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The Personalized and Inclusive MOOC: Using Learning Characteristics and Quality Principles in Instructional Design

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Abstract: In Ecuador, 30% of the population does not consume drinking water of good quality. One of the causes is related to the deficiency in the technical skills of water operators because some have not had access to elementary, high school or higher education due to factors of extreme vulnerability. The Massive Open Online Courses (MOOCs), having an inclusive and accessible typology with attention to people at risk of social exclusion are an option to strengthen the skills of operators. Therefore, the goal of this study is to create an instructional design in MOOCs that responds to the characteristics and learning needs of a sample of 286 operators of the drinking water system. The instructional design is based on the information systems success model of DeLone and McLean and the quality principles of Merrill, Margaryan, Locke, Latham and Seijts. The results present an instructional design including quality content with objectives and learning strategies that respond to the learning characteristics of the operators as well as activities and resources with a cognitive, emotional, and behavioral didactic approach oriented at changing attitudes to learning. Finally, we can conclude that the developed instructional design promotes a more inclusive, equitable and quality education.

Keywords: instructional design; quality MOOC; attitudinal learning; learner's characteristics

1. Introduction

The Constitution of the Republic of Ecuador [1] declares water as a vital and inalienable human right, and articles 55, 134 and 137 of the Organic Code of Autonomy and Decentralization Territorial Organization (COOTAD) [2] established that the provision of drinking water service is an exclusive competence of the Autonomous Decentralized Municipal Governments (GADM). Therefore, water management should be public- or community–based. However, the GADMs may delegate participation in strategic sectors and public services to joint companies.

According to the National Secretariat of Water (SENAGUA), community management is the most predominant form of water service provision in rural areas, so the GADPs coordinate this service with 7000 Drinking Water and Sanitation Administrative Boards (JAAPS) that are responsible for providing drinking water [3].

The 2016 National Employment, Unemployment and Under-Employment Survey (ENEMDU) indicated that 70.1% of the population at the national level has access to drinking water (79.1% in urban areas and 51.4% in rural zones). It's important to highlight that 49% of the rural area in our country lacks access to drinking water and the JAAPS present financial sustainability and water quality problems [3]. In Figure 1, it is observed that the provinces of Guayas, Los Rios, and Tungurahua have the lowest percentage representation (60%–78%) in the water treatment system, unlike the rest of the provinces [4].

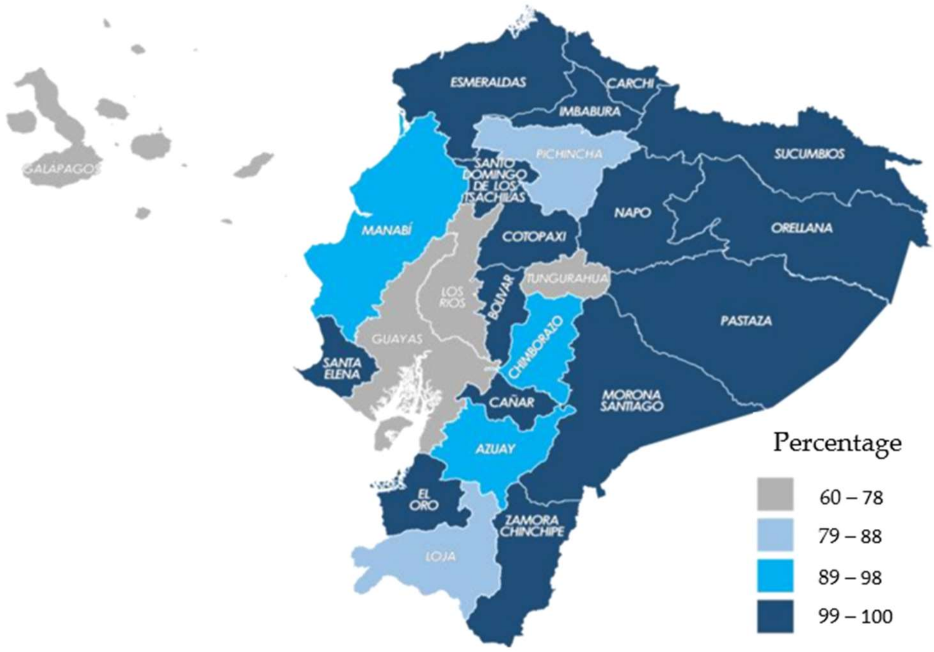

Figure 1. Percentage representation of provinces that have a drinking water treatment system.

On the other hand, according to the Water Balance carried out by the Water Regulation and Control Agency (ARCA) (SENAGUA, 2017), the demarcations of Jubones, Manabí, and Puyango-Catamayo have deficits in water availability, and instead the provinces of Pastaza and Napo have a greater availability of this resource [3].

In Ecuador, the Ecuadorian Standardization Service (INEN) is the body that issues, applies and evaluates compliance with the INEN 1108 Water Standard for Human Consumption [5]. The 1108 standard is based on international standards recognized by the United States Environmental Protection Agency (EPA), World Health Organization (WHO), American Public Health Associations (APHA), among other standards [6,7]. Only 4 out of 221 municipalities in Ecuador have received the quality seal for drinking water consumption by the Ecuadorian Standardization Service [8]. Some municipalities cannot meet these standards because they lack the knowledge or the technologies for drinking water treatment. One of the causes is related to the deficiencies in the technical ability of the operators due to their level of education, technical training, and experience, among other aspects. In addition, the academic offer of Higher Education Institutions (IES) does not respond to the number of operators, technicians, or engineers that the water sector demands in all regions of the country; for example, in Ecuador there are only three undergraduate programs in hydrology and three postgraduate programs related to water drinking treatment. So, there is no formal training program for water operators [9]. These problems are even worse in small cities, or rural areas. These difficulties also occur globally; for example, in a study carried out in 2015 by IWA [10] in 15 countries, such as Mali, Bangladesh, South Africa, Zambia, Tanzania, Mozambique, Burkina Faso, Niger, Senegal, and the Philippines. In addition, some deficiencies are related to the training and retention of human talent. These are:

- The educational offer does not adjust to the needs of the market.
- Lack of financial resources to recruit and retain staff.
- The number of existing technicians or engineers is insufficient for market need.
- Most human resources have elementary and high school instruction only.

From our point of view, one of the greatest problems in the training of operators is related to access to inclusive, equitable, and quality education. In Latin America and the Caribbean, 11,970 children, adolescents, and young people do not go to school because many of them may have special needs, are disabled or may be poor, refugees or may live in rural areas, among other types of vulnerabilities. However, speaking of inclusive education is usually associated with the needs of people with disabilities, when it really should be associated with diversity factors, such as: gender, age, location, poverty, disability, ethnicity, language, religion, migration or displacement situation, imprisonment, beliefs, attitudes, etc. Therefore, inclusive education is a process that contributes to achieving the goal of social inclusion where educational institutions, government, and industry are key actors for fair, responsible, and inclusive training [11].

We from the academy believe that the creation of Massive Open Online Courses (MOOC) could help bridge social gaps in relation to access to quality, inclusive, and equitable education for those groups that have historically been excluded but are interested in sustainable engineering practices, specifically related to the drinking water system in Ecuador. In this sense, the MOOCs have a disruptive approach because they are easily accessible, free of charge, and can be massified, allowing for the participation of a large number of students, contributing to social inclusion, the distribution of knowledge and educational innovation [12].

