Inter - departmental Student Projects – Challenges and Benefits

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Abstract: Our educational policy fosters young students to have broad perspective, high level expertise and logicality. The education system is not coping up with the same pace as technology changes are happening. Therefore, it is essential to tackle this situation with new ideas and adapt education to the changing needs. The interdepartmental educational programmes have already met new academic needs. Reinforcing this standpoint a unique approach on interdepartmental collaborative learning has been initiated by the department of Information Science &Engineering and Electrical & Electronics Engineering, Malnad College of Engineering, Hassan. This approach aims in promoting wide inter-department learning process where students from two different departments are conjoined to venture interdisciplinary projects. The students of 3rdsemester from both the departments were allowed to choose a particular domain of their interest and design prototypes for various applications. As a back – end support, the subject experts jointly nurtured the ideas of students and helped them to give a practical shape to their ideas. Further, adding a hardware component offered an opportunity to increase student engagement by strengthening programming concepts with relevant hardware projects. This process helped the students to work together in different domains learning new interesting solutions for different problems and has provided mutual beneficial results.

Keywords: *Interdepartmental collaboration, project based learning, collaborative approach.*

I. INTRODUCTION

It is a known issue that education is slow to change especially in implementing new concepts and technologies. The technology changes are fast arriving than education is preparing to cope up with. Our industry partners often voice a complaint that our newly graduated engineering students do not have sufficient problem solving skills, abstract thinking and poor preparedness in mathematics. This is not a new concern. It is essential for students to gain ability to use research to plan, implement and evaluate concepts and strategies. The need to emphasize more on outcome based education arises from here [1]. In a traditional undergraduate curriculum, the ability to apply the knowledge to practical engineering problems is frequently lacking. Students lack the motivation to their branch of study because of a perceived disconnect between practice exercises and real-world applications.Therefore, it is essential to tackle this situation with new ideas and adapt the present education scheme to the changing needs.

This approach is an effort to bring students across departments together to develop better insights into career opportunities. This is a process of equipping students with an enhanced capacity to generate ideas and skills. The methodology presented here involves the collaboration of the department of Information Science & Engineering and Electrical and Electronics Engineering, Malnad College of Engineering, Hassan, Karnataka. The focus was completely on the students from second year who are at the early years of their engineering course and require vast professional development skill.

With an already full to-do list, it is hard to imagine the benefit of creating and/or tackle cross-departmental projects. But, such cross- departmental activities benefit the students. There are various schemes implemented to promote the cross departmental activities [2]. Acquiring adequate knowledge on the process of inter department activity, the entire structure of the activity was composed. Rather than having students learn facts that they might need someday, we thought it would be better to put them to collaborative learning environments where group of students find solution to real world scenario [3].
In this paper we have presented a novel method that solves the pedagogical issue of teaching students with wide and

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varied backgrounds. Also, Multidisciplinary approaches and mixed pedagogies allow students to achieve a balance of skills and knowledge related few aspects such as enterprise awareness, entrepreneurial mindset, and entrepreneurial capabilities. Students from different department who work together on projects can benefit from sharing information, asking questions and learning new solutions. Students share the ideas on how each part of the module works. Also, they get the opportunity to look at the way with "fresh set of eyes".

The method is solely adopted for undergraduate students of 3rdsemester who were supported with different interdisciplinary project ideas provided by subject experts. Also, the post graduate students of Electrical & Electronics Engineering were called upon to involve themselves as instructors and render the required support in developing the hardware. Subject experts from both the departments prone to be the backbone for the students constantly guiding them to bring out creative and innovative ideas. Further, this method aims to promote discovery and exchange of knowledge over various fields of study.

Students of Electrical & Electronics Engineering were identified to have better hardware formulation ideas, potentially skilled in developing integrated circuits and prototypes. On the other hand, students of Information Science and Engineering had strong foundation in programming skills, coding, developing logics etc. Bringing students of these two departments gave us an opportunity to learn each one's motivation and relate it to the whole curriculum.

