Teachers' perceptions of learning design recommendations

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***Abstract* — The uptake of personalised approaches in education apart from students' learning needs should also involve teachers' needs. This paper addresses the understudied topic of integrating a Recommender System (RS) in a Learning Design (LD) environment as a means to personalise the support offered to teachers for designing learning. We present a study in a teacher education context, collecting teachers' perceptions of learning design recommendations to explore the recommendation form and method that teachers value while designing. Our findings point out teachers' appreciation of an LD environment integrating a macro form of recommending entire learning designs alike learning objects in online educational repositories. They also favour complementing the macro with a micro form that supports the LD process by recommending specific elements within a learning design. Our study indicates the need for a hybrid recommendation method appropriately filtering a learning design's context and evaluation. Also, this research justifies the need to integrate an RS in an LD environment, reporting as teachers' anticipated benefits (i) stimulating the initiation of designing for learning, (ii) advancing their LD practice by conceiving new design ideas, and (iii) providing a means of developing their LD experience effectively. The anticipated challenges point out the requirement of an RS that provides appropriate recommendations and the high need to cultivate teachers' LD knowledge and mindset towards employing LD environments and RSs effectively.**

Keywords — Recommendation, Recommender Systems, Learning Design, Learning Design environment, Teacher Education

I. INTRODUCTION

Educational research highlights the role of "teacher as designer" [1], [2], and promotes teachers' adoption of Learning Design (LD) environments and practices towards educational innovation [3]. To this end, several LD environments have been developed aiming to support teachers while designing for learning [4]. Existing LD research [5]–[8] reports three main challenges for LD environments: i) provide higher flexibility, for example, allowing the integration of different existing LD tools, ii) support all the phases of a design process (from conceptualisation to actual enactment with learners) and, iii) support and scaffold communities of teachers as co-designers. It seems that until now, considering and modelling personalisation in education [9], [10] towards both individuals' needs and the knowledge society at large, has scarcely targeted teachers

Indeed, the uptake of personalised approaches in education has mainly involved the learning needs of the students in supporting the so-called "technology-enhanced learning" [11], [12]. Although concentrating on students is justified by the long-standing advocacy of educators to move towards personalised learning [13], teachers' personalised needs on how to design for and implement learning interventions is also critical. Teachers' personalisation technologies have been scarcely addressed, mainly in the form of Recommender Systems (RSs) integrated into online repositories. Recommender systems have been introduced as systems that produce individualised recommendations as output or have the effect of guiding users in a personalised way to interesting or useful objects in an ample space of possible options [14], [15].

Research on RSs for teachers focuses mainly on recommendations for selecting and retrieving learning resources from online repositories -known as learning objects- for their practice [12], [16]. Up to our knowledge, research on RSs includes only one study [17] that integrates an RS in an LD environment (LAMS), recommending to teachers entire learning designs developed in it. Furthermore, supporting the LD process is limited to a few studies, e.g., [18] and [19] that integrate an RS in a training tool focusing on a specific element involved in the LD process, such as the didactic technique applied in a learning activity. Acknowledging the various elements involved in the LD process, research on the specific topic is necessary to shed light on how an RS system may efficiently support the LD process by being integrated into an LD environment. Typical elements, enumerated for example by [19], are the aims, learning objectives, teaching approach, method of assessment and the activities that learners will carry out in a particular sequence of learning, together with the resources needed and the constraints on the learning situation such as the learning environment and learner characteristics.

This paper aims to contribute to the understudied topic of personalised support for learning design. It investigates teachers' perceptions about learning design recommendations. It focuses on the recommendation form that teachers prefer regarding macro or micro recommendation, i.e. teachers' preference for recommending either entire learning designs or specific elements within a learning design value. It further explores the recommendation filters that teachers value to infer the recommendation method required by an RS. Also, it provides insights into teachers' perceptions of the anticipated benefits and challenges of integrating recommendations on the LD process.

