Board 177: Work in Progress: The Development of a Research-Based Application for Effective Mentor-Mentee Matching

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Alondra Gonzalez completed an Associate degree in Engineering Science at Wilbur Wright College and is pursuing a Bachelor's in Computer Science at the Grainger College of Engineering at the University of Illinois at Urbana-Champaign. She previously participated in the NSF HSI Summer Bridge. At Wright, she has been a tutor, near-peer mentor, and a research assistant. She was a Molecular Biophysics NSF REU Training Site participant at Princeton University. She is participating in The New Technologists internship program at Microsoft.

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Doris Espiritu is the Dean of the Center of Excellence for Engineering and Computer Science and Professor of Chemistry at City Colleges of Chicago-Wilbur Wright College. She also serves as the Senior Advisor to the Provost of the City Colleges of Chicago. Doris Espiritu is one of the first National Science Foundation's research awardees under the Hispanic-Serving Institutions (HSI) Program. She pioneered Engineering at Wright and had grown the Engineering program enrollment by 2500% within five years. Doris founded seven student chapters of national organizations including the Society of Women Engineers (SWE), the Society of Hispanic Professional Engineers (SHPE), the Society of Asian Scientists and Engineers (SASE), the National Society of Black Engineers (NSBE) and ten times Outstanding Chapter Awardee, the American Chemical Society-Wright College Chapter. Doris promotes collaboration between K-12 schools, other community colleges, 4-year institutions, non-profit organizations, and industries. Doris' current research is to design and implement practices that develop Community of Practice (CoP), Professional Identity, and Self-Efficacy to increase diversity in Engineering and Computer Science and to streamline transfer from community colleges to 4-year institutions.

Work in Progress: The Development of a Research-Based Application for Effective Mentor-Mentee Matching

I. INTRODUCTION

Mentoring is a relationship between two individuals, wherein a mentor, an experienced and knowledgeable individual, provides guidance and support to a less experienced mentee. This relationship is established with the objective of imparting knowledge, skills, and expertise to facilitate the mentee's personal and professional growth [1]-[5]. Currently, there are several models of mentoring relationships. Mentoring can happen on a one-to-one basis. It can be situational, group or peer-based [6]. It can also occur in formal or informal contexts [4]. An ideal mentoring relationship must happen organically [7].

Mentoring is an essential tool for engineering education that allows students to get support through learning the technical and behavioral skills needed to succeed [5]. The larger engineering community is responsible for ensuring that students do not exit STEM due to inequalities and exclusions [8]. It has been observed that a lack of mentoring can lead to underdeveloped identities in STEM, low self-efficacy, and low retention rates [9]. Thus, mentoring can serve as a catalyst to promote STEM pursuits at the collegiate level [10]. Mentoring encourages young professionals to remain in engineering instead of leaving for other fields [11]. Benefits of mentoring are not limited to the mentees, as mentors can also develop their leadership capacity and feedback practice [12]. Mentors also experience improved soft skills and an increased social network because of their mentoring relationship [6].

There has been progress in providing mentorship for young adults, but there is chronic lack of support [13]. Thirty-four percent (34%) of youths report never having an adult mentor during their education and development [14]. Traditional mentoring programs in STEM fields often result in mismatches for personality, professional expertise, or expectations [15]. Finding an ideal mentoring relationship is challenging. A well-designed mentor-matching process, mentor training, and ongoing support outside of the program are needed [16].

The aim of this research is to identify the critical components of successful mentor-mentee relationships. A preliminary research-based application has been developed to predict the percentage of compatibility between a mentor and mentee. The hypothesis is that for an ideal mentoring relationship to occur, there should be a percentage of matching between four dimensions: personality type, career aspiration, interests, and demographics.

The Four Dimensions:

A) Personality Type: The Myers-Brigg Type Indicator (MBTI) is a widely used personality assessment tool that provides insights into an individual's cognitive, emotional, attitudinal, and behavioral intricacies [17]. There is mixed consensus surrounding the MBTI's construct validity and reliability [18]-[21]. However, the MBTI has also been used extensively in many settings regardless of the mixed consensus [22]-[25]. MBTI's 16 personality types align very well with the tier-based approach of matching (discussed in the methods).

B) Career Aspiration: Mentoring relationships can have a significant impact on one's feelings of competence, efficacy, and interest in specific career goals [26]. Shared career aspirations help mentors and mentees relate to and understand each other and navigate the complexities of their related career paths [27]. Recognizing and acknowledging career aspirations can provide individuals with the necessary structure to grow and succeed on their professional journeys.

