the light when you leave the room and stuff like that.
13	I: Please, tell me the first three words that pop into your head when you hear the word "sustainability"
14	PI: Future, Green, Health
15	I: Are you familiarized with UNESCO's SDGS?
16	PI: I have heard about them a little in my classes, I am aware that they exist, but I know about them superficially. Wouldn't say I am an expert on them.
17	I: Do you consider you make a lot of activities pro-sustainability in your daily life?
18	PI: I try to, but I can't do a lot, really. In my college dorm, we try to separate the garbage, but people don't really follow the guidelines so it gets a little frustrating.
19	I do try to separate the garbage, though.
20	And I don't own a car, I try to use public transport the most, to save the planet from a lot of car fumes.
21	I: Do you believe the challenges that education for sustainable development faces are of economic, social or ecological nature?
22	PI: I think it is mainly an economic problem. If people with a lot of money considered that "going green" would mean they would earn more money in the long run, then they would probably make the necessary changes to make their practices more sustainable. But because money is their main motivation, they don't really make the necessary changes. So if they received an economic incentive, I do think we would see more changes in the world.
23	I: Can you tell me about the reasons you decided to leave the MOOC without completing it?
24	PI: The main reason I left the course unfinished because I tried to do too many things. When I first signed up to the course, I was in the summer where I had just graduated High School and was waiting for college to start. I signed to the course out of a whim, thinking that I might as well keep myself entertained with something

	productive while I waited for my first college semester to start. And things started calm enough. I did a couple of lessons for a couple of weeks, but then college started and I got overwhelmed with school work and I was just unable to finish. It was absolutely necessary for me to focus on my curricular studies rather than any extra studies.
25	I: Any recommendations for future online courses?
26	PI: Yes. I would recommend that the tests they design become less repetitive or boring. It was a little boring to always just reply to tests that were multiple choice options. I think that they could've spiced it up a little with different ways to evaluate our knowledge.
27	I: Do you consider this is a global challenge? What cooperating strategies would you consider valuable in order to promote sustainable development?
28	PI: I would recommend that the companies around the world should start using more renewable energy sources to make their craft. They should set an example to smaller companies that are just starting off, too.
29	I: Do you think future generations will take a lot of online courses? Do you believe the topic fo sustainable development will be important for future generations?
30	PI: Yes, I think that future generations will take more online courses. Even in my college classes nowadays, a lot of our activities and interactions are online between classmates, even though we have to go to class in person. I think that in a couple of years, online classes will have a bigger impact in future generations.
31	I: Do you believe MOOCs have the tranformative potential to teach about sustainable development to future generations?
32	PI: Maybe the biggest issue with MOOCs is that they are sometimes repetitive and boring.
33	If maybe the MOOC I enrolled in had been more interactive with other human beings and I had felt like it was worth putting some more time on it, even though college was being super hard, I might've finished the course. But I just found it too boring, it was difficult for me to feel motivated to log back in on my account.
34	I: What are some attractive elements for MOOCs that you would like to see in future courses?
35	PI: In the course I enrolled in, it was always the same old guy giving the classes through video format. It would be fun if they changed it up a little and maybe got more people to teach us about a topic, instead of just having the same person talk over and over again
36	I also think that the content got a little boring after a while because the format was always: read this, watch this video, answer these questions. I would much rather get to learn with different formats every now and then to change it up a little.



37	I: Any last free comments?
38	PI: I think that if they added a model of course in which they understand that sometimes college students will get overwhelmed by schoolwork, and for that reason they might get a longer period of time to finish the course, that would be great. If I had gotten maybe two more weeks given to finish the course, I might've gone back to the course to finish it. After all, I was halfway done. But the course period was strict with their timing and when I was able to log back in, the course was no longer accesible. So maybe they should be a little more flexible with the amount of time they leave a course online.