In what follows, Section II includes a literature review of RSs for teachers that drives our research. Then, in Section III the methodology of a study conducted in teacher education is articulated. Finally, the study's findings are presented and discussed along with implications for developing LD environments that integrate recommendations for designing learning.

II. LITERATURE REVIEW

Aiming to explore teachers' perceptions of learning design recommendations towards integrating an RS in an LD

environment, we consider how contemporary educational research outline the characteristics of RSs, and the particular characteristics of several RSs for teachers.

Educational research [10], [20], [21] has exploited RSs for learning, i.e., supporting educational stakeholders, focusing on (a) proposing learning resources to users that (a1) match their query, and/or (a2) have been previously found as valuable by other users, and/or (a3) fit better their profile; (b) delivering personalised recommendations for learning paths in online learning systems, or (c) suggesting peers and improving collaboration.

A comprehensive framework for the characteristics of RSs for learning, by [11], describes seven methods for personalising recommendations, five methods for generating the users' profile, and four types of supported tasks. The recommendation methods include (1) *case-based* with raw retrieval of items as results of typical search queries; (2) *manually-selected* based, e.g. from experts, (3) *stereotype-based* according to demographic attributes; (4) *content-based* by characterising the contents and the needs of users, and then use these representations to match content to users; (5) *collaborative filtering* to give recommendations according to what other people with similar profiles like; (6*) knowledge-based* by inferring about user preferences, and (7) *hybrid approaches* that combine some of the above methods. As far as the generation of a user profile is concerned, the methods classified are (1) empty profile; (2) manually created by the user; (3) filled in with stereotypes; (4) generated by the user with a training set of examples and (5) heuristic. After the initial user model is generated, an RS may or may not engage some method to update it using an appropriate technique [22].

According to [11], the tasks supported by RSs for learning that distinguish them from generic RSs are: (a) recommending novel resources; (b) recommending peers with relevant interests; (c) suggesting good pathways by recommending alternative learning paths through learning resources, and (d) going beyond content to predicting learners' performance and teaching qualities of teachers.

Considering RSs for teachers, we conducted a non-exhaustive literature review of RSs to identify their characteristics, i.e. the tasks such systems support, the methods they adopt and how they manipulate, if so, a teacher profile. Furthermore, this review allowed us to detect another interesting characteristic of RSs for teachers that strongly supports the LD process. This characteristic involves supporting a macro or micro recommendation form. The macro form refers to recommending entire resources such as learning objects in educational repositories or learning designs in LD environments. In contrast, the micro form refers to recommending specific elements of these resources, thus targeting the scaffolding of the LD process. In what follows, we present RSs that fall in these two forms, and in the end, we articulate how this review drives our research.

A. RSs supporting a macro recommendation form

Indicatively, a content-based RS for learning objects by [12] exploits teachers ICT competence profiles so that learning objects selection and retrieval from a repository aligns with ICT abilities. They utilise UNESCO ICT Competency Framework for Teachers [23], which comprises six categories of ICT competencies (1) Understanding ICT in Education; (2) Curriculum & Assessment, (3) Pedagogy; (4) ICT; (5) Organization and Administration and (6) Teacher Professional Development. These categories span into three proficiency levels (a) Technology Literacy, (b) Knowledge Deepening and (c) Knowledge Creation creating a framework of 18 modules. Each competence category is further divided into sub-competencies differentiated according to the proficiency levels and address diverse areas of teachers' school work. In their study, [12] assume that a teacher manually provides the ICT competence profile. This profile includes two series of competencies regarding: (a) educational resources and (b) lesson plans and learning scenarios by utilising 12 and 14 sub-competencies of the UNESCO ICT Competency Framework for Teachers, respectively.

