Competition Based Minor Projects–A New Experience

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Abstract: The existing practise for choosing projects for Mini, Minor and Capstone projects is either open ended, wherein the students propose the topic/area/field they wish to work in, or theme based, where the department defines the field/area in which the students pursue their projects.

A novel approach to projects was introduced in the department where a national level student competition (SAE Eco kart) was chosen carefully to reflect on the quality and quantity of project work, which required all the project teams to work towards a common goal. The Competition was aimed at designing a single passenger kart operated by a Motor AC or DC, where Source of running the motor is a battery.

The theme for the competition as specified by SAE India for the current academic year was adopted for the minor project and minor changes were incorporated in the rule book to suit important factors such as curriculum, timeline and available resources.

The primary objective of the theme chosen was to enable students to apply the fundamental knowledge gained in the curriculum and develop capabilities to formulate problem, design by analytical and computational methods, create manufacturing drawings and simulate the automotive systems and integrate them in virtual environment.

A. Competition Project

Eco-kart is an event conducted by the SAE INDIA in collaboration with collegiate club of Gautam Buddha University (GBU) where in the students design and fabricate a single seater kart operated by a AC or DC motor where the main source is battery. The idea behind the event is to promote green engineering concept. Eco-kart 2015 dynamic round was conducted on 10, 11, and 12 of February 2015 in GBU, Greater Noida.

The event is divided into two parts Virtual and Dynamic rounds. Those who qualify virtual rounds based on the performance of their vehicle design (Virtual) are eligible for participation in dynamic round with the full scale vehicle fabricated as per the approved design.

Key words: Theme based minor project, SAE Eco kart.

1. Introduction

Mini and Minor projects at the pre final year level are essential for bridging the gap in theory and practice. When open ended, the projects are varied and so is in most cases the development of the student skill set. This also poses a certain amount of difficulty during review in terms of evaluation. With theme based projects, the student skill set can be channelized in a particular field and also help the department target certain student competencies. This process, in the author’s perspective, can be further enhanced by introducing competition based projects.

The main focus of this exercise was to enable the students to apply the fundamental knowledge gained in the curriculum and develop capabilities to formulate problem, design by analytical and computational methods, create manufacturing drawings and simulate the automotive systems and integrate them in virtual environment.

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2. Implementation

The prime limitation with minor projects is the availability of time to execute the project; so the quantum of work expected by the students must be framed in accordance with the academic work load. Hence, for Minor project it was decided to implement only the virtual part of the competition for the initial experimentation, as this would justify the credits and timeline allocated for the task and yet consist of multi system design and integration. Also build of a physical kart would require larger team (multi-disciplinary) and resources which the authors found unsuitable. Changes were incorporated in the rule book to allow greater freedom in choosing system variants.

One multi-disciplinary student team (Electro Bug) participated in the dynamic round of Eco-kart in February 2015 and this was immensely helpful in the implementation strategy as the authors had first-hand information from the event. This experience was used for knowledge transfer to the remaining student teams by conducting tutorials in two stages. Tutorials were conducted in the projects hours allotted in time table for 3 hours each week. The following sections give the details of the tutorial implementations and review process.

Fig 1. Eco-kart by team Electro Bug

A. Tutorials

The role of tutorials in project based activities is of profound importance to convey the messages at each stage of the project. Nagaraj Ekabote & Krishnaraja. K. [1] have emphasized the same in project based learning implementation. They also suggest that the timely reviews for the project and tutorials bridge the gap, which was identified in reviews. Tutorials were planned twice in the schedule, one before the review 1 and another before the review 2. Each tutorial was to give specific support, which assisted in decision making process of the design. Both tutorials are explained in the following section.

A-1: Tutorial part 1

The physical kart by team Electro Bug was displayed to all the teams and detailed explanation of the entire design and manufacturing process was carried out. This was followed by discussion on ‘lessons learned’ at the event and potential areas of improvement. The entire exercise was aimed to help the teams visualise individual systems, their impact on the entire vehicle and the process of system integration. Students could feel the components, systems and their respective dimensions and major discussions were on decisions made in selection of each component while designing of the Kart.

A-2: Tutorial part 2

After tutorial 1, students’ response and understanding were judged during the review 1. The second part of the tutorial was dedicated to CAD and CAE tools. The student teams were encouraged to utilise as many design/simulation tools. A series of lectures were conducted on CAE software’s for static and dynamic analysis of the vehicle structure. Irrespective of the software used, the outcome of each design has been given the importance. The demonstration on ANSYS workbench was conducted to show the behaviour of the Electro Bug cart under static and dynamic conditions. The care was taken to make them understand the process of validation of the results obtained through the software tool and how to utilise these results for further design improvements/enhancements.

B. Review Process

Periodic reviews ensured the continuity of project process. Zikai Zhou and Pilar Pazos [4] claimed importance of factors like project selection, team formation, learning objectives of capstone design projects, coaching, mentoring, feedback, evaluation, deadlines and milestones in successful capstone project. Three reviews were planned and all three reviews had definite outcomes. Also reviews were served as checkpoints to give proper inputs to students whenever needed.

Review 1 was conducted immediately after first tutorial i.e 3rd week of the semester. Team formation, problem definition and subsystem distribution among students were the main highlights of the first review. Gaant chart and Work Breakdown structures were utilized by students to define the roadmap of the minor project. Similarly review was emphasized on designing of each subsystem, which included literature review on each subsystem, computations to decide the dimensions of the subsystem, material selection and availability in the market. Third review was on creation of virtual model and integration between the subsystems to function as a system in totality. All necessity modern engineering tools were utilized to achieve the system integration and modeling of the Kart.

An activity without a proper assessment didn’t motivate the learning [2]. Durward K. Sobek II, Vikas K. Jain [3] used the instruments for assessment such as Client Satisfaction Questionnaire and the Design Quality Rubric to measure the outcomes of the project and suggests to use
both separately for interpretation. So a rubric was set in accordance to satisfy the various ABET’s program outcomes. Especially, all the elements of program outcome 3c was highlighted to address through well defined rubrics. Rubrics used during all the reviews of minor project is shown in Table 1.

3. Results and Discussion

The review team observed direct application of subjects like Material Science, Vehicle Chassis Systems, Design Analysis Lab, Kinematics of Machines, Mechanics of Materials and Basic Electrical and Electronics by all student teams. Student teams also utilised various software tools that were not part of their academic curriculum like Catia V5, Solidworks, Ansys Workbench, Hyperworks, Proteus 8 and Keilu.

Other points include design for manufacturing (fig 2), detailed system integration (fig 3) and vehicle ergonomics (fig 4 a, b and fig 5), component design and analysis (fig 6 a, b; fig 7).

![Figure 2: Dimensioning of vehicle assembly](image)

![Figure 3: Model of assembled vehicle](image)

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<th>Table 1: Rubrics used for Continuous internal evaluation</th>
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4. Conclusions

The students were able to successfully demonstrate:

- An ability to design a, component, system, or process to meet desired needs.
- Improved technical writing, presentation and industry standard documentation skills.
- Sense of individual responsibility and contributing effectively as a team.
- Need for economic viability factor for the engineering solution.

Fig 4. (a) Driver seating position on the actual kart

Fig 4. (b) Students packaging the systems around the driver

Fig 5. Model with systems packaging around the driver

Fig 6. (a) Model of brake disc and calliper

Fig 6. (b) Analysis of brake disc

Fig 7. Analysis of vehicle frame

References

