

Enhancing Skills through Integrated Projects – the Student Experience

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Abstract -- *In order to become more employable and marketable, it is important for Mechanical Engineering graduates to be prepared in order for them to be able to demonstrate their ability to apply engineering knowledge to solve problems, work in a team, collect, analyse and organize information and present this information in oral and written form. In an attempt to prepare students for the workplace and to make learning more relevant, whilst promoting and enhancing requisite skills, the Mechanical Engineering Department at the Cape Peninsula University of Technology (Bellville Campus) provides students with opportunities at all levels of study to participate in an integrated project that requires them to apply their knowledge in a decompartmentalised fashion. Despite this integrated approach to learning and promoting valuable skills, many students have difficulty in coping with this approach and many find themselves having to repeat the project. This paper explores the reasons why students experience difficulty with these integrated projects and how this could impact on their potential preparedness for the workplace.*

Index Terms – *integrated project, group work, student experience*

Introduction

The Department of Mechanical Engineering (Bellville Campus) started a process of incorporating an integrated project across all study levels of its Mechanical Engineering Diploma just under a decade ago. The integrated project was born essentially out of the realization that the students compartmentalised their understanding of subject matter and found it difficult to make conceptual links, ultimately impacting on their ability to solve engineering problems. The project therefore became an important part of the assessment for each subject. The integrated project seemed to be a good vehicle to enhance and assess various skills. As students are required to work in groups, the project foregrounds and assesses, amongst other things, the students' ability to effectively: work in a group, manage themselves and their project activities, collect, analyse and critically evaluate information relevant to solving a problem (which they will have sufficiently contextualized), communicate, use science and technology. It was acknowledged that these skills were not only essential for students in their academic world, but would be critical when they entered the world of work. In this way, the integrated project could play a vital role in contributing to the preparation of students for the workplace. For example, working in a group promotes the notion that the workplace is not only about being individualistic, but working in collaboration with others in order to find workable solutions to problems.

The integrated project provides a novel, learning platform that gives students some experience of analyzing a problem and providing a workable solution within a given time-frame. Williams [1] points out the importance of educating students “in an environment where they get used to justifying and explaining their approach to solving problems and also to dealing with people who have other ways of defining and solving problems”.

The time-frame allocated to the integrated project has changed since the introduction of the projects. Initially students did the project over the duration of the semester. This was found to be somewhat problematic as many students did not work consistently and conscientiously on their projects during the semester, often resulting in poor quality projects in the end. It was felt that students were given too long a period of time to do work that could be completed in a shorter period. Also, if students were given a dedicated period of time to focus on the project the learning experience would be more immediate as opposed to drawn out and bordering on insignificant. A new way of executing the project was introduced which meant that students would do the project over a dedicated two week period where the primary focus would be their projects.

Over the years the projects have varied and a critical consideration has been to design projects that are sufficiently challenging, yet contain elements of fun and that promote competitive spirit. Examples of recent projects include: the design

and manufacture of a “ships derrick” that can lift a load from one point to another (semester one), design and manufacture of a submersible vessel that can travel a distance of 10 metres carrying cargo (semester two), design and manufacture a manually operated brick making machine that can manufacture a 220x105x70mm brick, and design and manufacture of a bicycle rack that can be attached to a tow bar of a motor car and carry a single bicycle (semester four). Elements of design and manufacture are found, in varying degrees, across all the projects.

One of the key elements of the project process is mentorship and supervision. A group of lecturers at each level is responsible for the development of a project that is sufficiently challenging. Each group is also responsible for mentoring and supervising students doing a particular project. The model of mentorship varies at different levels and includes either a mentoring system where a number of groups are assigned to one mentor or where a panel of mentors works together at providing collective guidance and feedback to students.

Despite the ambitions of the integrated project initiative, the changes made to better accommodate students and facilitate meaningful learning, some students struggle to complete their projects successfully. It would appear that there are areas of difficulty which students experience. This paper explores some of these areas of difficulty from the students’ perspectives.

Methodology

First semester (S1) and final semester (S4) mechanical engineering diploma students were asked to participate in this research by completing a questionnaire that was designed to give students the opportunity to reflect on the significance, shortcomings and strengths of their integrated project experiences, with particular reference to what the reasons are for students not completing projects successfully. The reason for focusing on first semester and final semester students was to see how different the experiences might be for a new student who experiences the project for the first time and for a student in the final semester, who will have had the experience of at least three integrated projects. Thirty four responses were received from semester one students and thirty eight from semester four students. Quotations from student responses included in this paper have not been edited.

Student Feedback

Reasons for doing the project

Both groups of students generally showed similar insight as to the reasons for the department wanting them to do the integrated project. They seem to understand that it is expected of them to do an integrated project: firstly, so that they can see the practical application and integration of their theoretical knowledge in solving an engineering problem. Secondly, to better prepare them for the workplace by providing them with learning experiences where they learn to think of various possible solutions to a problem, work in groups and have to meet certain requirements and produce outputs within a specified time-frame. From this perspective, students seem to have a good grasp of the intention of the integrated project. All the students, except two, agree that the integrated project is an important assessment and relate this importance to learning that takes place, the awareness of the world of work and the relevance of certain skills. As one student writes,

“... one does not realize how much work goes into producing 1 simple product until they have actually been in the production process. Industry does not have time to teach workers group dynamics, work must be done when it has to, period. Presentation is also a skill acquired thru practice and the project provides it”.

