MOOCEP: A Method for Building Massive Open Online Courses for Elderly People

The Analysis Activity

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Abstract— By the year 2060, the elderly population will double its current size in comparison to the results presented in the last census, according to the Administration on Aging (AoA). By that time an important part of the elderly population will be involved in technology. Moreover, it should be taken into account that the technological needs of elderly people will differ from those of the rest of targets. However, elderly people may not be fully aware of their situation concerning their lifestyle (e.g., own well-being, rights, nutrition); therefore, e-Learning can be used to improve their knowledge and integration with peers. Hence, the Massive Open Online Courses (MOOCs) can work as online resources designed to help expanding the knowledge of elderly people by means of technological tools. Even though a complete method to build MOOCs for elderly people has been proposed previously, this paper details the analysis phase, which constitutes the first step in the method. This proposal will help MOOC developers during the elicitation of the requirements towards building effective MOOCs focused on elderly people. In order to demonstrate the feasibility of this proposal, a MOOC related to nutrition recommendations for elderly people will be presented.

Keywords—elderly, e-Learning, andragogy, MOOCs, method, analysis.

I. INTRODUCTION

Nowadays, a lot of research is focused on improving the lifestyle of the elderly [1-4]. These studies have been growing potentially during the last years in response to an increased population of elderly people who have a lot of interest in socializing or participating in activities involving technology (i.e., social networks, e-Learning) [1]. Consequently, it becomes imperative to develop and improve applications, technological artifacts, and tools that contribute to improve their lifestyle.

Education needs to be present throughout the lifetime of people. Lately, most research has been focused on supporting lifelong learning problems [5]. Thus, the Massive Open Online Courses (MOOCs) have been considered as a potential environment with the ability to educate a large amount of people in a flexible way [6]. MOOCs are contextualized as *massive:* because they are designed for thousands of participants; *open:* because they are at everyone's disposal and no high standards of education are required; and o*nline*: because physical attendance is not necessary [7]. In addition, elderly people represent almost the 10% of total users of MOOCs [6]. Hence, it is necessary to improve the MOOCs in order to develop an adequate environment for elderly learning.

Despite much research being addressed in order to build effective MOOCs, they do not consider any methodology to build MOOCs that take into account the needs of elderly people. There are approaches [8, 9] that show methods to build these artifacts; however, they are not focused on elderly people and they do not consider andragogical techniques. In respect to these techniques, Knowles [10] has stated assumptions that show how learning considerations have to be oriented in order to suit adult education.

In a previous paper [11], the creation of MOOCs for elderly people was contextualized by means of a method called MOOCEP (Massive Open Online Courses for Elderly People) in order to create andragogical and accessible MOOCs for them. This process was based on the Instructional Design Model [12], which has been defined by the use of Software and Systems Process Engineering Meta-Model Specification (SPEM) [13], to define each activity, artifact, guideline, and role. The method includes an activity which allows the selection of the most appropriate accessibility criteria for elderly people [14] and a process which considers the selection of andragogical techniques and strategies [2, 15-17] to be included into MOOCs oriented to this target.

This paper explains the analysis activity of the MOOCEP method to understand how andragogical techniques can be included during the Requirements Elicitation (RE) of e-Learning Systems.

This paper is structured as follows: Section II presents a brief review about related works. Section III presents the theoretical framework about requirements elicitation for e-Learning systems, as well as andragogical techniques and strategies. Then, Section IV shows a brief review about the entire method for building MOOCs for Elderly People (MOOCEP) and presents the analysis activity explained in detail. Section V, illustrates the analysis activity. Finally, Section VI presents the conclusions and future work.

II. Related Work

MOOCs represent a good alternative for people who want to continue learning but find out that not all the courses are accessible nor easy to use for elderly people, or that they do not take into consideration their needs and preferences [14] [18].

The Unit for Educational Technology and Teaching Innovation (UTEID) [19] establishes a methodology for the creation of MOOCs. It presents the planning and design of a MOOC, the creation of audiovisual contents, evaluation mechanisms, communication tools, and support in the design and creation of a MOOC; however, they are not oriented to elderly people. On the other hand, Maldonado, Bermeo, and Mejía [20], describe a methodological proposal for the design, creation and evaluation of learning objects (DICREVOA) that has five phases (i.e., analysis, design, implementation, evaluation, publication). In addition, they present a case study, which shows the viability and usability of a methodology that allows the teacher to adjust to students' needs by creating a Learning Object (LO).

