A Novel Method for Designing Course Projects

***Abstract*—It is important to use acquired experience to provide better academic lessons and to experiment with new teaching methods in all fields of science and engineering majors. Considering this necessity, as a project design assistant team, we tried to use the experiences gained from the COVID-19 pandemic and research on project-based learning. By paying attention to the importance of modeling in problem-solving, we aimed to use innovative methods to design a project with a new style that differs from previous projects. Our goal was to find a new method for designing projects because the previous methods were used repeatedly.**

Our approach involved designing a project based on a real problem presented to students in a narrative form, unlike the theoretical exercises given during the term. Instead of presenting the prerequisites of a problem that somewhat specify the path of its solution for the student, we aimed to give a real problem to the student so that the student could take on the challenge of modeling and solving it by gaining information from the problem statement. We faced many challenges along this path, including finding interesting, useful, and novel topics. Additionally, the most significant challenge we faced in this design was the lack of an accurate and detailed source, such as academic books that cover all necessary topics about a subject.

In the next step, we required assistance in describing the subject, designing and refining theoretical and simulation questions. Another issue was conducting workshops to familiarize all students with prerequisite subjects they had less experience with. Finally, we had to find solutions to prevent cheating so that the project was completed with minimal dishonesty and maximum student effort. To solve these problems, we implemented various ideas which are discussed below and their level of success or failure is reported.

***Index Terms*—issue involves a real challenge,acquired experience, academic lessons, teaching methods, science, engineering majors, COVID-19 pandemic, project-based learning, modeling, innovative methods, new project design, real problem, student challenge, information-gaining, workshops, cheating, minimal cheating, maximum student effort.**

I. Introduction

A. Goal

Engineering students need to apply the concepts taught in the probability and statistics course [1],and it is also important to emphasize the role of data analysis in information which is basis of telecommunications courses, that is a subbranch of electrical engineering [2]. So probability and statistics for engineering is a course covered in the Department of Electrical Engineering at Sharif University of Technology, highlighting the significance of statistics in data analysis [3]. Hence, a project on this theme, using new methods of support via social media platforms, particularly through a Telegram channel, was developed for students. By evaluating the success and satisfaction rates of students using this approach, we aimed to make others aware of its results. However, implementing this new designing method, which involved providing a real-world problem as a group project for students to solve collaboratively, presented several challenges, including finding interesting topics and modeling questions based on selected topics, providing online support and answering potential student questions, accurately assessing the project, preventing cheating among different groups, and ensuring group work by students. We discuss how we addressed these challenges below.

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B. Project Based Learning

Project-based learning (PBL) constitutes an instructional approach where students delve into complex, real-world questions, problems, or challenges for an extended period of time. PBL has the potential to heighten students' engagement and motivation. Current research suggests that PBL can aid students in developing skills for success in both college and careers in the 21st century. Nevertheless, research is limited on the efficacy of PBL in vocational academies, particularly in how teachers can design and execute PBL projects in these academies. Regardless, PBL can be an appealing approach to learning as it deepens students' understanding and enables them to connect with the material on a personal level. [11]

Among the most crucial skills for an engineer to possess for creating better products and services and enhancing the quality of industrial items are team collaboration, modeling real-world problems based on engineering concepts, and optimizing industrial projects [10]. Considering these aspects, mastering and employing such skills should be a goal-oriented program in higher education. Therefore, our team decided to offer a project that allows for students to learn and implement concepts in a real-world model. This method has proven to be highly effective in terms of learning and retaining information. Furthermore, it is deemed the optimal way to impart the industrial experiences that the professors has gained to their students. Presenting the problem as a project enables the designer assistant team to research published articles related to probability and statistics, resulting in the modeling of a real-world problem. This allows students to simulate the problem, under the guidance of their instructors, and find the relationship between the problem and the materials they learned in class. They can then provide an appropriate solution to the problem by utilizing their acquired knowledge. It is evident that theoretical questions and short exercises do not have the potential to incorporate this modeling, and presenting a realistic model of the environment surrounding a large project is the best way to approach it [13][14].

Therefore, we decided to present the main idea of the project as a story, which was based on a real problem. Then, we provided students with the challenges of this story in the form

of theoretical questions and simulations. In fact, the main task of modeling questions was given to the students, and turning these challenges into the topics they had learned in their probability and statistics course was one of our primary objectives in offering the project in a modern style. Creating this narrative format greatly helped us in achieving this goal.

