



Leveraging Recommender Systems for Course Selection in Higher Education: A Pathway to Informed Decision-Making

Shivangini Bihari^{1*}  and Md. Irfan Alam² 

¹Research Scholar, Faculty of CSE&IT, Jharkhand Rai University, Ranchi, Jharkhand, India

²Associate Professor, Faculty of CSE&IT, Jharkhand Rai University, Ranchi, Jharkhand, India

*Corresponding author e-mail id: ¹shivisingh0509@gmail.com
²irfan2.alam2@gmail.com

Abstract. Recommender systems are extensively utilized across various domains to offer users personalized item suggestions based on their preferences, helping them manage the overwhelming amount of available information. Choosing the right courses when entering a new academic level can be particularly difficult for students, as selecting inappropriate courses can impact their educational progress and future career prospects. This paper investigates the application of recommender systems in aiding students in choosing courses aligned with their skills and interests. This paper examines the scope of recommender systems that assist students in selecting elective courses. The review findings indicate that a hybrid recommendation approach/system is likely the most effective method for helping students make informed course selections to prepare for their future careers.

Keywords: Course Selection, Elective Courses, Higher Education, Recommender Systems, Machine Learning

1. Introduction

Elective Recommender Systems is AI tool specifically created to recommend subsequent activities to the student based on various factors like priority and the student's previous record. These tools assist individuals in making decisions about things they enjoy. Generally, all recommender systems seek to produce valuable recommendations for users concerning items that may pique their interest. Consequently, recommender systems need to identify what characteristics users prefer and categorize each item into a collection of similar traits.

In the current landscape, the technology of recommender systems is means making suggestions for user's perspective. In this time, higher education institutions encounter obstacles like competitive education field, rising student populations, and a diversity of education areas. In spite of all these challenges, education leaders need to uphold sufficient and effective student's facilities, which include learning assistance, and career supervision. Certain researchers have discovered that numerous students globally struggle with the task of selecting their most appropriate university or college courses. These systems conserve time by offering students expert recommendations through their knowledge base component [30].

Many degree programs provide optional courses alongside required ones. The courses that students do not finish encompass both required and optional courses. Students select elective

courses according to their fascinate. Anticipating student scores in the programs, they will take aids in guiding students and enables them to make educated decisions about required and elective courses.[1][29].

In higher education, learners encounter challenges when selecting elective classes. A study conducted among first-year undergraduates at University Institution Dublin indicated that nearly 50% of the undergraduates opted for elective courses unrelated to their main due to their perception of the courses being thrilling. Specific challenges arise from the restricted availability in some elective classes and conflicts in scheduling with required courses, which lead students to choose alternative elective classes.[2] This system aims to suggest according to the student's features.

2. Literature Review

Incorrect course choice can lead to interruptions in finishing a condition as students may not have completed required prerequisite courses or have fallen short of the least credit necessities. Choosing the appropriate elective option is crucial for students to fulfill their degree program. [3]. Selecting an elective course is affected by elements for example the individual's own and academic preferences, along with the institutional rules that dictate the enrollment period for a specific elective course [4].

O'Mahony and Smyth [5] recognized these factors that affect students' decisions regarding elective courses: personal interest and academic objectives, professional aspirations and course prerequisites, skill to advance with their studies, course struggle and plan, knowledge of available choices, as well as accessibility of spaces, and scheduling conflicts [4].

AI is "computing systems that can engage in human-like processes such as learning, adapting, synthesising, self-correction and using data for complex processing tasks" Machine learning instruments and methods have led to groundbreaking changes across numerous sectors, and education has also been affected. Artificial intelligence is "computing systems that can participate in human-like processes such as learning, adapting, synthesizing, self-correcting, and utilizing data for intricate processing tasks. " ML is regarded as a subset of AI. ML entails creating algorithms to interpret data to adapt and glean insights from experiences automatically [6] [7] [8].

