



Aligning Add-On Courses with Student Needs and Career Goals through Recommendation Systems: A Survey-Based Analysis

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Abstract: Add-on courses in higher education can bridge skill gaps and enhance student employability, yet students often struggle to identify offerings aligned with their backgrounds, interests, and career goals. In higher education, add-on courses play an important role in improving students' skills and employability. However, students often face difficulty in selecting suitable courses from a wide range of options. The research paper highlights the importance of add-on courses in higher education for improving student skills and employability. The study proposes a recommendation system to guide students in selecting appropriate courses. The system's design is based on the analysis of student preferences for delivery modes, course formats and career aspirations which helps to provide insights for developing flexible, relevant, and student-centric programs. Overall, the research suggests that academic institutions should design flexible and industry-aligned add-on programs to meet student expectations.

Keywords: Add-on courses, Higher Education, Recommendation System, K-means Clustering, Collaborative Filtering

I. INTRODUCTION

Higher education in India is one of the largest in the world, offering diverse programs across universities, colleges, and institutes, focusing on skill development, research, and innovation to meet global standards. India's education system has undergone a significant transformation, shifting from the holistic, value-based methods of ancient times to the organized and technology-oriented frameworks of the modern era [1]. Education is the practice of enabling learning and gaining knowledge, skills, values, ethics, beliefs, and habits. It involves various methods such as teaching, training, storytelling, discussions, and guided research [2]. In the rapidly evolving landscape of higher education, institutions are increasingly introducing add-on courses to supplement the traditional curriculum. These courses are designed to equip students with additional knowledge and practical skills that improve employability, enhance domain expertise, and support lifelong learning.

In today's fast-changing educational environment, continuous learning and skill enhancement have become essential. To address this need, educational institutions are increasingly introducing a range of add-on courses to supplement conventional academic programs [3]. Add-on courses in areas such as data analytics, cloud computing, cyber security, soft skills, and entrepreneurship provide students with opportunities to align their education with industry requirements. However, despite the availability of such courses, many students encounter challenges in selecting the most suitable ones. The abundance of options, lack of awareness, and absence of systematic guidance often lead to random selection or underutilization of valuable learning opportunities.

To overcome these issues, recommendation systems have emerged as effective tools for guiding students toward relevant add-on courses. Recommendation systems in education analyze academic performance, learning preferences, and peer choices to generate personalized suggestions. Recommender systems are designed to minimize the time and effort users spend searching for relevant information online [4]. A recommender system, also called a recommendation system, is a specialized information filtering tool developed to predict the rating or preference a user is likely to give to a particular item [5]. The system can be implemented using various approaches, such as content-based, collaborative, or a hybrid of both [6].

Recent research in e-learning focuses on recommendation techniques aimed at enhancing the overall effectiveness of the learning process. Hence, developing a new recommendation system is crucial to provide improved support and resources for learners [7]. In today's world, where personalization plays a vital role in success, automated course



recommendation systems offer a smarter and more efficient approach to assist students in making decisions and planning their academic paths [8]. Recommender Systems (RSs) utilize data analysis and machine learning techniques to provide users with personalized suggestions for relevant information, such as items, content, movies, news, music, and more[9].

Research Gap: Although several models have been proposed, there is still a lack of hybrid frameworks that effectively combine clustering with collaborative filtering to balance both group-level patterns and individual-level recommendations. Existing systems either focus on one technique or fail to address scalability, diversity of student needs and the cold-start problem. Moreover, many studies do not emphasize integration with real-world institutional datasets, limiting their applicability in practical academic environments.

To address these gaps, this study proposes an Add-on Course Recommendation System using K-means clustering and collaborative filtering. Collaborative filtering is a technique used to make predictions based on students' interests by gathering and analyzing information from multiple sources [10]. Collaborative filtering recommender systems suggest items based on the idea that users with similar preferences in the past are likely to make similar choices in the future [11]. The k-means algorithm is one of the most widely used clustering techniques. It analyses a dataset with multiple attributes to group similar data points into distinct clusters [12]. The proposed system uses an association rule mining algorithm as its core technology to discover relationships and patterns among different courses [13].

II. LITERATURE REVIEW

Parikshit Layek, Shubhra Rani Sil [1], observed that it is challenging to determine which form of education is superior, as both hold their own significance. While they share similarities, they also differ in many ways. Modern education has evolved from traditional education, but the rise of modern methods has led to the neglect of traditional practices, risking the loss of cultural heritage. Therefore, both traditional and modern education should be valued equally.

Kalokhe Anil Sopan, Kumbhar Vijaykumar Sambhajirao [2], discussed that the Indian education system has shifted from the value-based approach of ancient Gurukuls to modern, technology-driven models. While traditional education focused on morality and creativity, modern methods emphasize flexibility and inclusivity, as seen in the National Education Policy 2020 and the Choice-Based Credit System. By combining traditional wisdom with contemporary techniques, India can develop responsible and innovative citizens, ensuring a balanced and forward-looking education system.

III. RESEARCH METHODOLOGY

This study adopts a hybrid approach by combining K-means clustering and collaborative filtering to design an effective add-on course recommendation system for higher education students. The research process began with a literature review to identify the limitations of existing models such as content-based and pure collaborative filtering approaches. Institutional data, including student academic performance, interests, course enrollments, and feedback, was collected and pre-processed through normalization, feature selection, and handling of missing values to ensure quality inputs.