C. Team-work

Considering the positive and direct impact of teamwork on organizations and industries, as evidenced by various research studies such as [4], [5], and [6], and recognizing the importance and impact of learning these skills in academic environments and universities for researchers and engineering students [8][12], we have decided to design a project specifically aimed at enhancing students' teamwork skills. This will involve the development of skills such as coordination in team activities, effective interpersonal communication, responsiveness, responsibility, leadership, and team management [7], which will be achieved through the conduct of a team project [9].

D. Target society

Initially, the decision was made to design a probability and statistics project for an engineering group that would present it in the Electrical Engineering department. However, later on, we decided to expand the project to three groups from two different departments - two groups from Electrical Engineering and one group from Computer Engineering. This decision was made to increase the topic's attractiveness, and measure student satisfaction levels with group work.

Once the project was designed, another group from the Computer Engineering department reviewed it and, with their professor's approval, decided to offer it to their own students. Ultimately, our designed probability and statistics project was presented to four groups - two from the Electrical Engineering department and two from the Computer Engineering department. The advantages of doing this were:

1.Extend the target society and assist in verifying methods

2.Create a comprehensive project and increase the attractiveness of the topic by comparing different groups based on the results obtained from the project.

3.Check the impact of students' educational backgrounds from various departments on the results(such as computer science students' familiarity with number theory and graphs, as well as electrical engineering students' knowledge of random variables, noise, and system behavior).

4.Create a sense of competition and motivation in the direction of doing the project as well as possible.

Teacher	students-NO
Dr.Yassaee	36
Dr.Karbasi	23
Dr.Sharifi-zarchi	74
Dr.Motahhari	11

Department	students-NO
Electrical Engineering Dept.	59
Computer Engineering Dept.	85

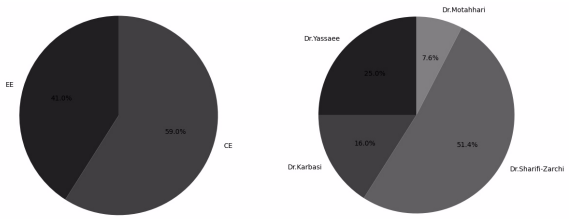

Fig. 1. course groups

E. The importance of the probability and statistics course and the syllabus of this course

Probability and statistics are among the most important and practical courses that are essential for students and experts in various fields, including engineering, basic sciences, economics, and medicine [15], [16], [17]. This course enables students to become familiar with statistical concepts and various methods, giving them a better understanding of data and information. Additionally, this course helps students obtain the necessary information for better analysis and examination of various topics, using accurate statistical methods.

Furthermore, the course on probability and statistics offers students a comprehensive understanding of statistical processes and fundamental concepts, such as mean, median, and standard deviation. These concepts are crucial in the field of statistics and prove extremely useful in analyzing various types of data, including medical and laboratory data [28][29].

At Sharif University of Technology, the course on probability and statistics is mandatory for students majoring in Electrical Engineering, Mathematics, Computer Science, Computer Engineering, and Industrial Engineering, while it is an elective for others. As an introductory course, it is delivered to groups and departments of more than 500 students each year during their second year of studies. This course enables students to receive effective and relevant training, allowing them to progress in professional and specialized engineering courses. Therefore, the course on probability and statistics helps a broad range of students with diverse specializations to advance their careers and achieve their goals.

The syllabus is common among groups without any significant differences or specifics, as follows:

Part I: Probability

1. Fundamental Concepts: What is Probability? Recall of Set Theory / Probability Space and Probability Principles / Conditional Probability / Law of Total Probability / Bayes' Rule / Independent Events

2. Counting Methods (Combinations) Permutations and Combinations

3. Discrete Random Variables Probability Mass Function / Common Distributions / Probability Distribution Function / Expected Value / Functions of Random Variables / Variance

4. Continuous and Mixed Random Variables Probability Density Function / Expected Value and Variance / Functions of Continuous Random Variables / Common Distributions / Mixed Random Variables

5. Joint Distribution of Two Random Variables Joint Probability Mass Function / Joint Probability Density Function / Joint Probability Distribution Function / Conditional Probability and Independence / Functions of Two Random Variables / Normal Random Variables

6. Multivariate Random Variables Multivariate Probability Distributions / Sum of Random Variables / Moment-Generating Function / Characteristic Function / Random Vectors Probability Inequalities: Bond / Chebyshev's / Markov's

7. Limit Theorems and Convergence of Random Variables Law of Large Numbers / Central Limit Theorem / Convergence of Sequences of Random Variables

Part II: Statistics

8. Statistical Inference I: Classical Methods This section covers estimation, confidence intervals, hypothesis testing, sampling distributions, linear regression, and the method of least squares.