Sanz, Moralejo, and Barranquero [21] present a methodology for the creation of learning objects (CROA), based on five stages (i.e., analysis, design, development, publication, evaluation). This methodology is focused on: i) Greater level of detail to reach the stage of development, ii) Allowing the same teacher to construct his own LO, and iii) Designing guides that contemplate a hybrid approach (technological-pedagogical). But this methodology is not oriented to elderly people; therefore, it does not take into account andragogical techniques during the creation of MOOCs. Hernández and Silva [22] propose a techno-pedagogy for the agile construction of learning objects that integrate knowledge of diverse areas of such as education, human computer interaction (HCI), and software engineering. On this paper, the authors do not present the entire process. Moreover, their paper is not solely focused on the development phase, but also it does not integrate any andragogical technique because it is focused on general users. Baruque and Melo [23] propose the Instructional System Development (ISD) Methodology, based on e-Learning Objects (ISDMeLO), which is focused on the design and development of educational content, and based on the instructional model named Analysis, Design, Development, Implementation and Evaluation (ADDIE). However, their methodology is oriented to general e-Learning objects.

As it is shown, there are a lot of methods which guide developers during the building of MOOCs and learning objects. But as far as we know, there are no methodologies oriented to elderly people that take into account their needs and preferences. Hence, the MOOCEP method addresses the creation of MOOCs oriented to elderly people, where a first approach to this method has been presented by Beltran, Cedillo and Rodriguez-Ch [11]. Also, this paper includes the analysis activity.

III. Theoretical Framework

Massive Open Online Courses (MOOCs) are online courses provided in large-scale [24]. The term MOOC came into scene in 2008 on a Skype chat between two Canadian educators, Dave Cormier and Georgie Siemens [25]. Also, MOOCs gained prominence in the year 2012, after Stanford University offered the first of a set of courses [26], later on the New York Times called 2012 "the year of the MOOC" [27]. Currently, there exist MOOCs focused on many different topics (e.g., mathematics, science, computing, social science, economics, finance, business.) [24]. Furthermore, an important percentage of MOOCs participants are elderly people, because MOOCs represent a good tool for adult learning [6]. However, there are few studies about MOOCs design and techniques that take into account the needs of elderly people. UTEID [19], advises the use of different platforms, management tools and programs, to create multimedia material. This material is oriented to educators interested in building MOOCs. Likewise, some methodologies focused on general users exist, like DICREVOA [20], CROA [21], techno-pedagogy for the agile construction of learning objects [22], and ISDMeLO [23] that do not consider any approach to elderly people. But, a method oriented to elderly people exists: MOOCEP [11], which considers an activity to include accessibility criteria, andragogical techniques, and strategies into the MOOCs development. Thus, the MOOCEP method proposes the building of MOOCs for elderly people, which is expressed by using SPEM 2.0 and ADDIE Instructional Design Model.

A. Requirements Elicitation (RE) for MOOCs

The improvement of information systems lies on a better-enhanced software development process [28]. The first step in this software development process is the RE [29]

According to Sommerville [28], the system requirements provide the description of what the systems should do, and they also contain the needs and expectations of customers about a software artifact. In this case, eLearning can differ from other types of software that solve different domains, as each kind of software requires different elicitation techniques [28]. Because MOOCs are considered "The future of e-Learning" systems [18], it is essential to focus on the e-Learning RE.

Likewise, there are many types of e-Learning systems defined from different perspectives. According to Rizk [29], e-Learning is classified taking into account various criteria.

The contribution presented by Rizk, and Gheith [29] looks for publications that involve special RE approaches for e-Learning. They list different approaches to other disciplines (e.g., activity theory, design thinking as group of user centered techniques, crowdsourcing) [29].

B. Andragogical Techniques and Strategies

In the beginning, learning was mainly focused on children, and adult education was not taken into account. However, developing a learning theory that deals with adults as its central figure was the main interest of Knowles [10], who suggested that adults appreciate self-directing rather that depending on a teacher. Based on this, he offers the initial four assumptions about andragogy in 1980. Later, two assumptions were added in order to explain the way in which andragogy drives adult learning, instead of pedagogy [2]. Therefore, pedagogical and andragogical models differ in the six assumptions listed in Table 1 [16].

