Fostering psychological ownership in MOOC through a self-regulation design layer.

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Abstract. The paper presents the design of a self-regulated learning support layer which focuses on fostering learning agency awareness and student ownership in MOOC as quality deep learning indicators. Rooted in self-regulated learning ownership provides remarkable learning factors such as a sense of belongingness, increased commitment and perception of self-efficacy. These qualities are rather scarce in MOOC, as shown by the predominant techno-pedagogical design of these courses. The self-regulation support layer was developed in two phases: first, a literature review on the field and the analysis of several MOOC provided relevant insights for the theoretical approach of the layer and, second, different types of prompts in the form of self-questions were contextualized and placed throughout an existing MOOC with the involvement of researchers, teachers and MOOC content developers. Finally, in order to refine the design and include elements to enhance a more psychological-ownership-oriented approach, interviews and a co-design workshop were carried out with MOOC participants. Some of the contributions made by the different actors are presented and so is the layer proposal. "Regulation activators" which act as a link between self-regulation and psychological ownership approaches are inferred, and correspondent "learning design effects" are identified to be incorporated into MOOC to promote learning ownership.

Keywords: Self-regulated learning, Psychological ownership, Learner agency, Learning design, MOOC.

1 Introduction

MOOC have spread rapidly in different formats in recent years and have sparked passionate debates about their perceived affordances and pedagogical quality. These massive online open courses are considered to enhance learning and are meant to be efficient, reusable and focused on specialized content, but the soundness of the knowledge acquisition they offer remains unproven, not to mention their extremely low participant completion rate. Moreover, MOOC, in contrast with other online courses, present a paradox due to their dual attribute of being massive but, at the same time, viewed as individualized since they are addressed to and respond to individual learning needs in specific content, often freely selected by the learner. In this learning context, owning the learning process is essential to success [1], even more so when there is minimum or no teacher support behind the learning process. But taking

ownership of one's own learning does not merely imply being engaged and making one's own learning decisions. It also requires learners to understand how they learn and to monitor their own progress, being able to reflect on their learning based on mastery of content [2]. It is at this point where learning self-regulation (SRL) and psychological ownership (PO) meet.

With the aim of helping to improve some of these critical issues with MOOC, this paper presents learning design elements intended to boost PO (also named learning ownership in this educational context) through the incorporation of a SRL approach in MOOC settings, based on the inclusion of deep learning construction and a sense of control over learning. Specifically, the aims of the paper are as follows:

1) To present the design of an SRL support layer for MOOC, with the purpose of scaffolding metacognition through the use of prompts.
2) To refine the design of the SRL support layer using a PO approach in order to emphasize aspects such as sense of control, goal orientation and self-efficacy, which are associated with learning regulation and performance.
3) To propose an operationalization of PO dimensions connected with SRL aspects that enable design improvements to be identified from participants' contributions which may result in design guidelines embodying learning ownership support.

The three following sections situate our view of the interplay among the research topics involved.

2 Why consider psychological ownership in MOOC

A review of technology-enhanced learning (TEL) in the area of higher education by Kirkwood and Price [3] concluded that most of the reviewed studies gave a vague meaning to the actual "enhancement" of the learning experience being pursued and focused instead on reproducing or reinforcing existing practices. That is, most of the studies focused on changes in the *means* through which teaching occurred and fewer considered changes in *how* learners actually learnt. A similar analysis could be conducted in the case of MOOC if we look at the growth in the number of courses and studies carried out from their promising connectivist origins. Toven-Lindsey et al. [4] examined the pedagogical practices in 24 MOOC in light of the Teaching Approach Framework [5] and reported that although all four categories (objectivist-individualist, objectivist-group, constructivist-individual, and constructivist-group) were identified in the analysed MOOC, all of them relied mainly on the objectivist-individualist approach. Behaviourist pedagogical approaches based on video lectures and multiple-choice test-based assignments are the most widespread in the so-called xMOOC type. Therefore, it is frequently unclear what exact contribution technology makes to supporting and improving learning and in what terms it enhances the learning experience in MOOC.

MOOC need to tackle a number of intrinsic limitations with respect to other forms of educational settings. The massive numbers of learners reduce the possibility of a

teacher or facilitator providing tailored individual support or feedback. Furthermore, it is difficult for participants to get to know their peers and engage in constructive conversations with them that can be sustained throughout the course [6]. Participation in MOOC is open and voluntary and that implies wide heterogeneity, not only in learner profiles and prior knowledge, but also in terms of motivations and orientations towards study, which in turn entails multiple levels and qualities of activity in the course [7]. However, and especially in the case of xMOOC, their structure and design is largely determined by the institutions and platforms that host them and, in general, they offer packaged, linear learning proposals with little flexibility for adaptation and personalization by the participants [8]. This set of characteristics and circumstances can lead participants to cognitive and social distancing and, as a consequence, to more casual and superficial learning [6]. It may ultimately lead to dropouts, the high numbers of which have already been amply evidenced by various studies: a recent one by Reich and Ruiperez-Valiente [9] found a variation of completion rates between 6% and 10% of all enrollees in the courses on the edX platform from 2012 to 2018.

MOOC participants seek opportunities for self-learning and self-improvement [10], [7]. They show selective participation and a preferred learning process that configures their learning trajectories in the course. They decide by themselves what and how they want to learn, and to what extent they want to deepen their dedication to study and learning in specific parts of the course [11]. This requires them to maintain the right attitude and develop specific skills to cope with a type of learning that is to a great extent self-managed and self-paced, such as stating their learning goals, planning their tasks, adjusting their time allocation and study settings, as well as identifying adequate sources and resources to support their learning process [12],[13]. This type of behaviour is closely related to taking ownership of one's own learning process. Students taking ownership of their learning are expected to be more eager to search for and equip themselves with the necessary resources to solve complex learning situations [14]. Learning ownership can be linked with positive attitudes towards learning, such as the perception of self-efficacy, accountability or belongingness, which require learners to take personal responsibility for decisions about their own learning [15]. On the other hand, all these skills correspond to a great extent with SRL subprocesses [16], which have already been significantly connected with MOOC learner success by recent research, as is the case of goal setting, task interest/value, causal attribution, time management, self-efficacy, and goal orientation [13]. Next section delves into the relationship between both concepts which, as we shall see, refer to two different multidimensional constructs, which encompass complex dispositions and processes, but which feed back into each other in many aspects.

