A Systematic Mapping Study of Recommendation Systems in Education

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Abstract. . Several academics investigate recommendation systems, which are largely utilised in e-commerce to assist users in the retrieval of suitable items and services. However, there is little data on the influence of recommender systems in other fields, such as education. Thus, the goal of this study is to summarise the existing state of knowledge regarding recommendation systems that have been used in the education domain to support instructional practises. A total of 44 research publications were selected, examined, and analysed from an original selection of 1181 papers using a systematic mapping approach. Our findings show how recommendation systems can be utilised to help major areas of education, what methodologies, techniques, or algorithms recommender systems use, and how they solve various difficulties in education. the academic world. Furthermore, this work has proven valuable in identifying several research gaps and crucial areas for additional inquiry, such as the use of data mining and artificial intelligence in recommender system algorithms to better personalization of academic choices.

Keywords: Recommendation systems Education E-learning Mapping study

1 Introduction

Recommendation systems (RS) are systems that retrieve and filter material based on content and comparable profiles. These systems are commonly employed in the field of e-commerce. For example, some websites, such as Amazon, employ RS to provide customers with recommendations for things they are unfamiliar with but that may be of interest to them. Suggested advice assist the user in overcoming the stressful search difficulty. However, this technique is used to recommend videos (YouTube), films (Netflix), and friends (Facebook), among other things.

This demand spans across several domains, among which is the educational domain. RS, which are applied in education, have the role of supporting teaching and learning activities through enhanced information retrieval. Nevertheless, there is limited information of the application of recommender systems in educational environments. As a result, the purpose of this study is to summarise the present state of knowledge regarding RS that have been used to support educational practises.

The following is how this paper is organised. Section 2 describes the study methodology and stages used for systematic mapping. Section 3 presents the mapping study's findings. Finally, Section 4 summarises our key findings.

2 Research Method

To acquire an overview of recommendation systems in education, we conducted a systematic mapping study using the principles presented by Kitchenham and Petersen et al. Several steps and activities were engaged in our systematic mapping project. The requirement for mapping is determined at the planning stage, the research questions are addressed, the search strategy is formed, and the mapping procedure is defined. During the conducting stage, primary studies are chosen, data is extracted, and the resulting data is analysed and synthesised. Finally, the mapping study findings are presented in the reporting step. The following subsections provide specifics on the planning and execution of our systematic mapping project. The reporting stage is discussed in detail in

Table 1 shows the terms used in the various scientific databases along with the search results, the asterisk "*" symbol was used as a wildcard in some databases to indicate

Any word variant on each term, for example, "recommend*" suggests terms like "recommendation" and "recommender".

2.1 Screening Process and Selection of Primary Studies

Once the search results were available, these papers were subjected to a pre-selection criterion. To apply the inclusion criteria, researchers evaluate the article title, abstract, and keywords and believe that at least one study should reference the keywords specified in the search strategy. The exclusion criterion was then applied during the complete article reading, resulting in the primary studies list.

Table 2. Data extraction criteria.

Database	Search string	Num. of studies
ACM Digital Library	(+"recommend* system*" +education)	181
IEEE Xplore	(("recommender system" OR "recommendation system") AND education)	224
Scopus	TITLE-ABS-KEY ("recommend* system*") AND TITLE- ABS-KEY (education)	596
Web of Science	Topic: ("recommend* system*") AND Topic: (education)	180

esearch question	Criteria	Options
RQ1. What are the educational areas covered by RS?	C1. Areas in education	– Academic choices – Learning activities – Learning resources – Academic performance – Vocational and educational training – e-learning
RQ2. What are the approaches used to generate recommendations within the educational context?	C2. RS approach	– Collaborative filtering – Content based – Hybrid approach – Knowledge based – Other
RQ3. Which platform is used for the recommender system deployment?	C3. RS Development	– Desktop based – Web based – Mobile based – Conceptual model
RQ4. Which evaluation or validation strategies are applied to recommendation systems?	C4. RS empirical validation	– Survey – Case Study – Experiment – None
RQ5. What are the challenges addressed by adopting a recommendation system in the educational context?	C5. Issues addressed by the RS	– Availability of information & content sharing – Personalized recommendations – Prediction accuracy & efficiency – Improve educational practices

3 Results

We identified 1181 papers derived from digital database searches using the search approach. Researchers evaluated the titles, abstracts, and keywords of the publications found during the initial search, and then applied selection criteria to obtain a list of 206 primary research candidates. Finally, as a result of the entire screening and data extraction process, our work identified 44 primary studies. Each primary study that was reviewed was categorised based on the probable answers to the key research questions. The mapping study results are organised according to the research topics, as shown in Table 4. It is important to note that RQ1 and RQ5 are not mutually exclusive; a study can be classed in one or more of the replies. As a result, the sum of the percentages is greater than 100%. Furthermore, see Fig. 1. displays a bubble graphic that summarises mapping findings achieved by combining research question options.

