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Analyzing Performance of Students at Engineering Mathematics Course in Different Departments

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Abstract. Mathematics courses are very important subjects for engineering students. These subjects are most of the time a pre-requisite for other engineering subjects. This study focus on performance of students at mathematics subject in different departments. It compares and analyzes performance of students in electrical, mining, mineral processing, civil, mechanical engineering and applied physics department together in engineering mathematics 3'subject.

Keywords: freshman engineering, prerequisite courses, grades

INTRODUCTION

The Papua New Guinea University of Technology (Unitech) is the second best university in south pacific. There are about 3000 students in this university from 24 different departments. Mathematical subjects offer from department of mathematics and computer science for all departments in Unitech.

Solving engineering problems is highly depended on mathematical skills. That is why in Unitech, engineering students have to take more than 18 credit of mathematical subjects.

Unitech authorities emphasizes on both graduation rate and quality of education for all students. So by research like this one, all departments can find performance of their students comparing other departments to improve their students' performance.

Mathematics is very important subject in all science areas. The grade that students scored in this subject can predict their academic success in the future (Van der Hulst & Jansen, 2002). Also a study done by Tyson revealed that students who did well in high-school mathematics subjects were more successful in the university level mathematics also (Tyson, 2011). Moreover, students that enrolled in an honor calculus course were more successful in performance comparing others who did not (Mesa, Jaquette, & Finelli, 2009). Another study in Texas by Easter shown that students who did well in chemistry one university level were more successful in chemistry two (Easter, 2010). Also when engineering and science merge together in any institute, it can effect positively on performance of students (Benedict, Napper, & Guice, 2000; PUVANACHANDRAN & SIVAKUMAR, 1996).

In this study performance of students in Engineering Mathematics 3'subject(EN212) that offered for civil, mining, mineral processing, mechanical, electrical engineering and applied physics departments at Unitech, has been analyzed. There were totally 267 students from all of these departments that enrolled in this course. But how difference is the performance of students from different department in this course? Students from which department had the best performance in EN212? Is there any different between male and female performance in this course? Which department had the worst performance in this course? It has been tried to analyze all of these questions in this study.

NOTATIONS AND AUXILIARY MATERIALS

This study examined data about current undergraduate students in the engineering departments to determine which one is better in mathematics.

Course grades in targeted courses were retrieved for all students. These include courses in the freshman curriculum and ED core courses and other prerequisites to those courses. After retrieval of data, the results from all sources were compiled, and all identifying information was removed (Simpson & Fernandez, 2014; Nyondo, 1993).

Grades in the classes were reported as letter grades. For analysis, the grades were assigned an equivalent point value (Table 1).

0-49	**50-54**	**55-57**	**58-61**	**62-64**	**65-67**	**68-71**	**72-74**	**75-77**	**78-81**	**82-84**	**85-100**
F	**E**	D^-	**D**	D^+	C^-	**C**	C^+	B^-	**B**	B^+	**A**
0	**1.0**	**2.0**	**2.3**	**2.7**	**3.0**	**3.3**	**3.7**	**4.0**	**4.3**	**4.7**	**5.0**

Table 1: Unitech's scheme for the assignment of weights to marks and letter-grades

For more convenience some abbreviations have been used in the following form:

- **BEME2**: Bachelor of Engineering-Mechanical Engineering-Second Year Students,
- **BEEL2**: Bachelor of Engineering-Electrical Engineering-Second Year Students,
- **BEMN2**: Bachelor of Engineering-Mining Engineering-Second Year Students,
- **BECV2**: Bachelor of Engineering-Civil Engineering-Second Year Students,
- **BEMP2**: Bachelor of Engineering-Mineral Processing-Second Year Students,
- **BSAP2**: Bachelor of Science-Applied Physics-Second Year Students.

The course that has been compared between all of these departments, was "Engineering Mathematics 3". The population of students in the study was the 267 undergraduate students who entered the school in the fall semesters of 2018 in electrical, civil, mechanical, mining engineering, mineral processing and applied physics. The majority of the students were traditional college aged first-time students. **Figure** 1 shows pre-requisite relationships for the courses considered in this study.