Student control and ownership have also been identified as basic attributes in TEL environments [17]. The role of learning ownership and control in the enhancement of the learning experience in online environments has previously been explored and discussed with regards to personal learning environments (PLE) [17], [18], [19] and ePortfolios [20]. We could not find studies directly addressing PO in MOOC but, apparently, most of these courses would not meet the most suitable conditions for the activation of this type of outcome among learners. That is, from a design perspective, most of these courses, especially the xMOOC type, would not provide opportunities for participants to think and recognize themselves as learners, or to act proactively by

making decisions and appropriating the environment and of the learning process. However, learning success in MOOC is indeed associated with many ownership-related factors and effects such as having a clear direction and goal-oriented approach [21], so it seems relevant to explore how it could be taken into account in MOOC design.

The Antecedents-Consequences Model of PO proposed by Buchem [18] intends to measure ownership in TEL environments. It considers the learners' perception of control as antecedents and the actual ePortfolio uses expressed as qualities of learning as the consequences. It considers five dimensions of PO based on Pierce et al. [22], [23]: (1) sense of responsibility, (2) sense of identity, (3) sense of accountability, (4) sense of self-efficacy and (5) sense of belongingness. The model also includes students' perceived control of different elements of the learning environment as the antecedents of PO including: (a) learning objectives (e.g. being able to determine own learning needs, goals and outcomes), (b) learning tools (e.g. being able to select, exploit, aggregate, organize, modify, orchestrate learning tools), (c) learning rules (e.g. being able to establish rules for storing information and content, and deciding about copyright and reuse), (d) learning community (e.g. being able to create and join communities and networks), and (e) learning tasks (e.g. being able to plan own learning activities). Our assumption is that this multidimensional perspective of learning ownership has a close relationship with the learning regulation construct which is largely expressed in the learners' agency to make conscious decisions about their performance in MOOC. Thus, our proposal builds on Buchem [18] and Pierce's [22], [23] PO dimensions to make this relationship explicit and to operationalize it in a design proposal for learning enhancement in MOOC.

3 SRL bridging learner ownership and agency

Learners develop feelings of ownership towards a variety of objects and aspects of a material and immaterial nature [24] also related to their learning experience. This PO state stems from a set of intraindividual motives [23] and is also shaped by interindividual aspects. Among the intraindividual aspects, SRL plays an important role because it articulates a large part of what is known as *the extended-self* [25], such as self-confidence, self-efficacy, self-perception, self-identity, among others. As interindividual aspects in an educational setting, we can refer to the trust the learner has in the institutional learning support or the technological learning environment provided [24].

PO in education can be read as a broad constructive governor procedure [26] and can also be associated with self-directed learning [27]. Both frameworks complement each other and nourish learner ownership as the former stresses learning environments that support thinking as zones of learning engagement which help students to know themselves, their learning styles and needs, while the latter focuses on a propositive process in which learners take the initiative to identify learning gaps, state own learning goals and develop an engaging learning strategy based on their preferences.

At that point, learner ownership relates to crucial parts of the SRL process over which it manifests a consensus in practice summarized by understanding and

planning, monitoring and evaluating approaches [16], [28], [29]. SRL is rooted in metacognition and critical thinking [30] and its main contribution in education is to provide students with a more conscious and deeper learning. The activation of the SRL skills based on psychological awareness avoids automatic reaction leading to continuous adjustments in behavioural, social and emotional elements. The result is conditional knowledge [31] that involves the need to apply a strategy to the common declarative and procedural knowledge by internalizing an active adjustment mechanism, thereby adding contextualization and quality to the educational fact. At the psychological level, the mechanism is articulated by chains of self-questions, decisions and actions which characterize the progression and final learner performance, which are basically connected to the learning environment, personal circumstances and task demands.

These regulatory skills are fruit of intentional choices made by the learner. It is in this reflective arena that SRL connects with agency [32] and leads knowledge acquisition to a new level of depth based on conscious students' decisions and actions. Following Martin [32] and Durrant and Holden [33] agency definitions framed in education, learner agency can be understood as the capability to act independently making one's own choices in the learning framework and act on those choices in ways that make a difference in their lives. This approach involves the learner autonomy, who has the initiative and the awareness to display self-regulation skills depending on the learning context and the demands. To achieve this, a corresponding learning design which displays opportunities for monitoring self-questioning and learning appropriation is required. Increasing agency is one of the current challenges in any educational scenario, but it seems critical in digital environments. These environments, and especially MOOC, are in their early stages, so deep learning approaches are welcome to constitute sensitive perspectives for reflective learning. For example, it has been shown that students' perception of the use of digital environments has an effect on their commitment and learning satisfaction as they maintain a relationship with the digital scenario and tools. Some of the modular aspects analysed are perceived control, sense of belonging, student involvement and identification [1], which form part of the PO construct.

In fact, the different approaches tackled in this section provide elements for learner ownership, some of which are intermingled as shown in the works of Savery and Duffy [34] and Savery [35]. This last author understands ownership of learning as a complex model including cognitive and metacognitive factors, personal and social factors, individual differences and affective factors. He stresses the educational relevance of understanding how ownership is demonstrated in a variety of instructional settings, since ownership of learning is characteristic of successful learners [36]. In our design proposal we have adopted this mixed model of learner ownership which integrates self-directed learning, agency and SRL, being SRL the bridge we use to build our support proposal.

