

A Process Innovation in the Way of Learning

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Abstract

New graduates in automotive engineering are expected having both technical skills and developed personal qualifications like creativity and teamwork. Owing to these requirements, the engineering education system should consist of a curriculum depending on the industrial revolution 4.0. Project based learning approach, a kind of process innovation, can be taken into account as a key to ensure this expectation. It is also an exit point to get the success in the pandemic period because project based learning can give the advantage to the students to study in online meetings. It's not obligatory to have face-to-face communication. This study aims to show the project based learning opportunities in Automotive Engineering Department in Çukurova University, Turkey. The students taking this course have the chance to develop themselves by working in group projects and this innovation course is based on the real problems round the world. Therefore, being a member of these groups lead the students to research, share their opinions and respect the others', prepare the report as it's required. In other words, it is possible to find a solution in a professional way and this helps the students add a different qualification in their resumes. It's no doubt that the university and industry collaboration needs this kind of students, having an experience in the real-life projects. The perceptions of the class in this course were further investigated through a questionnaire and the conclusion shows all the class is satisfied with this implementation. Furthermore, the performance of the students is appreciated and finally, project based learning is strongly recommended especially in pandemic terms in case of relevant.

Keywords

Automotive Engineering, Project-Based Learning, Process Innovation, Industrial revolution 4.0, the university and industry collaboration

1. Introduction

With the usage of digital platforms, life does not have a way out except for experiencing in industry 4.0. This rapid change also makes the world transform into systematic and ecological paradigm from a mechanistic one. Especially, digitalization trends depending on this transformation become more popular in pandemic term than before. For instance; having a chance to take the course in online way leads both the academician and students to prefer interactive learning mostly because it's easier to search for the students and faster to perform the students in academicians' side.

In this aspect, it can be said that education field should constantly be developing and progressing such as the other ones. It is very important for academicians to renew themselves and follow the tendency in the face of developing education methods to catch the current information of the modern world. Therefore, an effective way should be selected for the students so as not to make them forget the courses. In this point, project based learning, a student-oriented approach, is taken into consideration with its effectivity when compared to textbook-based and academician or teacher centered approach, which are traditional teaching methods. Moreover, it is a well-known fact that business life is framed of a project based world where many ideas are discussed and creativity comes to the fore. The authorities also support these kinds of courses to educate the students with the real problems.

In Turkey, university and industry collaboration prepares a platform for a strong and sustainable synergy by using project based learning method because the future graduates are requested to search, discuss problems and bring solution proposals. In other words, every step includes a project in itself and project-based approach can be considered as a process innovation in education field.

1.1 Objectives

Education has taken a priority place since the development of countries depending on creativity knowledge in today's contemporary understanding. Instead of traditional methods such as conveying information and controlling the learning processes, the courses should be designed on performing the students in 360 degrees. It can be started with giving a topic and leading the students to search about it. Then discussing the results can be the final step. In this process the knowledge and comments are both evaluated.

All these phases form project based learning which is the correspond of modern era education. Likewise, the role of academicians have also changed because the project based approach needs more communication. Thus, the academician should manage in an interactive way.

In this study, it was aimed to investigate the attitudes of the Çukurova University Automotive Engineering department students towards at the beginning and end of the term. In addition to this, it is investigated whether there are advantages and challenges of project-based implementation in entre course. It's expected that the course having project based method lets the students learn actively and construct the knowledge from their own experiences.

This study is addressed the questions written below:

- What are the students' attitudes towards innovation course at the beginning and at the end of the study?
- Are there any advantages of implementing project-based learning in innovation course? If so, what are they?
- Are there any challenges in implementing project-based learning in innovation course? If so, what are they?
- Is there a relationship between observation scores and exam scores? If so, is there a difference between learner performance regarding observation checklist?

This study aims to explore and evaluate the effects of using project based technique in teaching innovation course in Cukurova University Automotive Engineering Department when compared to using traditional methods and techniques used for the same purpose.

Significance of this study is that teaching a course to young learners in Turkey is scarce and this field needs more research with modern methods which are especially student oriented. Many studies are considered that project based method is useful in teaching in-depth understanding of the topic owing to more research requirement. and also provides students with active engagement and authentic learning opportunities during the course.