TABLE 1. Pedagogical and Andragogical Assumption about the Learner

No.	Aspect	Pedagogical Model	Andragogical Model
I.	Need to Know	Learners need to know what the teacher tells them.	Learners need to know why something is important prior to learn it.
II.	The learners' self-concept	Learners has a dependent personality.	Learners are responsible for their own decisions.
III.	The role of the learners' experience	The learners' experience is of little worth.	The learners' experience has great importance.
IV.	Readiness to learn	Learners become ready to learn what the teacher requires.	Learners become ready to learn content when they see it as relevant to their lives.
V.	Orientation to Learn	Learners expect subject-centered content.	Learners expect life-centered content.
VI.	Motivation	Learners are motivated by external forces.	Learners are primarily motivated by internal forces.

("According to several researchers [2, 15-17]") there are several educational techniques to be applied in education based on each of Knowles' assumption. However, andragogy has both strong advocates and strong detractors. Thus, there are some studies based on cognitive neuroscience that help to build a bridge between brain functioning, andragogical principles for adult instruction and instructional techniques [15]. According to these studies, Table 2 shows the first four andragogical assumptions made by Knowles, as well as the relations between their cognitive process, educational techniques, and the physical brain area where they take place [14].

TABLE 2. A model of adaptive cognitive neuroscience-adult learning structure

Physical area	Cognitive process	Andragogical Assumption	Educational Techniques
• Prefrontal Cortex • Cortical midline structure	• Higher older self-regulation • Goal Development & evaluation	• Self-direction	• Participative learning • Appreciative inquiry • Research papers • Class Presentation
• Fronto-temporal portion of prefrontal cortex	• Autobiographical info & self-awareness; retrieval and recall	• Prior Experience	• Problem based learning • Experiential learning • Essay/journals • Portfolio
• Hippocampus • Anterior cingulate cortex	• Fear & stress response • Social pain; relational connections; social knowledge	• Orientation toward social roles	• Interest identification • Role-play/Drama • Mentoring • Team Assignments/Tests
• Hippocampus • Frontopolar cortex • Polar Cortex	• Learning and memory • Prospective memory • Episode memory	• Application	• Labs/Goal setting • Service learning • Role-pay • Just-In time learning

This model provides important foundations for combining cognitive neuroscience and adult learning in order to show the way in which cognitive neuroscience physiologically contributes to adult learning. Besides, these findings related to the four first assumptions for andragogy provide scientific explanations and interpretations for adult learning theories [15].

Additionally, Attebury [2] analyzes three types of learning styles that use andragogical assumptions in order to select appropriate Professional Development (PD) opportunities [2]. Table 3 presents the three learning styles analyzed by Attebury [2].

TABLE 3. Andragogical Learning Styles for Professional Development

Name	Description
Transformational Learning	Learning takes place through phases initiated by the "disorienting dilemma". This dilemma triggers self-examination. Students begin to explore new courses of action. In essence, the student goes through a transformation.
Communities of Practice	Practitioners from a community increase their knowledge and skills among all members, by means of discussion and reflection. This discussion increases individual and group knowledge.
Instructional Design	Instructional design principles offer a systematic approach to professional development. A popular instructional design method is ADDIE: Analysis, Design, Development, Implementation, and Evaluation.

This paper does not aim to analyze each andragogical technique explained above. In the following sections, it will be explained how to integrate these techniques with a process of RE in order to build MOOCs for elderly people.

IV. MOOCEP: The Anaylis Activity

This section presents the analysis activity for the building method of a MOOC for Elderly People (MOOCEP) [11]. This activity considers some tasks, artifacts, roles, and guidelines based on ADDIE Instructional Design Model [12] and uses SPEM 2.0 [13] as modeling language.

A. The Main Method

The main method is composed by activities, that involve artifacts, guidelines, and people who perform those activities [11]. Fig. 1 shows the main method for building MOOCs for elderly people (MOOCEP). The entire method has five activities (i.e., analysis, design, development, deployment, evaluation). Thus, this paper is focused on the analysis phase.