3. Classification of Recommender System

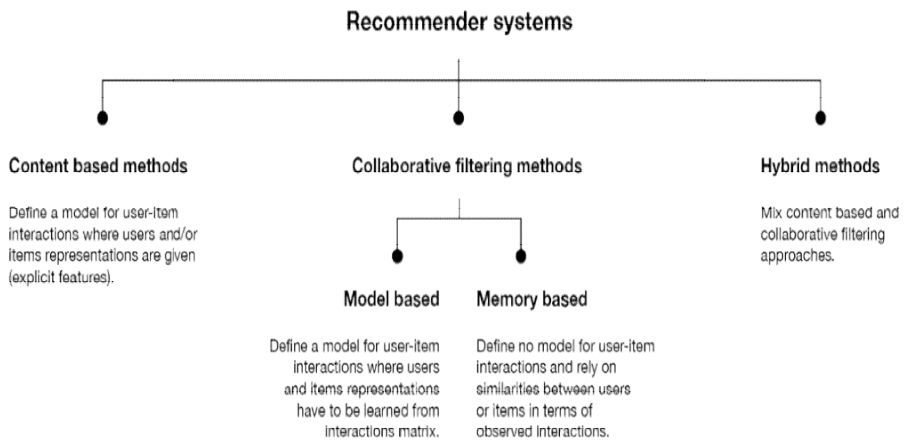


Fig. 1. Recommender System

4. Recommender Systems in Education: Applications

Recommender systems in education are powerful tools that personalise learning experiences, enhance student engagement, and optimise educational outcomes. Bayes algorithm calculates the probability of personalised recommendation suitability.

Personalized Course Recommendations: Recommender systems evaluate students' educational records, preferences, and objectives to recommend appropriate courses. This customization helps students in making knowledgeable choices regarding their educational journeys.[9]

Learning Resource Suggestions: By assessing a learner's existing knowledge level and preferences, these systems suggest customized educational resources, like articles, videos, or tutorials, to facilitate personalized learning experiences.[10]

Career Path Guidance: Advanced recommendation systems align course recommendations with employment market trends, assisting students in obtaining skills that are sought after and making informed career choices.[11].

Collaborative Learning Opportunities: These systems recognize and link students with classmates or study groups with comparable learning goals, promoting cooperative learning atmospheres.[12].

Instructor Support: Recommender systems support educators by proposing teaching resources and strategies customized to their instructional requirements, improving teaching efficiency.[12].

5. Course Selection

Course Selections are choices made by students or parents. It is a process in which students choose the subjects to take during a particular year. It is differently based on their internal policies. Course Recommender System uses data about learning activities and many more information to predict course. The selection of a course major can significantly affect their future. Individual's interests and course-related elements impact students' choices when determining which courses to take.

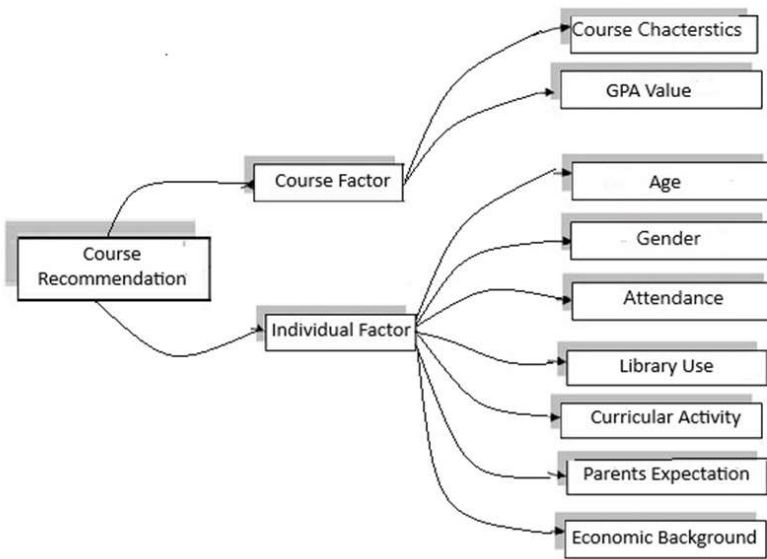


Fig. 2. Factor Influencing for Course Recommendation

5.1 Applying Recommender Systems for Course Selection

Course recommender systems are specialized to help students make informed decisions about their course choice. It must have fair amount of data to determine a recommendation strategy. It programs to develop students in identifying suitable fields of study. These systems consider general information, backgrounds, and aptitudes of students to guide them toward appropriate course choices.