In addition to this, innovation course is one of the popular trends in engineering departments. However, the way to use should be more attractive than teaching theory. Thus, it is also aimed to fill the gaps in literature in terms of teaching innovation course in engineering departments.

Assumptions:

Theorising that it will contribute to research and methodological practices in innovation course teaching, the study also assumes that project based approach is an applicable method for teaching innovation to young learners in university degree. Therefore, the findings are assumed to further developments in teaching to young learners in Turkey.

Limitations:

In this study, a questionnaire was distributed to the class of 46 students as participants. This questionnaire included four components of innovation literacy, knowledge, attitudes, use and concern.

The dependent variable of this study is the achievement of students in innovation course learning. The aimed behavior is their learning new definitions easily. They are expected to use these new ones in daily life. The independent variable in this study is the projects which are given to the learners throughout the course.

2. Literature Review

In today's world, students participate in authentic activities far beyond the walls of the classroom by means of internet. Therefore, they look at the world from a different perspective. It is no doubt that this definition describes the 21st century's learner. Electronic devices, such as modern computers, phones, iPads, and game consoles, capture

the world around them (Palfrey & Gasser, 2008). They present the world by only one click away (Perry & Stallworth, 2013). This digital life situation also makes the individual characteristics, competencies and learning activities change. The individual is no longer the passive recipient of the knowledge of the world in which s/he lives, but the creator and active user of development and change. According to this new structure, education systems must also aim to train learning individuals by undertaking the mission of preparing the individual for such a world (Korkmaz & Kaptan, 2001).

Individuals living in a rapidly changing world grasp the innovations and developments in education and they are aware of their duty and consciously perform these duties (Erdem & Demirel, 2002). In this sense, training students who can adapt to this changing environment is highly important. The future of these individuals and the society in which they live depends on their ability to access, use and produce information. To acquire and maintain these skills throughout life requires a modern education based on knowledge construction (Çınar, Teyfur and Teyfur, 2006). In such a situation, we must do our share as teachers/academicians and educate our students in a way that suits the needs of the age. One way to do this is to implement project-based learning (PBL) in classrooms.

Project-based learning is a method about teaching and learning that is designed to motivate students for investigation of authentic problems (Moursund, 1997).

PBL is also a comprehensive approach designed to engage students in the investigation of real life problems. Its defining characteristics include the use of authentic materials and a focus student-centered learning. Students' questions and interests influence the direction of the projects and the learning process in emphasized through the use of formative rather than summative assessment. The facilitator supports the inquiry process with a variety of resources and scaffolding, which enables learners to extend their skills and knowledge higher levels (Blumenfeld et al., 1991).

Project-based learning includes three words that explain the term clearly. First term is '*learning*' that takes attention to the learner, not the teacher/academician. The other term is '*project*' that means design, imagine, plan and cooperate instead of working individually. '*Based*' term is showing that project is not an aim, but a process. It emphasizes that the project is not a product of learning, it occurs within the learning process (Erdem and Akkoyunlu, 2002).

In project-based learning, the roles of students and teachers/academicians change where students play an active role in learning process, whereas teachers/academicians stay behind and help them as guides to develop their own projects that they can use in their real lives (Gaer, 1998). In this way, students construct and direct their own knowledge, improve their creativity, choose cooperating way when they face with a problem and families join learning process actively (Erdem, 2002). According to Toolin (2004), there are two parts of project-based learning. One of them is creating questions or problems and finding activities to solve these problems to create a project development process. Second one is producing a communication web and getting solutions for the problem with new ideas. Einstein stated '*It is the supreme art of the teacher to awaken joy in creative expression and knowledge.*' Then considering the definitions and the features of projectbased learning can help academicians/teachers while they are performing their art because students think that taking part in every step of the project from the planning to the end is enjoyable and interesting (The Challenge 2000 Multimedia Project, 1997).

2.1. The Steps of Project Based Learning

In the first step planning and secondly controlling the process are important in project based learning because students and academicians should be aware of what next step will be (Moursund, 1997). The three steps in project based learning method are as follows:

- **Beginning:** After deciding the topic, academician discusses about the topic with the students in order to learn their pre-knowledge and experience. Things to know can be asked via questions. There can be brainstorm about what students can do.
- **Developing:** Students start investigating various sources and brainstorming to find possible answers that they determined in the beginning part. Academician can help students by providing resources. Students can write, draw, experiment, observe or go to a trip. Academician can provide an environment that help different groups to communicate with each other about their works.

