CollabConnect: Where Skills Meet Opportunity

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***Abstract*—In educational environment, there are very few opportunities for students to regularly meet compatible peers outside of their close social circle because there is minimal information about their fellow students' talent, study interests, and psychological compatibility. CollabConnect fills this gap with centralized, AI-powered tool for smart team collaboration on the basis of a mix of skill profiling, study-interest filtering, and personality testing on the basis of the OCEAN model. In contrast to conventional systems where all of these parameters are treated independently, this website integrates machine learning-based and rule-based approaches to develop balanced teams sensitive to varying needs from research projects to hackathons. Based on the particular needs of the activity or project, the study facilitates both heterogeneous group creation where heterogeneity fosters innovation and creativity and homogeneous group creation where homogeneity fosters harmony. Alumni, student, and faculty role-based access is delivered, along with integrated communication functionality and event planning functionality. Continuous testing in different conditions has established the platform to optimize collaboration, mentoring, and engagement by being able to build high-performing, compatible groups of people across different departments and academic levels. Finally, CollabConnect redefines conventional collaboration as a dynamic, integrated, and data-driven process that encourages scholarly innovation as well as meaningful mentoring.**

***Index Terms*—Skill-based Team Formation, OCEAN, Clustering, Academic engagement, Psychological traits.**

I. Introduction

Academic excellence depends on collaborative study methods that encourage new ideas, encourage views from different fields, and improve the ability to solve problems. Students with similar study interests often work together on multifaceted projects in schools that are autonomous, which means they have academic freedom and self-governance [1]. Even though these kinds of partnerships have a lot of promise, it can be hard for students to find good partners outside of their immediate social and academic networks. These problems are mostly caused by poor ways for departments to talk to each other, not being able to see each other's skills and study areas, and not having any structured networking protocols. Because of this, important chances for academic growth, peer-mediated knowledge transfer, and collaborative work that works well together are still not being used.

It can be hard for both faculty and research scholars to find students whose research goals and skills are aligned enough to form useful academic partnerships. Without organized ways to connect students and professors, intellectual capital isn't being used to its full potential, and chances for mentoring and working together on research projects are greatly reduced.

The best answer is to set up an integrated collaboration ecosystem that takes into account a lot of different factors that affect matching, such as academic interests, complementary skill sets, psychological compatibility profiles, and personal experiences. Through clustering based algorithmic matching and OCEAN rule-based approach, this platform would make it easier for students, faculty members, and alumni to interact with each other in a dynamic way. This would support cross-disciplinary research projects and campus-wide innovation networks.

Empirical study backs up how important these collaborative factors are. Pavez et al. [2] study the connection between group potency, interpersonal affective trust, cognitive trust, and team resilience under stress in construction project management settings. However, their research is industry-specific and doesn't look at AI-driven team formation interventions. To et al. [3] look at how team diversity affects creation by looking at cognitive and emotional factors. They give us basic ideas for designing algorithmic teams that work well together in a variety of settings. Sherstiuk et al. [4] suggest a deep

learning-based strategy for team recommendations that uses MBTI personality types, performance metrics, and interaction patterns to improve team dynamics and productivity.

Existing methods deal with specific issues like trust, behavioral classification, skill development frameworks, and personality-based team formation, but there isn't a single platform that brings together academic skills, psychological traits, and cross-disciplinary collaboration in a way that works for the whole campus. Our study fills in this gap by creating an intelligent, multi-parameter collaboration platform that combines psychological compatibility testing, detailed skill mapping, and academic interest profile. The system gives personalized team suggestions for both students looking for people to work with and professors looking for people to do research with. It also makes it easier for people from different departments to connect and for alumni to get involved, which improves the culture of interdisciplinary research.

