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Impact of Project Based Learning Methodology in Engineering

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Abstract:

Learning from our own mistakes is one of the best ways of impactful learning. This comes into play when we practically apply and experience theoretical knowledge. This is where the concept of project based learning becomes the most powerful method. Having the theory knowledge is essential but having only the theory knowledge without knowing its application may not be useful in the long run. Project based learning (PBL) helps students to know the proper application of theoretical principles taken from the books. This paper describes how project based learning helps students in acquiring practical and technical knowledge. Project based learning is a model that helps student learn through projects. This involves the students in designing of new models and acquiring problem solving skills. Now-a-days industries demand graduates with multidisciplinary education. This paper discusses the benefits which are being achieved through development of project "Quad Bike" by our team of students in our college: Hyderabad Institute of Technology and Management (HITAM).

Keywords: Theoretical knowledge, practical knowledge, problem solving, PBL, quad bike.

1. Introduction:

With the theoretical knowledge of design and development of quad bike, the team of students felt the necessity for a practical experience. It is an experience that will help the students to learn design, development, and team work and also provide hands on experience.

Nomenclature

PBL: Project Based Learning

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Bringing the theoretical knowledge to reality is the biggest challenge that students face in any project. The best part of project based learning is that students gain a lot of real time experience and face practical problems faced by the industry. PBL curriculum helps in overall professional development [1]. The central activities of PBL involve the transformation and construction of new knowledge [2].

The design and development of the quad bike is a really challenging task. Students involved in this project learn skills such as team work, design of quad bike, selection of materials, manufacturing parts, and gain hands on experience. This project covers a lot of concepts that were once taught in the classes like resolution of forces, calculation of forces applied, study of metals, calculating centre of gravity (CG), centre of mass (CM) and various other concepts. The project also involves concepts like vehicle dynamics and computer aided design (CAD).

2. Methodology:

There are four major steps or phases in making any product. The first being conceptualisation; the second designing; the third testing and the final step: manufacturing.

1.1 Conceptualisation:

First all the students sit together and conceptualise the quad bike. This stage involves deciding roughly the overall dimensions of the quad bike, its approximate weight, the maximum speed, power and torque expected of it, the amount of fuel it will carry, etc. Depending on this the engine and fuel tank is selected. The rough structure decided in this stage then goes for designing. In case it is found out that the design is not feasible then the process starts over once again.

1.2 Design:

This is one of the toughest parts especially for first timers. The design of the various components of the quad bike is developed on Solidworks (a CAD platform). It not only involves designing the main frame and the wishbones but also finding out the perfect dimensions of various components like drive chain, rear sprocket wheel, wheel hubs, etc. The design has to be lightweight and yet have high structural strength. The three main points of the wishbones are found out using LotusShark suspension analysis software. This software is used to find out the optimum points of contact for the wishbones. This is done to reduce camber and toeing and provide better handling of the bike even in the roughest of conditions. It also ensures that a minimum impact is taken by the rider in case of bumps. Based on these points the structure of the wishbones is then decided

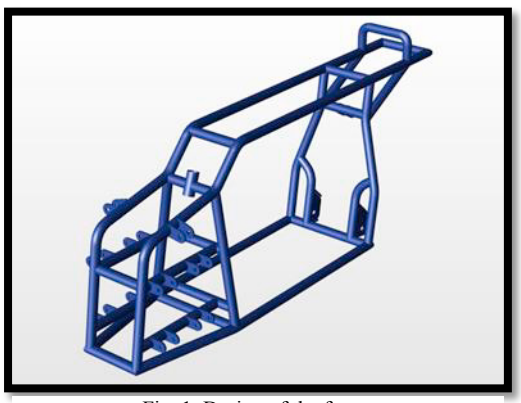

Fig. 1. Design of the frame

The next important part in this phase is the selection of the material of the structure. It is important as the stability and durability of the structure depends on it. If the metal is too soft it will break under pressure, if it is too hard it will transfer the impact force to the driver. In both the cases the frame does not fulfill the needs and requirements of the project.

This stage is usually the longest stage as many cases of trial and error have to be overcome to get the optimum design for each and every component, so that they have high structural strength and yet be lightweight and easy to manufacture. This part also provides the maximum area for flexibility and can often become a match winner in case of a competition.

1.3 Testing:

After the design has been made the frame structure is then tested in ANSYS testing software to check if it an take the stresses it will be subjected to during the course of usage. In case it is found out for any component that it cannot handle the stresses it will be subjected to then it again goes back to the design stage to be redesigned and again sent for testing.