Skills learned

All the students, except three, believe that the skills gained by doing the integrated project will be useful in the workplace. These include: project planning, communication skills, working in groups, managing time, conducting research. The semester four students’ responses differed only in their addition of drawing, manufacturing skills and using certain machinery. This could be as a result of the emphasis on manufacturing and producing a drawing pack at this level. The S1 students were not required to do any “heavy duty” manufacturing, hence the lack of emphasis on these aspects.

Reasons for poor performance

Several isolated reasons were given to explain why students do not perform well in their integrated projects. These included laziness, lack of understanding, lack of commitment and seriousness on the part of students. Two particular reasons were very prominent, namely time management and poor planning, and poor group work.

Time management and poor planning

It is interesting that most students highlighted the above skills as those that they have learned, yet the absence or lack of these same skills are noted as reasons why students do not do well in their integrated projects. Many students, S1 and S4, indicated time constraints and poor planning as reasons for poor performance. Learning to manage time is a critical skill as the workplace requires deadlines to be met, despite the resultant pressures exerted on the individual or team. Despite being given a two week dedicated time period for the project, some students seem to have been unable to manage their time efficiently. This appears to be one of the main reasons given by the S1 students as some of them indicate that other things, unrelated to the project, were done during this time and that the project work was left “for the last minute”.

This would seem to be indicative not only of poor time management, but of a lack of prioritization of work. It is cause for concern that the students are aware that the project mark contributes to the total mark for all their subjects, yet some choose to not take it seriously. This lack of prioritization could also be linked to the negative attitude to and lack of interest in the project mentioned by eleven S1 students. Students who start off with a negative attitude and poor work ethic may find subsequent projects, where the challenge and workload increases, problematic. In this way the poor performance may be perpetuated in the next level of study. In fact, Coll, Zegwaard and Hodges [2] point out the difficulty facing tertiary institutions who expect to instill competencies into students who do not see their importance. They further indicate that competent individuals have either specific skills that they can draw on to perform a task, or may have generic skills that can be used to perform tasks. It would appear from the responses that some students lack specific and generic skills to draw on for the successful completion of their tasks which renders them unable to perform successfully.

Group work

Another common problem indicated by both S1 and S4 students is difficulty in working in groups where some do not know how to work in groups and others just do not want to. This could perhaps be understood when mentioned by the S1 students, who may be new to the concept of group work and may lack maturity in this area. However, it is difficult to comprehend S4 students indicating that working in a group is difficult since they have experience of working in groups and should ideally have learned how to work in a group at this stage.

Several S4 students indirectly refer to working in groups as a problem, but eight students mention group work specifically. The issues relate to lack of communication amongst members. Other group related issues mentioned are conflict, lack of respect amongst members, poor listening skills, lack of performance of assigned tasks, a lack of accountability and responsibility, which leads to group apathy or heavy dependence on certain individuals in the group. Some of these could be seen as social issues that students need to learn to deal with as dealing with people is important in any work environment. Thus students seem to be unable to work collaboratively. Bennet, Dunne and Carré [3] point out that “attitudes towards others and oneself” are important “soft skills” that underpin collaboration. Previous research reported on by Omar, Ziegler and Garraway[4] particularly related to integrated projects, shows students highlighting group skills as an area of concern. It was concluded that “...not all learners appreciate group work and do not participate fully”[4].

Bennet, Dunne and Carré [3] suggest that being able to function in a team is an important part of the culture of a company. Poor planning and time management in addition to inability to work effectively in a group speaks to possible deficiencies in personal character and a lack in competence on the part of some students to do the tasks assigned. Coll, Zegwaard and Hodges [2] refer to competency as relating to how individuals use the skills and knowledge to perform tasks. How well one is able to do this will determine the extent of overall performance of the task.

Conclusions

Students clearly state that they have learned various skills as a result of having done the project. In this regard the integrated projects enhance learning. However, students also point out that the absence of these skills, or a disregard for learning them, can result in poor performance in the integrated projects. Students do see the value of the project in that it gives them exposure to some of the expectations and pressures that they might experience in the workplace one day. In this way the integrated project experience contributes to some extent, to preparation for the workplace. In addition, it gives them the opportunity to apply their theoretical knowledge and understanding in practice. This awareness was expressed by S1 and S4 students.

It would appear that problems experienced by S1 students are common problems that continue through to the S4 level. A point to note is how significantly the lack of non-technical skills can impact on technical knowledge and its use in solving problems efficiently. An example of this is the students' inexperience (at S1 level) and inability (at S4 level) to work effectively in a team.

It would also appear that the idea of learning from experience cannot be taken for granted since some S4 students have still not learned how to work in groups or deal with group problems in a constructive way, despite having had time to reflect on what went wrong previously and what areas could be improved upon. This impacts on the students' success with the project as group work is emphasized and lack of participation of one member intentionally or unintentionally impacts on the entire group. Students typically do their experiential learning after their fourth semester and this could pose a problem when they enter the workplace where, in most cases, they will be expected to work in a team.

Clearly, the experiences gained by doing the integrated projects are important for students as it can serve as an important means of reflection on learning that has or should take place. It is clear that many of the students experience problems, particularly with managing themselves and interacting with others in a collaborative space. These issues will have to be addressed by the department somehow as it would appear that these hinder the progress of the students and contribute to their poor performance. Poor development of critical skills can negatively impact on the students' employability in the future.

References

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