II. Related Works

A. Psychology

The research investigates how familiarity bias in team collaboration impacts dynamics, finding that teams that have more familiarity bias come up with fewer ideas and demote members who put forward alternative ideas, but fail to address individual personalities, team dynamics, and joint objectives adequately [5]. Another research looks into how trust, cultural diversity, and group construction processes affect students' behavior and participation in group work, discovering that trust affects engagement more than cultural diversity or group construction processes, but focus is less on key areas such as communication styles, conflict resolution approaches, and consolidation of diverse opinions, particularly appropriate for activities such as hackathons [6]. A meta-analysis among different demographic groups studied the internal consistency of the 44-item BFI and 60-item , thus establishing the reliability of the BFI-44 instrument. Nonetheless, this work is concerned with psychometric properties rather than applications to the team formation situations, hence, questions about implementation within educational premises [7].Research that has compared five variables in pair programming strategies reveals that dissimilar pairs code better when paired based on friendship and conscientiousness, and similar pairs have higher flow when paired on learning style but ignores such aspects as cultural background, motivation, cognitive ability, and fails to consider long-term team performance [8]. Yet another study points towards teamwork importance and group formation complexity but has incomplete knowledge about all the influencing factors and lacks comprehensive, actionable conclusions [9]. A study on emotional commitment, complementary and supplementary person-team fit reveals its influence on teamwork but does not touch upon such key aspects as diversity of thought integration, conflict resolution strategies, or communication [10]. [11] introduces a data-driven method of team formation in software engineering using personality attributes, which achieved better team performance through strategic matchings. Although, this research proves useful for personality-based setting up of teams, it is specifically targeted at software engineering settings and overlooks the diversity of the academic collaborative environments that prevail in the educational settings. . Lastly, a case study-based article examines organizational factors affecting group creativity but does not extensively examine individual-level factors such as personal motivation, cognitive styles, or interpersonal processes within teams [12].

B. Skills

Organized team building according to Belbin's Role Theory improves collaboration, critical thinking, and effectiveness through balancing a range of different abilities, but is challenged when assigned roles are not matched with students' natural strengths, and more flexibility is needed [13]. Strategies to enhance self-regulation in blended learning highlight the importance of scaffolding, technology integration, and additional research on self-monitoring, teamwork, and adaptability, with gaps in peer learning infrastructure, social requirements, group processes, procrastination habits, and technological adjustment [14]. Another article emphasizes the need for diverse, data-based team composition strategies to enhance team performance and satisfaction, noting that existing models tend to be non-scalable, fail to address interpersonal conflicts effectively, and have limited empirical support [15]. Collaborative learning has been found to improve major skills and student independence, needing robust technological and pedagogical infrastructure to facilitate efficient role allocation and feedback mechanisms, although difficulties continue in virtual contexts within the areas of task structuring, usage of technology, and the creation of social interaction [16]. In addition, although collaborative learning enhances engagement, autonomy, and work-readiness through technology integration, there is still a deficiency of interdisciplinary approaches, inadequate teacher preparation, low cultural adaptability, poor inclusion of diverse student groups, and an absent blended qualitative-quantitative evaluation strategy [17].

C. Clustering

Using a compatibility matrix, the article proposes a greedy algorithm (GAMT) for assembling programming teams with minimum overall runtime, maximum programmer-programmer interaction, but without employing machine learning to make predictions on or dependency in tasks, and with scalability and flexibility constraints [18] . Another study emulates team sports as biological multi-agent behaviors using the integration of trajectory prediction, rule extraction, and clustering and a combination of machine learning and rule-based methods to provide trade-off between prediction and interpretability, although it is only applicable to sports, and with high processing costs, but no real-time adaptability [19]. To analyze student behavior, a hybrid clustering technique (K-CFSFDP) that blends K-Means with CFSFDP is suggested, which effectively clusters students based on learning patterns but ignores professional objectives, external influences like employment,

and predictive modeling for career guidance [20]. Another research addresses the integration of agent-based simulation and social network capabilities to guide team-formation policies in crowdsourcing, prioritizing worker independence but not experimenting on large datasets, dynamic update of worker preferences, and adaptive feedback [21]. In addition, another work analyzes the impact of staff diversity on team performance by using MBTI, Belbin's roles, and other personality models in postgraduate experiments and discovers that deep-level factors enhance synergy, yet surface-level effects of diversity are unobtrusive, and it lacks a dynamic, systematic approach to maximizing team makeup [22]. Partitioning algorithms like K-Means, where points are repeatedly reassigned to the nearest centroid and cluster centers recalculated, are valued for their efficiency and ease with large datasets [23]. Hierarchical clustering builds a nested subset tree, allowing for inspection at different levels of resolution without having group numbers specified in advance [24]. Density-based approaches such as DBSCAN identifies cluster of any shape by identifying dense regions and hence eliminates noise [25]. Spectral clustering identifies complex relationships through eigenvectors of a similarity matrix and performs well on non-convex objects [26]. Each of these approaches sacrifices some combinations of scalability, shape flexibility, and parameter sensitivity.

