Mentoring approaches for various Learning behaviors of the future engineers in professional education: Competency and Commitment Development

MM Irfan[1], Ram Deshmukh[2], KBVSR Subrahmanyam[3]

[1]Department of Electrical and Electronics Engineering, SR University, Warangal, Telangana, India
[2]Department of Electrical and Electronics Engineering, SR University, Warangal, Telangana, India
[2]Department of Electrical and Electronics Engineering, D.N.R College of Engineering and Technology, Bhimavaram, India
[1]mmirfan.srec@gmail.com
[2]ramdeshmukh@gmail.com
[3]libra_22@rediffmail.com

Abstract: Mentoring in higher education facilitates students to enhance the confidence level, improves the probability of academic accomplishment, and reduces chances of failure. Students depend on the expertise and involvement of mentors to support them graduate in a well-timed manner and guide on them to their best possible career. The mentoring significance is not always distinctly understood in education. Researchers are becoming gradually more sensible of its complexity. Choosing a mentor is critical in any career field, and engineering is no different. Mentors can offer future engineers' an instrumental guidance and assistance early in their careers.

This research study explores the different learning patterns of the engineering students and recommends the new approaches required for the successful mentoring of these millennial students. Project-based course 'Product Design Studio' is considered, and total strength of 50 students classified into 4 groups based on their competency and commitment levels. At least one student from each of these 4 groups combined and 11 project teams formulated for the execution of the project. Competency levels identified through a test based on the skillset required for the project execution. Four different training models are proposed in this paper for each of the groups formulated and these approaches successfully implemented by the mentors. The learning reflections of the mentors and mentees are presented in this paper. The final product demonstration by the students reflected the success of the novel approaches implemented by the mentors. Competency and Commitment are the key factors to be considered for analyzing the performance of the students. in addition to the mentoring students for improving their competency levels, the role assigned during the project execution promoted the 21st

century skillset among the students. There is a huge scope to research and develop the appropriate mentoring strategies for the human resource management and development in the project-based courses.

I. Introduction:

The current higher education system is moving towards a dynamic shift by incorporating more and more project-based courses. The significance of project-based courses is becoming very significant to equip the students with the 21st century skills like team leadership, communication and problem solving [1-3]. The role of mentoring in those courses is very critical as the student teams work systematically with the proper defined set of outcomes. Mentoring is basically to develop and sustain the motivation among the teams to progress their work continuously without any deviations. The identification of the available skillset among the teams is very important so that the skills which are missing can be developed through multiple training sessions. The portfolios required for the project management are team leadership, project manager, financial advisor, web master and the communicator. Product Design Studio (PDS) is the freshmen course initiated in the engineering curriculum which promotes the 21st century skills [4-5]. Service learning and Design thinking courses are the advanced versions of PDS course. The human resources required for these portfolios are to be managed by the mentor in a proper direction to obtain the desired outcomes of the projects [6-12]. This paper deals with the discovery of skillset available, the skill-development strategies and finally the performance evaluation tools.

II. Discover - Competence and Commitment test:

Mentoring is a cyclic process where mentor discovers the potential abilities and hidden skills of the learners based on

the quick test or any google form questionnaire. The test conducted was based on two rubrics competence and commitment. As per the defined rubrics the learning levels are classified into 4 categories. All the 50 students grouped into 4 basic groups as per their competence and commitment. The basic criterion is shown below in table.1.

Table.1: Learners classified based on learning pattern

		Competence	Commitment
01	High performer	High	High
02	Enthusiastic worker	Low	High
03	Reluctant contributor	Mid	Mid
04	Dis-illusion learner	Low	Low

The learning levels of the students are tested using a questionnaire in which multiple questions asked to assess the level of the learners. The questionnaire used for this course is attached in the appendix. After testing the learning levels of the students, the students are classified into four categories and one student from each category will be grouped to form project teams.

Each mentor is assigned with two project teams each team consists of 4 students. Now the first job of the mentor is discovering the potential abilities of the learners required for the project execution. A quick test is conducted by each mentor to assess the available skill set and so to identify the field of interest of the team members.

The basic skill set required for the project execution comprises of of leadership skills, communication skills, documentation skills, resource management skills and software skills. After evaluating the nature of the learner and their potential abilities now the mentor assigns specific roles for each member of the team. The second important role of the mentor is to dictate the responsibilities & works to be done by each individual team member as per the role assigned. The roles required for the effective implementation of any project are given below.

- Project leader
- project manager
- project partner communicator
- financial officer webmaster.
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The second phase of the mentoring is to develop the learners according to their learning levels through multiple training sessions. As per the nature of the learning patterns of the learners four different types of training module are provided.

1. Delegating style of training is provided for the high performer learners community
2. Directing style of training is provided for the enthusiastic learners' community.
3. Supportive style of training is provided for the reluctant contributor section of the learners' community
4. Coaching style of training is provided for the dis-illusioned learners community.

The training modes adopted for the above said 4 modules are given below.