### Appendix 13. Interview Participant J

1	I: Hello, thank you for agreeing to taking this interview.
2	PJ: Thank you for having me.
3	I: First off, let's start by talking a little bit about you. Can you tell me about yourself? Are you currently working or studying? Where are you from?
4	PJ: Hello. My name is Participant J. (redacted)
5	I am from Uruguay and I am a college professor. I teach art, arquitecture and design. I also have my own business, but I have just started off, so I would say it is still a work in progress.
6	I: Do you remember which MOOC you enrolled in? How did you hear about this MOOC in the first place? What motivated you to enroll?
7	PJ: I remember that the course I signed up to was about convential energies and their technology. I was trying to teach myself more about the topic of clean energies.
8	I completely forget how I first found out about the MOOC, but I believe that maybe a colleague or someone in the university suggested it to me
9	The main reason I decided to enroll was because I was interested in teaching my students about the newest ways to generate energy that had a bit of a green approach, for the future. So, in order to teach them about it, I first had to learn about it myself.
10	I: Before this MOOC, had you participated in an online course that teached about sustainable development? Had you participated in any curricular or extracurricular activities that touched upon this subject?
11	PJ: This was my first time participating in an online course, and I must admit that it was... different from what I expected. I thought that I would have a real professor, not just some videos that I could play anytime. It was a different experience.
12	Regarding having experiences in any curricular activites, I would say no. I studied design and arquitecture, so we never really talked about clean energies back in the day. This is a somewhat new topic that has arisen.

13	Extracurricular activities, I would say that this MOOC I signed up to was my first attempt to getting myself involved in something that would help raise my level of knowledge about sustainable development. But I can't say it was successful.
14	I: Why is that?
15	PJ: When I enrolled to the course, I had some expectations. I thought that I would get to interact with other online students and an online professor. But... I didn't.
16	Most of the activities were done mostly by myself and the professor was in fact just a teacher that had recorded some videos who knows how long ago, and that was it. It felt very robotic, like there was no real human interaction behind all of this. And in the end, that was the reason I decided to quit the course. It felt too mechanical and I am more of a social learner. It wasn't the right fit for me.
17	I: Please tell me the first three words that come to your mind when you hear the word "sustainability"
18	PJ: clean energies, fututure, renewable
19	I: Are you familiar with UNESCO's SDGS?
20	PJ: Can't say I have heard of them, no.
21	I: Would you consider you have a lot of pro-sustainability activities in your daily life?
22	PJ: I try to not throw garbage in the street.
23	I: About sustainable development, do you think that the challenges it faces are of ecological, economic, or social nature?
24	PJ: Ecological. We can maybe change our socities and the way we run money in our world, but there are things that are out of our control, like ecological factors of the area where we live. So I think that first we need to learn about the environment we are getting ourselves involved in before suggesting things just from the top of our heads. We need to understand mother Earth first.
25	I: Could you share with me in more details the main reasons you consider influenced to decide to not finish the course?
26	PJ: As I mentioned before, it felt all very robotic. Like a pre-established system or program that was already scripted.
27	It felt like my presence or my logging in didn't make a difference at all, and in the end I guess it didn't, because after the second week I didn't log in again and I think nothing really happened.
28	It felt a little void just to take the course by myself.
29	And I am aware that there were sections in the course where you could write in message boards and stuff like that, but it felt a little bit like writing a letter to someone who would never reply.

30	I checked the message boards in my class and maybe two or three people had gathered the courage to share a short paragraph or two, but there were almost no replies to their comments and I figured it was just not worth the effort.
31	I: What recommendations would you give for future online courses?
32	PJ: Make it more interactive! Make the participants reach out and start a real conversation. I think that if I had felt a little more engaged with other users, I might've given the course a try.
33	I: What international strategies would you recommend in order to teach about education for sustainable development?
34	PJ: I think we need first to understand the word that we are facing right now. So I would say, first invest on research and find out all the information that is valuable so that it can be shared with the rest of the world through awareness campaigns.
35	I: What are some attractive elements you would like to see in future MOOCs?
36	PJ: I would definitely recommend interactive videos, like the kind where you click between two options and that develops a different script depending on what you chose. I would love that.
37	Also, to use more social media somehow. Maybe even open up chat rooms or stuff, so that you are able to interact with the teacher or other students easier.
38	I: Do you think future generations will take a lot of courses online? Do you think the topic of sustainable development will be important for them?
39	PJ: I definitely think that kids nowadays are more used to interacting and learning online than my generation ever did. So yes, I do think future generations will take more courses online.
40	I: Do you believe MOOCs have the potential to teach about sustainable development? Why?
41	PJ: I think the cool thing about MOOCs is that they are easy to access.
42	But I definitely think we need to share more that the courses are out there. There are a lot of people that are not informed that they could take free courses online if they wanted to. So we need to spread the word, definitely.
43	I: Thank you very much for your time. Any last comments?
44	PJ: No, that would be all. Thank you for the interview, I had fun.