Indeed, since the New York Times [13] named 2012 as "the year of MOOCs" the participation of people in massive online courses has been exponential. It is the case that the platform with the largest number of MOOCs -Coursera- offers approximately 3000 courses with more than 97 million students, followed by edX with more than 3000 courses and approximately 42 million students [14]. However, access to inclusive education should not be summed up as free access or in the potential of MOOCs to involve a large number of participants, but rather in creating content with quality resources and activities that respond to student characteristics and learning needs in order to have a positive impact on student learning [15]. This context generates a challenge due to the high heterogeneity of the students. However, this could be improved to the extent that the MOOCs respond to the learning characteristics of social groups or communities [12]. However, MOOCs still have problems, such as: The high dropout rate, the design of activities for engineering careers, the type of evaluation, communication, feedback, sustainability, among other aspects [16]. These problems have led to studies [17] that analyze factors which can influence the quality of the design and content of MOOCs, drop out as well as personalized learning in response to learning needs and preferences, prior knowledge, context of participation and diversity of functionalities on online platforms, such as: videos, readings, forums, wiki, quizzes, and exercises with options like multiple answers, fill-in-the-blank, and text, among other functions [18–20]. Personalization plays an important role in responding to personal, social, emotional, cognitive, and academic characteristics in a learning environment [21]. Cooper and Mehran in their paper "Education Reflections on Stanford's MOOCs" mention the need to create personalized courses with learning environments that respond to the unique learning needs of students [22]. Likewise, in 2015, Zapata Ros stated that: "In personalized education, the instructional design is individualized as a whole, or as far as possible, to adapt it to the learning characteristics detected in the student's personal environment" [23].

The most common way to carry out personalized MOOCs is through adaptive learning, which uses learning analysis and data mining techniques in order to identify characteristics, learning styles or interaction similarities, and then incorporating learning activities with the aim of promoting a significant impact on student performance [24–27]. There are also studies that consider the learning characteristics of the participants as a reference to offer a certain course, but the results have not been satisfactory due to the high heterogeneity of the participants [28]. Finally, another type of personalized learning in MOOCs is gamification, which mainly considers the social aspect of learning characteristics [21]. For us, a personalized MOOC is based on the creation of an instructional design that takes into account the characteristics, needs and learning preferences of the students, as well as the quality criteria and principles for designing a quality MOOC [29,30]. For now, in the reviewed literature it has not been possible to find studies that have described how the characteristics, needs, and learning preferences are considered in the instructional design of a personalized MOOC that is relevant, inclusive, equitable, and of quality. However, two different pedagogical forms of MOOC are discussed in the literature: The conventional massive open online course (xMOOC) and the connectivist massive open online course (cMOOC). Some researchers believe that these two approaches have a reductionist view [31], leading other researchers to present a MOOC taxonomy with eight different pedagogical perspectives, such as: transfer MOOCs, made MOOCs, synch MOOCs, async MOOCs, adaptive MOOCs, group MOOCs, connectivism MOOCs, and mini-MOOCs [32]. Added to these pedagogical perspectives are the transfer courses, the massive open online courses (tMOOC) and sMOOCs [33]. The sMOOC was developed in 2014 as part of a European Elearning project "https://project.eco-learning.eu" (accessed on 5 October 2022) based on connectivism, situated learning, and the social constructivist perspective that has characterized online learning [34].

The characteristic of the sMOOC model includes being open, inclusive, and accessible to a wide variety of people, paying attention to those at risk of social exclusion [35]. Likewise, the model aims to promote the relationship between learning and the life experience of users through the contextualization of content and supporting adaptive learning strategies [36]. Indeed, there is research that points to sMOOCs and tMOOCs C, as the most relevant and disruptive social learning phenomena and methods in emerging countries [37].

In summary, we can say that depending on the characteristics and approach to the type of MOOC, it could bring you closer to a more inclusive education. However, for learning to be transformative, personalization of learning must include activities that allow the student to activate, demonstrate, apply, and integrate knowledge together with the incorporation of authentic resources based on real activities [38,39]. According to Merizow's theory, education is a process of critical reflection that leads the student to a transformation of thought [40]. For transformative learning to occur, the student must have opportunities within the learning environment to allow them to act [40]. Therefore, the design of a MOOC must have activities and resources with an effective approach in order to generate an affective dissonance which motivates students to act both in the course activities and in their work, professional or personal activities [41,42].

In this paper our objective is to create an instructional design that takes as a reference the design approach of the sMOOCs model characterized by inclusion, equity, and access to a wide variety of people with diverse learning characteristics. In this sense, the application of criteria and principles such as: problem-centered, activation, demonstration, application, integration, collective knowledge, collaboration, differentiation, and authentic resources, will allow the creation of learning strategies that respond to the characteristics and learning needs of the water system operators. In summary, in this study we present a detailed description of the instructional design, including: (1) characteristics and learning needs of the operators of the Ecuadorian water system, (2) the application of principles and quality criteria for the instructional design and development of MOOCs, and (3) the use of the didactic concept; attitudinal change.

Finally, we want to mention that from May to October 2021, a survey was applied with the aim of identifying and assessing the characteristics and learning needs of the operators of the drinking water system, as well as to identify what type of activities or resources are preferred when taking an online course. The selected sample included cities from the population quintels Q25, Q50, and Q75 in order to understand the heterogeneity or diversity of learning characteristics. Twelve cities were selected, and eight cities confirmed their participation (67%) such as: Guayaquil (Q > 75), Portoviejo (Q50), El Empalme (Q25), La Libertad (Q25), Santa Elena (Q25), Salinas (Q25), Villamil Playas (Q25), and Gualaquiza (Q25). In the case of Guayaquil, the Posorja parish, and Puna Island were also included. Applying a stratified sampling by city, we determined a total sample size of 286 workers, which corresponds to the cities which participated in the project, and 100% of the sample was surveyed. With the collected data, an analysis of principal components and cluster analysis was carried out and the following profile was obtained [43].

Target Learners Profile: Operators have quality internet access at home, as well as access to computers and smartphones. They hold a high school degree and have between 1 and 5 years of experience as operators. They prefer the course to be online and face-to-face, containing mainly videos, practical exercises, hands-on activities, and readings focused on real situations as well as daily work activities. They would like to be trained in topics such as: Valves/Pump Types/Reservoirs/Power Generators/In-Line Sensors/Surface Water/Chemical feeders/Wells/Health risk assessment/Economic aspects. They prefer the MOOC to be a 4-week course with 2 h of weekly work. They would like to register for the course with friends/colleagues and prefer to take the course at home. Finally, the main motivation to take the course would be to obtain a certification and improve their performance at work.

Specifying the RQ.

With the objective in mind and the identification of the profile target learners, the following research question was developed:

What are the learning strategies that meet the principles and quality criteria of an instructional design as well as the characteristics and learning needs of water operators?

2. Materials and Methods

The main scenario that this study considers is the instructional design of a MOOC for operators of the drinking water system in Ecuador, which contemplates three perspectives: personalization, education, and technology.

Personalization perspective includes: (a) Identifying learning characteristics that have been widely described in the literature and can be synthesized into five categories: (1) personal; (2) academic; (3) social; (4) emotional; and (5) cognitive.

Education perspective includes: (b) Quality content through learning strategies and activities that considers generally accepted quality principles and criteria and that responds to unique learning needs to promote (c) attitudinal change in student behavior.