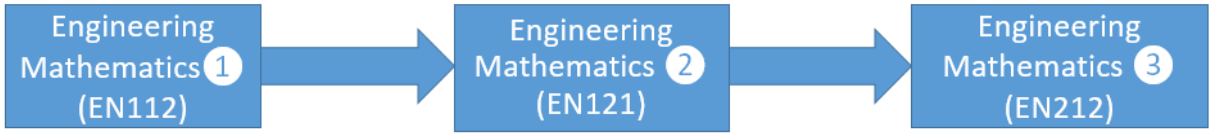

Figure 1: Course requisite

RESULTS

The best average was for mechanical engineering students with 59.83 while the worse one was related to applied physics department with 52.97. The total average for all students in this course was 57.46. For more information regarding the average see **Figure** 2.

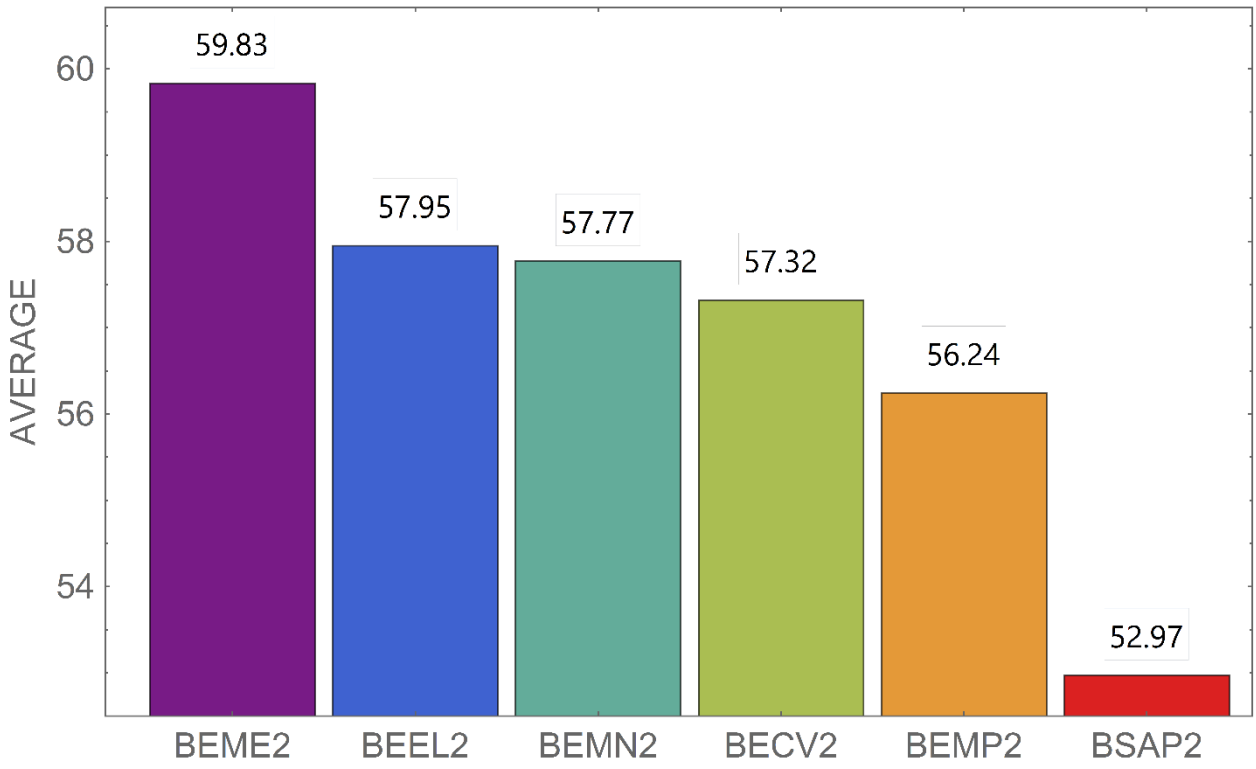

Figure 2: Comparison of average for all departments

The best department in term of fail percentage was electrical engineering with 7.01755 percent of fail while the worse one was applied physics department with 18.75 percent of fail. The second best department in term of fail percentage was mechanical department with 10.9375 percent of fail. The total fail percentage for all students in this course was 12.7341. For more information regarding the fail percentage in each department see **Figure** 3.