#### **Appendix 14. Interview Participant K**

1	I: Hello, thank you for agreeing to take part in this interview. Could you please share with me a little more about yourself? Where are you from? What is your main occupation?
2	PK: Hello, nice to meet you. My name is Participant K. (redacted)

3	I was born and live in Panama.
4	I am currently working full time for a business that specializes in administrative planning, with a specialization in financial advice.
5	I studied my Master's in Business Magament around five years ago.
6	I: Do you remember which course you signed up to?
7	PK: To be totally honest, I don't even remember what course I signed up to in the first place. It was a couple of months ago and I only signed up, I didn't even take one of the classes. So no, I don't remember what course I enrolled in.
8	I: According to the information you gave when you signed up, it was the course of Energy Market: Business Opportunities.
9	PK: That sounds familiar. Yeah, I think that was it.
10	I: How did you first hear about this course and what motivated you to enroll in the first place?
11	PK: I heard about the course from a colleague at work who was taking it weekly.
12	I decided to enroll because I wanted to see if the course could provide me with any valuable insight that might've helped me do my job better.
13	I would say that I know a little bit about the topic of the course, because I have collaborated with businesses that deal with the energy market before. So even though I was no expert, I did have a little bit of hands on experience from work.
14	I: Had you participated in an online course before?
15	PK: Yes, I have participated in at least five online courses before this one.
16	I: Had you had any experiences with curricular or extracurricular activities that touched upon the subject of sustainable development before?
17	PK: I had a couple of courses in my master's degree that touched upon the topic of sustainable development.
18	For extracurricular activities, I would say no, I didn't have any extracurricular classes that touched on the subject. I barely have time for extracurricular activities nowadays.
19	I: Please tell me the first three words you relate to the word "sustainability"
20	PK: Green, Growth, Finances
21	I: Are you familiarized with UNESCO's SDGS?
22	PK: Yes, a lot of companies nowadays use them as a sort of guide to plan their activities and their development. Because they are somewhat related to my field of work, I am familiarized with them.

23	I: Do you consider you make a lot of pro-sustainable activities in your daily life? Could you give me some examples?
24	PK: I try to divide the trash at home.
25	I: Do you believe the challenges to make sustainable development a reality are of economic, social or ecological nature?
26	PK: Definitely economic nature. We need to invest more money in these kind of efforts. Without money, it all becomes just good wishes for the world and nothing more than that.
27	I: Could you share with me the reasons as to why you decided to not finish the MOOC?
28	PK: I enrolled to the MOOC thinking that the topic was interesting and that I could probably learn a thing or two from it.
29	However, once I saw the titles for the class modules, I realized that it was a MOOC on a very basic level compared to my level of knowledge. Thus, I concluded that the course would now provide me with any valuable new knowledge and I decided to invest my time in other activities that would.
30	I: What recommendations would you give for future MOOCs?
31	PK: I think it would be great if they created online courses that were a little more challenging. I definitely feel like the courses offered were very basic and that was the main reason I felt like they might be more a waste of time, for me personally, than anything else.
32	I: What elements would you find attractive in a future MOOC?
33	PK: If it involved more team work oriented activities, that would be great. It is always fun to interact with people with different backgrounds and learn from them. Having participants collaborate more would've made me feel like it was worth a shot, but I saw that the course was very linear and that was a big turn off for me.
34	Also, to be challenged more would make the whole ordeal more interesting. Maybe set up challenges weekly and make everyone share the results of their challenges, that would be great. I would like that a lot.
35	I: Thank you very much for your time. Any last free comments?
36	PK: Thank you for taking my comments in consideration. I look forward to seeing future courses be more challenging and interesting!