- Ending: Academician prepares the environment for presentations which will be given completely by the students. The results of the projects can be in different shapes like drama, poster, game, story, etc. Sometimes the products of a project can be a start of another project.

In addition to this and according to study of Erdem (2002), Project based learning approach has many advantages as follows. It;

- Gives opportunities to the students for combining different disciplines.
- Makes students become professionals of the subjects.
- Gives the ability to work independently or in a group with minimum help.
- Guides students about how to feel self-confidence and high self-esteem with the thought of success.
- Improves students' evaluation skills as they start to evaluate themselves or their friends.
- Makes students feel like they are a part of the school as they have positive attitudes.

However, this approach has some difficulties written below;

- Project-based learning can take longer time than traditional methods. Therefore, time management should be done professionally.
- Students or academicians may need economical support for their projects.
- Students can have hard time while evaluating themselves or friends and this can effect their objectivity.
- If students don't come up with a product as expected, than their attitudes towards the lesson may change (Yıldırım, 2011).

Filcik et al. (2012) investigated the effects of project-based learning on achievement. In this study, two different schools were chosen as control and experimental group. Experimental group was a private school that organized all the classes based on a curriculum designed according to project-based learning. In the control group school, traditional learning methods were used. Students' self-regulation, self-efficacy and learning strategies were assessed with surveys in the beginning and at the end of each year. After two years of the study, it was seen that experimental school students performed better in every variables except effort regulation. PBL students outperformed Non-Projectbased learning students about learning motivational gains significantly and used more learning strategies than the control group. They showed significantly higher self-efficacy in mathematics. Non Project-based learning group had some negative changes about control of learning beliefs.

Afriana et al. (2016) took into consideration project based learning (PBL) by gathering together science, technology, engineering and mathematics (STEM) in order to assess scientific literacy. This was a quasi-experimental study and the sample was 56 students. Half of the students were experimental group receiving the air pollution theme with project based learning method and the other half was control group who was taught by traditional methods. After the post-tests, it was seen that project-based learning combined with STEM enhanced students scientific literacy. Experimental groups' knowledge, competence and scientific attitude were medium level but, control groups' levels were low. Experimental group was more motivated about the subject.

There are various benefits of project working which have been cited in the literature review. Researchers of this field assert the great contributions of project work to motivation, stimulation, self-esteem and autonomy. Especially it's a way of students' increased skills.

3. Method

In this section, the implementation has been completed in Automotive Engineering Department of Cukurova University. This department has close communication by means of university and industry cooperation agreement with Koluman Otomotiv Endüstri A.Ş. R&D Center. Both Koluman and the automotive engineering department have 360-degree collaboration model and one of the examples of this collaboration is that Koluman R&D Center staff, having PhD degree, can give course as a visiting academician. In this perspective, it is noticed that the graduates need to develop themselves in presentation and project skills.

3.1. About Koluman Otomotiv Endüstri A.Ş. R&D Center

Koluman Otomotiv Endüstri A.Ş. which has a history of more than fifty years, is rapidly investing in human resources and digitalization with its synchronous approach to technology. The company, which meets the customer expectations of today and the future with different environmentally friendly products, has received the R&D Center

certificate on 24.03.2016, after the supervision of the Ministry of Industry and Technology, under Law No. 5746. Having the first R&D Center of Mersin, Koluman carries out continuous improvement studies to progress simultaneously with Industry 4.0 transformation and creates a sustainable ecosystem with the corporate memory it creates in the big data area. It expands its scientific research and laboratory facilities, and improves its operations with robotic welding and painting technology based on automation in line with the value added production and export targets. With its perfection model, it provides infrastructure development with original products with high R&D quality.

