

How to Approach Learning: Engineering Students' Perceptions of Project-based and Problem-based Learning at an International Branch Campus in the Middle East

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Abstract

Project-based learning has widely spread as a learning tool that many students find useful. Branch campuses are no exception in terms of assigning projects as a way to achieve learning outcomes. However, the differences arise and are more distinguishable when the cultural diversity of the student population is taken into consideration. This paper aims at forming a better understanding of engineering students’ perceptions of project-based learning in the diverse context of an international branch campus located in Qatar, as well as to provide educators with suggestions on how to better manage group projects that involve a diverse population.

The research project bases its results and recommendations on data taken directly from the branch campus in the form of a focus group. A diverse group of students, from different majors, genders, and classifications were involved in an open-ended discussion on their perspective and experiences with projects, and what elements of a project were the most important to them.

Major findings discussed the role that the culture, of both the diverse group of students and of the physical location of the campus, plays when the students are working on projects. Students ranked teams, and their interaction with fellow team mates as the primary factor responsible for their satisfaction with the project. Other factors that influenced the perspective of the students about projects included relevance of the project to the major and the interest of the students.

We also argue that cultural factors play a large role in students’ perceptions of projects. Recommendations based on this will be useful for instructors working with diverse student populations on project-based learning.

Introduction

In this research paper, we examine project-based learning (PBL), which is one of many ways to approach learning in the field of engineering. PBL has long been shown to be an effective method for student learning and understanding, particularly if thoughtfully integrated throughout the curriculum [1] and if instructors include key features, such as meaningful inquiries, scaffolded assignments, and consistent feedback [2]. Other studies have shown that PBL is more effective in deeper retention of material, satisfaction of both students and professors, and

development of professional skills than traditional lecture methods [3]. However, the overall effectiveness of PBL, and experiential learning in general, may vary widely depending on the nature and structure of the teamwork [4].

This study was conducted at the branch campus of Texas A&M University at Qatar. The branch campus offers four different engineering undergraduate degrees, and the curriculum is exactly the same as the main campus in the U.S. The student body is small (approximately 450 students), and very diverse. Around 50% of the students are citizens of the nation, and the other 50% are international, meaning that they are from nearby countries in the Middle East and North Africa (MENA) region. The only American students are a small population of study abroad students (around 10-15 per semester) or those who carry an American passport, but often belong to various Arab or South Asian ethnic groups.

At the time of this study, our institution began a renewed emphasis on PBL, and we wanted to know more about the potential impacts of the culture of the region on teamwork and projects, given the diverse student body mentioned above. Our team of three undergraduate students and one faculty member collected data during a focus group discussion on project-based learning. Towards the end of our paper, we offer suggestions and implementations that will help professors improve the effectiveness of PBL when implemented in a diverse group.

Previous Studies on Project-Based Learning

Students with prior experience in PBL are able to perform better in teams, project deliverables, and learning outcomes than those who have not been exposed to it [5]. Additionally, students who are taught about the PBL process and involved in the design of the project also improve their performance and strengthen their skills, such as group work and time management [6]. Thus, understanding students' prior experience with and perceptions of projects can help meet the diverse needs of learners [7], especially as PBL is scaled up across the curriculum or across the institution.

Similarly, students come to university with different experiences of working in teams. Previous studies, particularly those done in American universities, have concluded that students find it difficult to work in teams [8]. Collaboration is a context-dependent skill, which means that individual, institutional, and cultural differences play a role in the outcome of the teamwork [4]. For international students working with an American curriculum, like those at our branch campus, collaborative projects can be a site of fairly significant cultural differences - between students, or between students and professor.

Other studies have discussed the effect of culture when discussing the impact of learning methods in the MENA region. A study conducted at the American University of Ras Al Khaimah in the United Arab Emirates, found a small but significant difference in the learning styles of their student population. They conclude that differences in culture may affect learning styles and hence peer learning opportunities, such as team projects [9]. The collectivist culture of the MENA region [10] values collegial relationships between group members, often over individualistic goals, while the U.S. is commonly known as an individualistic culture. Few resources exist on the adaptations or experiences of PBL in the MENA region, while 10.4% of international students in the US in 2017 were from this region [11], and many are enrolled in undergraduate engineering programs.

It has been noted in previous research done at an international context that the presence of international students or a diverse group of students unfortunately doesn't necessarily translate to a diversification in the pedagogical approaches employed by the instructor [12]. Thus, this study aims to contribute to the body of knowledge on PBL in a diverse context and provide recommendations on how international students can find PBL effective and helpful.

Methodology

The data used in this research is from a focus group in which five students held a 45 minute long discussion on their prior experience with projects. These students represented three different majors: electrical, petroleum, and mechanical engineering. In addition, the facilitator who ran the focus group is an undergraduate student and one of the researchers on this project.