### **Appendix 15. Interview Participant L**

1	I: Hello! Thank you for your time. We will start off this interview by asking you about yourself. Please share with me your name, where you are from and your current occupation.
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2	PL: Hello. My name is participant L. (redacted)
3	I am fro Ecuador.
4	I studied a technical career in natural sciences.
5	I am currently unemployed.
6	I: Do you remember which MOOC you signed up to? How did you find out about this MOOC? What motived you to enroll? How familiarized where you with the main topic of the course?
7	PL: To be honest, I don't really remember what course I signed up to.
8	I do remember that the reason I signed up was because a friend of mine told me about the free course and I thought that it would be a good opportunity to take the course if it was free.
9	I: According to your survey, the course you signed up to was about Clean Energies and their Technology.
10	PL: Oh, yeah! Now I remember.
11	The title of the course caught my attention. I thought it would be cool if I could learn about that.
12	I: Before this MOOC, had you participated in an online course before?
13	PL: This was my first attempt at an online course. Needless to say, it didn't go very well.
14	I: Do you know why?
15	PL: Well, when I first signed up to the course I had a stable job and income. However, things took a turn for the worse and eventually I lost my job. I went through a personal crisis, which made finding a new job the number one priority. My wife had cancer and I needed to earn money in order to pay for her treatment. It made all unnecessary activities, like an online course I has signed up to a couple of weeks before, become less important to me. I decided to put my family first.
16	I: I am very sorry to hear about your wife's situation.
17	PL: Thank God, she is doing much better now, so things are way better now. But those were hard times and I guess that was the main reason I decided not to continue with the course.
18	I needed to focus in more urgent matters in my personal life. The course, I thought, was an extra thing. And I couldn't deal with any extra burdens or homeworks.
19	I: I understand. What recommendations would you give for future MOOCs?
20	PL: I would definitely recommend that they would be a little more flexible with the time they offer their online courses. For example, once I had gotten a stable job again, I wanted to go back to the course and start from where I had left off. But I

	couldn't. If I wanted to rejoin the course, I would need to start from week one and I couldn't bring myself to do that. I definitely just wanted the possibility of starting from where I left off without losing all my previous progress, but that was not possible. That was the main reason I decided to not go back to the course.
21	I: Could you share with me the first three words that pop into your head when you hear the word "sustainability"?
22	PL: Growth, Future, Green
23	I: Thank you. Feel free to share with me any free comments you might have.
24	PL: Sometimes, life gets in the way. Unexpected things happen and we need to put our priorities straight. And that was the reason I decided to not continue with the course. However, I look forward to seeing the new and interesting approaches that future online courses might take.
25	Thank you for the interview.
26	Sorry it had to be cut short, but I must take my wife to her chemo sessions. I hope that what I shared, albeit short, was of help.
27	I: It was. Thank you very much for your time.

#### **Appendix 16. Interview Participant M**

1	I: Hello. Thank you for your time. Let us start the interview by talking a little bit about yourself. Could you please share with me your name, country and main occupation?
2	PM: My name is Participant M. (redacted)
3	I am from Argentina.
4	I studied natural sciences back in college and I own my own business. My main occupation is doing consultation jobs with schools and high schools about their green activities, so that they can say they are "doing their part" when it comes to "saving the planet", per say.
5	I: Could you please share with me which MOOC you enrolled in? Do you remember how you first heard about this MOOC? What motivated you to enroll?
6	PM: I saw an article about these online courses that were being provided by a well known private university in Mexico.
7	I was interested in joining one of these courses because the topic was somewhat related to my field of work: Energy Savings.
8	I was also very interested in getting an official certificate that said that I had taken a course that was designed and run by a private university that is well known, because I could've added that in my curriculum. I really do believe that it could've helped me and my business a lot if I showed credentials from a private university from Mexico.