B. The Analysis Activity

Fig. 2 shows the analysis activity of the method, which has two inputs and two outputs. The first input is the *Requirements Template*.
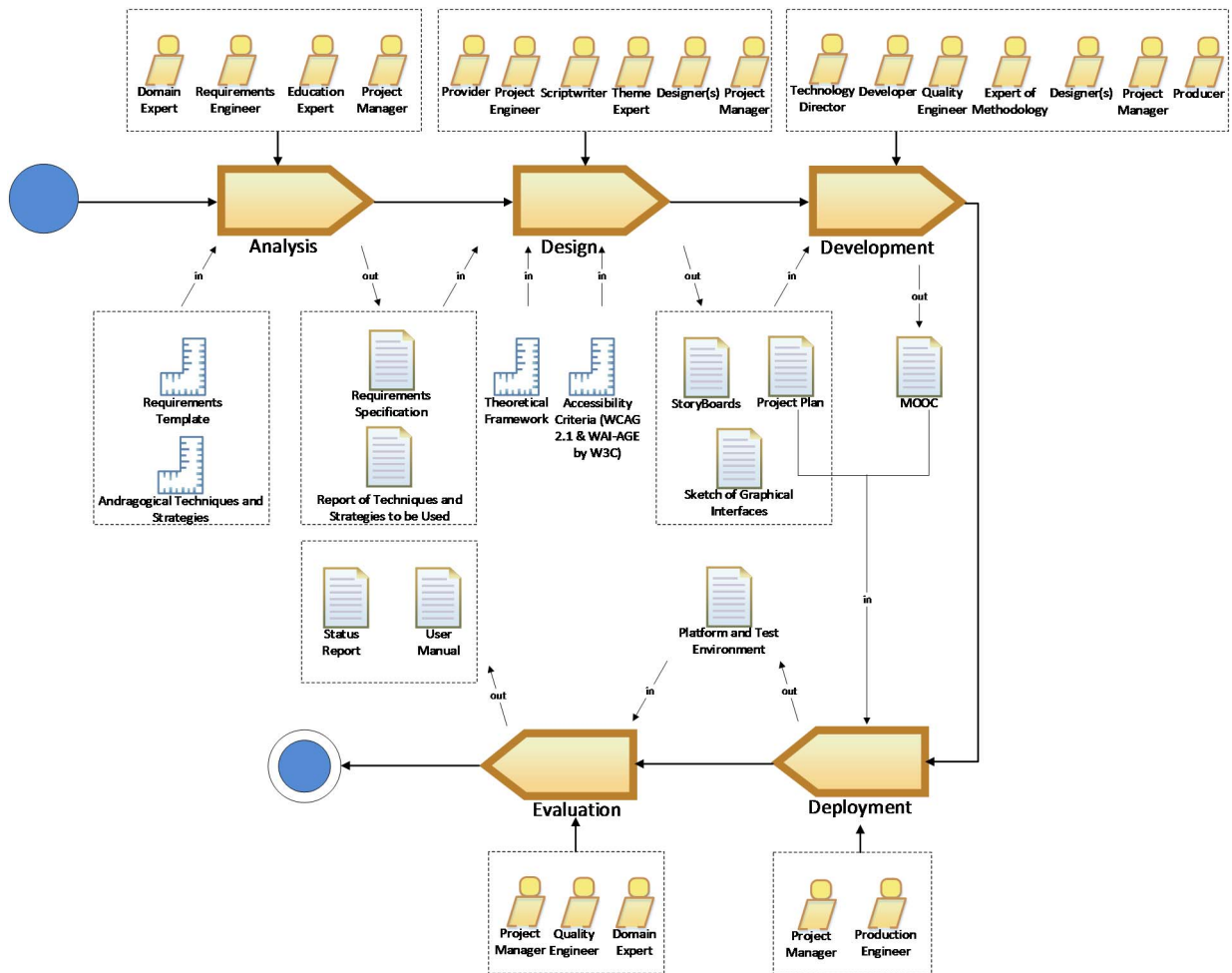
Fig. 1 Main Method for building MOOCs for Elderly People (MOOCEP)

This is a complete guide that supports the RE process and it is used by a requirements engineer [11]. The Andragogical Techniques and Strategies make up the next input. These techniques and strategies represent a set of educational theories [2, 11, 16-17].

In this phase, two artifacts are obtained: The *Requirements Specification,* which is a document that includes: i) The general goals of the high-level course, and the domain needs that have to be considered during the building of the MOOC. ii) A target audience analysis, which select the needs of stakeholders depending on their particular characteristics. And iii) The identification and classification of the course contents [11]. The second output is called *Report of the Techniques and Strategies to be Used,* which contains the selected andragogical techniques and strategies. In addition, the requirements of the selected techniques and strategies to be followed during the MOOC creation are included in the second output [11].