III. Methodology

CollabConnect is a web-based platform that helps in team formation among students based on personality assessment and skills. The system uses OCEAN (Big Five) personality assessment coupled with rule-based and machine learning algorithms for the generation of an optimal team for different scenarios. In addition, it allows the students to interact with teachers and alumni for academic help and career mentoring opportunities.

CollabConnect follows a multi-layered microservice architecture as shown in Figure 1, with each layer serving specific functionalities that work together to provide a seamless user experience. This microservice approach allows for greater flexibility, scalability, and maintainability compared to monolithic architectures.

A. Client Applications Layer

The client layer is designed as a responsive web interface comprising three different user interfaces.

1) Student Web Interface: The dashboard is designed that show personalised content such as profile details, events, and notifications. Created an events page that can be used by the students to look for upcoming events and register. Developed an interface for team formation with preferences for team size, formation algorithm, and preferences for team composition. Introduced the interface of personality assessment based on the OCEAN traits and constructed communication interfaces for communicating with teachers and alumni.

2) Teacher Web Interface: A dashboard is created in which teachers can manage their profiles, communicate with students, and receive requests. Created an interface to accept/decline a request for collaboration from students. Added a page for managing a profile on which the teachers can emphasize their areas of expertise and availability.

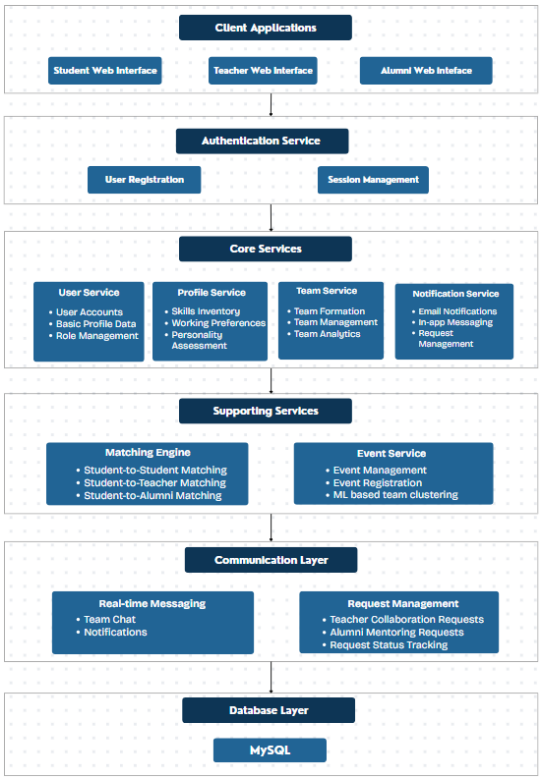

Fig. 1: End-to-End System Architecture Diagram

3) Alumni Web Interface: Created a dashboard for mentoring requests by students and communication history. Built a profile management for alumni to share their journey of career and experience. Developed an interface for dealing with availability and communication preferences. This layer addresses user stories like a clean and consistent design in all pages to ensure a seamless user experience, We introduced a consistent design system on all interfaces.

B. Authentication Service Layer

The authentication layer handles identity management and session handling.

1) User Registration: A secure signup process where necessary information can be obtained is implemented and developed role selection functionality that allows users to identify themselves as student, teacher, or alumni Constructed an email authentication system to prevent illegitimate users.

2) Session Management: Implemented secure login/logout functionality. Implemented session persistence for the state of the user to be preserved across pages Developed role-based access control to limit access to the pages depending on the type of user.

C. Core Services Layer

This layer has the key logic components.

1) User Service: user account management, where users can create and update accounts. Role management functionality to cater to different user types. Developed basic profile data management for any user.

2) Profile Service: Deployed profile inventory for storing and retrieving of users information. Developed working preferences tracing for team building purposes. Developed personality assessment for storage and processing, calculation, and storage of OCEAN scores.

- OCEAN model (Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism) was chosen due to scientific validity and applicability to the team dynamics. The well-known psychological instrument gauges five critical personality parameters using a 44-question examination, which derives a complete profile from which smart team building can formulate. Every trait provides important insights into the ways that students may work together, solve problems, and communicate with other team members.

3) Team Service: Implemented team formation functionality using both rule-based and ML-based algorithms. Creates the following team management features of view team and connection with the team. Introduced team analytics to give information about the types of teams and their performance.