The study of [24] exploits the teachers' context to model an ontology that serves as the basis for the learning objects' metadata and the teachers' profile. They follow a hybrid approach to recommend learning objects including both content-based and collaborative filtering by comprehending (a) the learning objects metadata (i.e. curricular context: author, title, educational level, area, concept, unit, topic, and subject); (b) the teachers' profiles; (c) the learning objects evaluations addressing the user satisfaction and (d) the statistics on the learning objects usage (number of downloads, evaluations made, the evaluations average, and last updated date). A teacher's profile includes the elements: educational level, subject, area, region, city, school type and school.

The study of [25] recommends learning objects from web repositories to teachers based on their teaching style. It utilises the Grasha Teaching Style following five categories: (1) Expert; (2) Personal Model; (3) Formal Authority; (4) Delegator and (5) Facilitator, to create four clusters of teachers profiles based on their primary and secondary styles. This clustering forms teachers' communities so that recommendations are based on teachers' preferences belonging to the same community, i.e. having the same teaching style.

The DELPHOS Recommender developed by [26] is based on a framework for recommendation in learning object repositories. In this RS, following a weighted hybrid approach, the users are obliged to use a text or keywords and optionally some metadata values to search for learning objects. They can also select the weight of four recommendation criteria supported by the system: (a) Content similarity, (b) Usage, (c) Evaluation and (d) Profile Similarity. Subsequently, the system applies a content-based recommendation approach for content similarity within the learning objects of the repository, a collaborative filtering approach for the usage and the evaluation of the learning objects, and a demographic recommendation approach for the profile similarity of the user and the editors of the learning objects. After filtering based on these four criteria, the weight of the criteria is applied to formulate the recommendations. It is worth mentioning that the values of these weights are adaptive and can be assigned either by the user or automatically calculated by the system based on the amount of available information about each filtering criterion. When DELPHOS presents the recommendations to the user, it also provides statistics and explanations of why an object is recommended. Apart from some general and personal data, the teacher profile includes the following academic information: Education level, Research area, Language, Teaching experience, Information Technology experience, Didactic experience, Design Instruction experience, Learning

Object editor used, Learning Management System used, and Learning Object Repository used.

The study of [27] recommends learning objects of the ODS platform [28] taking into account the inter-user trust relationships. Stereotypes initially complete teacher profile and then, as the teacher uses the platform, keeps track of the actions related to the so-called social activities, e.g. rating, tagging, bookmarking, or sharing content in the ODS platform. Following the collaborative filtering method, their trust-based RS copes with the 'sparsity problem' of computing the similarity of user profiles when users do not share a common set of ratings or when too few ratings are available [28].

A hybrid RS by [16] was integrated into a support program allowing teachers to pose their problems on ICT and receive suitable solutions suggested from other teachers considering the popularity of the solutions and the teachers' profile. The RS is named SCAT-ICT after the acronym of the teacher profile as ''Skills, Competencies, and Attitude toward ICT profile''. In the SCAT-ICT profile, they anticipate the teachers to manually fill in information about: (1) their skills in ICT problem-solving (problem-solving, coping technique, priority reference), (2) their competencies in ICT (regarding Computers, Office, Multimedia, Internet and Educational Software), and (3) their attitude toward ICT (Innovation predisposition, Techno-anxiety, Techno-Fatigue).

The research team of [17] focuses on supporting teachers during the LD process by integrating Mentor RS into the LD environment LAMS [29]. This RS does not utilise a teacher profile; instead, it uses a hybrid recommendation method based on case-based, and item-based collaborative recommendation approaches with several recommendation criteria. The teachers complete the case-based criteria in a preference form, including the following fields of a learning design: Pedagogical strategy, Subject domain, Level, Evaluation model, Delivery modality and Time. The item-based criterion leverages social tags. According to teachers' queries, the system recommends pre-existing learning designs to support finding and utilising designs that cater to their needs and preferences. Towards improving the teacher-perceived experience of the recommendations, an explanatory mechanism is integrated into the system. Thus, each recommendation is complemented by an explanatory text demonstrating how the proposed learning design corresponds to the teacher's preferences.

