Learning through Project-based Teamwork in Engineering Education

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Philosophy

I strongly believe that teaching is not merely about standing in front of a lecture theatre to convey information so that students can take notes and memorise them. Besides providing students a content-based syllabus with specific guidelines about what they should learn, and what skills and understanding they should value, it is equally important that the educator selects and designs the right combination of reading assignments and class projects. A well-chosen set of learning resources will equip students with the skills that will steer them towards self-directed learning and at the same time, provide them with the opportunity for classroom discussion. Such discussions will inevitably expose students to different viewpoints, develop their oral advocacy, encourage cooperative learning and enhance their ability to retain learned information for a longer period. To support this goal, case studies and/or project-based teamwork (Ngai, 2007) has been incorporated into the syllabus. In short, my teaching philosophy is to provide for all my students an environment that encourages lifelong learning. This article presents an exploratory study investigating the integration of a project-based teamwork approach to teaching and its impact on students’ learning.

Methodology

This study was conducted to a class of postgraduate students undertaking the course module ME6505 “Engineering Materials in Medicine” at the Department of Mechanical Engineering, National University of Singapore (NUS) in Semester 2 of Academic Year (AY) 2009/10. The lecture component of ME6505 will cover fundamental knowledge in the biomaterials field to ensure that students start their respective projects armed with the appropriate tools and know-how. Detailed specifications and requirements for the project are outlined and provided to the students at the beginning of the course. All 35 postgraduate students who enrolled for this module participated in this study. The class formed 7 groups, each comprising 5 students, and each group was tasked to prepare a research proposal based on an implanted device. During the study, I assumed the position of a facilitator pointing students towards possible solutions to the problems they were facing in the course of preparing their research proposal. A proposal report of no more than 5 single-spaced, A4-sized pages and a 25-minute presentation to the class were used as a form of assessment, which allowed the students to demonstrate their mastery of the subject material as well as providing ownership of the submission. A feedback questionnaire was administered among the students in order to collect both qualitative and quantitative feedback. The feedback was used to analyse the impact of the approach on students.
Findings and Discussion

It was observed, from the feedback obtained, that the majority of students felt that the project-based teamwork approach has enabled them to learn more about the subject matter, with 34.3% grading the approach as “excellent”, 62.8% as “very good”, 2.9% as “good”, and 0% as “satisfactory” or “poor”. At the same time, they felt that this approach has helped them to better understand the importance of clear presentation and good project management. I shall now look in closer detail at the opinions received from students with regards to this pedagogical approach.

- **Self-learning.** Generally, students felt that the project-based teamwork approach has enhanced and contributed to their ability to learn and has also given them the freedom to learn at a pace they desire, thus making the learning process more enjoyable and meaningful. This feedback is consistent with Ngai’s (2007) observation that one of the benefits of this approach is that students “built up their capabilities to learn independently” (pp. 27).

- **Deep learning.** The ability to engage, involve and develop students to think deeply during the learning process is important, such that they will then appreciate the knowledge acquired and thereby more effectively retain the knowledge gained for a longer period of time. Generally, students felt that the project-based teamwork approach has provided them the opportunity to learn more and in greater depth. From the submitted reports and oral presentations, I am convinced that this approach has indeed helped my students in their learning process since they are able to introduce the latest advancements in the biomedical field, and even some bioengineering concepts and terms that go beyond what the lectures covered.

- **Oral and written advocacy.** Giving presentations and writing reports do not simply mean extracting and copying information from the available resources, but rather it involves having to explain and present the information clearly to the audience. Indeed, the students do have a positive opinion that the project-based teamwork approach does enhance their oral and written skills. When assessing the students’ reports and presentations, I notice that the students have tried their very best to explain difficult concepts and facts in the simplest manner. Furthermore, all the students participated during the oral presentations, and most of them managed to overcome any initial stage fright after talking for more than 5 minutes. Similar results have been found in the study by Ngai (2007), where the project-based teamwork approach helped to enhance students’ communication skills.

- **Time and project management.** The importance of managing time effectively and the ability to work as a team are crucial in the completion of the assigned project since a great degree of responsibility falls to the students. The majority of students felt that this pedagogical approach has indeed helped them to plan their time better and to be better team players. During this study, I did not need to chase after any group to submit their reports. Instead, all the groups submitted their reports punctually, without any requests for deadline extensions. Furthermore, I did not receive any complaints from any of the groups. Basically, they are happy and comfortable working among themselves.

On the whole, students give more credit to the advantages of this pedagogical approach, and were very satisfied with the study. Nevertheless, should this model be implemented again, it is necessary to assign each group a research topic in the beginning of the course so that they will be able to kick-start the project early, rather than spending weeks deciding on a topic of interest.

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Conclusion

I believe there are many pedagogical models that can be applied to one’s teaching in order to realise one’s educational philosophy. In this study, I have presented the use of the project-based teamwork approach as a pedagogical model in Engineering education. The model is considered beneficial according to the students’ perception since it has helped them greatly by enabling them to develop and improve their oral, writing and self-directed learning skills, helped them gain a deeper understanding of the subject matter and enhanced their ability to manage their time and projects effectively. I would certainly encourage other educators to implement this model to their modules (if applicable) since it is clearly a refreshing departure from the current practice of assessment in most universities, i.e. via continual assessment or submitting a term paper. There is nothing wrong with these practices, but students usually tend to memorise, regurgitate and forget what they have learnt after going through many traditional types of assessments.

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References