Mentoring the Mentors : Importance, Methodology and Implementation

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Abstract— **Higher Education is an area where the rapid advancements in technology have created a disparity between what educational institutions teach and what industries require. More than the technology skills that are taught, the learning skills are required for the students to grab the essence of the technology and apply it. The accreditation organisations across the globe have included the mentorship for the students as a part of the assessment of effective teaching learning process but the assessment of any mentorship training for the teachers or any assessment metrics to evaluate the training has not been included in any of their framework. This paper provides a framework for the teacher's mentorship programme and a methodology to evaluate the programme by assessing it in the informal learning atmosphere of a talent show. The outcome shows that there is a positive improvement in the approach of the mentors to the students as a result of this effort.**

Keywords: Higher Education, Learning Skills, Teaching Effectiveness, Mentorship, Educational Framework, Student Mentorship, Faculty Mentoring, Academic Evaluation, Continuous Learning

I. INTRODUCTION

In an era of rapid technological advancements, faculty mentorship in engineering and technology education plays a pivotal role in fostering academic excellence, professional growth, and research innovation. With the increasing demand for interdisciplinary expertise, industry collaboration, and pedagogical advancements, higher education institutions worldwide are recognizing the need for structured mentorship programs that support faculty members at various career stages.

Mentorship in higher education extends beyond traditional guidance; it serves as a mechanism for career progression, leadership development, and institutional growth. For early-career faculty, mentorship provides essential support in navigating teaching methodologies, securing research funding, and balancing academic responsibilities. For mid-career faculty, it fosters opportunities for interdisciplinary collaboration, international engagement, and leadership roles. For senior faculty, mentorship facilitates the transfer of institutional knowledge, strategic planning, and policy development that shape the future of engineering education.

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Despite its recognized importance, mentorship in technology education faces several challenges, including inconsistent mentoring structures, lack of formal assessment metrics, and limited institutional support. Additionally, the diverse cultural, academic, and industry expectations across global higher education systems necessitate an exploration of best practices that can be adapted to different educational contexts. Understanding global mentorship frameworks, digital mentorship strategies, and the role of emerging technologies in faculty development is crucial to establishing effective and sustainable mentorship programs.

This paper aims to examine global best practices in technology education mentorship, identifying key mentorship models, challenges, and strategies for faculty growth. It will discuss the impact of mentorship on faculty performance and student outcomes, and provide recommendations for implementing scalable mentorship programs

II. EXISTING RESEARCH

A. Student Mentorship

Smith and Johnson (2021) explore the effectiveness of coaching and mentoring programs in higher education. Their study highlights the significance of structured mentorship in improving student engagement, retention, and academic success. The research provides a comparative analysis of different coaching models and their impact on diverse student demographics. Lee et al. (2022) present a holistic framework for academic support in universities, integrating mentoring, tutoring, and faculty guidance. Their research emphasizes the necessity of a multi-dimensional support system to bridge learning gaps and enhance student performance. Kim and Park (2022) introduce an interactive e-mentoring framework that leverages AI-driven adaptive learning. Their study illustrates how personalized mentoring enhances learning outcomes by catering to individual student needs. The authors propose a personalized learning framework integrated with interactive e-mentoring, aiming to improve the learning experience by tailoring educational support to individual needs. Liu and Chen (2022) demonstrate how blended mentoring programs utilizing audience response systems improve student learning outcomes. This work looks into blended mentoring approaches in higher education, particularly the use of an audience response system to facilitate mentorship and student engagement.