Technological perspective: Is the (d) quality of the online platform understood as easy to teach, use, and learn. Figure 2 presents an information model [44] adapted to the MOOC personalization context, where the three perspectives are displayed in components (a), (b), (c), and (d), influencing the design, development, implementation, and realization of the online course. Likewise, the degree of use or performance of the activities hypothetically supposes an increase in engagement, resulting in a positive influence on the performance of the student (water operator). Finally, with the results obtained in performance, improvements can be incorporated into each of the components.

It is important to mention that the perspectives of personalization, education, and technology are approaches that are deployed in the components described in the information model, and which in turn are executed systematically through the application of the criteria and principles of quality as well as the use of the didactic concept—Attitude Change—to create an inclusive, equitable, and quality instructional design. Figure 3 presents the relationship between perspectives and components, and how they are deployed through the application of the criteria and quality principles obtained as a result of the instructional design.

2.1. Application of Criteria to Design Quality

For the elaboration of the instructional design, it was necessary to use the criteria of the analysis and design phases to develop a quality MOOC [29]. The criteria of the analysis phase requires the creation of a team to plan the development of the MOOC, as well as to identify the stakeholders. In addition, the criteria indicate that an analysis of the needs and demands must be carried out to obtain a profile of the student. On the other hand, the criteria also recommend carrying out an analysis of the external context to learn about similar MOOCs in order to identify teaching opportunities through the activities and resources to be developed. Likewise, the criteria recommend knowing the training needs or requirements, as well as the information technology required for the development of the MOOC. Table 1 describes the criteria used in the analysis phase and their application to create the instructional design.

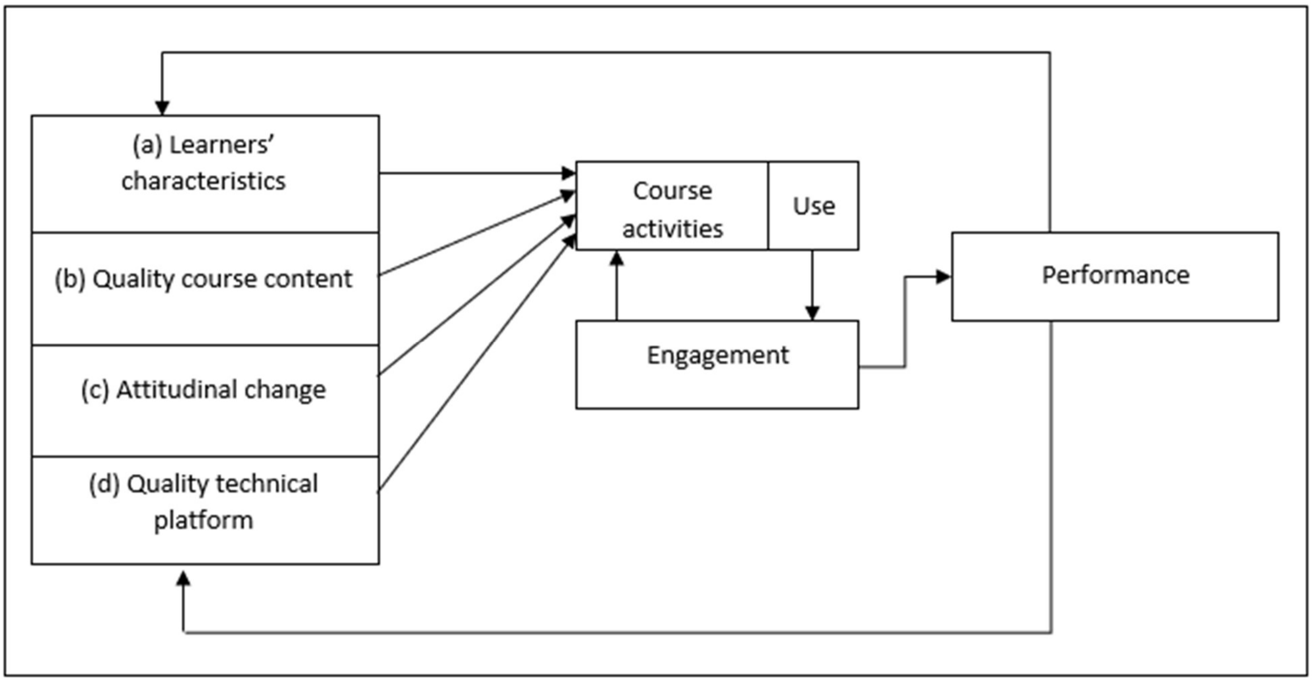

Figure 2. DeLone and McLean information model adapted to the context of personalized MOOCs.

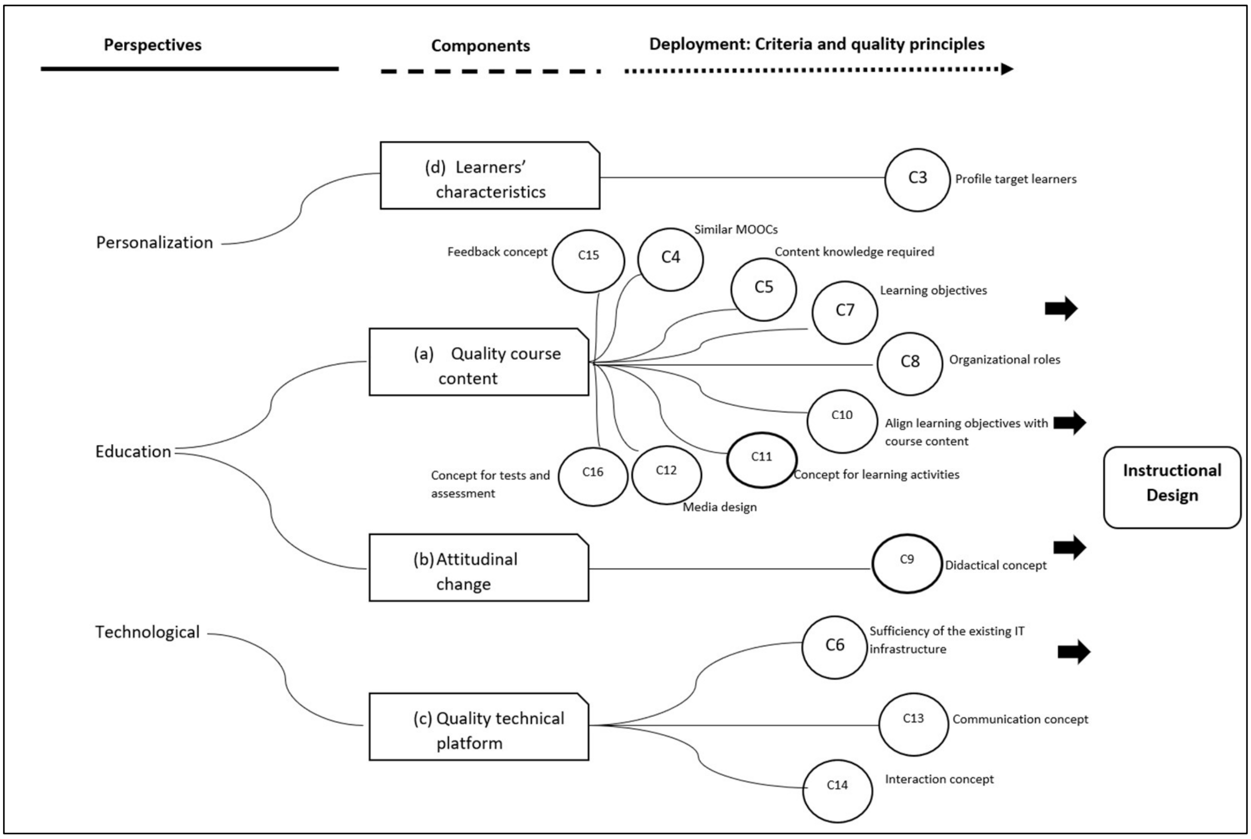

Figure 3. Relationship between perspectives, components and quality criteria, and principles.