9	I: Had you enrolled in an online course before? Did you have any curricular or extracurricular experiences that had touched upon the subject of education for sustainable development before?
10	PM: This was my first time trying to give online classes a chance. I didn't have any previous experiences before.
11	I had taken curricular and extracurricular activities before that touched upon the subject of sustainable development. They are necessary in my field of work, because I need to keep track of the new tendencies that are going on out there.
12	I: Could you share with me the first three words that pop into your head when you hear the word "sustainability"?
13	PM: Job, Opportunity, well being
14	I: Have you heard of UNESCO's Sustainable Development Goals before?
15	PM: Yes, I have. I am familiar with them, because they are somewhat related to my field of work. Schools nowadays use them as a guide in order to raise awareness about important topics with their students.
16	I: Do you consider you have a lot of pro-sustainable activities in your daily life? Could you share some examples with me?
17	PM: Definitely.
18	The very nature of my job is to raise awareness about the importance of sustainability. I believe that just by getting my job done, I am helping promote the education about this topic with younger generations who will shape our future someday.
19	I also attempt to save water and electricity at home.
20	I: Can you share with me the main reason you decided to not finish the MOOC?
21	PM: Of course. I will just be blunt, I hope that is okay.
22	The main reason I signed up to the course in the first place was because I was very interested in getting myself an official certificate that proved that I had taken a course by a very well known private university in Mexico. If we had to phrase it somehow, it was all about status, and knowledge, of course. But the certificate was very important to me. However, after I finished enrolling, I read the fine print and realized that I could take the course for free, but that I would get charged in order to have my certificate given. I felt very disappointed, because the whole point of MOOCs is, according to my knowledge, that they are free and accesible and all of that. But after I learned that they would need to charge me as an "extra" in order to get the certificate, I decided to not take the course after all. My main goal was not going to be fulfilled even if I finished the course correctly unless I paid, and they were charging in American dollars. The whole situation was a big no-no for me and that was the main reason I didn't end up taking the course.



23	I: What are some attractive elements you would like to see in future courses?
24	PM: It would be great if they informed about the certificates or lack of certificates from the start.
25	I would love to see online courses that offered free certificates if you complete the course, even if they are not very fancy. Maybe they can offer a more fancy version of the certificate for a price if it is necessary. But at least, if they offered a free version, that would help motivate me to enroll and actually finish the course.
26	I: Any other free comments?
27	PM: No, mainly the topic of the certificates again. Make them accesible for free and maybe offer a fancier version and charge for that one. That would really be useful.

### Appendix 17. Interview Participant N

1	I: Hello. Nice to meet you. Thank you for making the time for this interview. Let us begin the interview by learning a little more about you. Could you share with me some facts about yourself? Where are you from? What is your main occupation?
2	PN: Hello, nice to meet you. My name is Participant N. (redacted)
3	I am from Peru.
4	I studied as an engineer back in college and my current occupation is that of a full time job with a business that specializes in renewable energy.
5	I: Great. Do you remember which MOOC you signed up to? What motivated you to enroll in this course in the first place?
6	PN: Yes, I remember perfectly. I signed up to a course that was titled "Energy Market: Business Opportunities" or something similar of the sort.
7	I signed up because a colleague from work recommended it to me, he saw that they were offering these courses from an online post somewhere. It seemed like the topic was very related to my field of work and I was looking forward at the opportunity of sharing my knowledge with other people and even make some contacts that could help create maybe international job collaborations or something of the sort. In other words, I was looking forward to making some social networking and doing my job better in the long run thanks to this course.
8	I: Had you participated in an online course before? What about curricular and extracurricular activities that touched upon the subject of sustainable development?
9	PN: I have taken at least ten online courses before.
10	I love online courses because I have the freedom to organize my own time in order to participate in the classes and do the activities, even if I have a full-time job.
11	I have taken part in at least three seminars that are about renewable and clean energies, and my whole college was centered in this topic, so I would say I have

	both curricular and extracurricular experiences that are related to sustainable development.
12	I: Can you share with me the first three words that pop into your head when you hear the word "sustainability"?
13	PN: Business, Job, Future
14	I: Are you familiar with UNESCO's SDGS?
15	PN: Yes, very familiar. One of the seminars I had participated in before was specifically about these goals and how to achieve them. I am well aware of the goals and objectives UNESCO is aiming for in 2030.
16	I: Would you say that you have a lot of pro-sustainable activities in your daily life?
17	PN: I think my field of work is very pro-sustainability in general. Our main focus is to help people get involved with clean and renewable energies, so I think that my day to day job is my pro-sustainable activity in my daily life.
18	I: Do you believe that the challenges involving sustainable development are of ecological, economic or social nature?
19	PN: I would have to lean more towards a social nature. It all begins with us, and there is a lack of awareness and responsibility from the people in general. We need to educate ourselves in order to motivate future generations to take sustainability as an important factor in their daily lives.
20	I: Can you share with me the reason you decided to not finish the MOOC?
21	PN: Of course. I will go in detail, so here we go.
22	In the course, there was an activity where we had to review the work of other people who were taking the course, kind of like a peer review sort of thing. Now, I admit that maybe I am not the best expert in the topic, but I do have some hands on experience that comes from my daily job. And it was very shocking to me that the person that ended up grading me decided to give me half marks when my answer was relatively extensive and in detail to the question. I felt frustrated that I was being graded by an anonymous person online who probably knows less about the topic than I do, and that that would affect my general score in the course even though I had done my best trying to complete the activity I was given. I tried to send an email and see if the professor or the people behind the MOOC could help me get a second opinion or help my grade get better from that activity, but after several days I got an email saying that it would be a longer process and honestly, my time is precious. So I decided to just leave the MOOC unfinished. So if I had to summarize it, I would say that I was not very pleased with an evaluation activity that involved me being graded by strangers online who could affect my grade in such a way that it would entail a lot of extra work for me to get that fixed. I decided to quit instead.
23	I: What are some recommendations you would give for future MOOCs?