B. Peer Mentoring

Patel and Wong (2022) discuss the role of peer mentoring in engineering education. Their study indicates that peer mentors provide individualized academic assistance, improving students' understanding of complex technical subjects and fostering collaborative learning environments. The authors discuss a peer-mentoring program aimed at providing individualized attention to engineering students, enhancing their academic experience and professional development. Gupta and Singh (2021) examine the benefits of peer mentoring in project-based learning. Their study suggests that structured mentoring fosters creativity, problem-solving, and teamwork in first-year engineering students. The authors explore the role of peer mentoring in design projects within a project-based learning environment for first-year engineering students, highlighting its benefits for student learning and engagement. Martinez and Rodriguez (2021) examine how peer mentorship can be leveraged to attract and retain students in STEM disciplines. This work investigates the role of peer mentors in keeping STEM student recruitment relevant, emphasizing how peer mentorship can enhance outreach and engagement in STEM programs. Chen and Wang (2021) examines the integration of blended mentoring in higher education through an audience response system, facilitating interactive and inclusive learning environments. Dr. Pasik-Duncan (1,2,3,4), with her experience of teaching freshmen to honors calculus, probability and statistics for the engineering and science students, has developed vertical mentoring among students at the University of Kansas (KU) and in the city of KU, Lawrence, Kansas by engaging graduate students in mentoring undergraduate students and engaging undergraduate students in mentoring elementary, middle and high school students from local schools. Every student from high school senior to undergraduate to graduate can experience research that bridges mathematics, using systems and control, with different fields such as engineering, biology, physics, chemistry, economics, and medicine. One of the most successful methods of collaborating and helping others that she has developed and successfully applied is the "Peer Tutoring Program". In each class they have volunteers who are willing to spend some time on tutoring peers in a class.

C. Effective learning models

Nguyen et al. (2022) provide a systematic review of learning analytics in higher education. Their research underscores how data-driven insights can optimize teaching strategies and mentorship effectiveness. This systematic review analyzes the use of learning analytics to support the development of teaching skills, exploring how data-driven insights can enhance teaching effectiveness in higher education. Chen and Zhang (2023) investigate the transformative role of large language models (LLMs) in academic settings. This paper discusses the transformative potential of large language models in revolutionizing higher education, particularly in improving teaching and learning experiences through AI integration. Li et al. (2023) present a knowledge discovery framework that integrates data analytics with smart learning environments. Their research highlights how mentorship can be enhanced through predictive analytics and personalized learning pathways. This study presents a data-driven knowledge discovery framework for smart education, utilizing advanced analytics to optimize teaching and learning processes in educational settings.

D. Innovation Mentoring

Brown and Green (2023) emphasize the role of STREAM (Science, Technology, Research, Engineering, Arts, and Mathematics) education in fostering innovation. Their findings indicate that mentorship is crucial in guiding students toward sustainable and interdisciplinary problem-solving. Patel and Kumar (2023) The authors focus on the use of challenge-based learning to develop competencies in engineering students, proposing pedagogical strategies for enhancing student problem-solving and critical thinking skills. This conference paper describes an innovative graduate education course that applies the Lean Canvas method to support invention development, integrating mentorship for research and entrepreneurial growth. Wilson and Liu (2024) discuss how challenge-based learning (CBL) can be integrated with mentorship programs to build industry-relevant competencies in engineering students. The authors focus on the use of challenge-based learning to develop competencies in engineering students, proposing pedagogical strategies for enhancing student problem-solving and critical thinking skills.

E. Faculty Mentoring

Chen and Zhang (2024) review existing research on learning analytics in teacher training, highlighting its role in enhancing pedagogical mentorship. This systematic review investigates how learning analytics can contribute to the development of teaching competencies, providing insights into the ways data-driven tools can improve teaching practices. Kim and Park (2024) highlight the importance of mentorship and professional development programs for faculty during emergency teaching scenarios, such as the COVID-19 pandemic. The paper addresses the challenges university faculty face in emergency teaching scenarios, particularly during crises, and provides strategies for effective teaching in such contexts. Li and Zhao (2024) discuss various methodologies for assessing teaching effectiveness and student learning, emphasizing mentorship as a key evaluation component. This paper evaluates teaching and learning processes in higher education, focusing on methods for assessing and improving educational effectiveness through data-driven approaches. Johnson and Lee (2025) analyse the experiences of teaching assistants (TAs) in higher education. This study explores the experiences of teaching assistants in tutoring and assessing computer science courses, providing insights into the challenges and opportunities in undergraduate teaching. Smith and Brown (2023) explore how learning analytics can improve faculty mentorship programs by tracking student interactions and engagement. This study introduces a learning analytics approach to modeling student-staff interaction, aiming to enhance the educational experience by better understanding and optimizing these interactions.