C) Personal Interests: A mentoring relationship is likely to succeed if shared interests are also factored in [28]. Shared personal interests foster deeper connections because the relationship goes beyond career-related problems to sharing of interests, needs, and values [29].

D) Demographics: Demographic characteristics, such as age, gender identity, ethnicity, or race, can significantly impact mentoring relationships. When pairs share similar backgrounds, it is easier to build trust and empathy, which strengthens the relationship [30]. Shared identity has been shown to improve retention rates and lead to other successful outcomes [31]. However, this app respects individual's preferences. Demographics will be the mentor and mentees prerogative.

II. METHODS

An experimental phase algorithm and application was designed to test a preliminary combination using a Tier-Distance Based System. The overall strategy is shown in Figure 1.

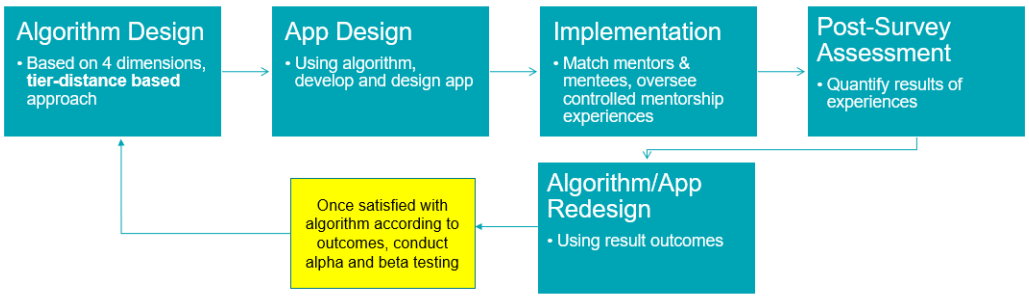

Figure 1. MentorMatch Methods & Process

A) Algorithm Design

The *MentorMatch* matching algorithm was designed based on the previously defined four dimensions. A modular quiz was designed to quantify the dimensions so that the algorithm's operations and comparisons can be implemented. The questions on the quiz change depending on the role of the participant. Answers to the questions are scored against each other using a Tier-Distance Based System. Currently, the algorithm cannot be disclosed because it is proprietary, and at the early stage of development.

The Tier-Distance Based System determines the similarity between any two sets of data by finding the tier distance between two answers to a question. Tiers are assigned based on the number of answers for a multiple-choice question. Answers determined to be closely related to each other are placed in the same tier. The distance or similarity of answers to a question are compared based on tiers. For example, the "Chemical" tier of majors, which may contain Chemical Engineering, Biomedical Engineering, etc., may be far from the "Software" tier. Any two answers within the same tier will be scored a 100% match while answers from different tiers

will have their percentage deducted by a defined amount based on tier-distance. The Tier-Distance Based System scores any two answers without individually scoring all possible combinations.

The initial algorithm is preliminary, and the *MentorMatch* application and the mentoring experience will be assessed through a post-survey. The results will be used to adjust the algorithm accordingly.

B) App Design

Following the creation of the algorithm, the *MentorMatch* application was developed using Flutter, an open-source multi-platform application framework owned by Google. Flutter helps mitigate the issues or differences of experience that may be present when creating multiple versions of the app for different platforms. Firebase, a cloud-storage infrastructure developed by Google, was used to host the application and as a database because of its scalability and top-notch security [32].

C) Implementation

1. Mentor's Preparation and Sign-up

A near-peer mentoring approach was used to test the *MentorMatch* application and algorithm for Phase 1 of experimentation at Wright College. The implementation procedure began by hosting a Faculty-led Mentor Training Workshop for students interested in becoming near-peer mentors. Training was utilized to minimize bias due to the students lack of mentoring experience. The workshops aimed to teach the best mentoring practices in alignment with research-based frameworks [33]. The sessions trained mentors on accountability, safety, assessment, and the overall execution of the mentoring processes. Participants who completed the training were asked to sign up for the application and complete a mentor's profile.

2. Mentee's Sign-up and Mentoring Experience

Currently, engineering students from Wright College were asked to register for the *MentorMatch* application. The experiments sample is limited to Engineering students due to ease of access. The match percentage between the mentor and mentee was generated by the app. They were prompted with multiple potential mentors and shown few characteristics such as name, personality type, major, and career stage. Pairs were requested to undergo mentoring relationships blindly to prevent bias. After two (2) months, participants in the mentoring experiences were asked to complete a post-survey to assess their experiences and to ask their perceived percentage of compatibility. The length of the experience provides enough time to assess the match and will be adjusted in future experimentations.