With the government incentives provided through the R&D center, which can be described simultaneously as a “Wallless Technocity”, the company has achieved significant benefits. Developing a visionary perspective, the Koluman R&D center is an extremely important point not only in the context of financial incentives, but also in terms of developing R&D strategies and corporate awareness, which simultaneously affect the future of the company. Having the vision of “being a global brand with world standards as a manufacturer of commercial superstructures and trailers”, Koluman Automotive Industry Inc. continues its R&D studies in order to “create innovative solutions for our customers and create value for all our stakeholders”

Koluman R&D center prepares projects for two main product groups, military and civilian. Innovative projects are also developed in the fields of semi-trailer group (curtain / open body, container carrier, tipper trailer, tanker trailer), truck superstructure (concrete pump, damper superstructure, vacuum road sweeper, tanker superstructure) and military vehicle. Focused fields that closely follow technology are created through feedback from customers and the industry. Projects are carried out in areas such as advanced material technology, internet of things, machine learning, autonomous vehicle, embedded systems, modular design and smart systems. In this process, synergies are created in order to create the highest level of benefit from university-industry collaborations with the “joint innovation” approach. The synergy created with the 360 degree collaboration model creates added value for both parties with the “win-win” logic and brings new ideas with it.

In briefly, Koluman takes into consideration science and academic world owing to its nature depending on university collaboration. Therefore, new graduates are requested to be more equipped with business world ecosystem of which project based approach is one of the base elements.

3.2. The Context and The Participants of The Study

The implementation has been done in two independent periods. One of them is fall semester and the other one is spring. Each term takes 14 weeks. The course called “Innovation and Cooperate Entrepreneurship” has three credits and it has been held once in a week and the number of the students taking the courses in different semester is the same.

The first semester is based on traditional method in which is used to indicate the usual way of teaching the basic of innovation classes. The aim of this classical method is to transfer information and the training program is deductive. The workshops in the course is related to the syllabus program that is limited to textbooks and each student works alone.

On the other hand, the project based learning approach is a different way leading the students in peer learning. It targets to construct knowledge and the training program is inductive. Academicians interact with students in the learning process as they are also learners and facilitators. Students generally work in groups and are seen as thinkers so that they can form theories about the real world.

Consequently, the project based learning and traditional one differ from each other, especially in their perspectives on knowledge. In the constructivist approach, knowledge is subjective and the student creates their own structures instead of learning the teacher's structures as in the traditional education approach. Learner thinks more complexly, asks questions and exchanges views. Contrary to the traditional education approach, learner also performs in the process instead of working only on results.

3.3. The Road Map of Implementation

The performance of the first group taking the course in traditional way of learning is assessed by the lecturer based on the following provisions: 40% midterm examination, 60% final examination.

Then, the second semester group, who take the course with project based, is evaluated by project progress and discussing solutions to problems. In addition to this, their performance depends on the whole term, not only based on two written exams like midterm and final. In this group students are expected to work in groups with minimum 2 people. In Project Based Learning, a topic which attracts students' attention is introduced. Students are put into groups and each group chooses one aspect of the topic and they plan what they should do, begin start to investigate and prepare the materials until the next course. In the next course, each group presents what they have done.

4. Data Collection

At the end of each (fall and spring) semester, student perceptions were further investigated through a questionnaire. As it's indicated in the introduction that this study is addressed the questions written below:

- What are the students' attitudes towards innovation course at the beginning and at the end of the study?
- Are there any advantages of implementing project-based learning in innovation course? If so, what are they?
- Are there any challenges in implementing project-based learning in innovation course? If so, what are they?
- Is there a relationship between observation scores and exam scores? If so, is there a difference between learner performance regarding observation checklist?

Therefore, the questionnaire has been prepared by taking care of these four questions and this questionnaire includes four components categories, which relate to the performance of course, assignments or written exams, academician and student.

Student responses to the questionnaire were divided into 5 categories: (a) strongly agree (5 points); (b) agree (4 points); (c) neutral (3 points); (d) disagree (2 points); and (e) strongly disagree (1 points). Hereafter, the total point of each statement in the questionnaire is calculated using Equation 1.

There are 15 statements in the questionnaire that must be responded by students (Table 1).