5.2 Difficulties students face when selecting courses

Although selecting the right course is highly important, many students struggle to decide. This challenge is partly due to the overwhelming number of courses offered by universities today,

which often leaves students feeling confused. With the advent of digitalization, most universities now conduct admissions online, requiring students to apply through digital platforms. However, this process often lacks proper guidance, and students frequently lack knowledge about available courses. Additionally, some course selection procedures and instructions universities provide fail to address students' needs effectively. Nevertheless, choosing the right course remains a critical factor in ensuring the successful completion of their studies.

5.3 Popular Recommendation Methods Used in Education for Course Selection

Designers have suggested multiple methods for course recommendations in higher education. Before using recommender systems, users need to understand the type of guidance they expect these systems to provide. Specific recommender systems focus on generating all possible suggestions, whereas others offer a limited number of precise results.

Table 1. Research studies that applied recommender methods for selecting courses.

Recommendation Approach	Reference
Hybrid Recommendation	[13-17]
Knowledge-Based Recommendation	[18-19]
Collaborative filtering (CF)	[24-28]

5.4 The Benefits of Utilizing Recommender Systems for Course Selection

Course recommender systems offer numerous benefits. First, they provide highly relevant recommendations. For example, using content-based (CB) filtering methods, the system generates results tailored to the student's unique future career interests by analysing characteristic similarities. Second, these systems deliver transparent recommendations, which build trust among students as they can clearly understand how suggestions are generated. Third, they help students uncover their skills, assist lecturers in identifying educational trends, and aid employers in recruiting potential talent. Higher education institutions are also encouraged to design courses aligned with job market demands, enhancing their reputation and maintaining academic standards. Lastly, recommender systems also support lecturers by simplifying the process of finding appropriate materials for preparing online courses.

6. Conclusion

This paper aimed to examine the recommender systems utilised by students in higher education for course selection. Various recommendation methods, including content-based, collaborative filtering, hybrid recommendation approaches, and other content-based techniques, were identified as having been applied at different times for this purpose. Among

these, the hybrid recommendation approach was found to be the most effective for assisting students in selecting courses. By integrating the strengths of all other approaches, it offers a robust solution capable of delivering highly accurate recommendations. This, in turn, can support students in achieving their career aspirations successfully.

Disclosure of Interests. The authors declare that there is no conflict of interests.

References

1. Cakmak, A.: Predicting Student Success in Courses via Collaborative Filtering. *International Journal of Intelligent Systems and Applications in Engineering* **5**(1), 10–17(2017)
2. O'Mahony, M., Smyth, B.: A recommender system for on-line course enrolment: an initial study. In: *Proceedings of the 2007 ACM conference on Recommender systems*, pp. 133–136. Association for Computing Machinery, Minneapolis, MN, USA (2007)
3. Samrit, Bhagwan, N., Thomas, A.: A Recommendation System for Prediction of Elective Subjects. *International Journal for Research in Applied Science and Engineering Technology* **5**(4), 36–43(2017).
4. Ognjanovic, I., Gasevic, D., Dawson, S.: Using institutional data to predict course selections in higher education. *The Internet and Higher Education* **29**, 49–62(2016).
5. O'Mahony, M., Smyth, B.: A recommender system for on-line course enrolment: an initial study. In: *Proceedings of the 2007 ACM conference on Recommender systems*, pp. 133–136. Association for Computing Machinery, Minneapolis, MN, USA (2007)
6. Thanh-Nhan, H., Nguyen, H., Thai-Nghe, N.: Methods for building recommender systems. In: *Eighth International Conference on Knowledge and Systems Engineering (KSE)*, Hanoi, (2016).
7. Akerkar, R.: *Artificial intelligence for business*. Springer (2019).
8. Dwivedi, S., Roshni, K.: Recommender systems for big data in education. In: *5th National Conference on E-Learning & E-Learning Technologies (ELELTECH)*, Hyderabad, (2017).
9. Lampropoulos, G.: Recommender systems in education: A literature review and bibliometric analysis. *Advances in Mobile Learning Educational Research* **3**(2), 829–850 (2023)
10. da Silva, F.L., Slodkowski, B.K., da Silva, K.K.A.: A systematic literature review on educational recommender systems for teaching and learning: research trends, limitations and opportunities. *Education and information technologies* **28**(3), 3289–3328 (2023).
11. Frej, J., Dai, A., Montariol, S., Bosselut, A., & Käser, T.: Course Recommender Systems Need to Consider the Job Market. In: *Proceedings of the 47th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp. 522–532. (2024)
12. Deschênes, M.: Recommender systems to support learners' Agency in a Learning Context: a systematic review. *International journal of educational technology in higher education* **17**(1), 50 (2020).
13. Arik, A., Okyay, S., & Adar, N.: Hybrid course recommendation system design for a real-time student automation application. *Avrupa Bilim ve Teknoloji Dergisi* **26**, 85–90 (2021).
14. Perez, J. C. S., Manrique, R. F., Mariño, O., Vázquez, M. L., & Cardozo, N.: A course hybrid recommender system for limited information scenarios. *Journal of Educational Data Mining* **14**(3), 162–188 (2022).
15. Esteban, A., Zafra, A., & Romero, C.: Helping university students to choose elective courses by using a hybrid multi-criteria recommendation system with genetic optimization. *Knowledge-Based Systems* **194**, 105385(2020).