Framing the approach in TEL settings, several studies have investigated the role played by PO in shaping beliefs, not only among students but also among teachers. SRL seems to depend on the learning design [37] which provides teachers and learning designers with the chance to amend some neglected aspects and propose new ways to orientate learning, especially in online environments. As regards teachers, [24] investigated the role played by PO in shaping teachers' beliefs about using a

cloud-based virtual learning environment. He found that teachers' experiences with the virtual learning environments significantly influenced PO, which in turn significantly predicted perceived usefulness and perceived ease of use of the virtual environment. Perceived usefulness and perceived ease of use constitute important belief factors when technology adoption decisions are made within a non-mandatory learning setting. It also illustrates that people can feel psychologically attached to a particular technology.

Talking about decisions, although exercising agency may have inherent value [38] based on the belief that learners are agents who play a defining role in shaping qualities of their learning [39], learners may use agency in ways that might not be initially expected in the planned learning design [39]. In this respect, if we focus on the use of technology from a learning design approach, we can distinguish between the affordances in the design of a learning tool to foster specific competences and its real use by the learner [40]. So, conceptualizing the personal tendency of use and the sense of belonging, both potential and real, helps us to demonstrate that learners are active agents in learning processes and can modify activities according to their visions, perceptions and intentions —modifications which may or may not be in direct accordance with those initially planned [41]. PO components can also be conceptualized as "lines of desire", an architectural term that Lukin and Du Boulay [42] apply to technology use to highlight the path or trajectories that people take which are often shortcuts that ignore the given route. This possible mismatch needs to be taken into account, as it could occur with the learning design including technology which could be potentially reflective, for example, but modified or shaped by students' attributions, decisions and actions according to their PO. It is in this framework where the specificity of student role and ownership style in the TEL approach acquires great importance.

Going back to the five dimensions of PO identified by Pierce et al. [22],[23] and Buchem's [18] model of TEL ownership and control, we propose to integrate these with the perspective of learning regulation and agency. Specifically, we propose that some elements used as support factors and indicators of learning regulation in a TEL environment, can in turn act as regulation activators (see Table 2) of the five PO dimensions. The contribution of this integrated framework of analysis is that it provides us with a transversal approach, allowing a more holistic view of the learning process driven by learners. In this way, the proposed framework adds valuable elements which foster PO as a more complete strategy for the "self", based on self-directed awareness, self-reflection and self-monitoring. This framework should be understood as a (macro)process in the form of an umbrella which enfolds the teaching and learning process. Agency brings the learner-driven education perspective while SRL contributes with a reflective attitude and self-monitored procedure in TEL.

4 Why learning design for PO

The need for a design for self-regulation, agency and ownership is particularly relevant in MOOC contexts. Sustained progression and completion in MOOC mainly rely on the participant's ability and willingness to perform, which is related to their

capacity to organize productive spaces and apply best and timely learning strategies [43].

Hood and Littlejohn [8], in their study of new quality measures for MOOC, identify "process variables" as those referring to learning design and pedagogy. They highlight that the "flexibility of participation and the self-directed nature of engagement" (p.31) calls for special attention to a balance between structure (content, resources, interventions, interaction) and opportunities for SRL. A learning design approach should then benefit MOOC design by targeting not only MOOC content specificities but also ways in which participants may reflect on their own learning and make conscious decisions and develop a feeling of mastery and belonging.

Learning design as a creative and deliberate process [44] supports teachers/designers to make theoretically founded decisions regarding "how they go about designing learning activities and interventions, which are pedagogically informed and make effective use of appropriate resources and technologies" (p. 121) [45]. Learning design emphasizes context and constructivist approaches where learning unfolds in an ecology of technological tools [46]. Even if a learning design cannot completely solve common MOOC personal barriers such as time availability, capacity to balance family and work obligations, minimum required previous knowledge [47] or digital skills for personal and social performance, it may scaffold participants in planning, monitoring and assessing their learning. It may also contribute to raising awareness of personal performance for corrective purposes and increased motivation.

Translating theory and concepts such as regulation and ownership into actual learning experiences is a challenging task. This is where design principles, arising from theory and practice and expressed as prescriptive statements, provide "the basis for designing practical action concepts to achieve the designed practice goals" [48]. A substantive advancement towards the development of focused design principles for SRL was presented by Huh and Reigeluth [49]. They proposed a set of universal principles after an analysis of most prominent SRL frameworks [50], [51], [52], [53] which might be applied to foster PO. The first relates directly to the type of activities that encourage motivation, interest, engagement and learner self-efficacy that they identify with real-world tasks and methods such as project or problem-based learning. A study from Stefanou et al. [37] showed that in project-based environments students reported higher levels of elaboration, critical thinking and metacognition as well as perceived autonomy compared to problem-based learning. The second focused design principle indicates the need to provide the students with time for setting their goals, which may differ from student to student according to diverse knowledge but also actual expectations. This principle also underlines the importance of ensuring recall of past experiences that should nourish the identification of more clear and significant goals. This is the basis for a more reflective planning of their learning. A third principle highlights monitoring and assessment in terms of "formative ongoing self-assessment" and "feedback from others" triggered by, for example, prompting questions that help structure the reasoning and exchange with others. Also "summative authentic integrated assessment" is part of this principle as an indicator of ongoing performance at key points. The fourth principle points to the need for modelling regulation, teachers and/or peers as those more knowledgeable others (MKO) that may intervene in the zone of proximal development (ZPD). Interventions

can be both enacted by the MKO through an explicit interaction or they can be present as a trace left on an environment that is observed by others. The fifth design principle suggests the provision of opportunities for application, where students may demonstrate to themselves or others what they are doing and achieving (e.g. presentations, discussions). The sixth principle directly addresses the need to enable situations where students specifically learn about regulation of learning. These can adopt "micro-level instruction" where a progressive and parallel process of learning about regulation skills unfolds with the main learning activity. The authors suggest using, for example, Merrill's [54] standard three-part skill development model, which starts by explaining general characteristics of regulation to learners, followed by teacher demonstrations of examples and nonexamples of regulation, and ends with the learners' direct practice of regulations skills assisted by feedback. This sixth principle can also be applied in "macro-level instruction" where an entire phase of learning regulation or all the phases are part of a whole task approach. A second set of design principles relate to situation and implementation issues. These are conditions such as course size, time availability, technology access and learning environment affordances which intervene in the design decisions and the kind of learning design experience.