- Two team formation techniques are present, one rule-based approach taking its direct similarity or complementarity computations between personality profiles to list them together in a simple kind of matching, and another, an enhanced K-means clustering algorithm for advanced pattern matching. K-means was picked for its effectiveness with multivariate data, interpretability, and the capacity to find natural clusters in the five personality dimensions. For identical teams, the system clusters students with the same traits together, whereas for non-identical teams, students are grouped from different clusters to achieve maximum diversity in traits as well as complementary strengths.

4) Notification Service: Developed a notification system for the updates and applied in-app messaging for instant communication within formed teams. Developed request management notifications for collaboration requests to teachers and alumni.

D. Supporting Services Layer

These services are specialized functionality that augments the core features.

1) Matching Engine: Deployed student-to-student matching based on compatibility of personality. Designed student-to-teacher matching based upon the student's request to the teacher and student-to-alumni alignment, also according to the student's requests.

2) Event Service: Built event management functionality, creation and viewing of events, and implemented the event registration system and capacity management system. The teams that are formed based on the matching algorithms can show overall team compatibility.

E. Communication Layer

This layer facilitates user interactions.

1) Real-time Messaging: Added the team chat functionality for the registered members and developed a notification system for up-to-date information.

2) Request Management: Developed teacher collaboration request handling. Implemented alumni mentoring requests processing. Development of the status monitoring of the built request for transparency purposes.

F. Database Layer

The CollabConnect platform uses 13 tables of a MySQL database designed with care to provide its functionalities. Composition of the schema includes user management (users), role-specific profiles (student_profiles, faculty_profiles, alumni_profiles), forming teams (teams, team_members, team_messages), event management (events, registered_events), communication (teacher_requests, alumni_requests, notifications), personality analysis (personality_clusters). Such relational structure is an excellent foundation for the microservices architecture, and clear data boundaries allow various services to access respective tables without any harm to the data integrity, as the tables are linked via foreign keys, supporting all means, from user authentication to rating personality-based team formation.

IV. Results

The designed system was assessed against its main functions: faculty/alumni communication, automated team formation, personality-type/team communication analysis. The next sections will demonstrate those modules visually, while showing how the platform supports intelligent team assignment, how faculty and alumni mentorship is possible by having them provide guidance and support, while allowing students to interact simultaneously regardless of location. We can conclude with confidence that the system supports enhanced engagement, allows for the potential of mentoring, and creates more balanced teams in academic and co-curricular activities.

A. Collaboration and Guidance

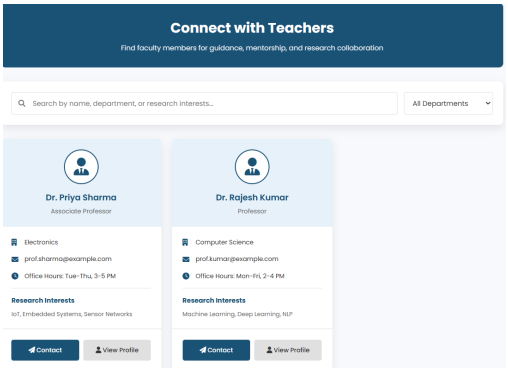

Fig. 2: Faculty Communication and Interaction Panel

The Figure 2 interface is the faculty search and contact page, so students can indicate professors based on the department

and research area. Each faculty card contains contact options and research areas to user story of setting up mentorships.

B. Mentor and System Notifications

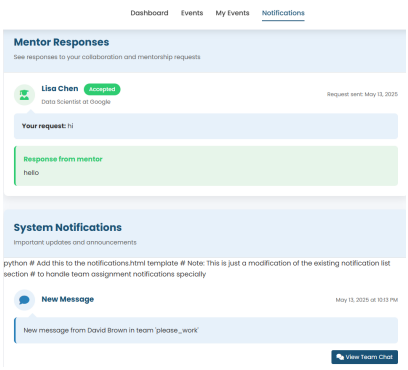

Fig. 3: Mentor Notification and Alert System Interface

This visualization of Figure 3 denotes the notifications panel with a breakdown of mentor responses and system notifications, allowing users to quickly determine the status of any collaboration requests and message alerts. This caters to the user story of being able to track interactions in real time.