Table 1. Quality Criteria-Analysis Phase.

Analysis Phase	
Criteria	**Application of the Criteria**
C.1 Initiation: Assemble an incubation team (relevant personnel and expertise) to kick start the planning and development of the MOOC	• Rector of the Escuela Superior Politécnica del Litoral (ESPOL) • Director of the Center for Water and Sustainable Development of ESPOL • ESPOL MOOC Team • Expert professors in education, water resources technology area from the University of Ghent and ESPOL • Expert professionals from drinking water companies
C.2 Stakeholder identification	• Decentralized Autonomous Governments • Water companies • Universities of Ghent and ESPOL • Managers and operators of water treatment plants • Teachers • Water company professionals
C.3 Needs and demand analysis: Profile target learners	To respond to the unique learning needs and characteristics to create a quality and personalized instructional design [21,45], the learning needs, and demands of the operators were identified in previous work [43], and the following profile was determined: Profile Target Learners: Operators have quality internet access at home, as well as access to computers and smartphones. Their educational level is high school degree, and they have between 1 and 5 years of experience as operators. They prefer the course to be online and face-to-face, containing mainly videos, practical exercises, hands-on activities, and readings focused on real situations as well as the daily work activities that they carry out. They would like to be trained in topics such as: Valves/Pump Types/Reservoirs/Power Generators/In-Line Sensors/Surface Water/Chemical feeders/Wells/Health risk assessment/Economic aspects. They prefer the MOOC to be a 4-week course with 2 h of weekly work. They would like to register for the course with friends/colleagues and prefer to take the course at home. Finally, the main motivations to take the course would be to obtain a certification and improve their performance at work.
C.4 Analysis of the external context: Identify and source similar MOOCs	Five similar courses were reviewed to learn about the most common types of activities and resources, and to identify opportunities in the design of activities: 1. Water Resources Management and Policy—Coursera 2. Introduction to household water treatment and safe storage—Edx 3. Drinking Water Treatment—Edx 4. Water and wastewater treatment engineering: biochemical technology—Edx 5. How to develop sustainability rural water and sanitation systems?—Miriadax
C.5 Analysis of the organizational context: Analyze proficiency in content knowledge required for the MOOC	According to the student's profile, the training needs are very diverse, and for this reason, in meetings with the heads of water treatment, the following training needs were identified: • Operators need to monitor intake water frequently (hour-by-hour) and use the results obtained for treatment decision-making • Operators need to perform proper coagulation and flocculation treatment when there are unexpected changes in water quality. At present, their knowledge is empirical and makes decision-making difficult. • Operators need to report the dosage of coagulants and flocculants objectively, because they currently report based on the operating conditions of the dosing pump. • Operators need to know the impact of chemical dosing on final water quality. • Operators need to technically determine the proper dosage of coagulant and flocculant because they are currently doing so empirically.
C.6 Analyze sufficiency of the existing (institutional) IT infrastructure	ESPOL has servers that allow the resources hosted on the Edx platform to be stored. The types of tools that can be used in Edx were also identified in order to select the most appropriate ones to respond to the student's profile [46,47].

With regard to the criteria for the design phase, these establish requirements to form a team that is responsible for the didactic concept, the development of course content, the visual realization, and to ensure the correct alignment between the course content, the learning objectives, and the student outcomes to respond to training needs. Likewise, the team is established to define the concepts for learning activities, communication and interaction, feedback, and evaluation. Table 2 describes the criteria used in the design phase and the application for the creation of the instructional design.

Table 2. Quality Criteria-Design Phase.

Design Phase	
Criteria	**Application of the Criteria**
C.7 Learning objectives: Define learning objectives based on the desired learning outcomes	Based on the training needs, the following learning objectives were established: • Identify catchment water quality parameters for proper monitoring of catchment water. • Understand the physical and chemical changes that occur in the coagulation and flocculation treatment of drinking water. • Calculate the dose of a flocculant and coagulant from relating the flow of water to be treated and the flow of chemical. • Perform a jar test to determine the appropriate dose of coagulant and flocculants for the treatment of drinking water. • Recognize the effect of the dosage of coagulant and flocculant in the final quality of drinking water.
C.8 Organizational concept and roles:	• Instructional Designer: Martín Bustamante • Content provider: Diana Tinoco • Designer and technical facilitator: ESPOL MOOC Team • Content peer reviewer: Water company professionals
C.9 Didactical concept and methods:	Attitude change concept: cognitive, affective, and behavioral engagement [42].Cognitive-Knowledge: Concepts, methodologies, practical exercises, statistics, facts, etc. Affective-Feelings: Testimonies, documentaries, interviews, etc.Behavioral-Acting: Projects, practical assignment, hands on activities.
C.10 Concept for content: Align learning objectives with course content	The selected content responds to the training needs and is aligned with the learning objectives and student outcomes.
C.11 Concept for learning activities	The concept for the development of learning activities is based on the 11 principles for quality instructional design [30]: 1. Problem-centered: 'Learners are engaged in solving real-world problems' 2. Activation: 'Existing knowledge is activated as a foundation for new knowledge' 3. Demonstration: 'New knowledge is demonstrated to the learner' 4. Application: 'New knowledge is applied by the learner' 5. Integration: 'New knowledge is integrated into the learner's world' 6. Collective knowledge: 'Learners contribute to the collective knowledge' 7. Collaboration: 'Learners collaborate with others' 8. Differentiation: 'Different learners are provided with different avenues of learning, according to their need' 9. Authentic resources: 'Learning resources are drawn from real-world settings' 10. Feedback: 'Learners are given expert feedback on their performance' 11. Goal Setting: Working on/setting measurable, difficult long-term goals, chunked into short-term goals. These principles will be fully described in the Table 3.
C.12 Media design	• Video • PPT presentations • Digital text • Lectures

Table 2. *Cont.*

Design Phase	
Criteria	**Application of the Criteria**
C.13 Communication concept	• Provide a bootcamp module to orientate • Mails WhatsApp group to facilitate support network
C.14 Interaction concept	• Forum in Edx • WhatsApp social media
C.15 Feedback concept	Automatic feedback
C.16 Concept for tests and assessment	• Formative assessment (weekly quizzes) • Practical assignment • Summative module assessment • Rubrics • Digital video to explain the expected result of a practical assignment.

Table 3. Alignment between the content, learning objectives, student outcomes and the identified problems.