B. RSs supporting a micro recommendation form

The study of [18] proposes an RS to personalise the LD process. A training tool for language teachers is presented as a simulator integrating a content-based RS. This training tool provides teachers with simulated scenarios for learning designs in which they have to consider the learning goals of the learning design (learners' expected competencies). They are also prompted to confront variable constraints related to the design process, e.g. features and particular needs of learners, and choose appropriate technological tools for developing technology-enhanced activities. Following a step-by-step recommendation, the tool suggests the most efficient or effective combination of technologies and tools to set up a language task that enables learners to achieve a particular competence.

Another approach focusing on scaffolding pedagogically the LD process was the one by [19]. They developed a hybrid recommender system to assist teachers in deciding the appropriate teaching-learning techniques for actualising teaching-learning activities to be carried out by students. The teaching-learning techniques recommendation (e.g. Brainstorming, Concept Mapping, Role Playing) is based on an association rules mechanism inferring possible combinations. This mechanism assumes that teaching-learning activities encompass standard features inherent to teaching-learning contexts, such as subject, learning goals, target population, difficulty level. It focuses on recommending the teaching-learning techniques, thus serving as a scaffold for actualising the teaching-learning activities.

C. Recommendation characteristics that drive our research

Our review explores primarily the *form* that recommending novel resources is supported by existing studies. Detecting RSs for teachers and classifying them based on the macro or micro recommendation, alike [12] and [16], we identified that the vast majority of RSs apply a macro recommendation form by retrieving entire learning objects from online repositories [12], [24], [25], [26], [27]. We detected only one macro form that integrates an RS in an LD environment rather than a repository and recommends entire learning designs developed in it [17]. We distinguished two very interesting micro recommendation forms that aim to support the LD process by integrating an RS in a training tool [17], [19]. These approaches focus on recommending particular elements of a learning design's activities, specifically recommending the technologies and tools [17] and the didactic techniques [19] appropriate for the characteristics of a learning activity.

Regarding the rest of the characteristics of RSs for teachers, we identified that they account primarily either for hybrid-based methods interweaving content-based and collaborative filtering [16], [19], [24], [26] or only content-based methods [12], [18], [25]. Recommendations are mainly grounded in a teacher's profile provided manually by the user [16], [24], [26], and some works do not utilise a profile [17], [18], [19]. Our literature review brings up the integration of an RS in an LD environment being an understudied topic in educational research. Our interpretation of the studies regarding RSs for teachers mentioned above drives our research towards investigating the recommendation form that teachers would appreciate. Although a macro recommendation form is widely adopted by RSs retrieving learning objects in online repositories, the micro recommendation form should be further investigated. A micro recommendation form holds great potential in supporting the LD process as it targets scaffolding teachers on specific elements of a learning design. We also consider researching the most valued recommendation methods and teacher profiles supported by such an RS of high priority.

III. METHODOLOGY

A. Context and Participants

We conducted a study in a teachers education context. This study spanned in two consecutive academic years of a postgraduate programme about Digital Transformation in Education held by a Greek University. Table I shows the demographics of the participants who formed Group A in the first year and Group B in the next year. Also, it is worth mentioning that they originated from a broad spectrum of academic disciplines such as pre-primary and primary

education, informatics, mathematics, engineering, pedagogy, philosophy, sociology and physical education.

TABLE I. PARTICIPANTS DEMOGRAPHICS

Group	*N*	*Sex*	*Teaching Experience*	*Perceived LD Experience*
A	18	1 Male 17 Female	50% In-Service 50% Pre-Service	33% Low 39% Moderate 28% High
B	19	1 Male 18 Female	79% In-Service 21% Pre-Service	26% Low 42% Moderate 32% High