1. Coaching style: mentor performs an activity, and the student will observe them very closely and try to mimic in a similar way.

2. Supportive style: Mentor performs the activity but here the students also involve and coordinates themselves in the activity performed by the mentors.

3. Directing style: Here the students will perform the activity and the mentor will simply facilitate through proper set of instructions.

4. Delegating style: Here a set of students performs an activity, and a new set of students will accompany them to observe, learn and develop the skill set required.

During all these training modules mentors provide the appropriate learning environment and guide them personally as per the learning patterns and the level of understanding.

Case study: 'product design studio' a project-based course for the freshman engineering students. The activities performed during all the training modules are summarized into 3 varieties.
1. Online and offline tools: Google classroom is used for sharing of material ad to submit the assignments.

2. Self-evaluation tools: Before every formative assessment, each team should submit their self-appreciation report. It reflects the status of involvement of everyone.

3. Peer evaluation tools: During every formative assessment, peer review also considered for grading.

III.   Demonstrate – Accomplishments and performance evaluation

The student teams were evaluated using multiple assignments through google classroom. The screenshots of

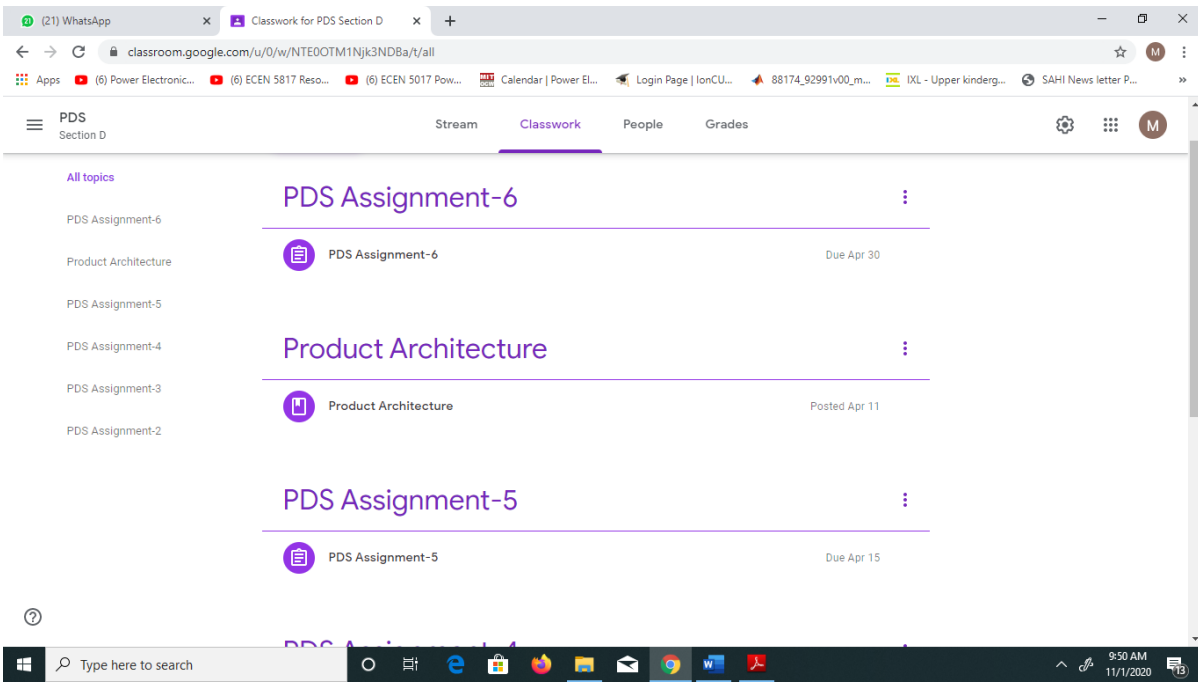the assignments and gradings using google classroom are shown below.

Fig. 1: PDS Course assignments posted on Google classroom

Fig. 2: Grading of the assignments through Google Classroom

This table reflects the benefits of mentoring with specific growth areas, as shown below. To see how the benefits that are important to the mentees with these areas, for each benefit mentee rated as somewhat or very important, grades varying from 5-1.

Table.2: Feedback collected from the mentees about the mentors

	Assistance in setting my career goals	Broaden my perspectives	Expand my network	Improve work performance & satisfaction	Self-development
Learn from another person's vision, experience, and knowledge.					
Obtain career advice and planning assistance.					
Get more involved in things inside me.					
Get more involved in things outside my life					
Learn more about myself and develop my skills.					
Gain assistance solving problems and changing my perspective.					
Build my self-confidence.					
Increase my energy and interest in my work.					

The class of 50 students participated in the reflections session and the feedback results are shown. The average results of the class of 50 students analyzed and shown in fig. 3. The parameters considered for the evaluation are shown in different colours.