Problems	Students Outcomes	Objectives of Learning Content	Content
Operators need to monitor intake water frequently (hour-by-hour) and use the results obtained for treatment decision making.	Knowledge of turbidity and pH level requirements.	(1) Identify catchment water quality parameters for proper monitoring of catchment water.	Module 1: Monitoring of intake water
Operators need to perform proper coagulation and flocculation treatment when there are unexpected changes in water quality. At present, their knowledge is empirical and makes decision making difficult.	Knowledge of the coagulation/ flocculation process.	(2) Understand the physical and chemical changes that occur in the coagulation and flocculation treatment of drinking water.	Module 2: Introduction to coagulation. Module 3: Introductionto flocculation.
Operators need to report the dosage of coagulants and flocculants objectively, because they currently report based on the operating conditions of the dosing pump.	Ability to calculate a dosage for a chemical feeder.	(3) Calculate the dose of a flocculant and coagulant from relating the flow of water to be treated, and the flow of chemical.	Module 4: Introduction to dosage.
Operators need to technically determine the proper dosage of coagulant and flocculant because they currently do so empirically.	Ability to perform a jar test.	(4) Perform a jar test to determine the appropriate dose of coagulant and flocculants for the treatment of drinking water.	Module 5: Optimum dose of coagulants and flocculants.
Operators need to know the impact of chemical dosing on final water quality.	Knowledge of the effect of dosage on the quality of drinking water.	(5) Recognize the effect of the dosage of coagulant and flocculant in the final quality of drinking water.	Module 6: Drinking water quality criteria.

2.2. Principles for Quality Instructional Design

The 11 principles to elaborate a quality instructional design were used in the design with the purpose that the content of the course and the learning activities consider the real problems that the operators have in their daily activities, in such a way that the existing knowledge is activated as a foundation for the acquisition of new knowledge and, at the same time, can be demonstrated, applied, and integrated in the real context of their work. In this sense, activities such as exercises or practical assignments activate prior knowledge with a problem focused on daily work activities, but later, through a practical assignment, the operator can demonstrate, apply, and integrate the new knowledge in the reality of their work. Similarly, the practical activities promote collaborative work to achieve the objective of the task, and through the experience and skills of the operators can contribute collectively to the integration of knowledge. On the other hand, the conceptualization of resources such as videos, interviews, testimonials, and readings are focused on showing real situations typical of the daily activities carried out by operators and considering their learning needs and characteristics. Regarding feedback, all the activities to be carried out must have automatic feedback given by the expert, which in our case is the content provider. In this way, we apply the 11 principles in a practical way in the elaboration of the instructional design and, in turn, we reduce the risk of desertion when the MOOC is implemented because we know the factors that most influence dropout is related to the design of the MOOC course and with previous experience because they are net factors or causes of the rest of the factors that generate dropout.

2.3. Didactic Concept: Attitude Change

The didactic concept for the instructional design of the MOOC—Attitude Change—is related to engagement in three aspects: cognitive, affective, and behavioral, allowing us to introduce dissonance as an instructional strategy [42]. For example, a student/operator has cognitive knowledge about how poorly treated water could cause health problems for a person and, therefore, is able to recognize the intense pain or dehydration of a person who has consumed contaminated water. Therefore, he/she experiences feelings of sadness for that person (and perhaps anger, frustration, or guilt). If he/she does not take action to stop a bad water treatment practice, his/her behavior will be inconsistent with his/her knowledge (cognition), and his/her emotions; therefore, she/he will experience unpleasant dissonance. Acting to find a solution will allow him/her to align his/her behavior with his/her emotions and knowledge, eliminating the dissonance which it creates. In this way, it is proposed that the learning activities have a sequential order in the advancement of a module, for example: A cognitive video is shown that addresses a concept, a methodology, statistics or exercises about water treatment, and then a second video where a person appears who suffered an illness due to the consumption of poorly treated water, with this, an emotional dissonance could be created to motivate the operator to carry out the activities of the course correctly and in turn he/she can identify specific activities that can be applied in the work, making the operator aware of the impact his/her work has on peoples' health. Among the cognitive resources that were selected were: videos and readings, while in the affective aspect testimonies, interviews, and documentaries were selected and in the behavioral aspect they were practical assignments.

3. Results

3.1. Student Outcome, Leaning Objective and Content

In total, the course would have six modules that contribute to the formation of five learning objectives based on Bloom and Anderson's taxonomy [48,49]. Likewise, these learning objectives are aligned to student outcomes that are evaluated and accredited in certification processes for operators in drinking water treatment in other countries [50]. It is important to mention that 12 heads belonging to treatment plants considered for this study participated in the definition of training problems, learning outcomes, and learning objectives. In general, we can say that the skills to be trained are related to problems of optimal dosage of chemicals in the processes of water intake and treatment of drinking water. Finally, the duration of the course would be 6 weeks with a dedication time of 2 h per week, thus responding to the requirements or preferences of the operators and the quality criteria. Table 3 shows the result of the alignment of the training problems with the student outcomes and the learning objectives.

3.2. Quality Learning Strategies and Activities

Generally, the principles of Application, authentic resources, problem-centeredness, and goal setting are applied in many MOOCs, unlike the principles of activation, collective knowledge, differentiation, and demonstration, which are only applied in less than half of the courses. The principles of integration, collaboration, and expert feedback are present in less than 15% of the courses [30]. In this study, learning strategies that meet the 11 quality principles have been described. However, for now, an application that is embedded in the Edx platform and which is capable of identifying and validating the percentage of participation of the members during the development of a group activity has not been identified. This could be considered a limitation that affects one of the components of the principle of collaboration. Table A1. defines the learning strategies for instructional design based on the 11 quality principles.

Conceptually, 32 activities were planned, including 41 videos, 23 formative quizzes, 7 forums, 6 summative quizzes, 5 practical assignments, and 1 course assessment. Each related to cognitive, affective, and behavioral aspects (Didactic concept: Attitude Change). Approximately 50% of the activities are related to videos because the positive impact it has on online learning is known and it is also a good resource to generate cognitive and emotional dissonance [42,51]. Table A2 presents the types of activities and resources that have been considered for each aspect of attitudinal change. It has been prioritized that the videos be of short duration, recorded in locations of the world of work and conceptualized in daily work activities of the operators. Likewise, videos with an effective approach are represented in the form of testimonies, interviews, and documentaries in order to generate dissonance. In addition, Table A2 shows formative and summative activities that propose a real problem using the “drag and drop” type of question that, in addition to facilitating the conceptualization of the real problem, will also allow the student to observe through images the equipment and tools that are used in water treatment plants, to activate prior knowledge, and hypothetically increase engagement.

3.3. Instructional Design

The sequential order of the learning activities applied in the instructional design is related to the didactic concept -Attitude Change-, that is: The initial activities will always have a cognitive approach, followed by an effective approach to generate an emotional dissonance that motivates the student to perform practical tasks or incorporate specific actions into daily work activities. This approach in other studies has allowed students to feel more informed and confident in their opinion on a topic and, in turn, to have been able to identify specific activities that can be incorporated into their personal or working life [42]. Table 4 shows the architecture of the instructional design of Module 1: Monitoring of intake water, with the learning activities proposed for the creation of a quality instructional design.

One of the limitations of this study is not having been able to identify a measurement instrument that clearly shows the individual contribution of each student in a group assignment. In the instructional design, practical group assignments are proposed to contribute to the principle of “collaboration”, however, for now we have not been able to identify or embed a tool in the edX platform that can identify and value the individual contribution of each student in a group activity.

Table 4. Concept didactic-Learning activities.