Designing for regulation becomes an intermediate state for designing for ownership. The interplay between these two explanatory frameworks is part of our research, aiming at contributing to the development of specific and complementary to regulation design principles for ownership.

5 Procedure for a learning design refinement based on PO

The study follows a design-based research approach [55] and is structured in a continuous cycle of design, intervention, evaluation, reflection and redesign. The intention is to bring about and to analyse changes in the practice of learning regulation in MOOC, based on the development and implementation of a design solution and also to advance the development of theory on the support of learning regulation processes that use prompts as scaffolds.

To collect, analyse and interpret the data a mixed approach is used, albeit predominantly qualitative in nature. In the case of the specific study reported in this paper, the sources of information are semi-structured interviews and a co-design workshop with four MOOC participants.

The first iteration of the research focused on the design of the SRL support layer to facilitate self-reflection processes. This layer was explicitly called "Lead and improve your learning" as it was embedded in the MOOC. As a result of this initial iteration a redesign of the layer is being carried out, paying special attention to the dimensions of ownership, agency and engagement among MOOC participants. Following the complete cycle and design procedure to develop the support layer in terms of increasing SRL, bridging PO and agency is explained:

a) Preparatory Phase (researchers and designers).

Once the SRL targets were defined, taking into account the particular characteristics of a MOOC, a twofold strategy was adopted to better understand the prior

contributions in the field. First, we conducted a targeted literature review that guided the establishment of relevant conceptual and applied categories of the topic that would be implemented in the layer in subsequent stages. Second, and based on the preparatory review, an exploratory analysis of three MOOC run on different platforms was performed in order to find potential and real possibilities for the occurrence and expression of SRL and agency, both in the MOOC structural design (modules, sequences,...) and the interactive nature of the tasks and spaces provided for participants which could have enabled the emergence of regulatory data from students.

From the first action, the authors decided to take into account: the phases of regulation (1. planning and goal setting, 2. monitoring and 3. evaluation), the dimensions to consider in the design (behavioural, socio-emotional, motivational and reflective as transversal for SRL) and the elements which frame each dimension as the task, the participant and the environment circumstances [28], [56].

From the second action of MOOC analysis very little self-reflective material was found in either the design or the participants' exchanges in the forums, as could be expected since most of the self-regulation processes happen at the cognitive level. Therefore, the intention was to incorporate specific orientations into the design layer as a system to support SRL in MOOC and provide digital spaces for expression where self-regulation thinking could be displayed and, as a consequence, identified, captured and used for learning and improvement.

b) Design Phase (teachers and researchers).

Due to the need to include metacognitive presence, the next action involved refocusing the literature review to include learning support in a wider sense and also specifically SRL [29], [57], [58]. At that moment, the researchers created a structure of prompts to be displayed throughout the course to increase participants' learning awareness, decision-making and the corresponding adjustments. Prompts provide educational support in the learning regulation process. Thus, and based on Bannert and Reimann's proposal [57], the next step was to agree on four phases of regulation linked to the MOOC activity and on three types of prompts: guiding prompts (GP), reflective prompts (RP) and feedback prompts (FP). GP were underpinned by guidelines and general orientations; RP were based on increasing students' awareness and FP were the participants' own responses to the reflective prompts forwarded to them.

The layer proposal was adapted to a specific xMOOC on the subject of gamification. This MOOC was selected from among the regular courses offered by the UOC, following criteria of acceptable participation and completion rates, teacher presence and involvement, transferability of content and duration (4.5 weeks). Two co-design sessions were carried out, in which researchers, teachers (also MOOC content designers) and the course tutor agreed on the layer integration and adaptation to the course. The first co-design session was to inform each other about mutual intentions and expectations regarding self-regulation and to think aloud agentic practice involved in the SRL support layer proposal. The second session involved negotiating the required changes to the MOOC and the layer in order to adjust to the course structure. During these exchanges a suitable balance was agreed on for integrating the layer into the existing MOOC, as the researchers wanted to be more exhaustive by advocating for more salient metacognitive support while the teachers

and content designers took a more conservative stance as they did not want to add complexity to the MOOC to avoid potential dropouts.

c) Implementation Phase (teachers, tutor and participants).

As a result, a MOOC embedded layer was proposed, taking into account the content, the internal logic and sequence of the MOOC, which were examined by the researchers and learning designers. At this stage, an external guiding tutor was appointed to ensure that the MOOC participants understood and followed the statements and tasks implemented in the form of prompts in the SRL layer. Once the prompt design was embedded, the MOOC was ready to be released. The MOOC was hosted by MiriadaX, UOC's institutional platform for MOOC, and connected with an external gamification application called Habítica. The content of the layer was highlighted with a different colour in the MOOC. The course was launched from May to June 2019.

d) Evaluation and Revision Phase (participants and researchers)

Data regarding the relevance and adjustment of the SRL design was gathered from participants immediately after the MOOC ended to preserve valid information retrieval. In this phase, semi-structured interviews were carried out for data gathering with a total of four participants having completed the whole sequence of SRL-related tasks, throughout the whole MOOC, and engaged in productive critical dialogues on the matter. These participants provided their insights into motivational and regulation aspects, understanding and use of the SRL support layer and general recommendations for improvement. This data on students' views was useful for refining the first version of the SRL support layer by integrating the perspective of the framework of analysis from the PO approach. After the interviews were analysed, a co-design workshop was organized with the same participants in order to collect more detailed information about critical aspects of learning self-regulation in MOOC and workable design solutions. Both types of participant contributions have been used to portray a more PO-oriented layer which is presented in its original version in a summary outline format below.