On the other hand, the tasks involved in the process are: 1) *The Establishment of MOOC Requirements* task and 2) The *Selection of Andragogical Techniques and Strategies* task.

Establishment of MOOC Requirements Task

In this task, the MOOC creation starts with the involvement of the *Project Manager* and the *Requirements Engineer*. The *Project Manager* will analyze the goals from a high-level perspective that takes into account the needs and the audience. The Requirements Engineer will consider the goals, needs, and audience in order to perform a RE with the help of the *Domain Expert*. Then, the course contents are identified and classified in compliance with the requirements obtained. The task results in a *Requirements Specification* artifact that contains all the needs to be included in the MOOC as its output.

Selection of Andragogical Techniques and Strategies Task

The *Requirements Specifications artifact is used as input in this task.*

This task uses the *Requirements Specification* artifact obtained from the previous task as input. On top of that, an *Education Expert* analyzes it in order to select the best andragogical techniques and strategies. Then, the *Education Expert* analyzes each user's needs and goals from a learning perspective and decides which the best andragogical practices to be used are.

Finally, the *Education Expert* creates a document named *Report of Techniques and Strategies to be Used.* This document will contain the best andragogical techniques to be included into the MOOC.
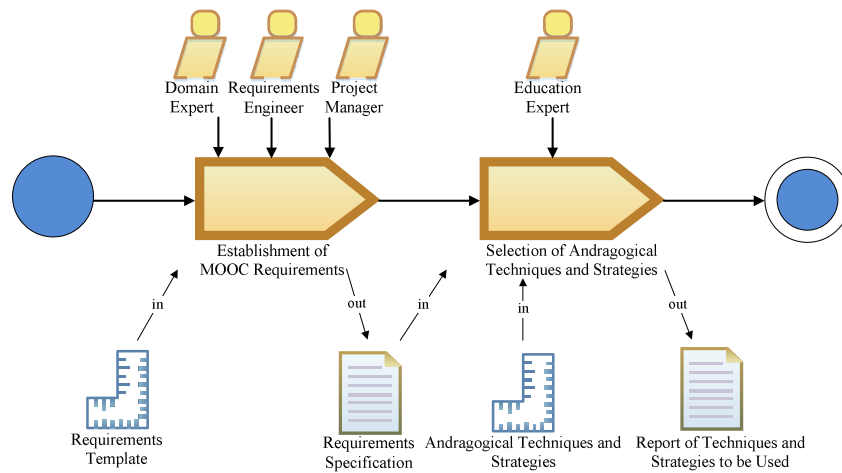
Fig. 2 The Analysis Activity Model for MOOCEP Method

V. APPLYING THE METHOD

In this section, the MOOCEP analysis phase has been applied in order to illustrate each one of its characteristics. It is necessary to mention that MOOCEP method is used to build MOOCs that will be used by elderly people including processes that allow the inclusion of andragogical techniques and strategies and accessibility criteria over the MOOC development. In this case, we use MOOCEP in order to build the analysis activity for a MOOC related to nutrition recommendations for Ecuadorian elderly people. This information may be useful for people who work at home with elders; however, the aim of this MOOC is mainly to be used by elderly people.

In 2010, the percentage of elderly people in Ecuador represented the 6.50% of the total population [30]. This percentage will increase to 18% by the year 2050 [31]. Therefore, a survey was applied in five locations of Azuay-Ecuador (i.e., Cumbe, Nabón, Ochoa Leon, Chiquintad, Cuenca) in order to know the nutrition habits of elderly people. The acquired data was analyzed and the results showed that the elderly people do not know how to select food properly. Therefore, a MOOC to teach elderly people about healthy nutrition becomes necessary to improve their health condition and knowledge.

A. Objective

Applying the first phase of the creation of a nutrition-oriented MOOC for elderly people in order to show how to apply the analysis activity of MOOCEP.

B. Request Question

Is it possible to apply the analysis phase of the MOOCEP method during the creation of a MOOC for elderly people, which takes into account all the requirements and the most suitable andragogical techniques?