Engagement Cognitive	Affective	Behavioral	Learning Activities	Approximate Time (Minutes)
			Watch introductory video 1: Monitoring of Catchment Water	2
X			Watch theoretical video 1: Variability of catchment water quality Answer 2 formative quiz questionsQuestion Type: Drag & Drop	2 5
X			Watch theoretical video 2: Parameters to monitor Answer 2 formative quiz questionsQuestion Type: Drag & Drop	2 5
X			Read 1 handout: Parameter concepts and their application Answer 2 formative quiz questionsQuestion Type: Drag & Drop	10 5
	X		Watch interview video 1: What problems can occur when the catchment water is not monitored in a timely manner? Discussion assignment: Answer the forum question	5 5
		X	Hands-on video 1: Collection of different types of water Group practical assignment 1- water catchment: Answer 3 summative quiz questionsQuestion Type: Drag & Drop–Multiple choice–File (video) Upload Question	5 30
			Watch theoretical Video 3: Summary Conclusions	2
			Module assessment: Answer 8 summative quiz questionsQuestion Type: Drag & Drop–Multiple choice	20

4. Conclusions

In short, an instructional design with learning strategies has been created that responds to the needs, preferences and learning characteristics of water operators belonging to both urban and rural sectors. These learning strategies are based on quality principles and criteria that respond to the demands and needs of a diverse group interested in accessing an inclusive, equitable, and fair education. In turn, the understanding and application of the criteria and principles should generate a space for reflection and thus propose quality content, with clear learning objectives consistent with the training needs and skills that operators are expected to acquire at the end of the course. Therefore, we have known that if it is possible to develop learning strategies that could generate an emotional dissonance that motivates the operator to act, either in the MOOC activities or in the application of specific activities at work, thus promoting awareness and sustainable management of water resources. Finally, we want to mention that the participation of expert professionals in the water sector, heads of water treatment in water companies, experts in education and technicians in the e-learning platform, has allowed the creation of an instructional design adapted to the working world of the operator/student. However, the challenge will be in the implementation of the personalized MOOC and how its execution positively impacts the performance of the operator.

5. Future Work

According to the findings, as future work, an inclusive, equitable and quality MOOC will be implemented considering the instructional design outlined in this paper. However, to assess the impact on student performance it will also be necessary to carry out an experimental study creating two MOOCs: The first is a personalized MOOC that responds to the strategies, activities, and learning resources identified in this study, and the second is a traditional MOOC. The traditional MOOC will reference the structures, activities, and existing resources in drinking water MOOCs found on platforms such as Edx, Coursera, Miriadax.

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Appendix A

Table A1. Learning strategies for the development of a quality instructional design.

Instructional Principles and Related Components	Learning Strategies
Problem-centered (1) The activities build upon each other (2) The activities in the course relate to the participants' real workplace problems (3) The course objectives are relevant to real-world problems (4) The problems in the course are typical of those learners will encounter in the real world (5) The problems are ill-structured–have more than one correct solution (6) The problems are divergent from one another	(1) (2) (3) (4) The proposed learning activities respond to real-world situations and are conceptualized in local learning environments, in such a way that locations of the water treatment plants are used in the recordings and problems to visualize the daily activities they carry out. The activities proposed for the instructional design are related to learning objectives, student outcomes and training needs. (5) Due to the fact that the quality of the water is changeable, either due to the winter season or demographic aspects, the measurement of several parameters subject to different chemical dosages is proposed in order to develop several solutions for water treatment. (6) The practical assignments in the design are conceptualized in real problems based on a local context and that demand an experimentation based on a creative solution, using materials that they could have in their houses or in the treatment plants. In addition, they must take videos or photos with their own phones to show the development of the practice.
Activation (1) The activities attempt to activate learners' relevant prior knowledge or experience	(1) In a previous unpublished study, we identified that approximately 30% of the operators say they know a lot or too much about issues related to the treatment and distribution of drinking water, but about 70% mentioned that they do not know, know something, or know little about the technical aspects. Determining prior knowledge accurately through the form that was applied is a limitation, however, we can say that their knowledge in general is empirical due to their academic training and years of experience, therefore, with this background we had to Know specifically the water treatment process of various companies to propose activities that activate knowledge from daily activities.
Demonstration (1) There are examples of problem solutions (2) Solutions represent a range of quality from excellent examples to poor examples	(1) The theoretical or experimental videos conceptualized in the design must show real solutions to real problems that operators have in their daily activities. (2) In such a way that in the practical assignment they can demonstrate the new knowledge acquired.
Application (1) The activities require learners to apply their newly acquired knowledge or skill	(1) Due to the training needs previously identified, it is required that the content of the course must contain a practical assignment in order for the new knowledge to be applied.
Integration (1) The activities require learners to integrate the new knowledge or skill into their everyday work	(1) The practical assignment can be carried out at work depending on the complexity, with the aim of integrating the knowledge acquired in the daily work activities.

Table A1. *Cont.*

Instructional Principles and Related Components	Learning Strategies
Collective (1) The activities require contributing to the collective knowledge, rather than merely consuming (2) The activities require learners to build on other participants' submissions (3) The activities require participants to learn from each other	(1) The practical assignments must establish a clear guide that facilitates the contribution of knowledge through the proposed solutions to the proposed problems. (2) (3) In addition, the practical assignments must be subject to peer review so that the reviewer can strengthen their learning from the proposals of other students and vice versa. (3) However, we believe that this component can be a real challenge due to the educational background of the operators.
Collaboration (1) Activities require participants to collaborate with other course participants (2) Activities require participants to collaborate with others outside the course (3) Activities require peer-interaction groups with individuals with different backgrounds, opinions, and skills (4) The individual contribution of each learner in the group can be clearly identified (5) Peer-interaction groups are given specific directions for interaction (6) Each member of a peer-interaction group has a specific role to play	(1) (2) (3) The discussion forums and the practical assignments are conceptualized in such a way that the participation in the activities is with operators who belong to the same treatment plant or to other water treatment plants. (5) (6) As mentioned in the collective principle, interaction and collaboration activities must have a clear guide that establishes responsibility for each member of the group. (4) For now, we have not been able to identify a tool in Edx that is capable of identifying the level of contribution of each participant in collaborative activities, therefore, this strategy could be a limitation when developing the MOOC.
Differentiation (1) There are activity options for participants with various learning needs	(1) The activities proposed in the instructional design must respond to the characteristics and learning needs of most water system operators.
Authentic resources (1) The resources are reused from real-world settings	(1) From the structure of the course, the content, activities, resources to the didactic concept, they have an authentic approach because it responds to unique learning needs.
Feedback (1) There is feedback on activities by the instructor(s) in this course (2) If there is feedback, the way feedback will be provided, is clearly explained to the participants	(1) The feedback is conceptualized to be automatic during the development of the activities. (2) In addition, all the activities and resources to be developed must have a validation and testing process to ensure the quality of the content.
Goal setting Goals are measurable Personal goals are incorporated	(1) The learning objectives will be measurable through rubrics and the performance obtained both in the grades and in the percentage of progress of the course activities. (2) Personal goals were described in the student profile.

Table A2. Types of resources and activities according to the aspects of attitude change.