Dataset:

The research was carried out with a sample of 243 students drawn from the Commerce and Science faculties of senior colleges situated in the Baramati and Daund talukas of Pune district. For data collection, an online questionnaire link was distributed to the participants through their respective class WhatsApp groups. The respondents were enrolled in undergraduate programs including B.Sc. (Computer Science), B.B.A. (Computer Application), and B.C.A. (Science). The use of an online mode was found to be convenient, enabling students to access the questionnaire easily and submit their responses efficiently.

The research questionnaire was designed to include questions related to add-on co-curricular courses, along with the participants' interest in and ability to use the recommendation system.

Data Pre Processing and Data Exploration:

The dataset collected from 243 students through an online questionnaire underwent several pre-processing steps to ensure accuracy and reliability of the results. Initially, responses were screened to remove incomplete or duplicate entries, thereby maintaining data consistency. Missing values in non-mandatory fields were addressed by either excluding such records from specific analyses or applying simple imputations where appropriate. For questions involving categorical choices (e.g., mode of course delivery, field of interest), responses were coded into numerical



labels to facilitate analysis. Similarly, Likert-scale ratings of programming skills were normalized to maintain uniformity across responses.

Following pre-processing, exploratory data analysis (EDA) was carried out to identify key patterns and distributions. Frequency counts and percentages were calculated for each survey item, providing insights into student preferences and career aspirations. Visualizations in the form of bar charts and pie charts were generated to represent interest levels, preferred learning modes, course formats, and domain-specific inclinations. This exploration revealed that a large majority of students favoured add-on courses, particularly those with practical, industry-oriented, and technology-driven content. The EDA served as the foundation for interpreting results and framing conclusions about student expectations from add-on courses.

IV. OBJECTIVES OF THE STUDY

The key objectives of this work are to:

1. To examine student's awareness and interest in pursuing add-on courses as a means of enhancing skills and employability.
2. To analyze student preferences regarding delivery modes, course formats, and areas of specialization in add-on programs.
3. To identify career aspirations of students and assess how add-on courses can support these professional goals.
4. To explore the role of practical, industry-oriented learning approaches in shaping student expectations from add-on courses.
5. To provide insights that can guide higher education institutions in designing flexible, relevant, and student-centric add-on programs.

V. RESULT AND DISCUSSION

The results indicate clear patterns in student preferences and participation. Certain trends and differences were observed across groups. These findings provide insights that can guide improvements and decision-making in the education system.

The first question is that are you interested in taking add on courses or not with option yes, no and may be. The result becomes is as follows.

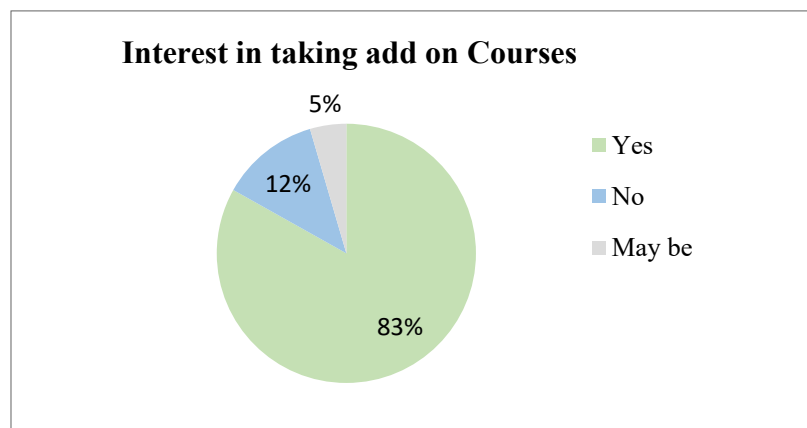


Figure 1: The result of respondents interest in taking add on courses

Figure 1 shows the **students' interest** in enrolling for add-on courses. Out of 243 students, 202 students (83%) expressed a strong interest in taking add-on courses, while only 41 students (17%) were not interested. This indicates a positive impact, as the majority of students understand the importance of add-on courses for improving skills and employability. However, the 17% disinterest suggests the need for better awareness programs and guidance to motivate all students to participate.

The next question is that Preference to attend add on courses with option online, offline and hybrid. The result becomes is as follows.