If all components are found out to be proper, only then we progress into the next phase of the process.

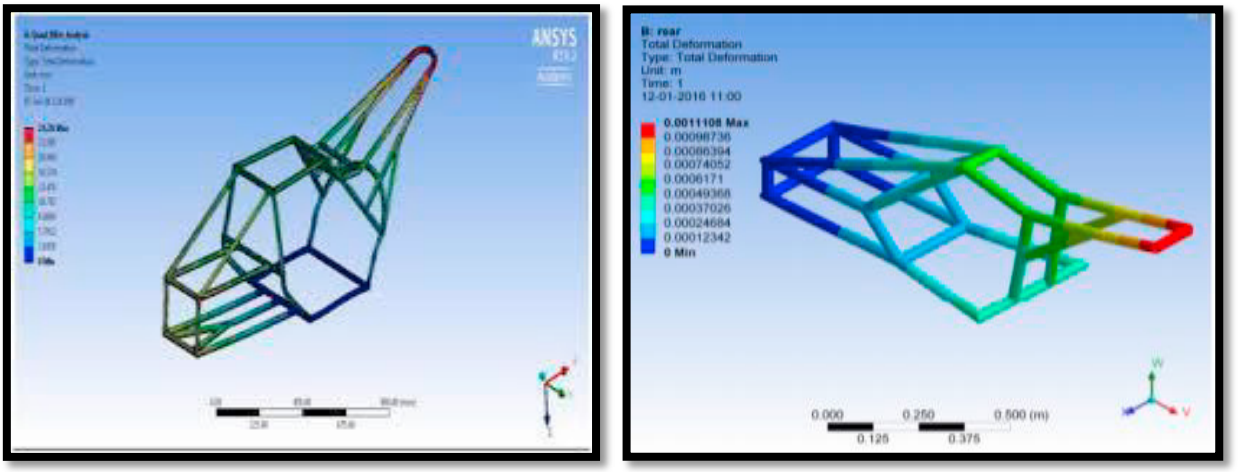

Fig. 2. Frame analysis

1.4 Manufacturing:

This is the most labor intensive part of the whole process. After the testing is done the metal pipes are brought and cut precisely as per the required dimensions. The next part is to weld the metal pipe joints for the construction of the frame. Wheels, tires and suspension are selected as per the requirement. The tires have to be off road tires as the quad bike is meant for off road riding too. The suspension also has to be heavy duty to take the high amount of jerking during usage. The project also involves handling the complex electronics of the vehicle.

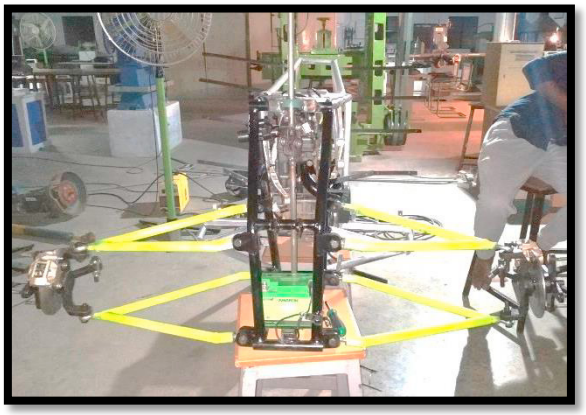

Fig. 3. Frame manufacturing

This part tests the effectiveness of the design in terms of ease in manufacturing because if the part is too complex then it may not be possible to manufacture it without the aid of heavy machines. One also acquires efficiency in working with machines and tools in this stage. In case of any imperfection, a component may have to be rebuilt or else the whole structure may break apart. In this stage one also learns how to handle and manage such imperfections so as to avoid extra labor and time.

3. Results and Discussions

The quad bike is made successfully. Students participating in this project acquire various skills. Alongside technical skills the students develop teamwork which is a key factor in these projects as there are a lot of students involved. The students acquire team management skills and also learn persuasive skills in getting their point or solution implemented. Project based learning helps students to overcome the real life problems faced while developing the projects. Also as each student looks at the problems encountered in his own perspective multiple solutions are obtained for the same problems. Project based learning model helps develop real-world problem solvers, thinkers, and doers instead of rule followers [3].

Fig. 4. Assembly

4. Conclusions

In effective project based learning experiences, students are actively engaged in decision-making and time management. They confidently manage their team's shared accountability, and develop quality products and performances within deadlines [4]. They participants not only become better in technical and practical skills but also develop their leadership and technical skills which help them become better citizens of tomorrow's society.

Fig. 5 The Quad Bike

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