Attitude Change Aspects	Brief Description of Resources and Activities	Total Resources and Activities
Cognitive activities	Introductory videos: They have the objective of creating expectations about the content to be taught and its application. These videos will be recorded in locations where the operators carry out their daily activities. The maximum duration time is 2 min.	6
	Theoretical videos: They aim to explain a concept, methodology, practical exercises, factual statistics, etc. Both its content and the learning environment will be adapted to real situations of operators. The maximum duration time is 2 min.	23
	Experimental Videos: They aim to show practical handling activities that could be recorded from a house or from a water treatment plant. The maximum duration time is 5 min.	5

Table A2. *Cont.*

Attitude Change Aspects	Brief Description of Resources and Activities	Total Resources and Activities
Affective activities	Interview videos: They aim to interview an expert to raise awareness of good practices in water treatment and achieve emotional dissonance in the student. The topic to interview as well as the learning environment will be adapted to real situations of the operators. The maximum duration time is 5 min.	5
	Testimonial videos: They aim to show people who have suffered illnesses due to poor water quality and achieve emotional dissonance in the student. The maximum duration time is 5 min.	1
	Documentary videos: They aim to tell facts about a subject of study, in which photos, videos and opinions are shown, in such a way that an emotional dissonance is generated in the student. The maximum duration time is 5 min.	1
Behavioral activities	Forum: These are questions that promote a dialogue between students based on situations expressed in testimonies, interviews and/or documentaries.	7
	Group-Practical assignment: These are experimentation practices that operators must do in a group of two, from home or from the treatment plant. The types of questions to use to solve the practices can be: "Drag&drop"-Select image-Multiple Choices-File (video) Upload Question.	5
	Quickly quiz: Quickly quiz: It is a questionnaire with a maximum of two questions, which seeks to evaluate essential learning from the observation of a theoretical video. The evaluation types can be: Drag&drop-Select image-Multiple Options.	23
	Module assessment: It is a questionnaire of questions with multiple options that evaluates the weekly performance of each module in relation to the proposed learning objective.	6
	Course assessment: Final exam of the course with multiple options that evaluates the learning objectives of the module.	1

References

1. La Asamblea Nacional de la República del Ecuador. *Constitucion de la Republica del Ecuador 2008*; La Asamblea Nacional de la República del Ecuador: Quito, Ecuador, 2008; p. 115.
2. Presidencia de la Republica Código Orgánico De Organización Territorial, COOTAD. Registro Oficial 2015, 55. Available online: https://www.defensa.gob.ec/wp-content/uploads/downloads/2016/01/dic15_CODIGO-ORGANICO-DE-ORGANIZACION-TERRITORIAL-COOTAD.pdf (accessed on 3 May 2022).
3. Consejo Nacional de Competencia. *Informe de la Competencia de Gestión de Agua Potable*; Consejo Nacional de Competencia: Quito, Ecuador, 2019.
4. INEC Boletín Técnico No 04-2020-GAD Municipales Económica en Gobiernos Autónomos Descentralizados Municipales Gestión de Agua Potable y Saneamiento. 2021. Available online: https://www.ecuadorencifras.gob.ec/documentos/web-inec/Encuestas_Ambientales/Municipios_2020/Agua_potable_alcantarillado_2020/Boletin_tecnico_APA_2020_VF.pdf (accessed on 13 October 2022).
5. Servicio Ecuatoriano de Normalización INEN. *Norma Técnica Ecuatoriana Nte Inen 1108:2020 Agua Para Consumo Humano, Requisitos*; Servicio Ecuatoriano de Normalización INEN: Quito, Ecuador, 2020; p. 14.
6. World Health Organization. *Guidelines for Drinking-Water Quality*; World Health Organization: Geneva, Switzerland, 2017; Volume 55, ISBN 9789241549950.
7. U.S. Environmental Protection Agency (EPA) Water Quality Standards Handbook. Available online: https://www.epa.gov/sites/production/files/2014-10/documents/handbook-chapter3.pdf (accessed on 16 October 2021).
8. Servicio Ecuatoriano de Normalización INEN Listado de Productos Con Convenio para la Utilización del Certificado de Conformidad Con Sello de Calidad INEN. Available online: https://drive.google.com/file/d/1XCotTNYWkWUMd0EVJf-N6ACHJ_fA4nKl/view (accessed on 14 September 2022).
9. Consejo de Educación Superior Oferta Vigente Del Sistema de Educación Superior del Ecuador. Available online: http://appcmi.ces.gob.ec/oferta_vigente/ (accessed on 17 August 2021).