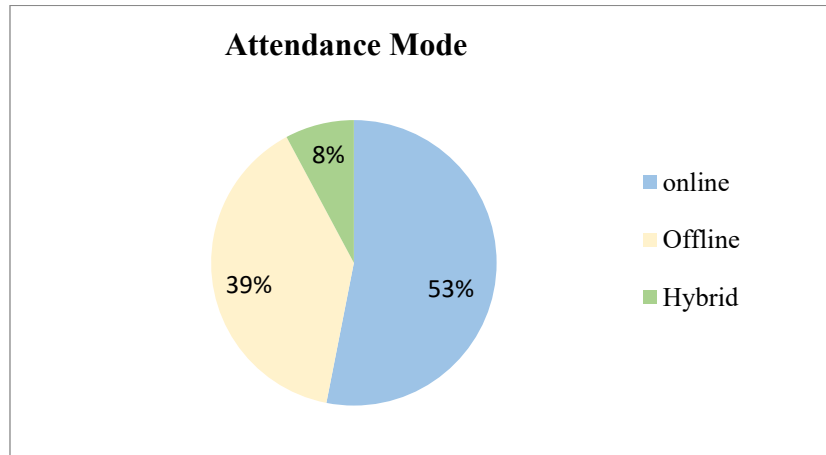


Figure 2: The result of respondent's attendance mode

Figure 2 illustrates the distribution of preferences for different attendance modes. The chart shows that online attendance is the most preferred, making up 53% of the responses. Offline attendance is the second most popular option at 39% and hybrid attendance is the least preferred, accounting for only 8%. The next question is that how interested are you in the areas with options given Data Science, Web Development, Cyber Security etc.,. The result becomes is as follows.

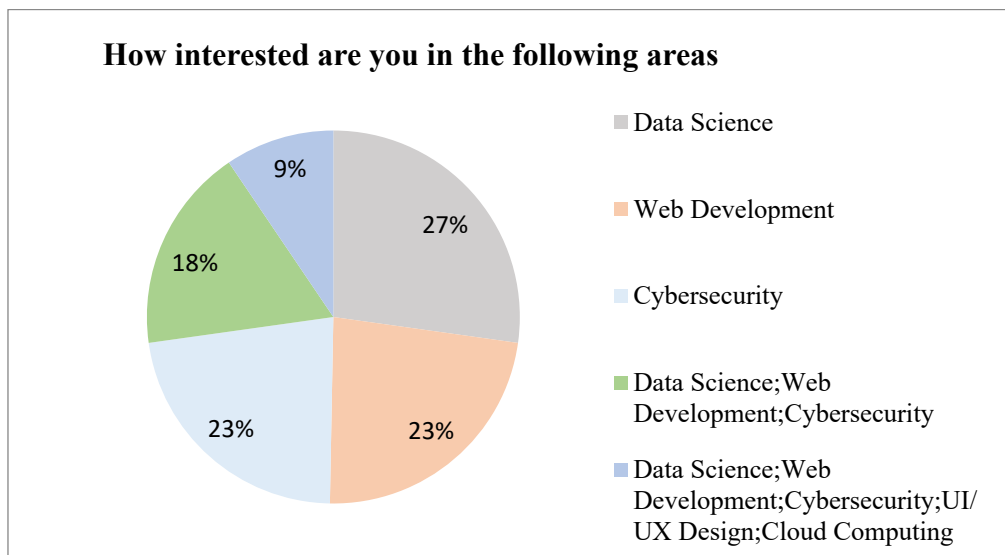


Figure 3: The results of respondent's interest in different areas

Figure 3 shows a breakdown of student interest in various fields. The most popular area is Data Science, with 27% of students expressing interest. This is followed by both Web Development and Cyber Security, which each account for 23% of the interest. The remaining students are interested in a combination of these areas with 18% showing interest in a blend of Data Science, Web Development and Cyber Security and a further 9% interested in an even broader combination that includes UI/UX Design and Cloud Computing.

The next question is that what type of add on courses would you like with multiple options given. The result becomes is as follows.

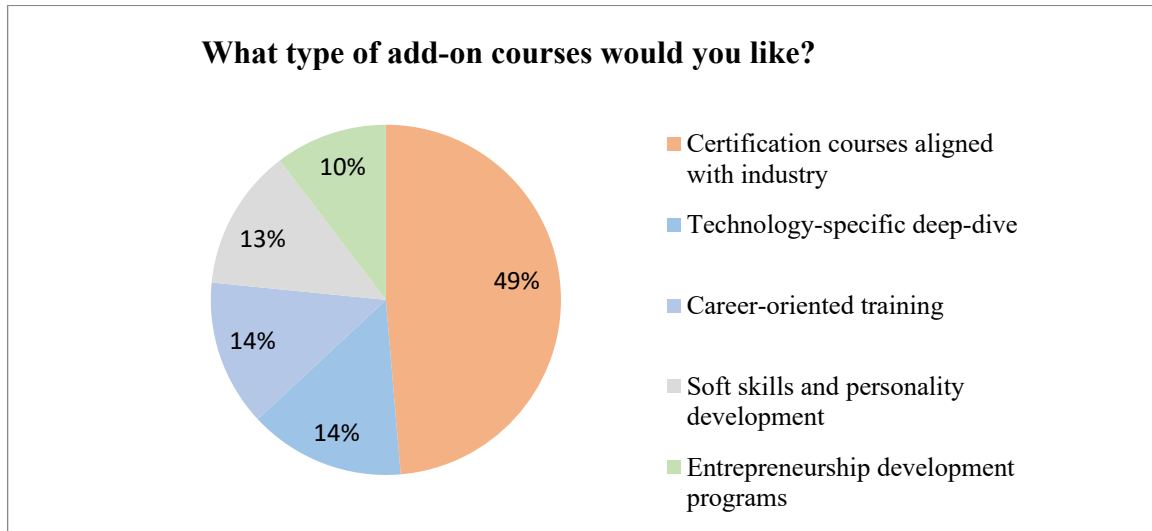


Figure 4: The results of respondent's interest in type of add on courses

Figure 4 illustrates student preferences for different types of courses. The overwhelming majority of students 49% prefer Certification courses aligned with industry. Other preferences are much smaller with Technology-specific deep-dive and Career-oriented training both at 14%. The remaining students are interested in Soft skills and personality development (13%) and Entrepreneurship development programs (10%).