6 Learning self-regulation design: a layer to facilitate PO in MOOC

This section presents two results related to the aims of the study: a) the original structure and the scaffolding content (prompts) of the SRL support design layer and b) the refinement of the original layer after analysing the participants' contributions with the PO approach in terms of "regulation activators".

a) LAYER: the embedded layer is deployed following the MOOC learning sequence and the SRL phases. As an abridged explanation, the table below presents the most important steps of the MOOC modular sequence in correspondence with the prompts (Table 1). Observe that the four regulation phases of the layer are stressed in three moments during the MOOC: starting, long/middle and end, so the three types of prompts are presented at these three moments, to be kept in mind during the development of the MOOC.

Table 1. General structure of the SRL MOOC layer "Lead and improve your learning".

MOOC content and sequence (teachers and instructional designer)	**SRL layer structure** (researchers and learning designers)	**Prompts applied** (researchers and learning designers)
Course and content introduction	*General introduction and explanation of SRL layer aim and organization*	*Examples*
Start of MOOC Week 1		
Module 0:	PHASE 1 (**Learning aids prior to the actual work**): UNDERSTANDING THE MOOC ACTIVITY AND CHALLENGE "Before you start working, you should first prepare yourself and make sure you understand the type of activity the MOOC outlines in general terms. To do this spend 5 minutes on:"	**Guiding Prompts** → Browse the MOOC and get a general idea of its structure, the purpose of each module, the type of content and tasks that arise. Would you say that everything is clear to you? Do you find it easy to orient yourself with the contents and tasks of the MOOC? → Assess what you already know about the content of the MOOC and what is completely new for you. → Check the available resources and learning material. Skim over the structure and some content to get an overview of the type and amount of information. → Think about what the main challenge is that you face with this task. → Share with the rest of the participants your first impressions about the MOOC, the purpose of each module, the type of content and tasks that are proposed, as well as the resources and materials that are presented. **Reflective Prompts** → Do I feel motivated by the contents of the MOOC? → Do I feel able to successfully complete the tasks and understand the contents of the MOOC? → Do I foresee any kind of difficulty associated with developing the tasks or understanding the content? **Feedback Prompts** (Participants' own responses record)
Module 1	PHASE 2 (**Learning aids to**	**Guiding Prompts**

	handle the work): GOAL SETTING AND PLANNING It is time to start working on the MOOC: Go ahead! Make sure you are well organized to make the most of the experience. The days go by very fast! *To do this, take 10 minutes to:*	→ Think and write what you are interested in knowing and learning in this MOOC, what your goals are. If it is easier for you, take each module separately as a reference. → Reflect on what you need to do to achieve these goals in each of the MOOC four-week duration. → Outline a plan for participation in the MOOC (it can be a simple scheme), which will allow you to achieve your objectives and finish it in the established time. Include in your planning a weekly work sequence with the allocation of time that seems appropriate. → Share with the rest of the participants your learning objectives in the MOOC and the planning that you have planned, as well as some of the uncertainties or difficulties that you foresee. **Reflective Prompts** → Am I clear about my learning objectives in this MOOC? → Am I clear about my work plan in the MOOC, incorporating weekly tasks and subtasks, with a specific time allotment, to achieve the established objectives? → Have I considered whether I have a physical and virtual environment, adequate resources and work methodology? **Reflective Prompts** (Participants' own responses record)
End Week 2		
Module 2 Week 3	PHASE 3 (**Learning aids during work**): ACTIVITY ENACTMENT "Two weeks have passed since the MOOC began. You are halfway through; therefore, the most difficult part is already behind you. It is time to take a short break to reflect on whether you could improve any aspect of your participation in order to enjoy it more and get more out of it. To do this, spend 5 minutes on:	**Guiding Prompts** →Remember the objectives and planning that you initially set for yourself. Am I following the proposed plan? →Check your understanding of the contents worked on in the MOOC so far. Is there a concept or explanation that is not entirely clear to me? What have I specifically learnt so far? →Share with the rest of the participants …. **Reflective Prompts** →Am I achieving the learning objectives that I had set for myself in this MOOC? →Am I satisfied with the work done and the way I have been dealing with difficulties? **Feedback Prompts** (Participants' own responses record)
End of the MOOC		
Modules 3-4 Week 4-5	PHASE 4 (**Learning aids after work**):	**Guiding Prompts** → Recapitulate the work and learning process

	PERFORMANCE EVALUATION AND ADAPTATION "We come to the end of the fourth week and the fourth module of the MOOC. You can be satisfied that you have completed the course. Spend a few more minutes of your time to share your experience with us and the other participants, evaluate it and reflect on it from the current perspective. It can help you identify areas for improvement in similar future activities that you undertake, and it will also be useful to us to improve the design of the MOOC. *To do this, spend 5 minutes on:*"	developed in the MOOC. What will you take away with you? What learning do you consider most relevant or remarkable? Would you be able to create a diagram that summarizes the concepts and strategies learnt? → Remember the main challenge you took on by participating in this MOOC, the difficulties encountered and what you did to overcome them. Think about whether your approach to the challenge and difficulties worked or whether you would do it differently another time. →Share with the rest of the participants …. **Reflective Prompts** → Do you consider that you have achieved the learning objectives that you set for yourself in this MOOC? → Do you consider that the knowledge acquired in the MOOC will be useful for your daily life or professional practice? What do you think you could do to improve your participation in the MOOC next time? **Feedback Prompts** (Participants' own responses record)

b) ACTIVATORS: Based on the works of Pierce et al. [22], [23] and Buchem [18], five PO dimensions were selected for the analysis of MOOC participants' contributions. To do this, we operationalized PO dimensions in specific categories, emphasizing common or synergetic elements with SRL processes and aspects that could be read in terms of learning design in TEL. The connecting elements have been called "regulation activators" in the sense that they act as potential activators of the respective PO dimensions. These activators allow us to: 1. connect the original SRL framework with the PO approach; 2. analyse data gathered from interviews and initial workshops with the MOOC participants which allow us to identify possible design changes to better support PO in MOOC.