Table 1 Questionnaire Content

Questionnaire Content		Categories
1	Outcomes of the course are clearly described	the performance of course
2	Materials are sufficient	
3	Examples reflect the real life	
4	Assesment of course implementation shows expected results	
5	Assignments or written exams are briefly described	assignments or written exams
6	Assignments or written exams contribute to the learning process positively	
7	The time given for assignments or written exams is adequate	
8	The topics are popular ones	
9	The topics lead the students to peer-learning	
10	The assessment method can be more useful for the future	
11	Assignments or written exams will be useful for business life in the next	academician
12	The academician has held a course that satisfies the outcomes and assignments or written exams feed the targets	
13	The academician has carried out the course as the students expect	Student
14	Students gain the basic knowledge about the course	
15	Students can satisfy with the outcomes and the targets	

$$P = \sum_{i=1}^n \frac{(n_i \cdot w_i) + (n_{i+1} \cdot w_{i+1}) + \dots + (n_n \cdot w_n)}{n_t} \quad \dots (1)$$

where,

- P = the total point of each statement in the questionnaire
- n = number of students/respondents according to the response given (strongly agree, agree, neutral, disagree, strongly disagree)
- n_t = total number of students/respondents
- w = points according to the response given by the student

5 points for strongly agree
 4 points for agree
 3 points for neutral
 2 points for disagree
 1 point for strongly disagree

Total points of each statement of 15 items in the questionnaire were used to evaluate the expectations of the students. For this reason, it is divided into 5 categories: (1) excellent (total points >4-5); (b) good (total points >3-4); average (total points >2-3); poor (total points >1-2); and unsatisfactory (total points 0-1). Moreover, average total points can be also used to evaluate student perceptions to the performance of course, assignment or written exams, academicians and student. This value is calculated using Equations 2.

$$\bar{P} = \sum_{i=1}^n \frac{(P_i) + (P_{i+1}) + \dots + (P_n)}{n_P} \quad \dots (2)$$

where,

$\bar{P}$ = average total point of each statement in the questionnaire
 P = total point of each statement in the questionnaire
 n_P = total number of P according to questionnaire categories

5. Result and Discussion

After getting all the questionnaires, the corresponds of each group compare with the other one. In that point, the traditional learners generally agree with 43.7%. On the other hand, project based learners strongly agree with 84.9%. Consequently, it is determined that the performance of the course is at an excellent level when project assignment is given and the academicians and students satisfy with the result.

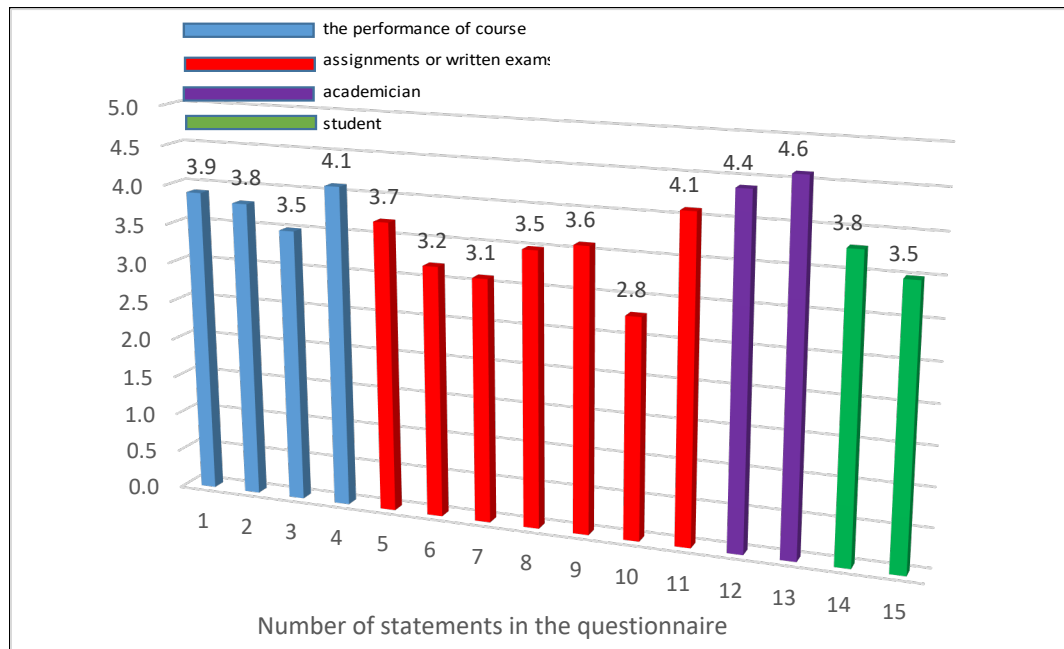


Figure 1 Average Total Point of Each Statement in the Questionnaire
 (for students in traditional method)