The next question is that how should add on courses be structured to benefit students most effectively with multiple options given. The result becomes is as follows.

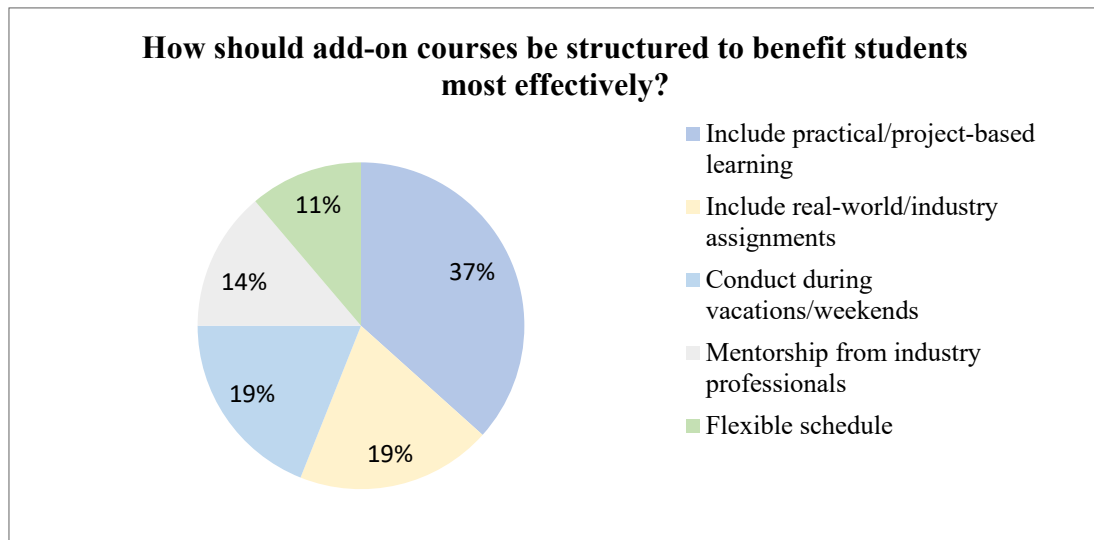


Figure 5: The results to check add on courses structured to benefit student's mode effectively

The chart shows that most students (37%) prefer add-on courses to focus on practical or project-based learning, reflecting the importance of hands-on experience. Around 19% each favor real-world/industry assignments and conducting courses during vacations or weekends, indicating a demand for application-oriented and convenient formats. About 14% of students suggest mentorship from industry professionals, while 11% prefer flexible schedules. Overall, students emphasize practical exposure and industry integration as key elements for effective add-on courses.

The next question is that what is your career goal with option given software developer, Cyber Security Expert, Data Scientist, UI/UX designer and System Administrator. The result is as follows.

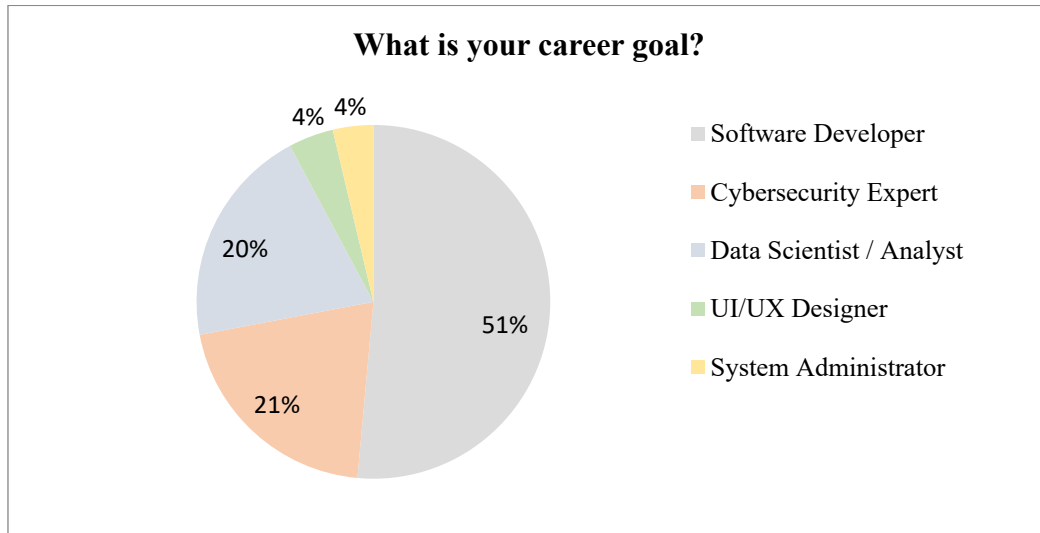


Figure 6: The result of respondent's career goal

The chart highlights that a majority of students (51%) aspire to become software developers, making it the most preferred career goal. Cyber Security expert (21%) and data scientist/analyst (20%) are also significant choices, showing growing interest in emerging technology fields. A smaller percentage of students aim to be UI/UX designers (4%) and system administrators (4%). Overall, the results suggest that most students are inclined toward software development, with considerable interest in specialized IT domains.