24	PN: Work in the way you evaluate the knowledge of the people that sign up.
25	Also, maybe it would be a good idea to do a little background check on each participant and to group them by their level of knowledge depending on the field they are in. That way, people that are on the same level can collaborate and even do some networking, and then circumstances like the one I had to go through wouldn't repeat themselves, because I would feel confident that at least one person that is on the same level of knowledge as me is going to be grading or checking my activities, rather than a random stranger who probably doesn't know a lot about the topic in the first place.
26	I: What are some attractive elements you would like to see implemented in future MOOCs?
27	PN: Maybe more team work activities would be nice. An actual chance to interact with other people who are interested in the topic of the course could prove useful and interesting.
28	I: Do you believe future generations will use online courses more?
29	PN: I think that it is still long ways into the future, because first we have to make computers and internet more accessible all around the world in order to claim that there will be a strong rise of the use of online courses, but I definitely think that future generations will find more benefits and use of online courses than my generation ever did.
30	I: Thank you for your time.

### Appendix 18. Interview Participant O

1	I: Hello! Thank you so much for agreeing to taking this interview. I really do appreciate you making the time. The first question I would like to pose to you is the following: Please, tell me more about yourself. Where are you from? What is your main occupation?
2	PO: Hello, nice to meet you. My name is Participant O. (redacted)
3	I live in Salamanca, Spain. I am a full time professor at a university here in Salamanca. I am also a researcher.
4	I: Do you remember which MOOC you signed up to?
5	PO: Yes, the MOOC was about Energy, Past, Present and Future.
6	I found out about this MOOC because a visiting professor that came from Mexico mentioned us about a series of free online courses that we could take and recommended them to us.
7	The title of the course seemed interesting and I decided to give it a try. It seemed like a topic that would help me understand what has happened before and what to expect in the future when it comes to the energy we use.

8	I: Had you taken any online courses before?
9	PO: I do have experiences with other online courses. I like to take courses that allow me to advance at my own pace, considering I am pretty busy every now and then.
10	What about previous experiences when it came to curricular or extracurricular activities regarding sustainable development?
11	PO: I wouldn't say I had any curricular formation that touched upon the subject.
12	Sadly, I don't recall enrolling or participating in an extracurricular activity that involved the topic of sustainable development.
13	I: What are the first three words that pop into your head when you hear the word "sustainability"?
14	PO: Wealth, Family, Future
15	I: Are you familiarized with UNESCO's SDGS?
16	PO: I am no expert in the topic, but I have definitely heard about them before and have heard about them in conferences and short sessions with other fellow professors who try to implement them in their classes.
17	I: Do you think that the challenges when it comes to securing a sustainable future for everyone are of economic, social or ecological nature?
18	PO: Definitely all three.
19	I: And if you had to pick one?
20	PO: I would lean more towards a social nature. In the end, if it the society the ones who difine which actions, or lack of actions, will shape our future.
21	We need to raise awareness of future generations, that is for sure.
22	I: Can you share with me the reason you didn't complete the MOOC?
23	PO: My intention from the start, even when I signed up, wasn't to get a certificate or even complete the MOOC. As I mentioned before, it was a visiting professor who first introduced me to the courses and I decided I just wanted to check quickly if there was any content in these courses that could be applied in my own courses or classes. I just wanted to check the kind of material and approaches that were used in the online course, and if I could learn a little bit about energy in the process, that was great. But it wasn't my main objective.
24	PO: What would you recommend for future courses?
25	PO: I didn't really check the course in depth because, as I mentioned before, my main interest was just to browse quickly to see the type of content that was out there. So I don't feel comfortable giving recommendations over material that I just checked once and quite superficially too.
26	I: What are some attractive elements you like in online courses?