- Assistance in setting my career goals - orange in colour

- Broaden my perspectives – Blue in colour
- Expand my network – Purple in colour
- Improve work performance & satisfaction – Red in colour
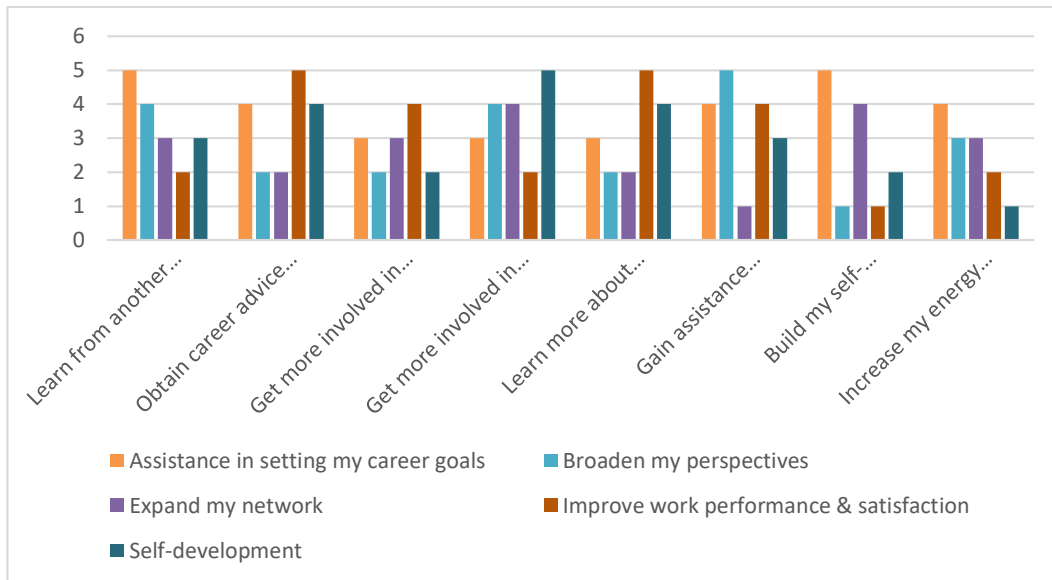- Self-development – Dark blue in colour

Fig. 3: Summary of the feedback results

The end of the course is celebrated as the Demo Day, where teams demonstrate their course-end projects. The expert teams evaluated the final summative assessment.

Fig. 4: Students demonstrating the course products

IV. Mentoring skills:

A) Understanding what is required

There are certain behaviors that could be considered requirements on the part of the mentee and the mentor in a mentoring relationship, including:

□ Taking initiative and risks
□ Accepting each other
□ Agreeing upon and working toward specific goals
□ Dealing effectively with unmet expectations or objectives

Preparing for first meeting
Along with working through this toolkit, following are also important for first meeting:

□ Mentee goals
□ Mentee background (how have you gotten to where you are now?)
□ What both hope to get from the relationship
□ What both have to offer
□ Questions for your mentor

B) Establishing norms

Whether you are in a formal, informal, or situational mentoring relationship, it's important to establish norms, or guidelines, for how the relationship will work. Doing this up front can help avoid needing to resolve differences later-on. Both you and your mentor should give some thought to the norms you would like to establish, have an open discussion about them, and come to an agreement. Some things to consider:

□ How often will you meet, and for how long each time?
□ How you will communicate between meetings?
□ Where or how will you meet (in person at a particular location or via a video chat service such as Skype or Zoom)?
□ What will you do if a meeting must be canceled or rescheduled?
□ How will sensitive information be dealt with?

C) Building a Successful Relationship

There are several ways you can contribute to a productive relationship with your mentor:

□ Be willing and able to let your mentor know what you need.
□ Be clear with your needs. Do not beat around the bush—your mentor's time is valuable.
□ Feel comfortable with your mentor.
□ Trust your mentor and be open with them.
□ Be ready and willing to develop and change.

Research has shown that effective relationships have similar factors upon which they are built, including:

□ Mutual respect
□ Acceptance and flexibility
□ Honesty and direct communication
□ Preparation
□ Commitment

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□ Some shared values
□ Trust
□ Willingness to work through obstacles

V. Learning reflections and Observations:

The learning reflections shared by the team leaders are graphically represented in the fig.4. the parameters considered for the reflections report are:

- I changed my perspectives
- I achieved desired outcomes
- I improved my communication
- I developed team skills
- I learned design skills

Fig. 4: Learning reflections of the team leaders

The observations and the recommendations given by the mentors are as follows:

1. 78% of the students improved the levels of competence and commitment
2. 6% of the students not responded to the instructions of their mentors
3. Students involvement in playing the assigned roles was satisfactory

D) Conclusion:

The role of mentoring in the engineering colleges through the project-based courses is discussed in this paper. 'Product Design Studio' is the freshman engineering course where students are formulated into teams to execute the project assigned to them. The process of forming the teams, assigning the roles, and providing the training was completely based on the novel strategy proposed in this paper. The competency and commitment levels if the students analyzed and appropriate guidance provided by the mentors. Finally, the accomplishments achieved by the student teams in terms product design was appreciated by the expert team during the Demo day organized as an event at college level.

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