The next question is given regarding the rating of interest in the different domains like Programming, Web Development, Mobile Applications, Data Science/AI/ML and Cyber Security. Results of all ratings are shown in the following diagrams.

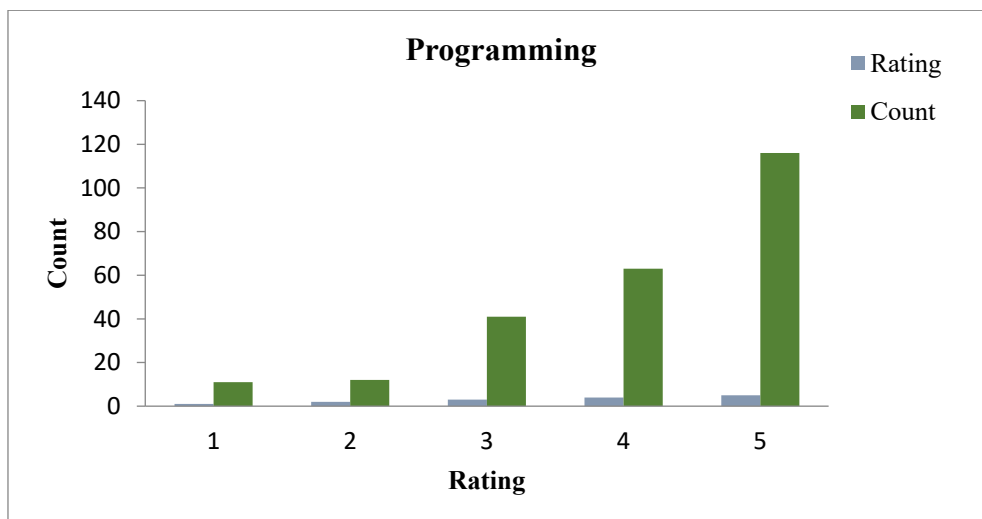


Figure 7: Result of respondents Programing Rating and Count

Figure 7, which utilizes a 5-point Likert scale to measure students' programming proficiency, indicates a high level of self-assessed skill among the respondents. The data shows that the majority of students rated themselves at the highest levels, 4 and 5, with over 100 students selecting the top rating. This finding suggests a strong collective confidence in programming skills among the students surveyed, which can be an important factor for their career goals in technology fields.

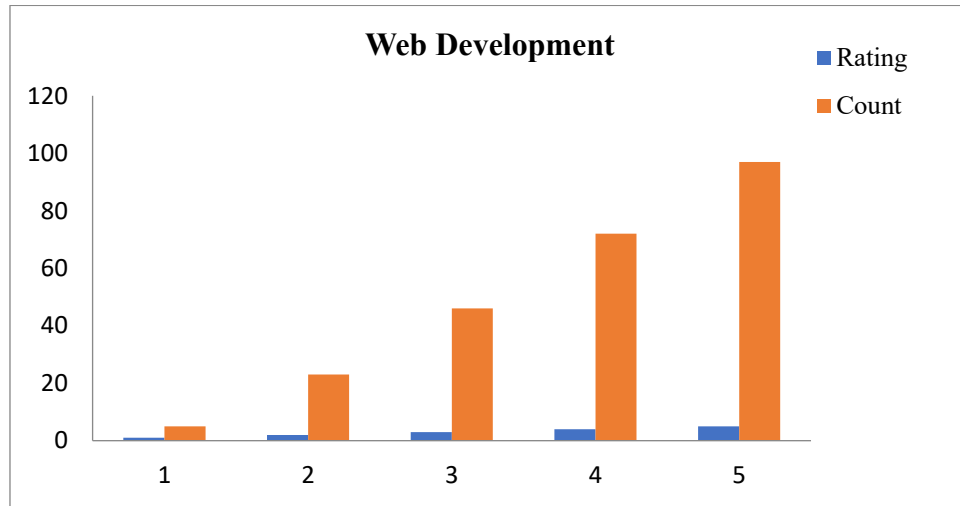


Figure 8: Result of respondents of Web Development

Figure 8 illustrates the distribution of ratings (on a scale of 1 to 5) and their corresponding count in a survey. A visual inspection reveals a highly skewed distribution towards the higher rating values, suggesting strong overall positive sentiment. Specifically, the Count of responses increases substantially with the rating, culminating in the highest frequency at the Rating of 5, which has a count of approximately 97. The data strongly indicates that the vast majority of respondents rated "Web Development" highly, with the mode of the distribution being the highest possible rating.