10. International Water Association. *Wash Human Resource Capacity Gaps in 15 Developing Economies an Avoidable Crisis*; International Water Associatio: Seacourt, UK, 2014.
11. UNESCO. *Inclusion and Education: Sustainable Development Goals United Nations Educational*; Scientific and Cultural Organization: London, UK, 2020; pp. 1–34.
12. Teixeira, A.M.; Mota, J.; Morgado, L.; Do Carmo Teixeira Pinto, M. Can MOOCs close the opportunity gaps? the contribution of social inclusive pedagogical design. *Rev. Fuentes* **2019**, *21*, 239–252. [CrossRef]
13. Pappano, L. The Year of the MOOC. Available online: https://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html (accessed on 11 December 2021).
14. Shah, D. By The Numbers: MOOCs in 2021. Available online: https://www.classcentral.com/report/mooc-stats-2021/ (accessed on 15 February 2022).
15. Ngubane-Mokiwa, S. Accessibility strategies for making MOOCs for people with visual impairments: A universal design for learning (UDL) Perspective; Pan-Commonwealth Forum Open Learn. March 2016, pp. 1–12. Available online: http://oasis.col.org/handle/11599/2561 (accessed on 14 September 2022).
16. Ruipérez-Valiente, J.A.; Martin, S.; Reich, J.; Castro, M. The UnMOOCing process: Extending the impact of MOOC educational resources as oers. *Sustainability* **2020**, *12*, 7346. [CrossRef]
17. Aldowah, H.; Al-Samarraie, H.; Alzahrani, A.I.; Alalwan, N. Factors affecting student dropout in MOOCs: A cause and effect decision-making model. *J. Comput. High Educ.* **2020**, *32*, 429–454. [CrossRef]
18. Conache, M.; Dima, R.; Mutu, A. A comparative analysis of MOOC (massive open online course) platforms. *Inform. Econ.* **2016**, *20*, 4–14. [CrossRef]
19. Pereira, J.; Sanz-santamaría, S.; Gutiérrez, J. *Comparative Technical Analysis and Prospective of the Major Open Source MOOC Platforms*; RED. Revista de Educación a Distancia: Marcia, Spain, 2014; Volume 44, pp. 73–87.
20. Martín, J.L.; Amado-Salvatierra, H.R.; Hilera, J.R. MOOCs for all: Evaluating the accessibility of top MOOC platforms. *Int. J. Eng. Educ.* **2021**, *32*, 2274–2283.
21. Antonaci, A.; Klemke, R.; Kreijns, K.; Specht, M. Get gamification of MOOC right! how to embed the Individual and social aspects of MOOCs in gamification design. *Int. J. Serious Games* **2018**, *5*, 61–78. [CrossRef]
22. Cooper, S.; Sahami, M. Education reflections on stanford's MOOCs. *Commun ACM* **2013**, *56*, 28–30. [CrossRef]
23. Zapata-Ros, M. El Diseño instruccional de los MOOC y el de los nuevos cursos online abiertos personalizados. *Rev. De Educ. A Distancia (RED)* **2015**, *45*, 1–35. [CrossRef]
24. Daniel, S.J.; Cano, E.V.; Cervera, M.G. The future of MOOCs: Adaptive learning or business model? *RUSC. Univ. Knowl. Soc. J.* **2015**, *12*, 64–73. [CrossRef]
25. Marosan, Z.; Savic, N.; Klasnja-Milicevic, A.; Ivanovic, M.; Vesin, B. Students' perceptions of ils as a learning-style-identification tool in e-learning environments. *Sustainability* **2022**, *14*, 4426. [CrossRef]
26. Lerís, D.; Sein-Echaluce, M.L.; Hernández, M.; Bueno, C. Validation of indicators for implementing an adaptive platform for MOOCs. *Comput. Hum. Behav.* **2017**, *72*, 783–795. [CrossRef]
27. Hone, K.S.; el Said, G.R. Exploring the factors affecting mooc retention: A survey study. *Comput. Educ* **2016**, *98*, 157–168. [CrossRef]
28. Teixeira, A.; Garcia-Cabot, A.; Garcia-Lopez, E.; Mota, J.; De-Marcos, L. A new competence-based approach for personalizing moocs in a mobile collaborative and networked environment. *RIED Rev. Iberoam. De Educ. A Distancia* **2015**, *19*, 143–160. [CrossRef]
29. Stracke, C.M. Quality Reference Framework (QRF) for the Quality of MOOCs. Quality Reference Framework (QRF) for the Quality of MOOCs Developed by MOOQ in Close Collaboration with All Interested Parties Worldwide. Available online: http://www.mooc-quality.eu (accessed on 8 May 2020).
30. Hendriks, R.A.; de Jong, P.G.M.; Admiraal, W.F.; Reinders, M.E.J. Instructional design quality in medical massive open online courses for integration into campus education. *Med Teach.* **2020**, *42*, 156–163. [CrossRef] [PubMed]
31. Hayes, S. MOOCs and Quality: A Review of the Recent Literature. QAA MOOCs Network. July 2015. Available online: https://pure.aston.ac.uk/ws/files/18622357/MOOCs_and_quality_a_review_of_the_recent_literature.pdf (accessed on 1 March 2022).
32. Clark, D. MOOCs: Taxonomy of 8 Types of MOOC. Available online: http://donaldclarkplanb.blogspot.com/2013/04/moocs-taxonomy-of-8-types-of-mooc.html (accessed on 23 August 2022).
33. Hueso-Romero, J.J.; Gil-Quintana, J.; Hasbun, H.; Osuna-Acedo, S. The social and transfer massive open online course: Post-digital learning. *Future Internet* **2021**, *13*, 119. [CrossRef]
34. Jansen, D.; Schuwer, R. *Institutional MOOC Strategies in Europe: Status Report Based on a Mapping Survey Conducted in October-December 2014*; EADTU: Maastricht, The Netherlands, 2015; ISBN 9789079730155.
35. Brouns, F.; Teixeira, A.; Morgado, L.; Fano, S.; Fueyo, A.; Jansen, D. Designing massive open online learning processes: The SMOOC pedagogical framework. *Lect. Notes Educ. Technol.* **2016**, *16*, 315–336. [CrossRef]
36. Brouns, F.; Mota, J.; Morgado, L.; Jansen, D.; Fano, S.; Silva, A.; Teixeira, A. A Networked Learning Framework For Effective Mooc Design: The Eco Project Approach. In *8th EDEN Research Workshop. Challenges for Research into Open & Distance Learning: Doing Things Better: Doing Better Things*; Teixeira, A.M., Szücs, A., Eds.; EDEN: Budapest, Hungary; Oxford, UK, 2014; pp. 161–171.

37. García-González, S.; del Pozo, F.; Paredes, W.; del Pozo, H. Los MOOC: Tecnología y pedagogía emergente para la democratización del conocimiento. *Rev. Perspect.* **2018**, *19*, 215–224.
38. Merrill, M.D. First Principles of Instruction. *Educ. Technol. Res. Dev.* **2002**, *50*, 43–59. [CrossRef]
39. Margaryan, A.; Bianco, M.; Littlejohn, A. computers & education instructional quality of massive open online courses (MOOCs). *Comput. Educ.* **2015**, *80*, 77–83. [CrossRef]
40. Mezirow, J. Transformative learning: Theory to practice. *New Dir. Adult Contin. Educ.* **1997**, *1997*, 5–12. [CrossRef]
41. Hudson, L.; Wolff, A.; Gooch, D.; van der Linden, J.; Kortuem, G.; Petre, M.; ten Veen, R.; O'Connor-Gotra, S. Supporting urban change: Using a MOOC to facilitate attitudinal learning and participation in smart cities. *Comput. Educ.* **2019**, *129*, 37–47. [CrossRef]
42. Watson, S.L.; Loizzo, J.; Watson, W.R.; Mueller, C.; Lim, J.; Ertmer, P.A. Instructional design, facilitation, and perceived learning outcomes: An exploratory case study of a human trafficking MOOC for attitudinal change. *Educ. Technol. Res. Dev.* **2016**, *64*, 1273–1300. [CrossRef]
43. Bustamante-León, M.; Herrera, P.; Domínguez-Granda, L.; Schellens, T.; Goethals, P.L.M.; Alejandro, O.; Valcke, M. Toward a More Personalized MOOC: Data Analysis to Identify Drinking Water Production Operators' Learning Characteristics—An Ecuador Case. *Sustainability* **2022**, *14*, 14206. [CrossRef]
44. el Said, G.R. Understanding how learners use massive open online courses and why they drop out. *J. Educ. Comput. Res.* **2017**, *55*, 724–752. [CrossRef]
45. Drachsler, H.; Kirschner, P.; Nederland, O.U. Learner Characteristics. In *Encyclopedia of the Sciences of Learning*; Springer: Berlin/Heidelberg, Germany, 2012. [CrossRef]
46. Albelbisi, N.A. Development and validation of the MOOC success scale (MOOC-SS). *Educ. Inf. Technol. (Dordr)* **2020**, *25*, 4535–4555. [CrossRef]
47. Albelbisi, N.; Yusop, F.D.; Salleh, U.K.M. Mapping the factors influencing success of massive open online courses (MOOC) in higher education. *Eurasia J. Math. Sci. Technol. Educ.* **2018**, *14*, 2995–3012. [CrossRef]
48. Anderson, L.W.; Krathwohl Peter, W.; Airasian, D.R.; Cruikshank, K.A.; Mayer, R.E.; Pintrich, P.R.; Raths, J.; Wittrock, M.C. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. 2001. Available online: https://www.uky.edu/~{}rsand1/china2018/texts/Anderson-Krathwohl%20-%20A%20taxonomy%20for%20learning%20teaching%20and%20assessing.pdf (accessed on 14 September 2022).
49. Barari, N.; RezaeiZadeh, M.; Khorasani, A.; Alami, F. Designing and validating educational standards for e-teaching in virtual learning environments (VLEs), based on revised bloom's taxonomy. *Interact. Learn. Environ.* **2020**, *30*, 1640–1652. [CrossRef]
50. California Water Boards. *Water Treatment Minimum Qualifications for Examination/Certification*; California Water Boards: Sacramento, CA, USA, 2016.
51. Fuller, J.S.; Brantley-Dias, L.; Lokey-Vega, A.; Woodham Langub, L. Learner perceptions: Gauging the effectiveness of instructional strategies implemented in one university's inaugural MOOC. *Open Learn. J. Open Distance e-Learn* **2021**. [CrossRef]