The participants in the focus group were a targeted sample based on their interest in the topic of discussion and availability. Both male and female students were in the focus group, and three out of four majors available at the university were represented. In addition, the five participants represented students from four different countries: Qatar, Pakistan, Egypt, and Palestine. The participants were second- and third-year undergraduate students at the time of the study. Further details about the participants are discussed in a later section on the limitations of the study.

The questions asked by the facilitator (see Appendix A) focused on students' perspectives on projects. These questions were open-ended, which allowed for more ideas to emerge between the participants and a deeper understanding of students' perceptions. The moderator attempted to eliminate groupthink, or a false sense of agreement, by encouraging debate among the participants. Through these interactions, the facilitator was able to help the participants examine differences as well as similarities in their experiences with projects at the branch campus.

Case Study Analysis

The first step in approaching the analysis was to transcribe the recorded focus group and collect the notes recorded by the facilitator. The team members read through the transcript to get a general idea of the main points that were discussed. Then, we approached the transcripts through thematic analysis for a better understanding of our case study [13]. The focus group transcript was coded for common themes [14]. During this coding process, we began to understand that student participants' perceptions tended to rely upon two categories of relational factors and learning factors. These factors are discussed in the section below.

Results and Discussion

Our analysis showed that the key factors that impacted students' perception of projects were regarding learning and relationships. As we argue below, the relational factors were influenced by cultures of the MENA region and it may be helpful for other instructors to consider these when assigning projects to students with diverse backgrounds.

Learning Factors in Perceptions of Projects

In the focus group, students tended to prefer projects over exams or other forms of homework because of the stress, which we interpreted to mean the perception that in projects there were many 'right' answers for them to be graded upon. They noticed that some faculty members were assigning problems and calling them projects, as in this exchange:

D: In class the problem I have[...] this semester [...] it's basically a big collection of homeworks. Now you do this [problem], now you do this, now you do this, and there's only so much you can do differently from anyone else.

E: That's what usually happens. The projects are divided into smaller deliverables, but the way the project is designed *there's one right answer* [italics ours] and everyone ends up doing the same thing or copying off each other.

F: Actually it's what we do, we have the same thing *يعنى* [Arabic word for 'like'] the projects that we're doing is mainly you have a question and you just write the code. You don't actually do an [...] actual thing, like build a circuit [...] Just write code, it's the same as homework *بس* [Arabic word for 'but'] instead of doing it on paper you do it in MATLAB.

The focus group noted how projects varied across disciplines, such as how Petroleum Engineering students had a difficult time finding projects applicable to their major. One explained that while the class got to go on a field trip to see petroleum facilities, they did not have a chance to work with data from the field, as that was considered classified information.

Overall, students in the focus group relied on their perceived relevance of the project when judging its effectiveness. For instance, the student in the above example used relevance to the workforce as a way of indicating the lack of good projects in Petroleum Engineering courses. Another used relevance as a reason to take projects out of the curriculum:

F: Here in Qatar, no one works as an Engineer by definition. [Instead] we work as a construction commission. So you don't work as an engineer, pure engineer. So I don't feel like [projects] would be beneficial. If the professors keep giving you projects, you're not going to apply it actually at work. Instead they [could] give you calculations to the problems - that might be helpful.

As the above example shows, students in the focus group drew upon their understanding of the nature of the workforce in the region in order to determine the relevance of the project. While such views are not likely to reflect the emerging job functions in the MENA region [15], instructors may garner more student buy-in by engaging with these perceptions of the working lives of engineers in different contexts.

The last learning factor that was coded in the transcript was the spectrum of student choice and professor guidance. Students in the focus group noted what aspects of the project were chosen by the professor and what aspects were left for the students to work out among themselves.

B: But you know if we are sitting in a group and we're giving a project and nobody decided what or who to do what exactly? So that's a big mess.

C: Like last semester, I was with Dr. ----. She assigned us to do community research and to write a whole research about it. And collect data by doing surveys and such and such. [...] So my interests were about nature and [...] climate change researchers. So, I interviewed the person who I knew through Twitter. He is a climate change advocate and researcher. So he'll help me a lot with this project and also the survey was actually, also a key for my statistics and such. So, she gave us like, the green light to do and search about anything, we want but like communities. She just said search about a community that you would like to search into. So, many people did different things, not related to their majors. Maybe some did some research about their majors.

D: I feel like having guidelines and the specifications, not too specific but specification is much better than having a like a vague topic. And then the students are lost, like most of the time is wasted on: what do we want to do as a project? Not like the actual work. But the aim of the projects is to learn. If you want us to learn about something, then assign that thing. If you want us to experience what would happen in real life, when we work then: assign us a case-study and we work on it, and then that's our project. But if we have like a vague topic then we would be lost, and like what do we do? Like what do you want? What do you expect?