16. Deepak, G., Trivedi, I.: A hybridized deep learning strategy for course recommendation. *International Journal of Adult Education and Technology (IJAET)* **14**(1), 1- 16 (2023).
17. Butmeh, H., Abu-Issa, A.: Hybrid attribute-based recommender system for personalized e-learning with emphasis on cold start problem. *Frontiers in Computer Science***6**, 1404391 (2024).
18. Agarwal, A., Mishra, D. S., & Kolekar, S. V.: Knowledge-based recommendation system using semantic web rules based on Learning styles for MOOCs. *Cogent Engineering* **9**(1), 2022568 (2022).
19. Beutling, N., & Spahic-Bogdanovic, M.: Proceedings of the AAAI Symposium Series, pp. 72-81. (2024).
20. Mishra, P., Jain, V.:2023 7th International Conference on Trends in Electronics and Informatics (ICOEI), pp. 1431-1436. (2023)
21. Morsomme, R., Alferez, S.V.:Content-Based Course Recommender System for Liberal Arts Education.International educational data mining society, (2019).
22. Javed, U., Shaukat, K., Hameed, I. A., Iqbal, F., Alam, T. M., & Luo, S.: A review of content-based and context-based recommendation systems. *International Journal of Emerging Technologies in Learning (iJET)* **16**(3), 274-306 (2021).
23. Shu, J., Shen, X., Liu, H., Yi, B., & Zhang, Z.: A content-based recommendation algorithm for learning resources. *Multimedia Systems* **24**(2), 163-173(2018).
24. Jena, K. K., Bhoi, S. K., Malik, T. K., Sahoo, K. S., Jhanjhi, N. Z., Bhatia, S., & Amsaad, F.: E-learning course recommender system using collaborative filtering models. *Electronics* **11**(1), 157(2022).
25. Chang, P. C., Lin, C. H., & Chen, M. H.: A hybrid course recommendation system by integrating collaborative filtering and artificial immune systems. *Algorithms***9**(3), 47 (2016).
26. Salehudin, N. B., Kahtan, H., Abdulgabber, M. A., & Al-bashiri, H.: A proposed course recommender model based on collaborative filtering for course registration. *International Journal of Advanced Computer Science and Applications* **10**(11), (2019).
27. Huang, L., Wang, C. D., Chao, H. Y., Lai, J. H., & Philip, S. Y.:A score prediction approach for optional course recommendation via cross-user-domain collaborative filtering. *IEEE Access* **7**, 19550-19563 (2019).
28. Bozyigit, A., Bozyigit, F., Kiliç, D., & Nasiboğlu, E.: 2018 International Symposium on Computers in Education (SIIE). IEEE(2018).
29. Maphosa, M., Doorsamy, W., & Paul, B.: A review of recommender systems for choosing elective courses. *International Journal of Advanced Computer Science and Applications*, **11**(9), 287-295 (2020).
30. Lynn, N. D., & Emanuel, A. W. R.: A review on Recommender Systems for course selection in higher education. In: *IOP Conference Series: Materials Science and Engineering*, pp. 032039. IOP Publishing (2021).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