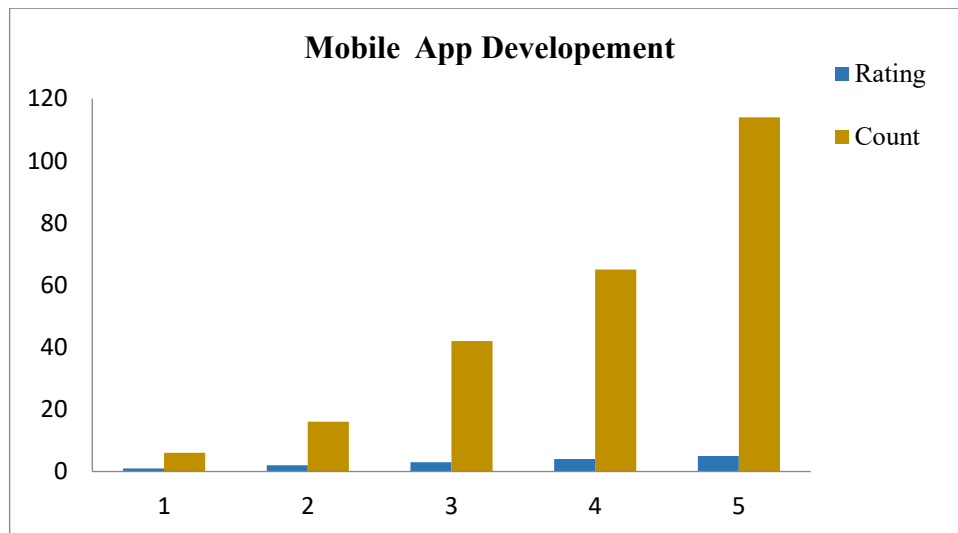


Figure 9: Result of respondents of Mobile App Development

Figure 9 illustrates the frequency distribution of ratings (on a 5-point scale) for the subject. Similar to a positive skew, the data clearly shows an overwhelming concentration of responses at the higher end of the rating scale, indicating a strong positive perception. The Count of respondents progressively increases from the lowest rating (1) to the highest rating (5). Specifically, the Rating of 5 is the modal category, garnering the highest frequency with an approximate count of 115, significantly outnumbering all other ratings combined. This pattern suggests that a decisive majority of the surveyed population rated "Mobile App Development" as either excellent (5) or very good (4), with minimal negative feedback recorded at the lower ratings.

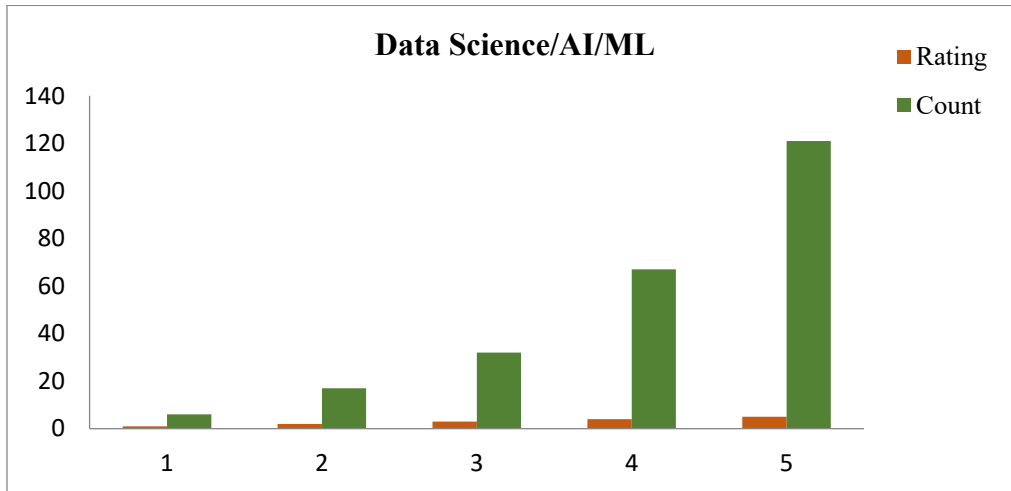


Figure 10: Result of respondents of Data Science/AI/ML

The figure shows that the data presents a remarkably strong positive skew, indicating exceptional approval for the subject matter. The frequency of responses, represented by the Count of responses, demonstrates a clear, accelerating upward trend as the rating increases. The Rating of 5 is the dominant mode of the distribution, registering the highest frequency with a count of approximately 121 respondents, far surpassing the counts for all other ratings. This highly concentrated distribution on the highest end of the scale statistically confirms an exceptionally positive perception and high demand or interest in Data Science/AI/ML.