Also, bringing in the involvement of subject experts across departments helped us to serve the institution's mission.
Each of the departments rendered their contribution by working on a common goal that is complementary to a typical work that provides new insights into how the other department serves the institution's mission and vision.
Additionally, we will put forth how introducing such a strategy in the curriculum during the initial years of engineering will help the students respond to changing needs of engineers and to change the perception of engineering.

Section II addresses the need for inter department activity, Issues related to collaborative learning and the advantages of inter-department activity.
Section III elaborates the entire structure and composition of the activity. The collaborative measures and compilation of the process is presented in detail.
Section IV discusses the outcome and the benefits from this approach and Section V describes the advantages of the activity in a nutshell.

II. NEED FOR INTER DEPARTMENT ACTIVITY

Project based learning approaches have served students to develop constructive learning instead of having the objectivist view about the facts and concepts.

It is very much essential that students gain confidence early in their college days. The situation about a decade was different rather than now. Start-ups are coming up, entrepreneurs are being fostered to new developments. In order to cope with this rising demand, every student must develop an attitude to work in different domains rather than adhering on to a single already known concept [4 - 5].

Worldwide various research and innovation strategies have been proposed to inspire and support students to achieve their potential and meet the challenges of society. There are various issues in collaborative learning process and the situation of new academics in the early stages of engineering. The importance of collaborative learning has tended to encourage individualism and competition between students [6].

A case study reported in [7] shows that the development of a practical-learning case based on the combination of computer techniques adapted to hardware control will increase the motivation of the students and improve the assimilation of theoretical concepts.

A new project based learning based approach [8] complements five principles that provide a framework to guide the working practices of student teams: distribution of responsibilities; regular interactions and solicitations within the team; anticipation and continuous improvement; positive interdependence and alternating individual/collective work; and open communication and content management. The results show that project based learning helped the course's students to acquire important professional knowledge and skills, experience near-real-world professional realities, and develop their abilities to work both in teams and autonomously.

The need for inter departmental collaboration arises to improve teamwork, face new challenges, improve leadership qualities, encourages the importance of good design, implementation and testing. The collaborative learning process enables the students to feel a stronger sense of ownership and have an active participation in making things improve across departments [9].

Here we have brought out an approach that allows students to work in a domain that is familiar and in which they can immediately contribute.

A major justification for adopting this was to improve student engagement and help reinforce their traditional programming assignments with practical hardware applications. To help accomplish this, a project was added to students of both the departments that would involve writing programs to control hardware such as sensors (e.g., temperature sensors), input devices (e.g., switches and keypads), and output devices (e.g., LCDs, LEDs and motor controllers). The projects would be tailored to the students' skill level and be made interesting.

Another goal was to utilize simple electronic components and not rely on expensive modules, not only to reduce the cost but also to inspire more creativity among students.This teaching – learning activity has been shown to improve student retention, increase long-term interest and improve performance in future design course.

The goal of our approach is teaching student's life-long learning.

III. STRUCTURE

The proposed activity is conducted to strengthen the fundamentals the students have learnt and enable them to develop strengths that build their skill set. This method has indeed proven to be instrumental in making career decisions. As the students would have begun learning the required fundamentals during their study, the proposed method serves to build professional experience & develop a varied body of work.
The strategy involves a chain of events that occurred for several weeks in order to achieve the set objective. The events are:

A. Collaborative measures

The start-up of this venture was bringing in the subject experts across the two departments and convincing them the need for a collaborative learning environment. We later figured out certain collective areas where students can work towards a common goal and set the objectives.
The effort towards achieving the goal started by organising a seminar involving the students from 3rd semester of IS& E and E&E Engineering departments, 3rd semester Post graduate students of E & E engineering and subject experts of both the departments. The seminar was presided by the Head of IS & E department who not only elaborated the need of collaborative learning and also put forth a road map for the process to begin.

The seminar was to briefly outline the technological challenges faced by students in present day industries. We emphasised more on the necessity of collaborative learning. We further motivated the students that learning the benefits of working together across various departments would in turn benefit their career developments.