9. Statistical Inference II: Bayesian Methods This section covers estimation, linear estimation, vector estimation, and Bayesian hypothesis testing.

10. Introduction to Stochastic Processes This section covers fundamental concepts and the processing of random signals.

11. Important Stochastic Processes This section covers Poisson processes, discrete-time Markov chains, continuous-time Markov chains, and the Wiener process.

12. Introduction to Python Simulation.

II. Methodology

A. Workshops

There wasn't a special workshop for our project. Instead, we relied on a few workshops that were presented to students students' computer Homeworks, specifically ones focused on Python programming language and various libraries such as networkx, numpy, scipy, random, matplotlib, and scikit-learn.

In these workshops, students were introduced to the basic tools of these libraries and obtained the necessary skills by solving simulation questions. These workshops provided an excellent opportunity for students to gain knowledge and experience in the field of programming. By attending these workshops, students were able to perform their projects in the best possible way by learning new fundamental methods and working with more advanced tools.

B. Telegram Channel

In the process of responding to and supporting students, we decided to use the Telegram platform as the primary platform and substitute for the LMS page, considering the benefits that social media platforms such as Telegram and WhatsApp have, as well as their facilitation of communication and their usefulness [18] [19].

The Telegram channel of the project, managed by the assistant team, was the most important and essential informational tool. Each section of the project had a message template that allowed comments. The assistants could address students' questions and resolve their issues anonymously as the channel admin using the Telegram feature in the comment section [27].

In addition, the Telegram channel was not only useful as a communication tool, but it also helped to track and record all discussions and problem-solving processes. This allowed the assistants to monitor the progress of each section and identify any issues or errors reported by students. With this approach, assistants could address fundamental problems and provide additional support to students who needed it.

Another advantage of using the Telegram platform was the ability to set reminders and notifications. The assistants could simultaneously send reminders to all students about upcoming announcements, project stages, and sessions, ensuring that everyone was aware of the notifications. This feature was useful in preventing misunderstandings, especially in this large-scale project with multiple participants.

In general, using the Telegram channel as a communication tool was very useful for the project. This tool facilitated fast and efficient communication, exchanging multimedia content, tracking and recording discussions, and creating a platform for making reminders and announcements. With these advantages, it is undeniable that using the Telegram channel as an essential tool for learning and collaboration within the project was extremely helpful.

In addition, for better and faster service, we also set some rules that are mentioned below:

1.Send the whole question in one message.A question broken up into several messages will be deleted.

2.Do not use voice messages to ask questions.(There is no problem in giving a voice reply if requested by someone)

3.If your question is related to general project matters such as project delivery, etc., ask it in the comments section of related part.

4.Please only ask questions in the comments so that if someone else has the same question, their problem can be solved.For this reason, apologies for not answering private messages.

In addition to the Telegram channel, support was also provided via email by the assistants, so that in case of any problems with using the Telegram channel, questions could be answered via email as well.

C. Cheating and Academic Integrity

Cheating in exams and assignments is always a challenge for universities. There is evidence of cheating in both offline assignments and long-term projects [22]. Therefore, it is predictable that some students may resort to cheating, especially in projects for a course. We have employed several solutions to prevent and detect academic misconduct. To efficiently tackle this issue, we first analyzed the main cheating methods. Since the questions in this project are based on different methods and algorithms for solving real problems, data analysis, and prediction, several cheating methods can be identified [20],[21]:

1. Obtaining answers from other students and copying them.
2. Using algorithms described in online sources.
3. Outsourcing the project in exchange for payment.
4. Copying code from online sources.
5. Using artificial intelligence tools to solve problems and simulate codes.

To prevent cheating in the educational environment, we have taken different measures. One method we have used is to apply a group penalty of zero grade to all members of the cheating group and those who have attempted to submit cheating assignments. This method has been effective in preventing cheating and can also be effective in the future. Additionally, to prevent the sharing of simulation questions code between students, we have employed visible tools to examine codes. This has deterred groups from sharing simulated code questions in fear of being examined. Of course, these methods can address most of the problems related to cheating to some extent. However, in addition to them, we have considered using text processing tools to identify similarities between different answers, selecting people for online submissions, creating customized questions for each group, and employing various educational methods. Therefore, relying on only one solution does not solve all the concerns of the educational environment [23],[24],[26]. Using scientific sources for students is crucial, as studying from books, articles, and credible sources can improve their knowledge and expertise, leading to better performance on their projects and assignments. But, it is important for students to strive for problem-solving and search for better, more advanced solutions. Collaborating with others and seeking their guidance can also assist in improving efforts and achieving accurate answers to issues. Given limited educational resources and the newness of material, using other sources and consulting with others can be helpful. However, denying students access to scientific and online sources could limit research and hinder performance. It is crucial for these articles and sources to remain accessible to students as a guide. Additionally, to prevent cheating and ensure the accuracy of information in projects and assignments, students must carefully choose their sources and reference people who have helped them in project details; doing so can help students enhance their efficiency and abilities for future projects.