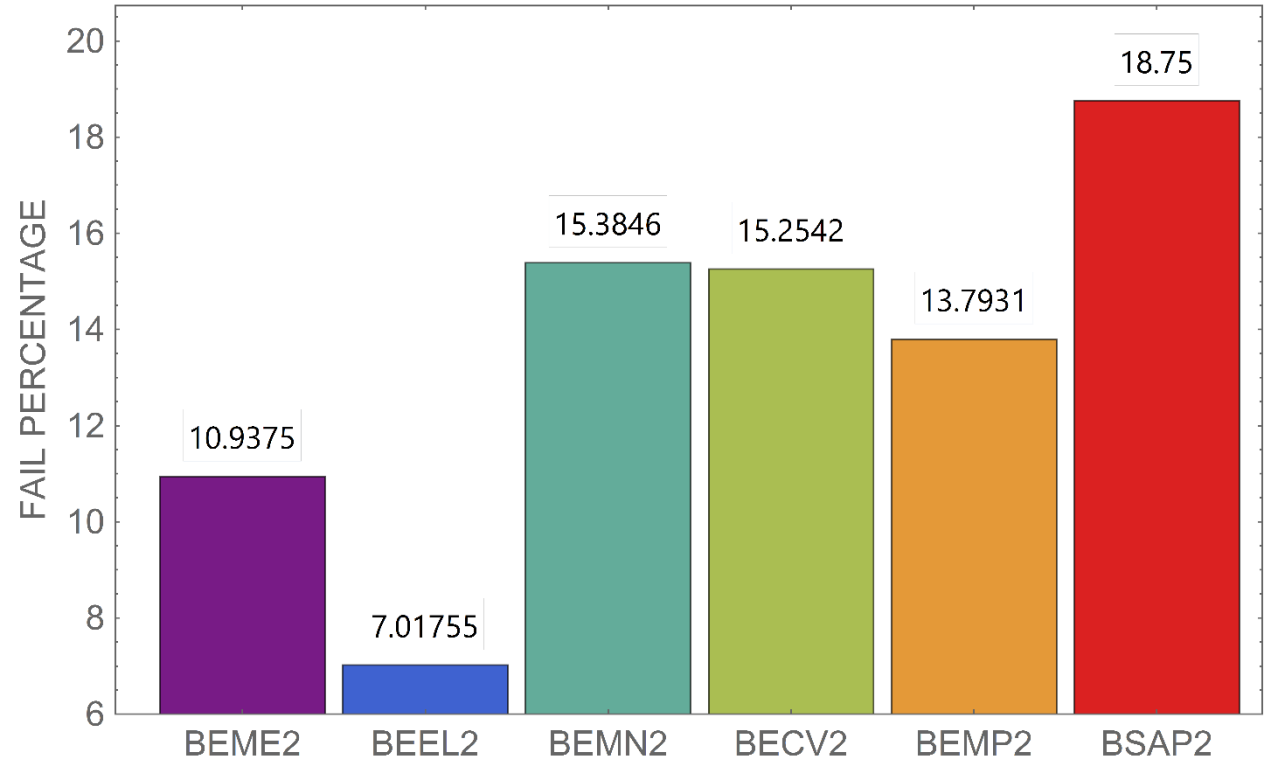

Figure 3:

Comparison of fail percentage for all departments

Information related to standard deviation for each departments is mentioned in the **Figure** 4. The total standard deviation for all student in this course was 13.6081.