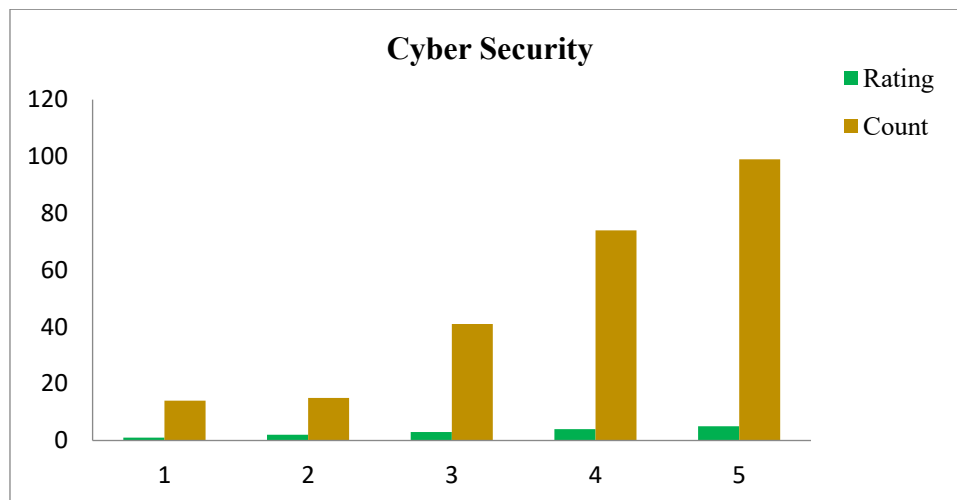


Figure 11: Result of respondents of Cyber Security

The figure shows that the data exhibits a distinct positive skew, with the vast majority of responses concentrated at the higher end of the rating spectrum, suggesting a very favourable perception of the subject. Specifically, the Count of respondents shows a progressive and steep increase from the rating of 1 to the rating of 5. The Rating of 5 is the modal category, recording the highest frequency with an approximate count of 99. This distribution pattern indicates that Cyber Security is exceptionally well-received, with strong positive sentiment dominating the survey results.

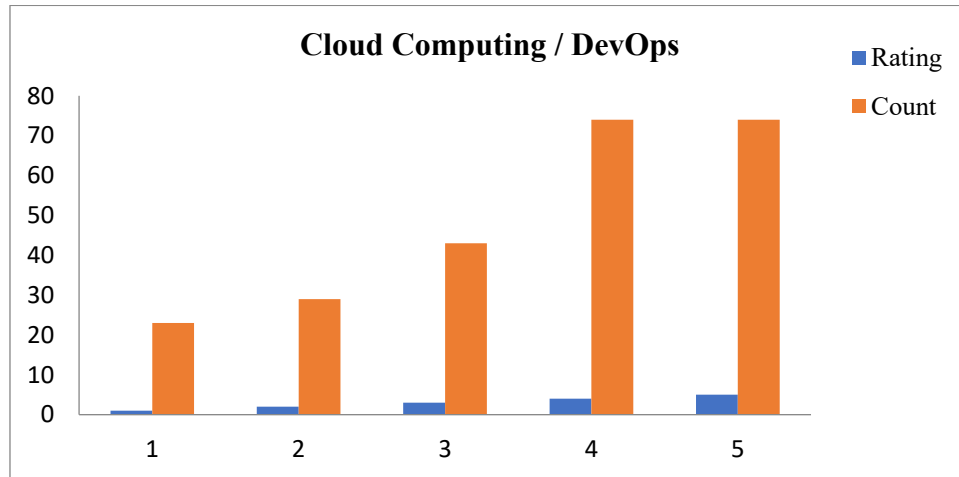


Figure 12: Result of respondents of Cloud Computing/Devops

Figure shows that the data reveals a strong positive skew, indicating a highly favourable overall perception of the topic. The frequency of responses, as shown by the Count, increases sharply with higher ratings, suggesting positive sentiment dominates. Ratings of 4 and 5 are the joint modes of the distribution, both registering the highest frequencies with counts of approximately 74 each. This pattern confirms that the vast majority of respondents rated Cloud Computing / DevOps as highly satisfactory, with minimal negative feedback.

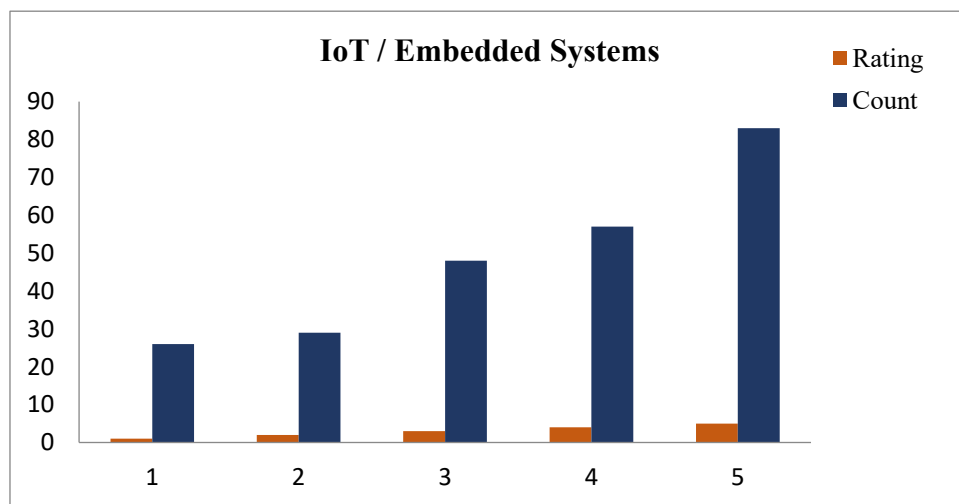


Figure 13: Result of respondents of IOT/Embedded Systems

Figure shows that the data exhibits a clear positive skew, where the frequency of responses increases monotonically with the rating value, indicating strong overall positive sentiment. The Count of respondents progressively rises from the lowest rating (1) to the highest rating (5). The Rating of 5 is the modal category, registering the peak frequency with an approximate count of 83 responses. This distribution strongly suggests that the majority of respondents hold a highly favourable view of IoT / Embedded Systems.