To prevent unauthorized use of artificial intelligence, we have utilized AI tool to analyze responses and detect the level of artificial intelligence usage. In cases where the responses were wholly generated by artificial intelligence, there were inaccuracies and their meaning was apparent. Additionally, in some cases, the responses were incorrect, which helped us identify cheating. However, students may use this tool to search for algorithms, research articles, or other solutions, which alone would not lead to cheating [25].

Despite all of these measures, to ensure the identification of any potential cheating that may occur through text and code editing, all members of the assistant team were required to fully understand all aspects of the project. After the project was completed, further tasks were assigned to allow assistants to study the project and determine the results of various sections. Until the delivery, all responsible assistants were well-informed about all parts of the project.

D. TA selection process

The same process as previous semesters was used to select TAs in this new project.Students either sent an email to their respective professor and sent their resumes or filled out a form that had been determined by the professor.At the end, some of TA's were chosen by the professor, and some others were chosen by the Head-TA that had been appointed by the professor, based on the resumes that the students had sent.Among the selected volunteers as course TAs, some were also chosen as project TAs.

The use of students who familiar with the concepts of the course and have successful graduates who had passed this course with a high grade and had also shown success in completing projects and had a heavy transcript was always important in selecting assistants to help in solving exercises, conducting workshops, and designing projects.However, the most important and unique challenge in selecting and choosing assistants to help with the implementation of this new project was its novelty and dissimilarity to previous projects. As a result, to assess the scientific ability of volunteers, we took two steps. Our main goal in doing this work was to recognize the ability of these individuals to model and design good and challenging questions from existing articles in scientific journals.

We first asked the volunteers to choose two or three topics from a range of options considered for the project team selection, and to proceed with studying and developing the problem by expanding on it. Due to various restrictions, we had almost the appropriate number of volunteers for each topic, considering its difficulty and size. For each topic, we provided the volunteers with one or two articles as examples, which we had previously studied. This was to help them become familiar with the keywords and details of the topic. They were then asked to search through references and journals and read more articles related to their chosen topics. After that, they were required to provide us with a summary, the number of theoretical and simulation questions, and their accurate solutions while referencing the previously given articles.

This work provided us with a foundation for the project before the assistant team was formed, and we were able to access many more articles. Next, we reviewed the questions and answers. Finally, after assessing the scientific ability of some individuals, they were dismissed, and the remaining volunteers were ranked based on three factors: scientific ability, availability of free time, and the ability to communicate and interact effectively with other students. Using these factors, we selected the assistants for the project.

E. Designing project process

The project was a collaboration between three groups with shared interests, and a Head TA was selected by the three

instructors leading these groups. Additionally, the Head TA introduced some new team members based on his personal experience to complete the project team. After the team was assembled, they began the process of designing the project.

The project design process involved consultation with the instructors and the other Head TA members from all groups. Together, they decided to focus on the project theme of community detection. Unfortunately, no specific reference book existed for this field, so the necessary information had to be gathered by reading related articles. Therefore, the project team needed to read various articles related to community detection to gain mastery of the subject matter.

To accomplish this, the Head TA identified basic topics within the field by studying relevant articles and assigned a separate section to each project team member to work on. Each team member was responsible for presenting their proposed questions based on the topic assigned to them.

After consulting with other Head TAs from different instructors, the Head TA for the project defined the final project storyline as "Using Community Detection for Film Companies' Recommendation Systems" and asked the project team members to propose questions based on this. Following the proposal of questions by the team members, the Head TA revised them to ensure the project's different sections were consistent. The three instructors' Head TAs also reviewed the project, and it was finally ready for release.