The results of this analysis are shown in Table 2. The first two columns, PO dimensions and Regulation Activators, are built from theory, based on the literature review, while the contributions from MOOC participants —third column— have been associated with these PO dimensions and RA dimensions by agreement of the three authors. Each researcher first selected individually the most relevant contributions from participant interviews (I) and workshop (W) transcriptions regarding the different RA; then, the three of them shared the coincidences and discussed the differences to arrive at a consensus of what quotation could best illustrate the related RA to be presented as an example here. Correspondingly, in the fourth column, the researchers proposed a "learning design effect" (paraphrasing "organizational effect" in Pierce et al. [23], meaning a likely PO supporting element to be added to the original SRL layer. These learning design effects (LD effects) are one of the

contributions of this paper, as the materialization of the PO approach in a refined SRL design layer.

Table 2. Participants' contributions to the design refinement by means of PO of regulation activators.

P. OWNERSHIP DIMENSIONS	REGULATION ACTIVATOR	PARTICIPANTS' CONTRIBUTIONS	LEARNING DESIGN EFFECT
1. Sense of responsibility	1.1. Intending to fulfil own goals and planning	1.1.1."(...) set some objectives, set yourself a few hours and try to follow those indications that are at the beginning of all the modules because they are really very good to clarify about how the development of the module is." (IM1)	1.1.1.1. Introduce the support guidelines at the beginning of the MOOC and before each module to make the whole procedure clear so that participants can consider the commitment entailed from the beginning. 1.1.1.2 Set a personal plan that corresponds to the goals of each module, allocating time.
	1.2. Perceiving duty to invest effort, time.	1.2.1 "I was referring to the fact that the MOOC requires you to post the planning, so you have to consider what you are going to do during the process of this MOOC, that you say on Wednesday, I will wear three hours in the afternoon. This makes you think a bit […] but as you feel a little more forced yourself, you internalize more that you have to do that day ".(WH2) 1.2.2 "(...)[the regulation support system] forces myself to be able to finish the MOOC, it was like not to drop out, I said if I follow this, I will be forced myself and it will be like a small incentive to be able to do more, like a personal challenge, let's say." (IH2)	1.2.1.1 Propose a work plan as the first MOOC activity after its presentation, as a requirement to start working with the modules. 1.2.2.1 Propose a progressive system based on the regulation phases as a parallel motivating element for carrying out the activity / course.

		1.2.3 “Because I knew that the course was going to be done in my own way, and proof of this is that I did not finish it, that is, imagine if I signed up for the collaborative, it would not have worked, because if there were other people who He is trying to keep up with the right rhythm, which in my case was not going to work because I already told you, I did half a course all at once, then I did a little more and I missed the deadline.” (IH1)	1.2.3.1 Identify the pace and level of involvement that each participant wants to follow in order to organize group work by affinities.
	1.3. Willing to maintain, improve, enhance, deepen (referring to learning process, learning environment)	1.3.1 “First have more time and then I do it with something in mind, that is, I believe that if someone wants to learn from this, like everything in life, the best thing is to apply it, until you do not apply it, you do not learn , it would be interesting, to put on a case and use all the tools that were put on and even if it is not something that will have a useful life after that, drawing a simple project, without going into too much detail, but with 3, 4 brush strokes ”. (IH1) 1.3.2 The truth is that I looked at it very briefly, because I am the typical person who does not like to look at instructions, so I go groping and doing. So I looked at him and I said "well, ok", but then I continued doing the course. (IM1) 1.3.3 [Habítica] ... the fact of having things written down and having everything well organized, being able to see, being able to mark up, that is what helped me the most, and the fact of ... what is always said , learn, but the way you learn is also part of the content. And the truth is that I saw that I really, simply the fact of having everything visible and being able to mark and see visually, be very clear about what I was completing and what I was missing (IM1).	1.3.1.1. Provide opportunities to apply the contents to own experience (a project, a case). 1.3.2.1 Propose a “light” (short investment) solution to support learning regulation. 1.3.3.1 Provide an easy-to-use planning and monitoring tool to keep a record of decisions and ongoing performance.
2. Sense of identity	2.1. Reflecting on own attitude towards learning or own role or	2.1.1 “So, personally I would have liked to learn by doing. Now I can't think of an example, but it is true that I did a face-to-face gamification course and we have learnt many things first. We did a practical exercise and then they explained	2.1.1.1 Include learning opportunities based on reflection from practice.

	self-concept as a learner	the theory to us."(WM1) 2.1.2 (Self-concept). "… In the face-to-face course I took on gamification, the first thing they did was explain this concept to us, but told us, classifying ourselves in each group. In relation to seeing the results of the others, in the course, they then put us in groups in which there were other profiles because in this way we realized what each profile can bring to the group. I think it could be interesting to work with profiles that are different from mine and see how each one can contribute different things. " (WM1) 2.1.3 I mean, I think what I did is, I didn't send the first one [the responses to the regulation form], then in the second I thought it would have been useful and I don't know if I sent it to myself in the end, or not. (IH1) 2.1.4. That each one chooses how they want to do it (the activity), maybe that way there would be people who would like to collaborate with others ... You already give the option to someone who is very individualistic who wants to follow their lead, but there are people who are more social. Maybe you do want to do it collaboratively, even if it is also the easiest activity. (WM1) (collaborative activity)	2.1.2.1 Propose activities/instruments for self-knowledge of one's learning profile. 2.1.2.2 Share learning profiles among participants to have references about others and identify complementarities. 2.1.3.1 Reinforce the importance of keeping a record of own reflections for subsequent contrast and self-awareness. 2.1.4.1 Offer flexibility in different options to follow up the course with various degrees and types of involvement.
	2.2. Displaying own content, presenting oneself and customizing/personalizing (referring to the learning environment, activities, etc.)	2.2.1. "Automatically record the time dedicated to the activities, which is a little in relation to the second… like you plan yourself and then automatically the platform will record how much you have dedicated, what you have dedicated and be able to see a comparison of this." (WH1)	2.2.1.1 Make (selected) learning analytics visible to participants to increase awareness of their learning process.
	2.3. Transforming or adapting to oneself the	2.3.1 "...the good thing about using a social network is that you can finish the course, but this can continue, and that people continue to contribute, even keep	2.3.1.1 Extend the activity in the course beyond its duration through the