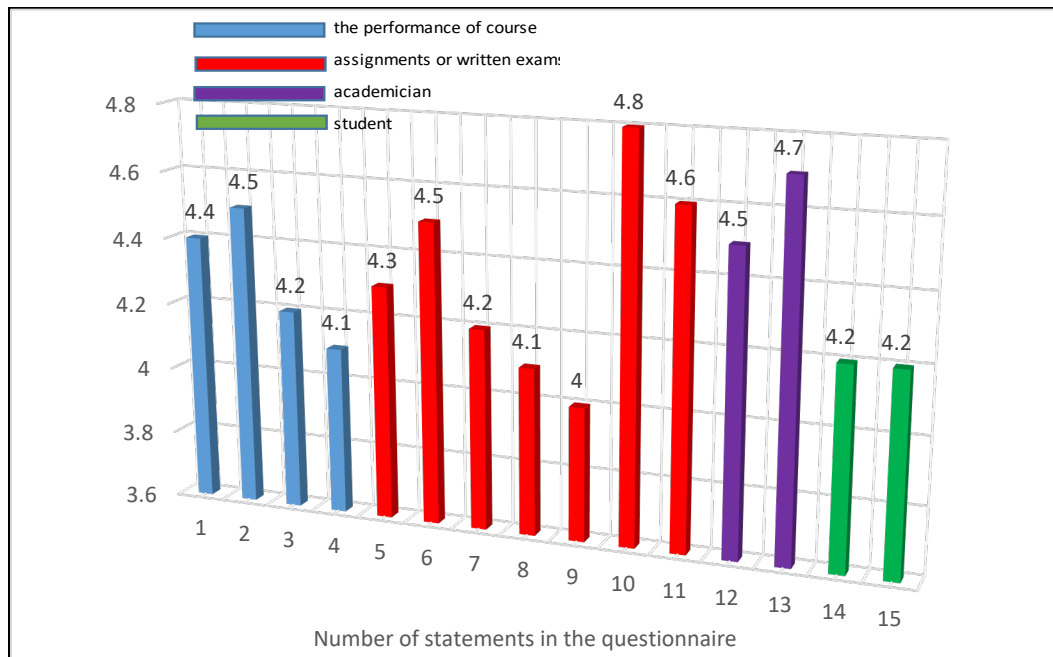


Figure 2 Average Total Point of Each Statement in the Questionnaire (for students in PBL)

When the figure 1 and 2 are compared, the PBL results are better than traditional learning expectations. While observing each statement of the questionnaire about PBL, it shows that the minimum performance was good because there is not any point less than 4. According to this fact, it can be concluded that the course has been implemented well (assessed from the student's perspective). As it is seen, there is a meaningful difference in academic achievement levels in the favor of experimental group.

5. Conclusion

This study was conducted with the aim of evaluating the effects of using Project Based approach in “Innovation and Cooperate Entrepreneurship” course to young automotive engineer candidates compared to using traditional methods and techniques. It is also aimed to investigate the expectations of students on PBL teaching.

The findings of the implementation elicit that teaching innovation through PBL ensure more successful scores than teaching by the use of more traditional methods and techniques. PBL is an outstanding approach as it is applicable to all grades of learners and almost in all areas of education. It provides an active process for students enabling them to cooperate with each other and motivating them through the activities and with a product that is presented by students to real audiences. In other words, PBL can be taken into consideration as a process innovation that leads peer-learning, too. Especially, in pandemic terms PBL is a practical and future-oriented way of students' evaluation. It is also thought as a future based method

Furthermore, PBL may be recommended for use in other courses depending on implementation. In essence, PBL supports peer-learning by means of group working and learning principles. Before the process, a brief knowledge about projects may be given, thus this may help the students manage the time. Also group work in crowded classrooms can be a little bit hard and may create class management problem which can be a negative situation for timing. In that situation, number of group members may be limited by the academician. The full implementation of PBL in the curriculum is not easy to do, so the first experience can be a partial implementation, too.

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Biography

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