Another challenge in designing this project was the lack of a reference book that specifically addressed the field of community detection. However, by dividing tasks, the team successfully defined a topic that lacked resources. Using this approach, the team utilized available reference books for fields that had them and divided tasks among the members to design the project. Nonetheless, the team faced additional difficulties in the design phase. For instance, some members had different interpretations of community detection, and the lack of tangible resources made developing a precise operational plan difficult. Nevertheless, despite the challenges, the team remained committed to the project goal and worked hard to present a comprehensive and innovative solution. By leveraging the strengths and expertise of each team member and utilizing innovative approaches and technologies, the final product was accomplished and was a considerable success. This project not only showcased the team's ability to collaborate but also demonstrated how innovative thinking and persistence in the face of challenges can be vital and impact efficiency.

F. Judgement

Due to time constraints and consulting with other students, as well as using artificial intelligence tools, it was highly probable that the provided answers would be accurate and free of major scientific or simulation errors. Therefore, relying solely on manual correction for evaluation and grading did not seem appropriate. As a result, we have decided to administer the project online, following a predetermined schedule, where an educational assistant - possessing expertise in the given project topics and knowledge of the answers - would pose queries on various segments of the project. The questions mainly focused on the students' grasp of the project concepts, the answers they provided, and the simulation algorithms employed. The grading was based on individual readiness and proficiency in different sections, although at times, some students excelled in a specific segment while lacking knowledge in others, which was not considered a significant concern. In the end, grades were given based on the total preparedness and team effort of all individuals involved.

The grading process considered the fact that students lacked experience and access to precise and detailed source code. This was factored in while evaluating the provided answers. Consequently, matching the answers with the articles or algorithms presented by the assistant team was not the main criterion for grading since such answers were primarily the product of individuals with higher abilities and experience gained from advanced-level courses, often at the graduate and doctoral levels. Furthermore, various methods, formulated after numerous experiments, extremely precise comparisons, and supervised by experienced professors in these fields, were published in the form of research papers. It was not necessarily expected that our students would provide answers that were an exact match. Therefore, the logic and relevance of the answers provided with respect to the topics covered, as well as the effort invested in searching and experimenting with different methods, were the essential grading criteria. Lastly, numerically reported answers with a relative margin of error were also accepted.

G. Future working on this subject

The team of assistants is very important and necessary for a faster and better project preparation.Having a strong team of assistants consisting of skilled individuals with appropriate resumes is highly important in the design and implementation stages of the project.The team of assistants is also responsible for reviewing and correcting the project, ensuring that it is flawless from a scientific perspective and approved by professors and students.

To form a team of assistants, all requests, regardless of being voluntary or paid, must be reviewed. Having a strong resume alone is not enough; members of the team need to have proper coordination with other members and managers, with their top priority being the optimal completion of their tasks and timely reporting.

To select members for the team of assistants, we can use the method we have employed to select volunteers. This involves assessing individuals' performance by providing tasks related to the main project. Additionally, to attract a sufficient number of members, it is better to recruit more than necessary so that the team can still function optimally if some individuals are rejected or left by themselves.

To ensure the best supervision over the activities of the team of assistants and improve their performance while ensuring timely task completion, specific deadlines should be set for them. This will contribute to creating order and discipline,

leading to better performance by the team of assistants and improvement in their task planning.

Presenting suitable and relevant topics related to each field undoubtedly has a significant impact on the performance of students who have an interest in their field of study or work. Just as our team has designed a project by identifying relationships between telecommunications tasks and data analysis, in the future, topics can be proposed for various fields in most disciplines. For example:

1.In designing clinical trials for drugs, Probability and Statistics can be used as tools for calculating the sample size of clinical trials.Using these tools can lead to the design of clinical trials in such a way that a greater confidence in the results can be obtained.Therefore, providing data related to real trials and analyzing them is an interesting topic that can help people working in the field of drug development.

2.In the field of banking, Probability and Statistics can be used to predict problems in credit card transactions, such as fraud and deception.By using these tools, credit card problems can be predicted and prevented.This can be useful for students who intend to enter financial and service markets such as banking.

3.In determining earthquake intensity, Probability and Statistics can be used to predict seismic flows and improve warning systems.If Probability and Statistics are offered as a course for civil engineering students, it can be used to recognize civil engineering plans, materials, behavior of structures and resistance against earthquake for the strong design of projects.

4.Economic modeling is another application of using Probability and Statistics.With these tools, financial and currency flows between countries can be investigated and changes in capital markets can be predicted.Learning statistics and data analysis can also be useful for economic students to analyze stock exchange issues.

5.Medical image recognition is another application of using Probability and Statistics.These tools can help diagnose and predict heart and cancer diseases.This skill is now considered one of the most important artificial intelligence capabilities in medicine and there are many articles on this topic that can be highly useful for designing a valuable project.

6.In systems engineering, Probability and Statistics can also be used.These tools can be used to design and optimize complex systems such as communication networks, transportation, and computing systems.