F. Smart Education Models

Patel and Wong (2025) present AI-powered mentoring bots as a future-oriented approach to providing scalable, personalized student support. The authors propose the use of mentoring bots as a novel approach to personalized learning in higher education, exploring how AI-powered mentors can

support students' academic and professional development. Singh and Li (2025) propose an evaluation model that integrates mentorship assessment within smart education frameworks. The paper presents a smart education management evaluation model that leverages perception behavior data to optimize educational management and decision-making. Wilson and Green (2024) analyze mentorship-driven pedagogical strategies in STREAM education. This paper discusses pedagogical strategies in the design of STREAM-based initiatives, focusing on how interdisciplinary approaches can foster innovation and skill development in students. Nguyen and Patel (2024) explore a mentorship model that employs Lean Canvas methodologies to guide research teams. The authors present a team-based framework for research development and mentoring, utilizing the Lean Canvas model to foster innovation and collaboration in graduate education. Kumar and Wilson (2025) discuss how formative assessment and mentorship can be combined to enhance engineering education. This paper explores formative assessment strategies in challenge-based learning environments, focusing on how assessment can support competency development in engineering education.

G. Inference

The literature survey highlights the evolving role of mentoring, coaching, and advanced learning frameworks in higher education. Studies emphasize the significance of peer mentoring, faculty coaching, and personalized e-mentoring in enhancing student engagement, academic performance, and professional development. Various models, such as the Academic Support 360 Framework, Blended Mentoring, and Challenge-Based Learning, are explored to improve individual attention, competency-based education, and adaptive teaching methodologies. Additionally, the integration of learning analytics, large language models, and mentoring bots demonstrates the growing impact of technology in data-driven decision-making, personalized learning, and faculty support in times of crises.

The research also underscores the importance of STREAM education, project-based learning, and innovative frameworks like Lean Canvas in fostering creativity, problem-solving, and interdisciplinary skills. Special attention is given to mentoring programs for underrepresented groups, such as women in STEM, highlighting their role in increasing diversity and inclusivity. The evaluation of teaching methodologies and student-staff interaction models further suggests that structured mentoring significantly contributes to knowledge retention, academic progression, and student well-being. Overall, the survey underscores a shift towards holistic, data-driven, and technologically enhanced mentoring approaches to improve learning experiences and outcomes in higher education..

III. Mentorship Programs by Governing Bodies and Government Organisations

Mentoring programs are an essential part of the Assessment and Accreditation Bodies in every country. In India, mentorship training programs for senior faculty in engineering education are gaining recognition as essential for fostering academic excellence and professional development. Several initiatives have been established to support and enhance the mentoring capabilities of senior faculty members.

A. National Institute of Technical Teachers' Training and Research (NITTTR)

NITTTR offers comprehensive faculty development programs aimed at improving teaching methodologies, research skills, and leadership qualities among engineering educators. These programs are designed to equip senior faculty with the necessary tools to effectively mentor junior colleagues.

B. All India Council for Technical Education (AICTE) Initiatives

AICTE, through its Training and Learning (ATAL) Academy, provides continuous professional development opportunities for faculty members.

C. University Grants Commission (UGC) Guidelines

The UGC guidelines emphasize the importance of induction and mentorship for teachers in higher education.

D. Indian National Academy of Engineering (INAE) Mentorship Program

INAE has initiated a mentorship scheme where senior engineering educators mentor regular or permanent engineering teachers from AICTE or Ministry of Education recognized institutions.

IV. Mentorship through Professional Organisations

Dr.Pasik-Duncan founded and has served as Faculty Advisor of Association of Women Mathematicians (AWM) and Society for Industrial and Applied Mathematics Student chapter at the University of Kansas. AWM has the successful mentoring network which provides mentoring opportunities to girls, women, and gender non-conforming individuals. Students who are interested in mathematics or are pursuing careers in mathematics are matched with mentors, of all genders. The network is intended to link mentors with a variety of groups: recent PhD's, graduate students, undergraduates, high school and grade school students, and teachers. Matching is based on common interests in careers in academics or industry, math education, balance of career and family, or general mathematical interests.

AWM has also an award for mentoring undergraduate students (27). IEEE Returning Mothers Conference has launched and successfully established the "Bozenna Pasik-Duncan Humanitarian Mentorship Award" in the year 2023 to encourage the mentors who work towards supporting women education and career (28).

V. Mentorship Through Events

Events such as Youth Endeavours on Social Innovations through Sustainable Technology12 and Returning Mothers Conference are excellent platforms to test a mentorship program for the school teachers and higher education teachers.