While student opinions were mixed on the right level of guidance to be provided by the professor, good and bad experiences with projects were often tied to what choices the students had to make about topics, teammates, work distribution, and other sources of learning.

Relational Factors of Project-Based Learning

The initial analysis suggested that teamwork, work distribution, and assessment were strongly associated with projects, and this proved true in our thematic analysis as well. However, upon analyzing the transcript, we determined that students often contextualized these concepts with a nuanced understanding of relationships between themselves, their teammates, and their professors. When students expressed displeasure with previous projects, their reasoning was that their teammates had ruined the experience for them.

C: With a project it depends like if you are doing them with a group or yourself. If it's with a group, you feel like everyone is relying on the other but really not doing anything.

This experience might be exacerbated by two factors: the collectivist cultural norms of the Middle East - North Africa region [10] and the small size of the international branch campus. Broadly speaking, students from the MENA region tend to feel more obligated to help team members or cover for them if they are not contributing to the work. For some, breaking the norms or risking friendships is not an enough cause for a discussion about the conflict with the team and especially not with the professor. This matches other, larger scale findings from studies about project management in the workplace [16].

In addition to relationships with teammates, relationships with professors and other course mentors were important to students in the focus group. Students who maintain a better relationship with the professor tend to be more likely to engage with them in outside-of-class work, such as research projects.

C: Some projects when they are explained, [...] they lose my attention. When I am like listening for two hours about the whole project. It's like *يعنى خلاص* [Arabic words for 'that's enough'] just give us the [main] points, let us work, and then see our mistakes, and then help us with that. [...]. Like one of the engineering projects [...], I think his name is Dr. -. He assigned us with [...] the petroleum project for the engineering class. He explained it very well and everything. And then when we started working on it, he was checking our calculations, the numbers, or if there was a mistake, okay: "Fix that, do that."

Again, students' relationship with the professor may vary according to culture, particularly in the MENA region, where traditional teacher-led classrooms are the norm in secondary education.

Overall, the key factors that determined students' perceptions on projects were related to the structure of the project:

- Does the project have many answers (open-ended) or is really a problem with one answer (closed)?
- How many choices do students get about the project, in regards to teammates, topic, etc.?
- What parameters are selected by the professor, and which parameters do students have to figure out on their own?
- Do students see the topics or skills as relevant to the workplace in the MENA region?

Engineering instructors have often considered their answers to these questions when designing projects; however, the following relational factors may vary across cultures and should be given special attention when working with diverse student populations.

- What teammates are students working with, and how is that teamwork structured?
- How do students perceive the role of the professor? How does the professor encourage (or discourage) extracurricular projects?

Suggestions and Implementations

The main takeaway that can be interpreted from the discussion section is that international students in a group project interact differently based on their cultural background. Not only that, but some international students might regard the dynamics with other team members as the primary factor that can make or break a successful project experience.

Instructors of projects involving international students from collectivistic cultures need to pay closer attention to techniques followed to form teams. It was reported earlier that many problems occur in projects that cause delays or failure of the project altogether due to the team formation step. This occurs because of the uneven load shared among the team members due to the lack of response from some team members which may be due to both random selection and students choosing their own teams. A way to form teams could be based on existing tools such as CATME, an online system of services which help professors build effective teams based on a wide variety of criteria, including race/ethnicity. This has the potential to reduce the amount of failed projects due to incompatible teams and unstable team structures.

Another side to the problem is not bringing problems taking place within the team to discussion with either the instructor, or between the team members. Students who belong to collectivistic cultures may experience shame in doing so. That can put an extra load on the instructor of the course as he or she may need to find a way to solve issues between the team members in a less direct way than inviting them to openly discuss their problems.

Further problems arise when the level of motivation and understanding of the project and course objectives differ between group members. This eventually leads to some members carrying an uneven load compared to the others and the pressure of task and report completion falling completely on their backs. This highlights the importance of all students keeping track of the team dynamics to make sure that they are capable of collectively working as a team towards successful learning outcomes. Providing a variety of teamwork tasks prior to assigning the actual project may aid in identifying the nature of the team's compatibility.

Limitations of the Study

As the campus size in which the study was done is relatively small, finding more students to be part of the focus group was not an easy task. That resulted in a small sample size of only five students. Another consequence of having a small campus and a very diverse population is not being able to accurately represent all of the students demographically. The branch campus includes students from over 30 different nationalities, which makes it very hard to create a focus group that represents everyone.