7.Risk analysis is another application of using Probability and Statistics.These tools can be used to analyze risks in various industries, such as sudden accidents in the oil and gas industry, aviation, and traffic accidents.

8.In analyzing election data, Probability and Statistics can also be used.These tools can be used to analyze election data and predict election results.

Presenting projects in phases is an aspect that we did not pay attention to before. Based on feedback we received from students, it was burdensome for them to handle the pressure of all the phases at the end of the semester. They suggested that presenting the project in different stages during the semester could aid their learning.

One of the crucial factors to consider is the need for proper planning at the beginning of the semester. After forming the assistant teams, dates and times for each phase of the project should be decided before the start of the semester. This would enable students to coordinate their schedules with the project phases and receive necessary feedback from the instructor after each stage.

It is recommended that all necessary items for each phase be prepared before starting the preceding phase. For instance, if a specific tool is required for the second phase, the tool should be arranged and taught to them before starting the first phase, and the relevant training should be offered to the students.

Finally, it is advisable to complete the evaluation of each phase of the project before beginning the subsequent one. This will make students aware of their faults and help them avoid repeating them in future phases. Therefore, by focusing on each phase separately, students can work effectively on their project and deliver it with high quality.

III. Results

A. survey results

A survey was conducted among the students and they were asked to rate the questions from 1 to 5 assuming that 5 represented the best desired situation and 1 represented the worst desired situation when answering the questions.The questions are as follows:

1.How useful and practical was the project content?

2.How much the project content was easily understandable in your opinion?

3.How much the professor's teaching approach on the topic of Probability and Statistics for engineering provide you with the necessary insight to solve the project?

4.How much the project was free of technical or scientific problems in your opinion?

5.How much were you satisfied with the Telegram support (was it better than previous conventional support)?

6.How much the project presentation help you better understand important concepts of Probability and Statistics for engineering?

7.How much the assistants provide sufficient guidance for you to complete the project?

8.How much the project deadline was suitable and acceptable?

9.How much did you experience interaction with your fellow students in the project process?

10.How much the teamwork experience was educational regarding the project?

11.How much did the Probability and Statistics project provide a solution for real problems?

12.How much did the Probability and Statistics project help you to understand large data analysis better?

13.How much did the Probability and Statistics project show you how to better use existing data?

14.How much did the Probability and Statistics project show you how to better measure new data?
15.How much were the Probability and Statistics project concepts appealing to you?
16.How much did the Probability and Statistics project demonstrate how to easily manage different types of probability distributions?
17.How much did the Probability and Statistics project help you to properly review your data for errors?
18.How much did the Probability and Statistics project help you to cluster your data?
19.How much, based on vectorization, were you able to optimize your data in the Probability and Statistics project?
20.How much, based on probability dependencies, were you able to make the best effort for predictive analytics in the Probability and Statistics project?
21.How much, based on parameterization, were you able to create a suitable model for the patterns you found in the data in the Probability and Statistics project?
22.How much, based on probabilistic approximation, were you able to make the best decision regarding your data in the Probability and Statistics project?
23.How much did the Probability and Statistics project help you to achieve the best results, even if your data was incomplete?
24.How much did the Probability and Statistics project provide you with a new perspective for analyzing data?
25.How much did the Probability and Statistics project bring about new creativity for you?
26.How much were you able to be more creative with artificial intelligence and machine learning?
27.How much did your extensive knowledge in data science help you make better decisions for your problems?
28.How much was the Probability and Statistics project focused on data analysis and as a coursework for you?
29.How much were you able to complete the project regularly and with desirable grading?
30.How much did you benefit from topics other than the project in Probability and Statistics course?
31.How much did you have enough focus and motivation to do the project?
32.How much did you fare well with the relevant and necessary software for the project?
33.How much did you use class videos and materials?
34.How much was the project challenging in terms of the contents?
35.How much new course materials did you learn?
36.How much was the project useful for visualizing statistical concepts?
37.How much did you use the explanatory sentences and graphs that you prepared for the project?
38.How much did you experience special cases in the project that had a more educational feature for you?
39.How much were you satisfied with collaborating with other team members?
40.How much did the Probability and Statistics project enhance your teamwork skills?
41.How much did the project align with your field of study and work strategies?
42.How much was the project clearly demonstrated regarding the topics you needed to learn?
43.How much were you able to work with the required specialized programming language for the project?
44.How much can you use what you learned in this course in your future work?
45.How much did the project have more thinking compared to other activities you participated in at the university?