C. How to collect data?

Data was collected from various sources by using the follow techniques: interviews, observation, and archival data. The interviews were structured following the Funnel Model [32]

and this activity was performed by the project manager, the expert domain, the requirements engineer and the education expert. The observation [32] and the "think aloud" techniques [32] were applied during the requirements elicitation. Finally, the meeting minutes were analyzed in the archival data. For data analysis, we looked for clear evidence that helped us to answer the research question. Due to space constraints, the complete explanation of the techniques applied and the complete artifacts and templates has not been included in this paper.

TABLE 4. EXPERIENTIAL LEARNING STRATEGIES [33]

Strategies	Definition
Concrete Experience (CE)	Adults learn better when the learning experience goes beyond the chalk-and-talk routine. Kinesthetic learning or learning by encouraging physical actions (simulations) and learning that evokes strong emotional responses (realistic scenarios that reveal cause-effect relationships) create powerful experiences that are not forgotten easily.
Reflective Observation (RO)	Adults need to engage with and reflect on their experiences to glean insights and acquire knowledge. So, it is critical to not only create opportunities for experience-based learning but also provides time and space to encourage reflection. Create opportunities for "watching" the action unfolds before the eyes and "analyzing" processes and procedures.
Abstract Conceptualization (AC)	The success of experiential learning lies in the learner being able to decode abstract concepts from their reflections, generalize these ideas, and realize the relevance to their reality. Designs assessments to encourage learners to exercise their "critical thinking" abilities, so they can formulate concepts and procedures.
Active Experimentation (AE)	Role-playing activities, internships, and other hands-on tasks let learners apply the learning and thus truly "learn by doing." Active experimentation leads to concrete experiences, and the cycle of experiential learning resumes.

Fig.3 shows the *analysis* activity of the MOOCEP method for building a MOOC focused on nutrition recommendations for elderly people. In order to illustrate the application of the analysis activity, it has been decomposed in sub-tasks.
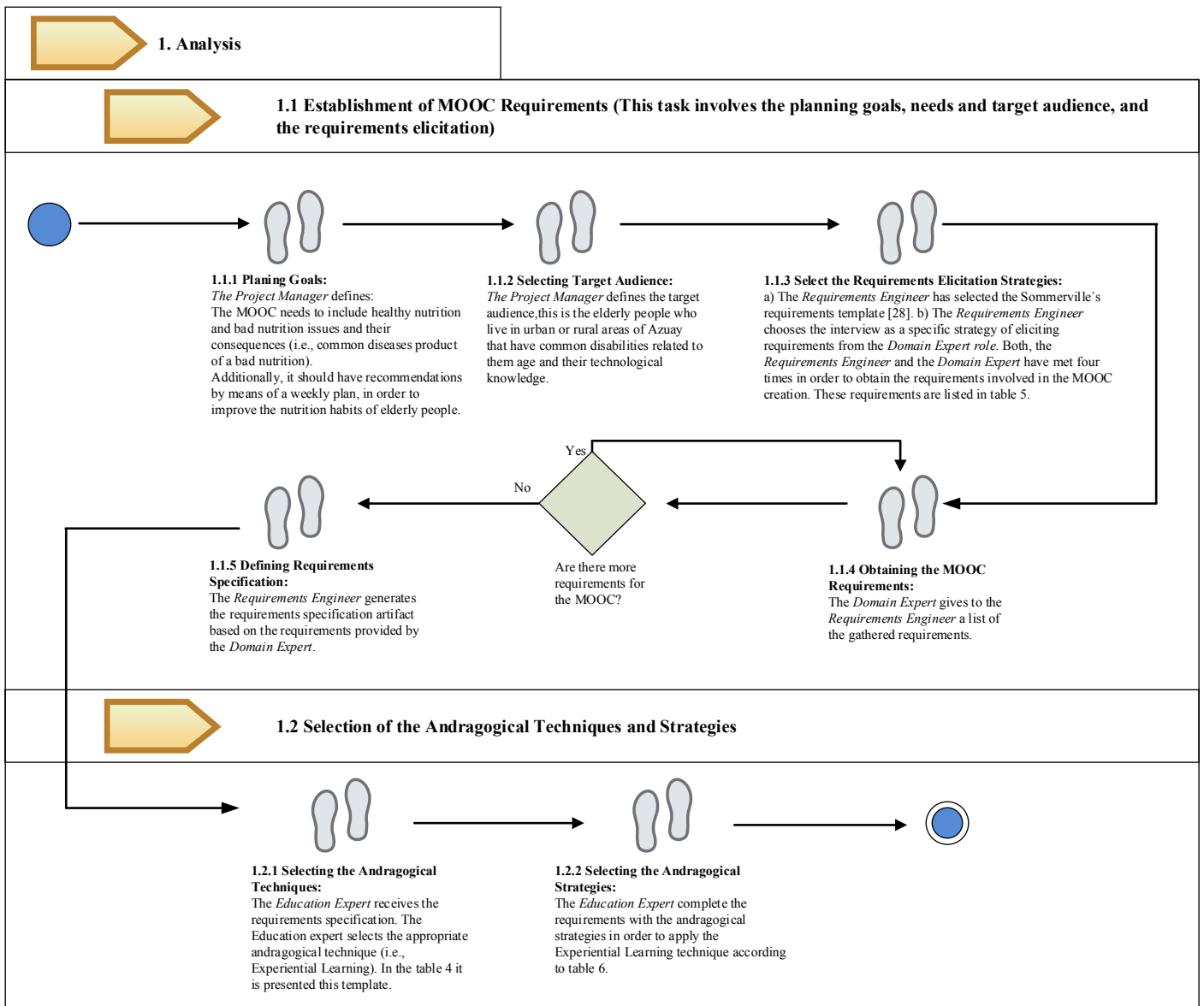
Fig. 3 Steps of Analysis Activity Model for MOOCEP Method