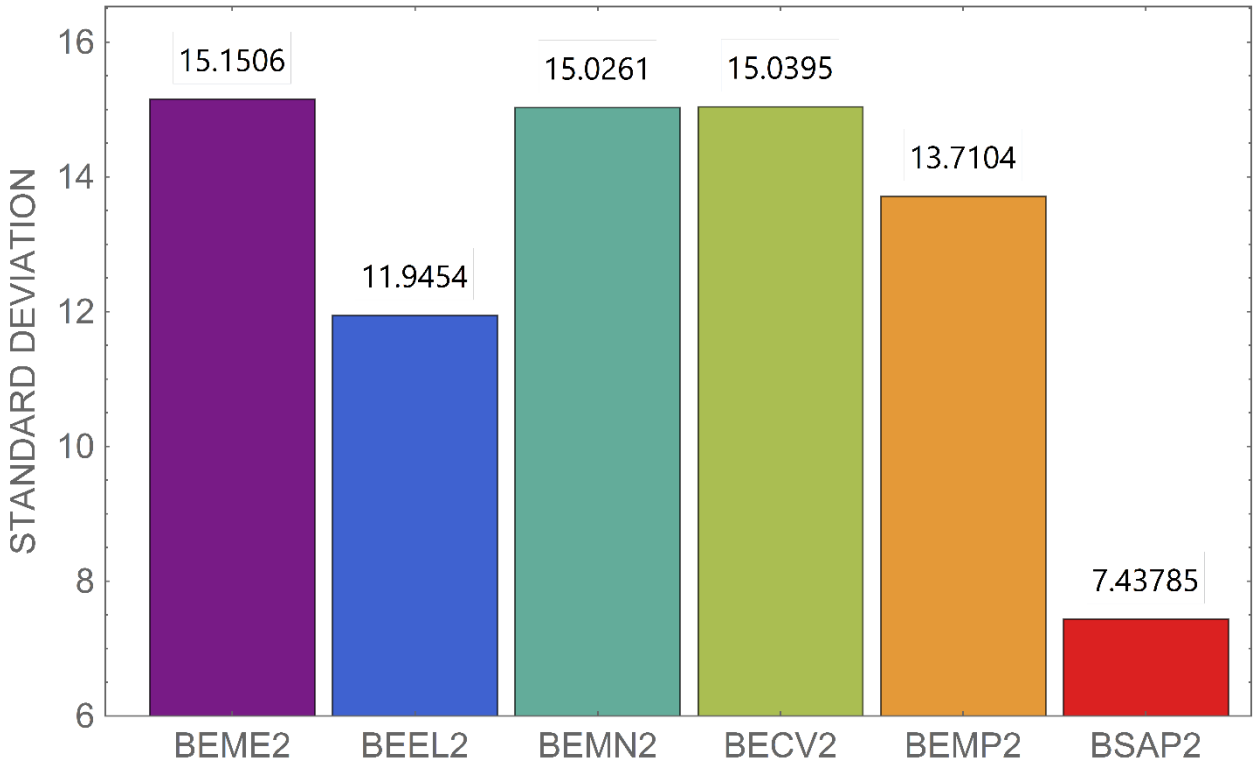

Figure 4: Comparison of standard deviation for all departments

9.375 percent of mechanical engineering students obtain grade A in this course while there was no student in applied physics department with A grade. The total percentage of students with A grade in this course was 6.74157 percent. For more information regarding the percentage of A-grade for each department see **Figure** 5.