VI.CONCLUSION

The present study highlights the growing importance of add-on courses in higher education as a means to bridge skill gaps and enhance employability. The survey findings indicate that a large proportion of students are highly interested in pursuing such courses, with particular emphasis on technology-oriented domains like Data Science, Cyber Security, and Web Development. Certification-based and practical, project-driven formats were strongly preferred, reflecting the need for industry-relevant and hands-on learning experiences.



Furthermore, the results show that students favor flexible delivery modes, with online learning emerging as the most popular choice, followed by offline and hybrid approaches. Career aspirations centered largely on software development and related IT fields, supported by self-reported strong programming skills. These insights suggest that academic institutions should focus on designing flexible, practical, and industry-aligned add-on programs, while also implementing awareness initiatives to increase participation and ensure that such courses effectively contribute to students' skill development and career readiness.

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REFERENCES

- [1]. Parikshit Layek, Shubhra Rani Sil, "A Comparative Study of Ancient and Modern Education System: With Reference To India," *International Journal of Advanced Research*, 9(04), 427-434, April 2021, DOI: <http://dx.doi.org/10.21474/IJAR01/12704>.
- [2]. Kalokhe Anil Sopan, Kumbhar Vijaykumar Sambhajirao, "A Comprehensive Evolution and Impact of the Indian Education System: From Ancient Wisdom to Modern Innovation," *Journal of Nonlinear Analysis and Optimization: Theory and Applications*, Vol. 16, Issue. 1, No.1: 2025, 144-151, <https://doi.org/10.36893/JNAO.2025.V16I1.020>.
- [3]. Kalokhe Anil Sopan, Kumbhar Vijaykumar Sambhajirao, "Intelligent Course Recommendation for Students using Machine Learning Models," *International Journal of All Research Education and Scientific Methods*, Volume 12, Issue 12, December-2024, 2397-2402.
- [4]. Deepjyoti Roy, Mala Dutta, "A systematic review and research perspective on recommender systems," *Journal of Big Data*, 2022, <https://doi.org/10.1186/s40537-022-00592-5>.
- [5]. Anil Sopan Kalokhe, Vijaykumar Sambhajirao Kumbhar, "A Review on Course Recommendation System in Higher Education using Machine Learning," *International Research Journal of Humanities and Interdisciplinary Studies*, 47-55, 13 January 2024, <https://doi-ds.org/doi/10.2024-62641628/IRJHISIC2401007>.
- [6]. Miftahul Jannat Mokarrama, Sumi Khatun, Mohammad Shamsul Arefin, "A content-based recommender system for choosing universities," *Turkish Journal of Electrical Engineering & Computer Sciences*, 2128 – 2142, March 2020, doi:10.3906/elk-1911-37.
- [7]. Alber S. Aziz, Reda A. El-Khoribi, Shereen A. Taie, "Adaptive E-Learning Recommendation Model Based On The Knowledge Level And Learning Style," *Journal of Theoretical and Applied Information Technology*, Vol.99, No 22, 5241- 5256, 30 November 2021.
- [8]. Kalokhe Anil Sopan, Kumbhar Vijaykumar Sambhajirao, "A Personalized Course Recommendation System for Students Using Machine Learning Techniques," *Journal of Technology*, Volume-12, Issue-12, 903-912, 2024.
- [9]. Matthew O. Ayemowa, Roliana Ibra, "Analysis of Recommender System Using Generative Artificial Intelligence: A Systematic Literature Review," Volume-12, 2024, 87742-87766, doi: 10.1109/ACCESS.2024.3416962.



- [10]. Udhayakumar S, Harisai V, “College Recommendation System for Students Using Datamining with Colaborative Filtering Algorithm–2,” *International Research Journal of Modernization in Engineering Technology and Science*, Volume-3, Issue-8, 427-433, August 2021.
- [11]. Ashuta Thakur, Sheetal Rathi, “Automated Online Course Recommendation System using Collaborative Filtering,” *International Journal for Research in Applied Science & Engineering Technology*, Volume-9, Issue-2, 222-229, February 2021.
- [12]. Sonia Souabi, Asmaa Retbi, Mohammed Khalidi Idrissi, Samir Bennani, “A Recommendation Approach in Social Learning Based on K-Means Clustering,” *Advances in Science, Technology and Engineering Systems Journal*, Volume-6, Issue-1, 719-725, February 2021.
- [13]. Dr. D. V. Divakara Rao, Dr.P.M.Manohar, A.Venkatesh , A. Lokesh Kumar, Abhinav, “Course Recommendation System using Machine Learning,” *Dogo Rangsang Research Journal*, Volume-13, Issue-4, 64-73, April 2023.

BIOGRAPHY



Kalokhe Anil Sopan holds an M.Sc. in Computer Science, has qualified the SET examination and is currently pursuing his Ph.D. in the Department of Computer Science at Shivaji University, Kolhapur. He has taught a wide range of courses including B.Sc. (Computer Science), M.Sc. (Computer Science), MCA (Science), BCA (Science) and BBA (CA). His academic contributions include the publication of 18 research papers in reputed international Journals. He has the authorship of a Textbook on E-Commerce for BBA(CA), B. Com (CA), and BCA students of Savitribai Phule Pune University. His professional journey reflects a strong commitment to teaching, research, and

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