TABLE 5. MOOC REQUIREMENTS LIST

	Functional Requirements
1.	Users (elderly people) must be able to use the MOOC through the web.
2.	Accounts can be created by using a social network account or by signing in the MOOC platform.
3.	The platform sends an e-mail when the user is registered in the course
4.	Users must be able to reach and learn from the learning objects of the nutrition-oriented MOOC.
5.	Users can enroll in different MOOCs.
6.	Users may be able to store and check their course progress status by using their accounts.
7.	Users can improve their knowledge by repeating any module that they need.
8.	The evaluations should be associated with enrolled users to approve the courses
9.	The evaluations must allow two attempts in order to be approved
10.	Users can obtain an approval certificate.
11.	The platform sends an e-mail when the user finishes the course

	Nonfunctional Requirements
1.	The MOOC have had a high availability.
2.	The MOOC is expected to be multi-platform.
3.	The MOOC should be able to be displayed in many devices, design responsive (e.g., tablets, smartphones, laptops).
4.	The MOOC must have accessibility criteria for elderly people with well-formed graphical interfaces.
5.	The MOOC should be easy to use
6.	The login should be intuitive and easy
7.	The MOOC must be able to be used without having to install any additional software besides a web browser (i.e., Firefox, Opera, Chrome, Safari)
8.	The MOOC must have properly structured user manuals
9.	The MOOC must provide informative error messages.
10.	The MOOC must have an online help module
11.	The platform must be able to operate properly with up to 50 users with concurrent sessions
12.	The messages should be meaningful and easy to understand.

TABLE 6. REQUIREMENTS LIST ACCORDING ANDRAGOGICAL STRATEGIES FROM THE EXPERIENTIAL LEARNING

Strategies	Requirements
Concrete Experience (CE)	The MOOC should have a channel to motivate the peer connectivity using by this social networks and forums.
Reflective Observation (RO)	The MOOC should have links to more specific information about each topic contained in it using text pages, videos, audios, that take into account related interested topics. The MOOC should make emphasis in the problems of a bad nutrition, according to the common diseases of elderly people on the target audience.
Abstract Conceptualization (AC)	The MOOC should have initial nutritional habit questions in order to motivate reflections on the users.
Active Experimentation (AE)	The MOOC should contain interactive animations, avatars, videos of elderly people talking with them.

VI. CONCLUSIONS AND FUTURE WORK

In this paper, we have addressed the tasks involved in the analysis activity of the MOOCEP method. This activity helps MOOCs developers in the building of effective MOOCs oriented towards elderly people. The tasks involved in this activity have been stated considering methodologies of requirements, engineering and andragogical techniques and strategies in order to obtain effective MOOCs for elderly people. It is important to highlight that this method is flexible, extensible, and could be adapted to specific situations. As further work, we plan to describe the next activities of the MOOCEP method and evaluate each one of them empirically. In order to improve the education of this target, it is necessary to integrate elderly people in learning activities that improve their quality of live and their integration with other sections of the population.

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