27	PO: I think that when the material is offered in more than one language, it really opens up the opportunity of making international collaborations more accesible and natural. I would most definitely recommend that future courses are presented at least in English and Spanish, that way it would be easier to connect with other participants around the globe.
28	I: Do you believe future generations will use online courses more in the future?
29	PO: I think that future generations need to raise awareness of the amount of knowledge that is available to them only by a click away. A lo of the younger generations spend a lot of time entertaining themselves with the internet, rather than seeing it as a tool to learn more. I strongly believe we have to help them see the potential of the internet as a huge library of knowledge besides it being their "meme machine", if you know what I mean.
30	I: Any other comments you would like to add?
31	PO: Thank you for considering me for the interview, I really appreciate it. Cheers all the way to Mexico!

#### **Appendix 19. Interview Participant P**

1	I: Hello, nice to meet you. First of all, thank you so much for agreeing to make this interview, it will really help my thesis. The first question I have for you is regarding your person. Please state your name, where you're from and what your main occupation is.
2	PP: Hello, my name is Participant P. (redacted)
3	I am a master's student and I am from Monterrey, Mexico.
4	I: Was this your first time taking an online course?
5	PP: No, I have taken several MOOCs before.
6	I: What about curricular or extracurricular activities that touched upon the subject of education for sustainable development?
7	PP: Some of the classes I have taken in my Master's program have touched upon the topic of Sustainable Development, so I would say that yes, I have had some curricular activities.
8	However, I can't think of any extracurricular activities, so I would have to say no to that one.
9	I: Do you remember which MOOC you signed up to? How did you find out about the MOOC? What was your main motivation for joining?
10	PP: Can I be honest with you?
11	I: Definitely

12	PP: No teachers will know what I'm going to say? I don't want my reputation as a student to be hurt.
13	I: I will keep your identity anonymous.
14	PP: Okay. I trust you. Here it goes.
15	I first heard about the MOOCs during one of my online classes for my Master's Degree. The teacher that gave us the class mentioned that we would receive bonus points if we signed up to one of the MOOCs that the private university was offering and we proved that we had at least taken 80% of the MOOC before the semester ended. They offered us 5 extra points over our final grade, and that was my main motivation to sign up to the MOOC, if I'm being honest. Not to learn or because the topics were super interesting to me, but rather, because I just wanted to have those five extra points in case I needed them. Just to be on the safe side, you know?
16	I: I understand. Could you please share with me the first three words that pop into your head when I say the word "sustainability"?
17	PP: Energy, Green, Future
18	I: Are you aware of UNESCO's SDGs goals?
19	PP: No, I am not familiar with them
20	I: Do you consider you have some pro-sustainable activities in your daily life?
21	PP: Yes, I do.
22	I try to walk to school or my office, I reduce the use of electricity in my home and I am very picky when it comes to trying to make sure I don't waste water.
23	I: Do you believe that the challenge of making the future sustainable is of ecological, social or economic nature?
24	PP: I would say mainly social. We need to educate people more about this topic.
25	I: Can you share with me the main reason you didn't finish the MOOC you enrolled in?
26	PP: Well... truth to be told, at the beginning I was afraid my online class would be super hard and that I would need those five extra points for my final grade. But I soon realized that if I did the activities exactly as the instructions suggested I should, I would get almost full marks in every single activity and as long as I got a 90 or more, I was more than satisfied. In the end, I finished the class with a 98 and I figured that was good enough, so I never really finished the course because I never needed the 5 extra points I had been promised.
27	I: I see
28	PP: I did try to take the course for a week, though, just out of curiosity.

- 29 But the course content was a little bit too boring, if I'm being honest. The format had a lot of text that was painful to read, because the letters were too small and it just made me feel like it was more like a chore than an actual class or learning process.
- 30 I: Do you have any recommendations for future courses?
- 31 PP: Yes!
- 32 Make more videos for the courses instead of putting just giant walls of text to teach about a topic. It keeps it more fun and easier for us as users to keep engaged.
- 33 I: Any other free comments?
- 34 PP: Just please don't tell any professor my name, I am scared they will know I was talking about them. Thanks!

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