The participants formed teams of mainly three members and were assigned to develop an LD project collaboratively in two courses. The *group A* participants were the attendees of the "Collaborative Learning with Digital Technologies" and "Digital Transformation in Theoretical Disciplines" courses through the first year who consented to take part in the study. Likewise, the *group B* participants were the course attendees of "Distance and Online Learning" and "Collaborative Learning with Digital Technologies" courses through the second year who consented to take part in the study. The LD project of each course required that the learning designs meet specifications related to its topic and utilise a specific LD environment for developing the learning designs. The "Collaborative Learning with Digital Technologies" course used WebCollage [30] integrated into the LD community of ILDE [31]. Also, it required learning designs to apply a collaborative learning technique (e.g. Brainstorming, Jigsaw) and implement it through a digital tool. The course "Digital Transformation in Theoretical Disciplines" utilised the PeerLAND [32] and required that the learning designs apply personalised learning with digital tools in the context of a theoretical discipline. The course of "Distance and Online Learning" utilised the Learning Designer [33] and required that the learning designs apply personalised learning in a distance education context.

Consequently, both groups had a contemporary LD experience designing for collaborative and personalised learning under the umbrella of Technology-Enhanced Learning (TEL). Also, both groups designed in two LD environments. As far as designing for personalised learning is concerned, both groups approached personalisation based on a framework [34] that interweaves aspects of students' profile regarding interests, strengths, and needs [10] with personalisation practices based on the principles of the Universal Design for Learning (UDL) paradigm [35].

B. Research Design – Data Collection and Analysis

Aiming to explore the teachers' perceptions of learning design recommendations, we address the following research questions:

RQ1 What recommendation form do teachers value in a learning design environment?

RQ2 What recommendation method do teachers value in a learning design environment?

RQ3 What benefits and challenges do teachers anticipate from integrating recommendations on the learning design process?

The 1st research question derives from the literature review and our practice in supervising LD projects in teacher education. Our practice reveals the persistent need to provide entire learning designs or particular learning activities as exemplars meeting several specifications. The 2nd research question derives from the literature review and explores the recommendation method that an RS system should support [11] through the recommendation filters that teachers value. Also, it contributes to the teacher profile required to support these methods. The 3rd research question aims to provide insights into teachers' perceptions of the benefits and challenges towards a deeper consideration of teachers' anticipations of integrating recommendations on the LD process.

We opted to address the 1st and 3rd research questions qualitatively due to their exploratory nature. To this end, we conducted interviews of a representative sample regarding demographics of 8 group B participants applying afterwards a content analysis [36] that followed a deductive coding process.

To address the 2nd research question, we applied an exploratory sequential mixed-method design [37]. We initially conducted a qualitative strand collecting data through reflection self-accounts regarding recommendation filters that group A participants valued. We applied content analysis [36] following an inductive coding scheme. The findings extracted allowed us to develop a quantitative instrument in the form of a survey questionnaire. This questionnaire included 13 Likert-scaled statements, each addressing a particular recommendation filter and was extended to include demographics regarding participants' sex, teaching experience and LD experience. Subsequently, we conducted a quantitative strand collecting data through this survey questionnaire from group A and group B participants about the recommendation filters they value.

We performed frequency analysis in SPSS of the quantitative data. Regarding qualitative data, the coding process of all content analyses was performed in NVivo by the primary researcher, who consulted the other senior researchers systematically to confirm their consensus.

IV. FINDINGS AND DISCUSSION

A. The recommendation form that teachers value in a learning design environment (RQ1)

Our research focuses on investigating two recommendation forms. The macro form refers to recommending entire learning designs, while the micro form refers to recommending elements within a learning design. The content analysis of the interview data shows that 5 out of 8 participants would like to utilise both macro and micro recommendation forms. As the following quotations show, their primary rationale is fitting the form to their multifaceted needs:

> I think both the micro and the macro recommendation would be helpful because the more design information, the better for design ideas. I feel that both options are complementary to my needs. (Participant 5).

> It would be ideal to combine both forms of recommendation. As a designer, I would occasionally like to use either one or the other depending on my needs. If I am not familiar enough with a learning object or a teaching unit, I would need a macro recommendation to consider entire learning designs. But if I am pretty familiar, I would need a micro recommendation to scaffold designing a particular learning activity. (Participant 8).