and we have the results like this:

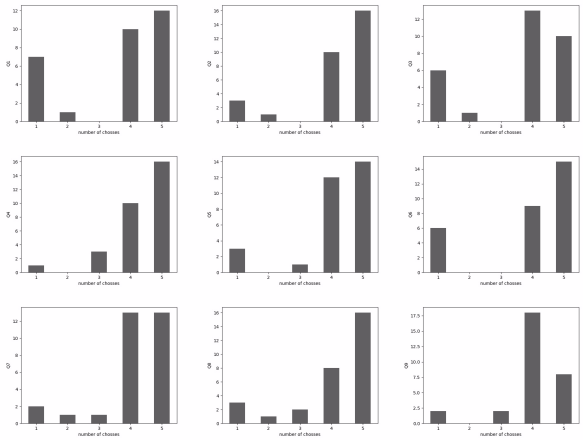

Fig. 2. Q1-9

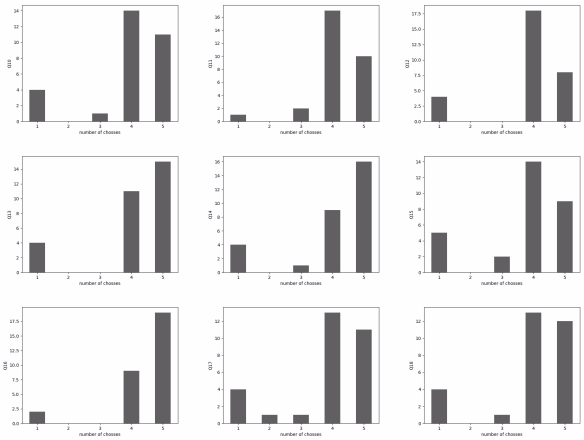

Fig. 3. Q10-18

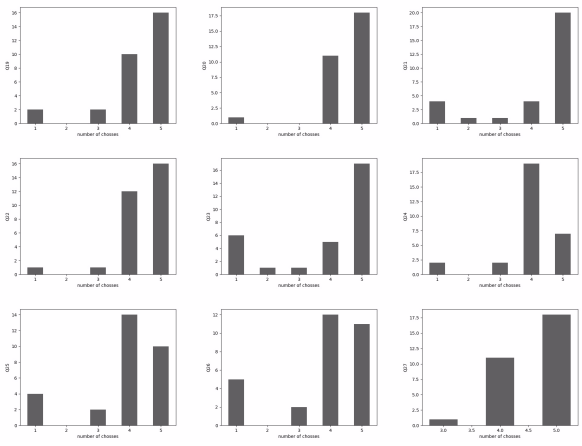

Fig. 4. Q19-27

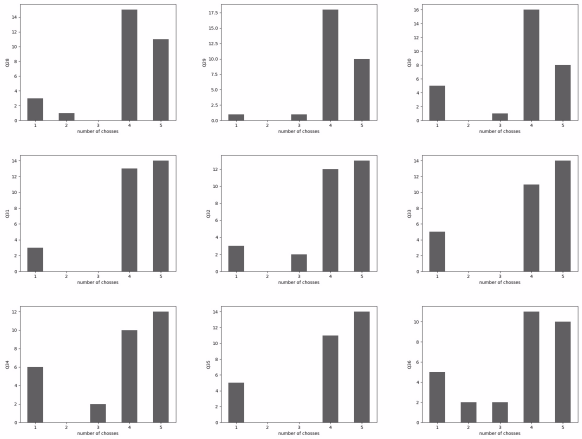

Fig. 5. Q28-36

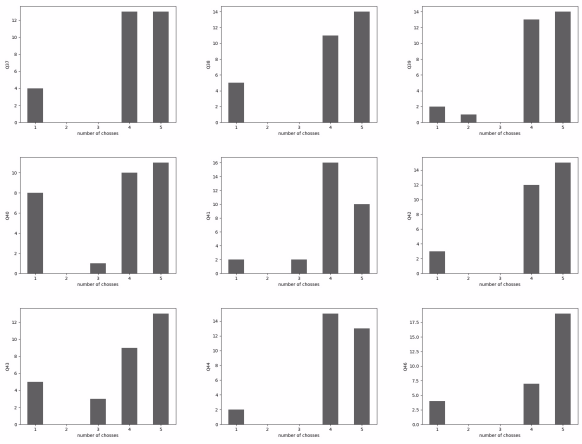

Fig. 6. Q37-45

Q.NO	point 1	point 2	point 3	point 4	point 5	average
1	7	1	0	10	12	3.63
2	3	1	0	10	16	4.17
3	6	1	0	13	10	3.67
4	1	0	3	10	16	4.33
5	3	0	1	12	14	4.13
6	6	0	0	9	15	3.90
7	2	1	1	13	13	4.13
8	3	1	2	8	16	4.10
9	2	0	2	18	8	4.00
10	4	0	1	14	11	3.93
11	1	0	2	17	10	4.17
12	4	0	0	18	8	3.87
13	4	0	0	11	15	4.10
14	4	0	1	9	16	4.10
15	5	0	2	14	9	3.73
16	2	0	0	9	19	4.43
17	4	1	1	13	11	3.87
18	4	0	1	13	12	3.97
19	2	0	2	10	16	4.27
20	1	0	0	11	18	4.50
21	4	1	1	4	20	4.17
22	1	0	1	12	16	4.40
23	6	1	1	5	17	3.87
24	2	0	2	19	7	3.97
25	4	0	2	14	10	3.87
26	5	0	2	12	11	3.80
27	0	0	1	11	18	4.57
28	3	1	0	15	11	4.0
29	1	0	1	18	10	4.20
30	5	0	1	16	8	3.73
31	3	0	0	13	14	4.17
32	3	0	2	12	13	4.07
33	5	0	0	11	14	3.97
34	6	0	2	10	12	3.73
35	5	0	0	11	14	3.97
36	5	2	2	11	10	3.63
37	4	0	0	13	13	4.03
38	5	0	0	11	14	3.97
39	2	1	0	13	14	4.20
40	8	0	1	10	11	3.53
41	2	0	2	16	10	4.07
42	3	0	0	12	15	4.20
43	5	0	3	9	13	3.83
44	2	0	0	15	13	4.23
45	4	0	0	7	19	4.23

B. grades results

1) Phase 1:

average	std
84.51	17.8

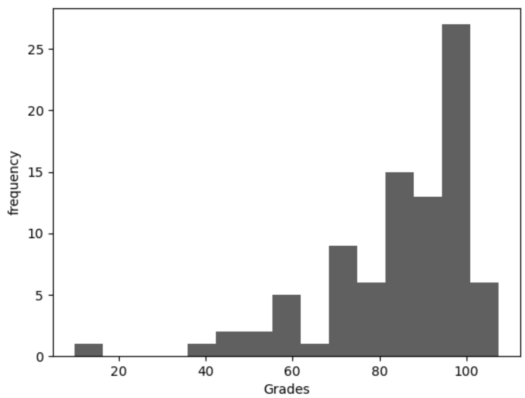

Fig. 7. Phase 1 grades

2) Phase 2:

average	std
80.6	26.8

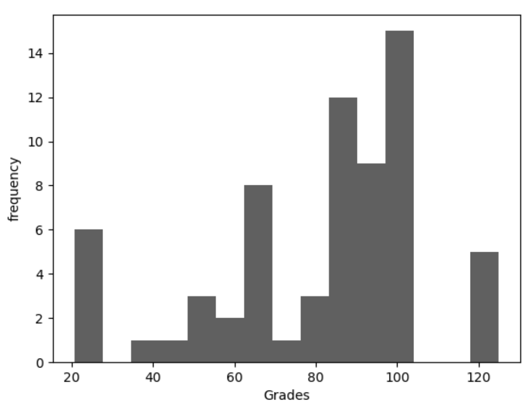

Fig. 8. Phase 2 grades

IV. CONCLUSION

The aim of this article is to examine the effectiveness and usefulness of a class project in the field of probability and statistics for engineering. The project was inspired by a real-world problem and used resources such as recently published articles instead of relying solely on reference books. Designed as a narrative model, it was presented to students as a challenge, providing them with an opportunity to challenge their own findings through a group project.

According to the results of the student survey, this type of project was described as very useful and informative. The responses indicated that students found the challenges presented in the project to be interesting. Despite the novelty and difficulty of the project, they were drawn to it, and put in all their effort to provide the best possible answers to the project questions.

Additionally, the feedback received from the assistant team who helped in designing and correcting the project indicated their eagerness to learn more about the issues raised and their readiness to collaborate again on similar topics.

Another important aspect of this project was the success of the correction team in detecting answers provided with the help of artificial intelligence tools. They reported any cheating incidents to us after careful examination and confirmation, resulting in negative marks for the perpetrators. This indicates the success of our cheating detection method in distinguishing the cheating incidents that occurred with the help of artificial intelligence tools.

V. ACKNOWLEDGEMENTS

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