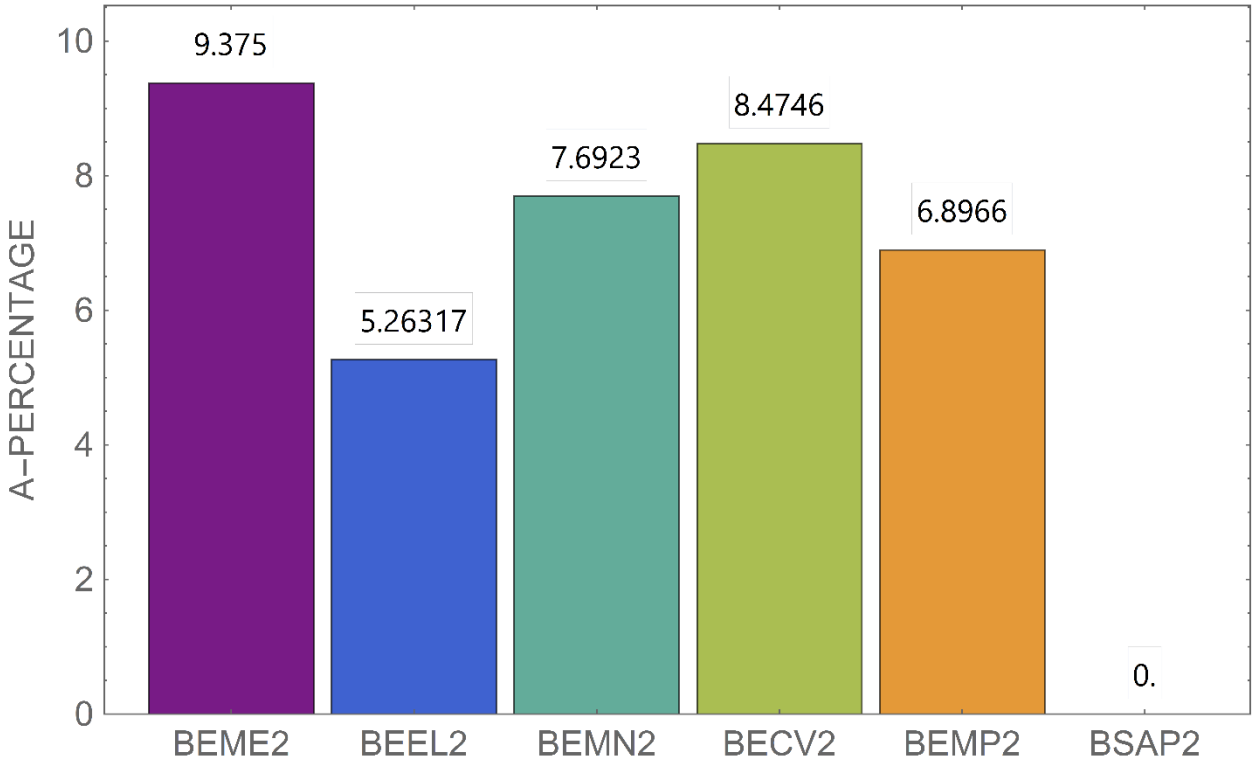

Figure 5: Comparison of A-grade for all departments

7.8125 percent of mechanical engineering students obtain grade B in this course while there was no student in applied physics & mining processing departments with A grade. The total percentage of students with B grade in this course was 4.11985 percent. For more information regarding the percentage of B-grade for each department see **Figure** 6.