	prescribed meaning or use (referring to the learning environment, activities, etc.)	giving them new pills and that they find out through the social network." (WH1) 2.3.2 ...because the problem is privacy that you are not interested in using social networks in a more private term or whatever... (WH1) ...but you can create a fake Twitter or Instagram account and follow... (WM1) ...more specific for this type of thing. You can even have two accounts, one more public and one more private. (WH1)	use of social networks. 2.3.2.1 Use your own account in a social network for "personal" use (or create a new specific one) to keep track of the course.
3. Sense of accountability	3.1. Justifying actions, decisions, motivations, feelings, related to the goal	3.1.1 "[Habitica, planning and monitoring tool] ... the fact of having everything organized, that is, they told me how to organize it and I could see it, that is what helped me the most and for me it was already a reward crossed out something, it gave me pleasure to cross out" (IM1)	3.1.1.1 Incorporate a system that allows users to contrast what was planned with what has been done in order to assess real progress and confront possible causes.
	3.2. Self-monitoring and self-assessing own learning process	3.2.1 "Automatically record the time spent on activities, which is a bit related to the second (…) such as that you plan and then automatically the platform records how much you have spent, what you have spent and to see a comparison of this () that you do a more or less planning and then the platform is able to record what you have dedicated more and then compare with results." (WH1)	3.2.1.1 Use system awareness functions to support student progress monitoring.
	3.3. Explaining or expressing own level of performance	Not found	
4. Sense of self-efficacy	4.1. Reflecting on own learning achievements, competences, success/failure.	4.1.1 If they ask me something very deep..., for me it is like a cold shower, I do not know what to say, but I often realize that having a dialogue with someone, speaking, you get to have some incredible reflections. So, maybe if we link it to the topic of interacting with other people in the course, getting to that	4.1.1.1 Create spaces for interaction to socialize, reflect on own progress considering others, have other references.

		reflection for me is easier, if I do it with other people, but by myself alone with a question I can't, I need a clue, you have to go one way and in the end there will be the answer. (WM1) 4.1.2 ... include it as part of the topic [reflect on how you are learning in the MOOC]. If it is an objective of the MOOC, you internalize it and say it is worth it, it is part of it and I have to "follow". Or when you go to register in the MOOC, you say: this interests me or it doesn't interest me, I decide to enter the MOOC knowing that it is part of it. [comment referred to reflective prompts] (WH1)	4.1.2.1 Make content related to reflective skills for learner self-efficacy explicit in the course. 4.1.2.2. Make a smooth integration between the layer and the learning content/activities.
	4.2. Perceiving ability to control the environment, the learning process, sustain own motivation level	4.2.1...that account could also serve to keep people up to date, for example, that they would say in an 'Instagram Story': today topic 3 begins, then people would see it and say well look today, topic 3 begins. That would serve to follow the course (WM1) 4.2.2 ... there was a section to access Google forms, I think it was, and you went there writing down the opinions. What I do remember, that the last ones [forms] I did not see clearly how to access them, and I finished the course and I also did not finish ... I think that the last lessons I could not participate in, I did not know how to find it [forms] and as I was also very imbued in finishing. (IH3)	4.2.1.1 Provide tools for daily use to facilitate control of deadlines and course activities. 4.2.2.1 Provide visible, easy to identify itinerary to keep track of regulation support scaffolds.
	4.3. Being aware of the factors that influence own decision making	4.3.1. For me, the problem was that, by not asking me for anything, being just a passive subject, it was not like in a class that, for example, the teacher can stop and can ask you and can tell you what you think, that makes you more involved in the class and that you assume better the contents. So, I think that, if they were shorter, they would ask me for something, until I answer or do something, I can't go on. I think that this would help me, in part, to be more motivated to better understand the content and reach a point	4.3.1.1 Incorporate scaffolds that facilitate conscious and active decision-making at critical moments of the course. 4.3.1.2 Avoid generic questions or guidance, connect reflective questions with specific

		where I can go deeper. [talking about the videos] (WM1)	content to anchor the situation.
5. Sense of belongingness	5.1. Expressing availability, willingness to help, contribute.	5.1.1 What it could be is that there was an activity that is compulsory and can be done in a group or not. That each one chooses how he wants to do it, maybe that way there would be people who would like to collaborate with others ... You already give the option to the very individualist who wants to follow alone, but maybe there are people who are more social, maybe who want to do it collaboratively. (WM1)	5.1.1.1 Offer optional collaborative activities that may or not be chosen based on the participant learner profile. 5.1.1.2 Provide spaces for social interaction that facilitate the offer of help among participants.
	5.2. Being identified with a group, generation, content, style, technology, brand	5.2.1 "… perhaps do some previous module without collaboration so that people start sharing things on the forum, saying: Ah! Well this guy seems interesting; I want to join him. And that later, 'I don't know', from the second week, groups are made, group activities. " (IH1) 5.2.2. ... I think that the people who are doing the same course have similar interests and can, in some way, contribute with something to you, you can meet someone that probably also teaches classes and gives you ideas and things like that. [people with similar interests to the interviewee, teacher] (WM1) 5.2.3. As always, I say that my proposals have to do with my own profession. I work in social networks, so for me it would be a good idea, just to socialize, use social networks. I don't know in what	5.2.1.1 Provide spaces for social interaction and knowledge exchange to foster group formation according to common interests, level of commitment and performance. 5.2.2.1 Offer spaces for social interaction to facilitate the identification of like-minded participants. 5.2.3.1 Provide and suggest familiar, more current, and