Conclusion

This research looked at the student's perception and what factors impact their learning when it comes to project-based learning. The uniqueness of the study being done at an international branch campus of an American institute in the Middle East adds a cultural element that revealed itself throughout the data collected. In analysing the case study, relational and learning factors were the main themes of the results. As different students from different backgrounds interact differently in teams, and also place importance on different elements when it comes to defining a successful learning experience, it is important that educators keep that in mind when creating assignments and evaluating group work.

Future Research

In the future, we aim to conduct discussions with a wider range of students to get a broader picture of students' perceptions. Getting a good number of participants from both collectivist and individualist cultures in the discussions is also a key goal we have.

We also plan to talk with a diverse set of faculty present in the campus and ask them about the basis on which they form teams and whether or not they consider the aforementioned factors while building a team. We would also ask them their thoughts on getting directly involved to help resolve team conflicts.

References

- [1] J. W. Thomas, "A Review of Research on Project-Based Learning," The Autodesk Foundation, 2000.
- [2] Joseph S. Krajcik and Phyllis C. Blumenfeld, "Project-Based Learning," in *The Cambridge Handbook of the Learning Sciences*, R. Keith Sawyer, Ed. Cambridge University Press, 2006, pp. 317–334.
- [3] J. S. A. A. van Barneveld, "When is PBL More Effective? A Meta-synthesis of Meta-analyses Comparing PBL to Conventional Classrooms," *Interdisciplinary Journal of Problem-Based Learning*, vol. 3, no. 1, 2009.
- [4] J. Heywood, *The Assessment of Learning in Engineering Education: Practice and Policy*. John Wiley & Sons, 2016.
- [5] K. J. Chua, "A comparative study on first-time and experienced project-based learning students in an engineering design module," *Eur. J. Eng. Educ.*, vol. 39, no. 5, pp. 556–572, 2014.
- [6] K. Gavin, "Case study of a project-based learning course in civil engineering design," *Eur. J. Eng. Educ.*, vol. 36, no. 6, pp. 547–558, 2011.
- [7] R. Felder and Rebecca, "Understanding Student Differences," *Journal of Engineering Education*, vol. 94, no. 1, pp. 57–72, 2005.
- [8] "Teaching teamwork in engineering and computer science - IEEE Conference Publication." [Online]. Available: <https://ieeexplore.ieee.org/document/6143000>. [Accessed: 22-Mar-2019].
- [9] A. Y. Darwish, "Learning style preferences of undergraduate students," *Education & Training*, vol. 60, no. 9, pp. 971–991, 2018.
- [10] E. Ourfali, "Comparison between Western and Middle Eastern Cultures: Research on Why American Expatriates Struggle in the Middle East," *Otago Management Graduate Review*, vol. 15, 2015.
- [11] A. Craddock, "Students From the Middle East and North Africa: Motivations, On-Campus Experiences, and Areas of Need - WENR," *WENR*, 07-Feb-2017. [Online]. Available: <https://wenr.wes.org/2017/02/campus-life-students-middle-east-north-africa>. [Accessed: 22-Mar-2019].
- [12] J. Ryan, Ed., *Cross-Cultural Teaching and Learning for Home and International Students*. Routledge, 2013.
- [13] J. Case and Gregory, "Emerging Research Methodologies in Engineering Education Research," *Journal of Engineering Education*, vol. 100, no. 1, pp. 186–210, 2011.
- [14] L. S. Nowell, J. M. Norris, D. E. White, and N. J. Moules, "Thematic Analysis: Striving to Meet the Trustworthiness Criteria," *International Journal of Qualitative Methods*, vol. 16, no. 1, p. 160940691773384, Dec. 2017.
- [15] World Economic Forum, "The Future of Jobs and Skills in the Middle East and North Africa: Preparing the Region for the Fourth Industrial Revolution," 2017.
- [16] L. Baumann, "The impact of national culture on project management in the Middle East," Loughborough University, 2013.

Appendix A. Questions asked in the focus group

- Projects within courses
 - Do you prefer when a course has a research component?
 - What kind of help does your professor offer you throughout the project?
 - Who gets to pick the project idea? you, or is it predetermined?
 - Do you think projects aid in the learning? or do you prefer exams and homeworks?
 - Do you feel you put more effort in in-class projects rather than outside-of-class projects because they affect your grade?
- Projects outside of classroom
 - Do you enjoy outside-of-class projects more because they don't affect your grade?
 - What kind of projects are offered outside the class?
 - Do all of the projects you do are related to your major?
 - How open are the other departments/professors to involve you in a project that is not related to your major?
- Research
 - Are you involved in any research projects?
 - How open are professors to involve you in their research projects
 - Have you taken any research-based courses? If yes, how did the professor help you through?