Nevertheless, the two participants favouring only a micro form provided a rational argument regarding a concentrated recommendation supplied by a micro form vs a broad recommendation provided by a macro form:

> I prefer some form of micro recommendation; I prefer focused guidance during the LD process. I will be bewildered if I get a broad recommendation of entire learning designs. I favour getting focused information on particular learning activities. (Participant 7)

Also, the participant preferring the macro form for providing a comprehensive approach to design ideas should be considered:

> A macro recommendation form suits me best because I need to consider an entire learning design to comprehend its context. I need a comprehensive approach to design ideas to take them into account. (Participant 1)

Consequently, these findings, similar to the study of [16], designate participants appreciating an LD environment integrating an RS that filters and proposes entire learning designs. Furthermore, findings highlight participants' high appreciation of micro recommendations for specific elements of a learning design. Regarding these elements, alike[18] and [19], the participants focused on articulating learning activities and applying recommendation filters to their context.

B. *The recommendation method that teachers value in a learning design environment (RQ2)*

As seen in Table II, the initial qualitative strand of the exploratory sequential mixed-method indicated 13 recommendation filters, including nine elements related to a learning design's context and four elements associated with a learning design's evaluation.

TABLE II. RECOMMENDATION FILTERS

Type	***Filters***
Learning Design Context	Designer's Name, Education Level, Grade, Subject, Didactic Technique, Design Title, Delivery Modality, Personalised Learning, Special Education
Learning Design Evaluation	Likes, Views, Copies, Experts' evaluation

In the quantitative strand that followed, these filters were further investigated through a survey questionnaire. Applying a Mann-Whitney test, we determined no statistically significant difference between group A (N=18) and group B (N=19) participants since the P-value was more than 0.05 for all filters. Consequently, the results presented in Fig. 1 and 2 regarding teachers' value of recommendation filters refer to all the participants (N=37). Likewise, we did not determine any statistically significant difference between groups related to participants' demographics, i.e., gender, teaching experience and perceived LD experience.

The synthesis of the nine filters for a Learning Design's Context reveals the strong influence of cased-based and content-based methods [11] supported by online educational repositories in participants' preferences. As seen in Fig. 1, the most valued filters were "Education Level", "Grade", and "Subject". These filters are applied in typical case-based recommendation methods in online repositories and are also adopted in previous research on RSs for teachers [17], [24], [26] Regarding content-based recommendation methods, alike [24], the results of this study indicate that participants highly value recommendations based on the "Design title", and they consider as less needed, although not being negative, the recommendations based on the "Designer Name". The highly valued filtering of the "Didactic Techniques" used in a learning design highlights the participants' need for scaffolding pedagogically the LD process. It inclines to the implementation approach of the study of [17] rather than [19]. An interesting finding of this study is that participants praised the "Delivery Modality", referring to online, blended or classroom-based delivery mode, as a contemporary filter for learning designs, which was previously suggested in [17]. Finally, novel findings of this study about filtering a learning designs' context are participants endorsing filters of supporting "Personalised Learning" and "Special Education" to inform their design process.

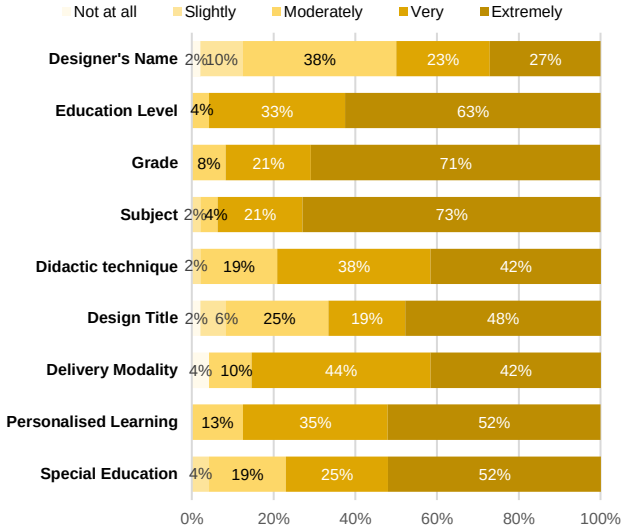

Fig. 1. Teachers' value of recommendation filters for a Learning Design's Context