B. Compilation of the entire concept

The activity was compiled by the subject experts of both the departments. Student teams were set, each team involving 2 members of IS & E and 2 members of E&E Engineering respectively. The subject experts assigned topics of the relevant field involving both the streams of study to each of the team. The students were initially trained to learn the different components required for the formulation of hardware and the programming language required. The subject experts also instructed the PG volunteers to render necessary support in building the hardware.
The most interesting part was the selection of topics. Not only the topics involved recent technological development, it paved the way for learning & sharing knowledge about new happenings. Few of the case studies involved in this process are:

- Arduino based control of DC motor.
- Arduino based temperature control of fan.
- PWM based speed control of a motor.
- 8- Channel PWM switching circuit.
- Arduino Based home automation.

The students were instructed to start by learning the basic concepts of motors, their operation and the control process. The PG volunteers educated the IS & E students the theories necessary to build the control algorithm.

Basically, the Arduino language is usually a set of C/C++ programme that can be called from the code. The activity undergone by the students in the previous workshop [10] came to a great help. In [10] the students were trained with the basics of C/C++ which helped them to develop the required codes.

The students of E & E Engineering helped the co-students of IS & E to understand the working principle of motor/PWM so that they could develop the required control algorithm. On the development of the prerequisite code the students of IS & E would explain the logic to the co-students. Thereby, sharing knowledge and giving a food for thought in learning new things was achieved by the students of both the departments. Fig.1 indicates the development phase of the modules.

The entire process was kept track of by the subject experts. The teams were asked to make presentations every week which would cover the development stages of their work. The progress of each team was checked regularly by the subject experts of both the departments and necessary suggestions for scope of improvement was provided on a timely basis. The same procedure was followed for all the batches.

In the entire activity, a full design report with commented source code and prototype was required, and each team was expected to demonstrate and discuss their work with the instructor (PG Student).

Fig. a Fig. b

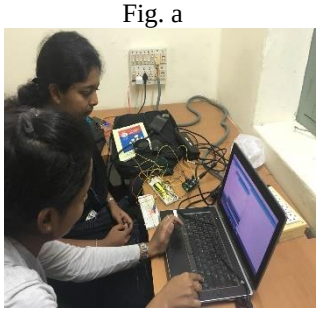


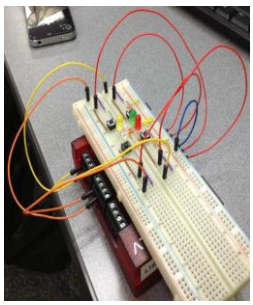

Fig. c Fig. d

Fig. 1(a-d) Snap shot of one-to one interaction during the activity

Having observed project teams for several years, a common trend is evident in how students schedule their time. The first week or two was minimal improvements, as teams initially feel flooded by the amount of design decisions they have to make. However, as a week progressed, the students gained confidence by having one-to-one interaction & obtaining instructions from the PG students that touch on specific issues related to the project. The students began to narrow their focus and start building the program's overall infrastructure. By the fourth/ fifth week, the hardware portion of the project was typically complete, and the core functionality was in place. This period is the most time and effort intensive, as students iterate through multiple trial and error sessions to write a program that can efficiently control hardware in real-time. During demonstration week, most teams rush to finish their report and add last-minute extra features and "polish" to their module. On an average, teams spend between 30 to 40 hours on hardware construction, program design, coding, debugging, and report writing.

By the end of the entire process, which took about 6 weeks to complete, the students came out with exciting automated prototypes. The images in Fig.2 represent snap shots of few modules developed.

With such an interdepartmental activity, the students of both the departments felt mutually benefitted. They could import the required concepts and embed the same in developing real time modules.

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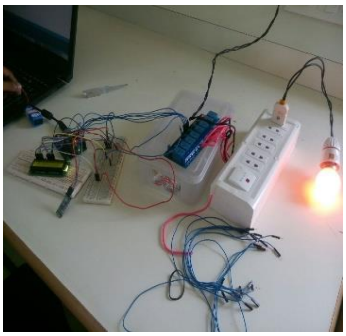
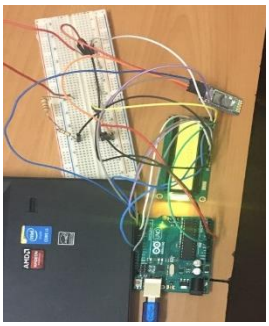

Fig. c Fig. d

Fig. 2(a-d) Snapshots of modules developed

IV. OUTCOME

As an initiative towards meeting the new demands of the present day technological development, interdepartmental project based learning approach aimed to build exemplary ideas and innovations. This inter department collaboration benefitted the students to exchange ideas and it provided experiences which would definitely help their future professional development.