The teachers are from various countries and hence from various backgrounds giving diversity in the beneficiary list. The programs are running for more than 10 years thus giving a robust list of teachers in the database. It was decided to use the assessment framework of AICTE for the higher institutions as the base and create a mentorship training program for the mentors from schools and higher education institutions. The mentors who have been consistently contributing to this international talent show were deemed suitable to test the ideas of mentorship in the framework developed below. The following framework covers only some of the aspects that are necessary to make the mentors knowledgeable on encouraging students to develop innovative mindset.

VI. A Structured Mentorship Program Framework

A structured Mentorship Training Program for senior faculty in engineering should focus on teaching excellence, research mentoring, leadership skills, and industry collaboration. Below is a proposed curriculum framework that can be implemented at engineering institutions. The broad outline of the Curriculum Framework is given below:

Module 1: Fundamentals of Academic Mentorship, covering basics on the importance of mentorship, Roles and responsibilities of a mentor.

Module 2: Developing Design Thinking Mentorship, understanding the community context, defining the problem statement clearly relevant to the community, developing feasible and tangible solutions

Module 3: Research Mentorship, publishing in SCI/SCOPUS-indexed journals, Research ethics, plagiarism detection tools, and peer-review process, developing interdisciplinary and industry-collaborative research projects, Tools used

Module 4: Industry Collaboration & Entrepreneurship Mentorship, Building partnerships with industries and R&D organizations, Tech-based entrepreneurship, guiding startups, Patent filing process & Intellectual Property Rights (IPR)

Module 5: Leadership Development Mentorship Soft skills such as Emotional intelligence, conflict resolution, motivation techniques, Time & project management for research and teaching, fostering diversity, equity, and inclusion in academia.

Module 6: Mentorship Implementation & Impact Assessment for assessing the effectiveness of the program, Establishing mentorship goals and tracking progress, Mentorship assessment tools & feedback mechanisms, Best practices for mentee career growth.

In addition to the curriculum, the implementation strategy also plays a crucial role in the success of the program. So, we decided to implement parts of the framework through keynotes and workshops during the event in the years 2022-2024. The rest were covered through webinars.

A. Evaluation and Implementation of Mentorship Programs

Evaluating mentorship for teachers in higher education requires well-defined metrics that assess its effectiveness, impact, and long-term benefits. The metrics developed were participation percentage for the sessions, the number of community projects developed during the current year, the number of projects selected for the Grand Finale, the number of projects awarded during the Finale, number of funded projects and number of startups. This gave an indicator of how the mentors absorbed the contents of the program and were able to implement them during their teaching. The following table shows the outcome of the mentorship programs every year from 2022.

Table 1: Outcome of the Mentorship Programs

S.No	Metric	2022	2023	2024
1	% of mentors who attended the sessions	18	14	10
2	Number of community based projects developed	10	8	8
3	Total Number of projects received	1128	1217	1249
4	% of Projects selected for the Grand Finale	13%	12%	12%
5	% of Projects awarded in the Grand Finale	3%	3%	3%
6	No of Projects which were selected for Government / industrial funding	1	3	7
7	Number of projects commercialized/ developed into startups	0	1	2

B. Implementation Strategy

The above metrics were implemented by the following methods individually or in combination, based on the outcomes required.

- **Annual Review & Surveys:** Conduct faculty feedback surveys to assess the mentorship program's effectiveness.
- **Data-Driven Assessment:** Use performance tracking tools (analytics tools, publication databases) to measure progress.
- **360° Evaluation:** Gather feedback from mentees, mentors, students, and administrators to refine mentorship programs.

VII. Conclusion

Faculty growth and development play a critical role in ensuring the quality, relevance, and innovation in higher education. As educators, researchers, and mentors, faculty members influence student success, institutional reputation, and societal progress. Continuous professional development enhances teaching effectiveness, research productivity, leadership potential, and industry collaboration, making it essential for academic institutions to invest in faculty growth

initiatives. This standardized mentorship training program ensures that senior faculty are well-prepared to mentor the students as well as the junior faculty in schools and engineering institutions, especially in developing the innovation mindset. Though the progress seems to be slow, there is a definite upward trend of awareness to improve their approach to the students and projects. By focusing on teaching excellence, research mentorship, industry collaboration, and leadership development, this program strengthens faculty capacity, leading to high-quality education and impactful research outcomes in engineering and technology. By using a combination of qualitative and quantitative metrics, institutions can ensure mentorship programs effectively support faculty growth and align with accreditation standards.

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