		way because maybe it is not the most appropriate to give your phone number to unknown people to create a WhatsApp group, but maybe there is some other application or, for example, following an Instagram account and commenting or Following the stories, participating with Hashtags on Twitter, I don't know, with some social network to allow that interaction. (WM1)	daily-use tools that facilitate social contact among participants.
	5.3. Feeling of attachment or inclusion	5.3.1. Maybe something occurs to you, you say: well then, I'm going to say this. So, you get to the forum and you see that the previous comment has nothing to do, you say: well then, I put my idea. You put yours and maybe the next [comment] has nothing to do with it either. So, that absence of interaction to say: where we are going with this, I put it there [my idea] and that's it, I am like a madman talking about my own things and the other one keeps talking about his. (WM1) 5.3.2. It would be nice if it were more gradual, that is, if we start, for example, by doing that test in which we see what type of player we are; then we have to join someone who is from a different profile. So, doing a little job with these people and then, having to do more important work, would be more gradual. (WM1) 5.3.3. It is related to social networks and since I use Instagram a little and all these things, what I had thought was a chat on the screen where people could talk. Then, if you get together with a group, then have a private chat, create a room and you are with the three of you who were talking, because if not everyone is saying things. […] A study room, to put it in some way, what we are doing here, but without the need for any type of software, that you connect to that site and that you can do cooperative work or anything and speak from there. (WH2)	5.3.1.1 Propose functionalities and strategies to facilitate conversation and knowledge building in forums. 5.3.2.1 Facilitate and drive gradual and progressive social interaction through diverse activities that contribute to the perception of collectivity/community in the course. 5.3.3.1 Facilitate meeting spaces in small groups to support the follow up of the course.

In: Interviewed participant n; WPn: Workshop Participant n (W:female; M:male)

The LD effects can be understood, in this context, as learning design "pre-guidelines" towards the refinement of the SRL support design layer through the embodiment of the PO approach. Guidelines are defined here as proposed by Fu, Yang and Wood [59] as "context-dependent directive, based on extensive experience and/or empirical evidence, which provides design process direction to increase the chance of reaching a successful solution". In this sense, we use the term "pre-guidelines" to confer on them a prior stage of guidelines from the understanding that they must be empirically tested in order to be considered as such.

The analysis of the resulting LD effects from participants' contributions allows a preliminary grouping to be made around their main purpose or the type of embodiment that they propose. This results in four main groupings of LD effects: a) those related to the support of SRL processes, addressing diverse regulation strategies, targets and phases, such as planning, self-organization, self-awareness or self-monitoring; b) those related to providing personalization and flexibility options, both referring to the technological environment and to the learning process itself, for example through the facilitation of different itineraries for different profiles of participants; c) those associated with improving the usability and traceability of the regulatory support system itself, and therefore referring to the formal aspects of its technical integration in the MOOC to facilitate and ensure that the support layer is followed up and used; and d) those linked with facilitating processes of social interaction, which may involve different levels of commitment and interdependence towards the creation of a sense of community, whether in the form of integrating tools or spaces into the virtual environment or proposing learning tasks that involve them.

A more generic approach, considering the existing literature on learning design and the support of learning regulation in MOOC, allows us to associate these typologies of LD effects with three main dimensions: reflective or metacognitive (LD effects classified in the "a" typology), motivational or related to learning engagement (classified in the "b" and "c" typologies) and social ("d" typology).

From this perspective it could be said that promoting and supporting the dimensions of learning ownership through the design of learning in MOOC has implications at many different levels, which is consistent with the multidimensionality of this concept. Thus, although aspects of the four different typologies of LD effects could be identified in all the dimensions of PO, an apparently closer relationship between certain PO dimensions and some specific LD effects typologies is also observed. Such is the case, for example, with the dimension "sense of belongingness", which would indicate a relationship with aspects of a social nature, or "sense of identity", which seems to instantiate more clearly aspects that have to do with personalization and flexibility.

6 Conclusions

In this paper, we have proposed a refinement of the design of an SRL support layer for MOOC using an approach that boosts learning ownership. To do this, we have built on Buchem's model [18] and on Pierce et al. [22], [23] PO dimensions. The operationalization of these dimensions has proved useful for identifying factors

related to the support of learning regulation that could serve as activators of PO in online learning environments, such as MOOC. This has shown the synergistic relationship between ownership and regulation of learning and has delved into the aspects that can contribute to enriching and enhancing regulatory processes from the perspective of learning ownership.

The detection of LD effects has been based on the experience of a group of participants in an xMOOC in which an SRL support layer was implemented. Despite this, it seems generic enough to be able to adapt it to different types of xMOOC. However, an analysis in the context of cMOOC would probably offer different and predictably expanded possibilities to favour learning ownership, as well as learning regulation.

The analysis has revealed some challenges in thinking about supports specifically and differently aimed at enhancing the sense of responsibility and accountability. This observation could be consistent with the non-prescriptive nature of these courses and the fact that participants are not primarily geared towards obtaining accreditation. Another remarkable aspect is related to the role of opportunities for personalization and flexibility in decision-making and self-management in the development of a sense of identity in these courses. Finally, the social component appears as an underlying element in the different dimensions of ownership and stands out in a very special and relevant way with reference to the sense of belongingness. The social perspective has not been specifically addressed, as it was not the object of the analysis sought in this paper, although it is undoubtedly interwoven with the individual perspective of learning regulation support.

All these aspects deserve to be studied further and specifically. The next steps in the research presented in this paper will be to redesign the original SRL support layer based on the resulting LD effects or pre-guidelines and carry out a new implementation in the selected xMOOC. The evaluation of this implementation, as well as of the effectiveness of the design pre-guidelines to boost ownership in the xMOOC will allow us to advance towards the development of design principles to support regulatory processes and facilitate learning ownership in MOOC.

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