C. Team Formation and Analytics

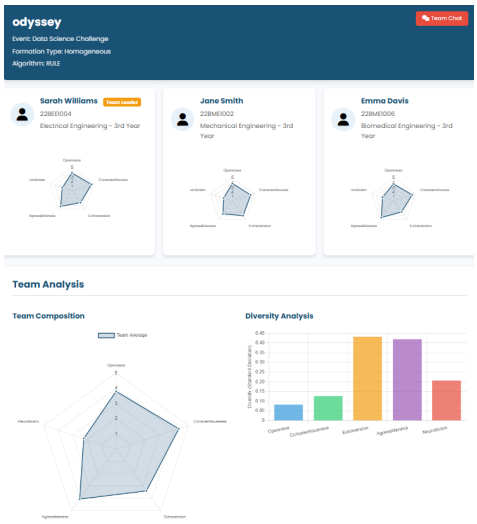

Fig. 4: Team Analysis Dashboard

The Figure 4 depicts a generated team including visualized personality radar charts and diversity analytical results. It also shows how the system is creating balanced teams while providing comparative analytics to create fair and compatible groups.

D. Team Communication Module

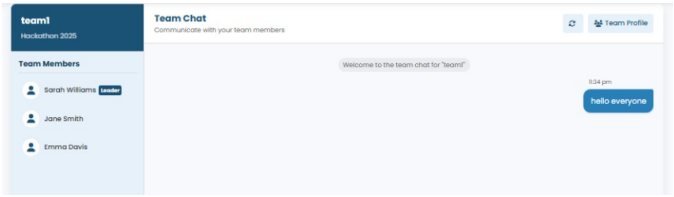

Fig. 5

The Figure 5 illustrates the live team chat interface that allows members to share messages and announcements. In relation to the user story, this feature allows for communication with teams to enhance the plan review process and team alignment.

E. Alumni Interaction and Feedback Mechanism

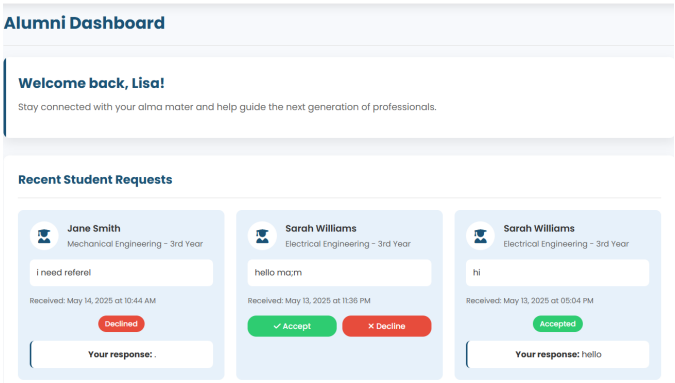

Fig. 6

The Figure 6 demonstrates the alumni dashboard where alumni can see requests from students and respond directly. It emphasizes the mentorship loop which connects current students with alumni who have experience, and supports user story of learning guided by alumni.

V. Conclusion and Future Directions

The proposed intelligent collaboration platform comes up with effective solutions to issues such as the weaknesses of traditional team formation methods by creating a single, data-driven system with the integration of psychological compatibility, skill profiling, academic interests, and cultural diversity. Adaptive, scalable, and personalized team recommendations for students, teachers, and alumni are ensured by using both supervised and unsupervised machine learning algorithms on the platform. This not only creates interdisciplinary teamwork and inclusive participation but also expands project success rates, people's engagement, and readiness for the career. The fact that the system can dynamically match people using holistic profiles helps to create stronger cohesion among the members of the team, enhances communication and creates a more innovative academic ecosystem. In the end, this platform

transforms the concept of collaborative learning as it forms purposeful, balanced, and target oriented academic groups.

The future directions for Collab Connect are intended to increase its effectiveness and usability by increasing its scope and level of technology. One of them will be Cultural Diversity Assessment in which cultural intelligence measurements will be integrated with personality measurements to create teams with different cultural backgrounds – stimulating global competence and facilitating cross-cultural communication competencies. Another development is the Mobile Application Extension, whereby a mobile app version of Collab Connect is developed to strengthen accessibility with regards to real-time notifications and the management of team events by users on the go. In addition, Integration with Learning management Systems (LMS) like Canvas, Moodle, or Blackboard is scheduled to achieve seamless integration between event schedules, assignments, and team structure with the current academic systems – simplifying both administrative as well as learning processes.

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