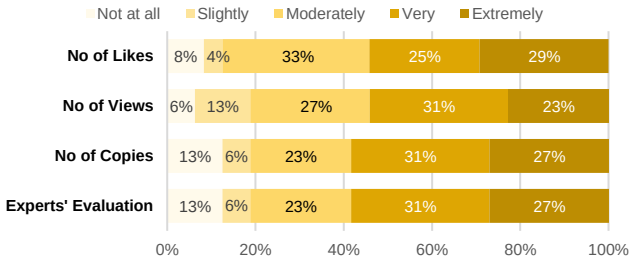

Fig. 2. Teachers' value of recommendation filters for a Learning Design's Evaluation

The synthesis of the four filters for a Learning Design's Evaluation reveals that collaborative filtering recommendation methods highly influenced participants [11]. Such methods are widely adopted in commercial RSs and have been previously suggested in [24], [26], [27] and [17]. As seen in Fig. 2, the participants value filtering learning designs based on a "Like" mechanism and considering the number of the "Views" and "Copies". It is worth mentioning that the "Experts' Evaluation" filter scored a significantly higher appreciation of participants and had no negative responses.

Inferring the teacher profile needed to support these recommendation methods is challenging as previous research is inconclusive. Such methods are mainly either supported by a teacher profile provided manually by the user[16], [24], [26] or without any profile [17], [18], [19]. Also, our study did not provide any statistically significant difference between participants' demographics that could guide our research. Thus, interweaving the realisation of these recommendation methods with a teacher profile requires further investigation.

C. *The benefits and challenges that teachers anticipate from integrating recommendations on the LD process (RQ3)*

Three codes emerged from the content analysis of the interview data regarding the anticipated benefits of integrating an RS in an LD environment:

- Stimulating the initiation of designing for learning;
- Advancing LD practice by conceiving new design ideas; and
- Providing a means of developing LD experience effectively.

Indicative perceptions are the following:

> Recommendations will be a stimulus towards transforming them and initiating the creation of my learning designs. (Stimulus / Participant 7).

> I would exploit picking a recommendation to transform it to my needs. I would enrich it and adapt it to my practice. Such exemplars would help me embellish them with my own perspective and expertise. (Stimulus / Participant 3).

> Recommendation of particular learning design elements will intrigue me to conceive design ideas that I had not thought of and consider incorporating them into my designs to advance my practice. (LD practice advancement / Participant 5).

> I anticipate recommendations of compelling learning designs to devise design ideas that will boost my LD practice. (LD practice advancement / Participant 1).

> Recommending is an effective practice for teachers as designers. I would save time since I will not develop a design from scratch but utilise the community's expertise. A design community that teachers filter each other's work and adapt it to their context. I think that through a recommendation mechanism, I may gain many years of design experience. (LD experience / Participant 8).

Consequently, insights into participants perceptions of anticipated benefits confirm the finding of [17] about an RS contributing to the effective development of LD experience, focusing on saving designers' time. This study also underlines that an RS integrated into an LD environment provides designers with stimulus to initiate designing for learning and advance their LD practice by conceiving new design ideas.

Four codes emerged from the content analysis of the interview data regarding the anticipated challenges of integrating an RS in an LD environment and constitute novel findings in the area of RSs for LD:

- Disregarding creativity in designing for learning;
- The appropriateness of the recommendations;
- Designers having adequate LD experience; and
- Designers having the appropriate LD mindset.