3. Assessment

Responses from the post-survey were used to determine how well the preliminary algorithm performed when scoring a particular match. This will be compared with the app-generated

matching (see Future Works). If the post-survey revealed a poor experience but the algorithm predicted an excellent experience, changes will be made to the algorithm. For example, if the algorithm predicted a mentor-mentee match to be 90% but participants say they felt a 40% match, it tells us the algorithm was not effective. Recursive testing and experimentation will be done until a consensus between the algorithm's effectiveness and the participants' mentoring experience is achieved.

III. PRELIMINARY RESULTS AND DISCUSSION

This research investigates the effectiveness of a preliminary algorithm designed to match engineering students in mentor-mentee relationships at Wright College. The initial sample size consisted of 110 engineering students from Wright College. Only 21 students completed the mentorship experience and 18 completed the post-experience survey on the first round. 58 experiences were implemented in the second round of experiences, and 28 students completed the post-experience survey (data not shown).

The first question asked on the survey was about how much they agreed with a particular match. 89% of participants agreed with their match. The second round of assessment specifically asked for the perceived percentage of matching rather than a "Strongly agree to Strongly disagree" Likert scale.

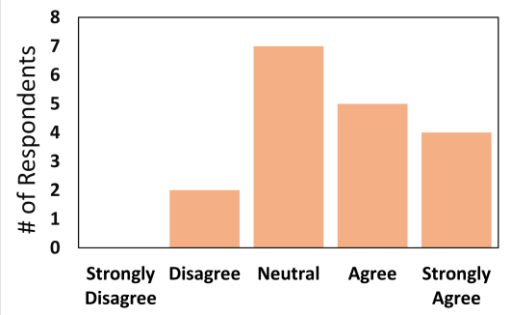

Figure 2. Participant survey results on how much they agree with mentor-match.

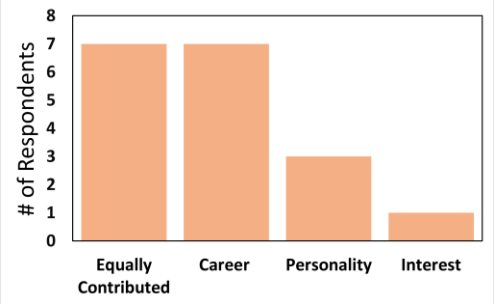

Figure 3. Participant survey results on dimensions most believed to impact mentoring experiences.

The next question asked on the post-survey was which dimension is most believed to have the greatest impact on the relationship. Thirty-nine percent (39%) of participants believed all dimensions equally impacted the mentoring experience, while twenty-two percent (22%) of participants believed career aspiration to be the most impactful dimension.

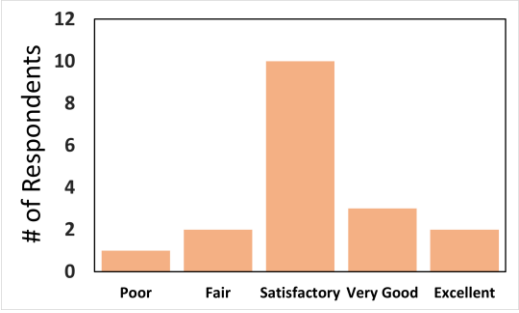

Figure 4. Participant survey results on satisfaction with the application: poor, fair, satisfactory, very good, excellent.

In another question, participants were asked about the *MentorMatch* application experience. Approximately eighty (80%) of participants rated the experience as satisfactory, very good, or excellent.

Results are very preliminary. Most participants appear to be satisfied with their match, but no conclusions can be made on the effectiveness of MentorMatch. Although first round of preliminary data does not reflect the perceived percentages, it collects the participants preferences on the dimensions and point the research to the right direction with regards algorithm. Most participants deemed the application experience and design as satisfactory in its current stage. More experimental data needs to be collected and analyzed before making changes to the algorithm.

IV. FUTURE WORKS

There is a need to increase the sample size to change the current algorithm. Continuing to expand the number of participants by recruiting more mentors and mentees is a priority. Currently, the mentoring experiences are limited to a near-peer mentoring model at Wright College. Holding more mentor workshops is to be implemented as part of the methods. The expectation is to have 100 total post-mentoring surveys analyzed.

This study and its application are in a very preliminary stage, thus more data needs to be collected and analyzed before reconstructing the algorithm. The algorithm will be reconfigured and assessed until the difference between the participants perceived matching with the app is withing +/-5%. Once a satisfactory algorithm is constructed, Alpha and Beta testing will be conducted. The results of these tests will be used to make necessary improvements to enhance the overall experience and usability of the *MentorMatch* application.

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