Table 3. Results of the mapping study based on the possible answers to the research question.

Research question	Options	Number of studies	Percentage (%)
RQ1. What are the educational areas covered by RS?	– Academic choices	21	47.78
	– Learning activities	8	18.18
	– Learning resources	13	29.55
	– Academic performance	11	25.00
	– Vocational and educational training	4	9.09
	– e-learning	15	34.09
RQ2. What are the approaches used to generate recommendations within the educational context?	– Collaborative filtering	13	29.55
	– Content based	1	2.27
	– Hybrid approach	20	45.45
	– Knowledge based	1	2.27
	– Other	9	20.45
RQ3. Which platform is used for the recommender system deployment?	– Desktop based	3	6.82
	– Web based	23	52.27
	– Mobile based	1	2.27
	– Conceptual model	17	38.63
RQ4. Which evaluation or validation strategies are applied to recommendation systems?	– Survey	8	18.18
	– Case Study	1	2.27
	– Experiment	21	47.73
	– None	14	31.82
RQ5. What are the challenges addressed by adopting a recommendation system in the educational context?	– Availability of information & content sharing	17	38.64
	– Personalized recommendations	19	43.18
	– Prediction accuracy & efficiency	18	40.91
	– Improve educational practices	11	25.00

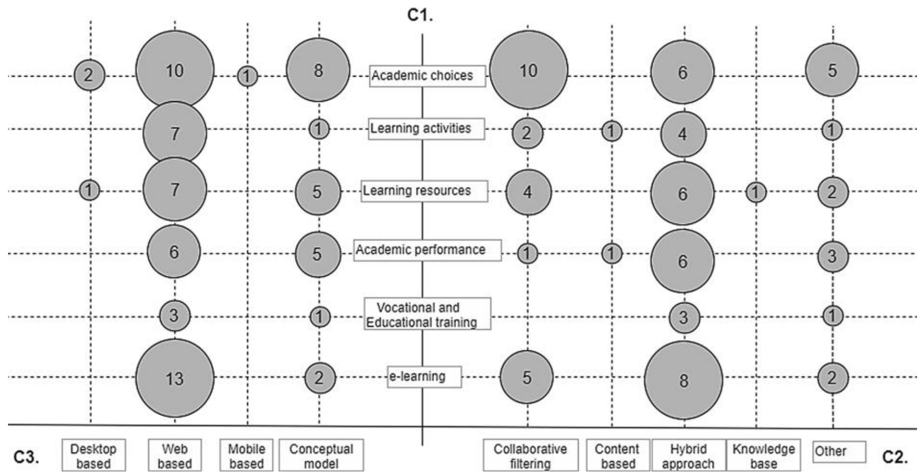

Fig. 1. Mapping results obtained from the combination of the first three research questions

3.1Recommendation System Evaluation

According to the RQ4 results, 31% of the studies did not conduct any type of method validation (see Table 4). Approximately 18% of the papers presented RS that had been validated using a survey. For example, suggested a questionnaire for assessing e-learning programmes. Students completed a survey designed to validate the recommendations received. The empirical evaluation results allowed for improvements to the educational RS to be built in order for it to be more reliable.

Approximately 47% of the studies report some form of experimental. For example, ran an experiment to assess the effectiveness of a recommender system. Furthermore, only one study (2% of the total) included a case study. carried out a case study to validate the suggested hybrid recommender system, demonstrating the efficacy of adopting hybrid techniques in virtual learning settings.

4 **Conclusions**

Overall, there has been a lot of interest in using recommendation algorithms in educational settings. However, due to a lack of information about how recommendation systems have been used in educational settings, what approaches have been used, and how they have addressed various issues in the academic world, many researchers and practitioners are having difficulty retrieving relevant and useful information that summarises the utilities of using RS for educational purposes.

As a result, we conducted a comprehensive mapping study to evaluate the usage of recommendation systems in education in this work. An computerised search of scientific databases yielded 44 primary studies, which were thoroughly examined. Relevant data was gathered and categorised from chosen research to get important insights into the uses, methodologies, and difficulties addressed by RS. The most commonly cited uses of RS in education are assisting in suggesting courses, or simply e-courses, research document management, course supplemental materials, resources, and academic activities. Another aspect of education improved by RS is e-learning via web platforms.

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