Indicative perceptions are the following:

> While recommendations are beneficial to devise design ideas, a designer might get trapped in them and disregard his creativity. I think you should always design based on the context of your class and, more importantly, the learning profile of your students. Therefore, I am sceptical of the "copy-paste" effect of recommendations. (Creativity - Participant 1).

> Filtering the context of a learning design does not provide you with good recommendations. I mean, you don't know the quality of the content. Getting a list of recommendations that matches your query without knowing somehow their quality is bewildering. I would like recommendations that consider the popularity of the designs. So definitely, a combination of the number of views and likes would be essential to me. (Appropriateness - Participant 3).

> More often than not, I get recommendations in educational repositories that have nothing to do with my query. I would like an LD recommendation mechanism, micro or macro, to provide appropriate recommendations. (Appropriateness - Participant 2).

> From a research point of view, an RS is supportive, but you need first to consider how to involve teachers in LD. From my point of view, teachers do not have LD experience. Not all of them practice LD adequately. They are not aware of the elements inherent to the LD process, so they can actually utilise recommendations. (LD experience, Participant 1).

> An RS needs data to provide recommendations. These data, i.e., learning designs, require a robust teacher community developing and sharing learning designs. On the one hand, designers need to make their designs public. On the other hand, designers need to respect copyrighting when reusing the designs. All in all, I think that an RS is greatly affected by teachers' LD mindset. (LD mindset - Participant 3).

Among these challenges, only the appropriateness of the recommendations is related to the development of an RS per se. The other three reported are rather challenges of teachers' professional development in providing teachers with the appropriate theoretical background to the LD process and cultivating an LD mindset that will promote teachers participating in LD communities and effectively exploiting recommendations.

V. CONCLUSIONS

This paper investigates teachers' perceptions of learning design recommendations by exploring the recommendation form and method that teachers value while designing and the anticipated benefits and challenges of integrating recommendations in the LD process. We present a study in a teachers education context collecting quantitative and qualitative data to consider teachers' perceptions more profoundly as the main stakeholders in LD.

Regarding the ideal recommendation *form*, our findings indicate that the well-established macro form of recommending learning objects in educational repositories is also appreciated in an LD environment. An RS by filtering and bringing into foreground entire learning designs is valuable to designers. Furthermore, the findings highlight that the understudied micro form of recommending specific elements within a learning design, and specifically for learning activities' articulation, is highly appreciated in the LD process. Teachers in our study appreciate both micro and micro recommendations of learning designs. Regarding the

most suitable recommendation *method* of an RS for LD, our research leans towards a hybrid approach pointing out 13 filters related to cased-based and content-based recommendation methods for a learning design's context and collaborating filtering recommendation methods for a learning design's evaluation. Our study did not provide any evidence towards inferring the teacher profile that would support these recommendation methods, while relevant research approaches are also inconclusive.

Our research justifies the need to integrate recommendations on the LD process with teachers reporting as anticipated benefits: (i) stimulating the initiation of designing for learning; (ii) advancing LD practice by conceiving new design ideas; and (iii) providing a means of developing their LD experience effectively. The complementary challenges reported include (i) disregarding creativity in designing for learning, (ii) the appropriateness of the recommendations, (iii) designers having the needed LD knowledge, and (iv) designers having the appropriate LD mindset towards sharing and reusing learning designs. These perceptions point out the challenge of an RS providing appropriate recommendations and the high need to cultivate teachers' LD knowledge and mindset towards employing LD environments and RSs effectively.

The limitations of this study refer to the small sample of participants. However, unlike the usual approach of a specific RS' study aiming to ground its evaluation mainly in quantitative findings, this study collected teachers' perceptions towards a potential RS. As this work is in progress, our research team intends to investigate these findings further. They may also stimulate momentum for further attention to researchers involved with LD environments' development.

Towards achieving an overall perspective of teachers as designers' needs and developing an LD environment that integrates an RS, our future work involves investigating the correlation between the recommendation form and methods with a teacher profile. We also intend to focus on the specific elements of learning activities that teachers need scaffolding in the context of a micro recommendation.

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