Working with new team, they could attain new skill and perspectives. The students also served to help attain the institution's mission and build their own need for professional development by partnering with another team. The students could practise and understand the importance of good design. The students of IS & E could experience the touch & feel of the hardware components used and the students of E &E Engineering could experience a good deal of improvement in developing codes.

The subject experts could observe greater improvements in communication skills, presentation style etc. This approach encouraged good team work & peer communication. Also, this scheme facilitated the students to cultivate a strong desire to learn new techniques.

Few of the modules developed were selected for project presentation at IEEE youth congress. The students learnt the art of facing new challenges, interacting with new students and connecting to new ideas and innovations.

Appraisal of the activity

Student performance is assessed by the weekly presentations, mini projects, and surveys. Project success among the student teams was typically high, with completion rates in the 95% range. We consider a project successfully completed if students can demonstrate its use as a "real" game machine, and if hardware and software satisfied all the requirements.The students of both the departments appraised the activity and were very excited throughout the process as it enabled them to extend and explore different ideas.

When students were asked in surveys if the collaborative learning approach was able to reinforce the programming principles and hardware formulation they learnt, a majority agreed strongly that it did, as shown in Fig.3. Many also stated that they enjoyed the practical aspects of the project, which maintained their interest.

On the whole, the students felt, this platform indeed gave them an exposure on how different branches of engineering are interlinked. Learning the practical implementation from a set of students from another branch geared up their confidence to work in any environment (may be designing/ coding). On the other hand, a common complaint was the significant amount of time it takes to develop the hardware and debug code.

The feedback of the students further motivated us to look for newer developments in this activity and put forth much effort to bring out more innovations in teaching- learning process.

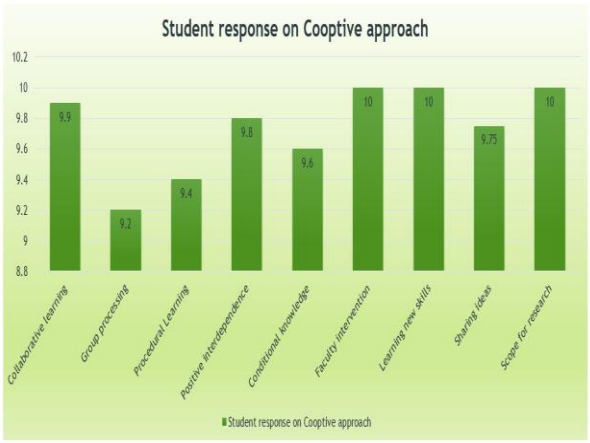

Fig.3 Result of survey regarding the effectiveness of Collaborative learning.

V. CONCLUSIONS & FUTURE PLANS

The implementation of cross department activities stimulate students to expand their learning skills by analysing already learnt information or problem and bring out effective solutions.

We have demonstrated that it is possible to magnify students programming skills and simultaneously keep them engaged through realistic and complex projects.

The students are trained to develop exciting and innovative ideas that can make them foster a fruitful culture of innovation. As a whole, the students are motivated to enrich their ideas.

These are our first few steps to improve students' comprehension of the subject material. For now, the inclusion of a programming and hardware interfacing assignments in the second year engineering of Electrical engineering & Information science & Engineering sequence has shown positive benefits for our students and justifies its continuing use in our curriculum.

Further, for the forth coming years the subject experts from both the departments have considered to add a course that would focus on longer-term projects with more advanced hardware interfacing using C or Python.

Also, measures are being planned to motivate students to build prototypes that would serve in building start - ups and hence master themselves as job makers rather than job seekers.

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