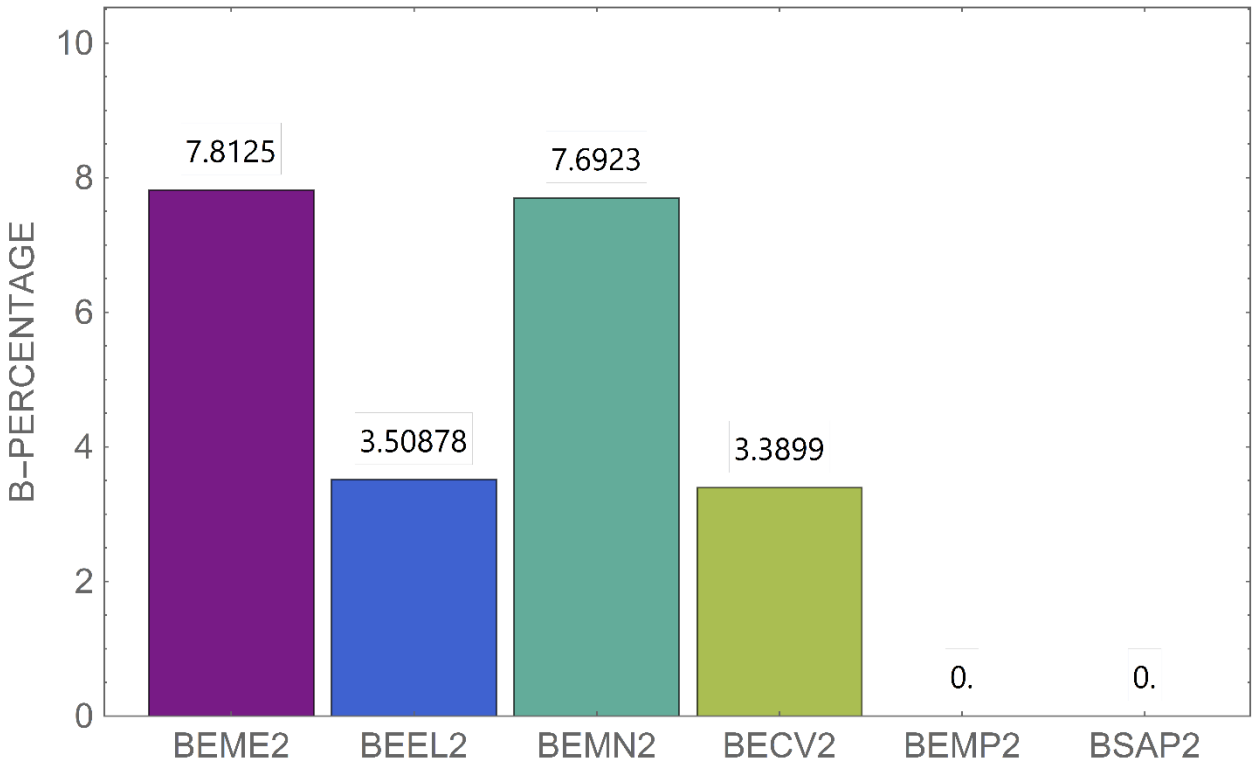

Figure 6: Comparison of B-grade for all departments

15.7895 percent of electrical engineering students obtain grade C in this course while there was just 6.25 percent of students in applied physics department with C grade. The total percentage of students with C grade in this course was 13.1086 percent. For more information regarding the percentage of C-grade for each department see **Figure** 7.

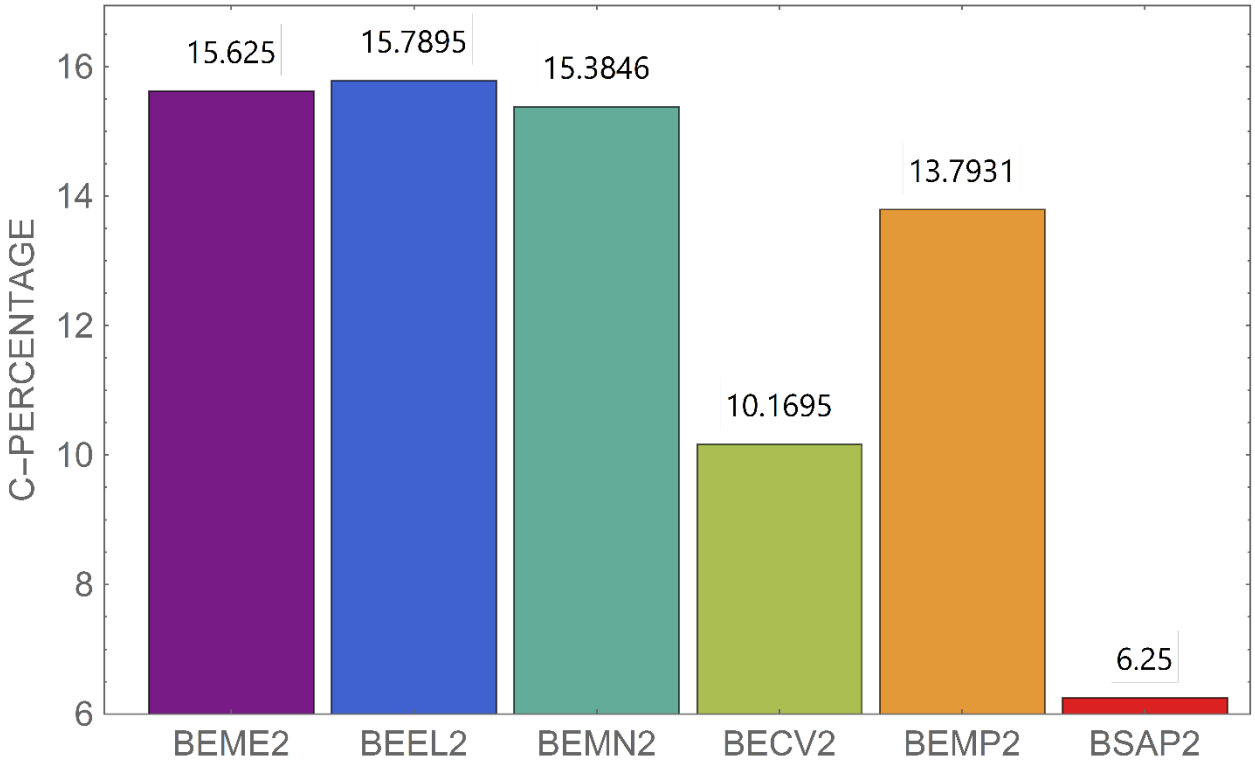

Figure 7: Comparison of C-grade for all departments

28.125 percent of applied physics students obtain grade D in this course while there was 19.2308 percent of students in mining engineering department with D grade. The total percentage of students with D grade in this course was 23.5955 percent. For more information regarding the percentage of D-grade for each department see **Figure** 8.

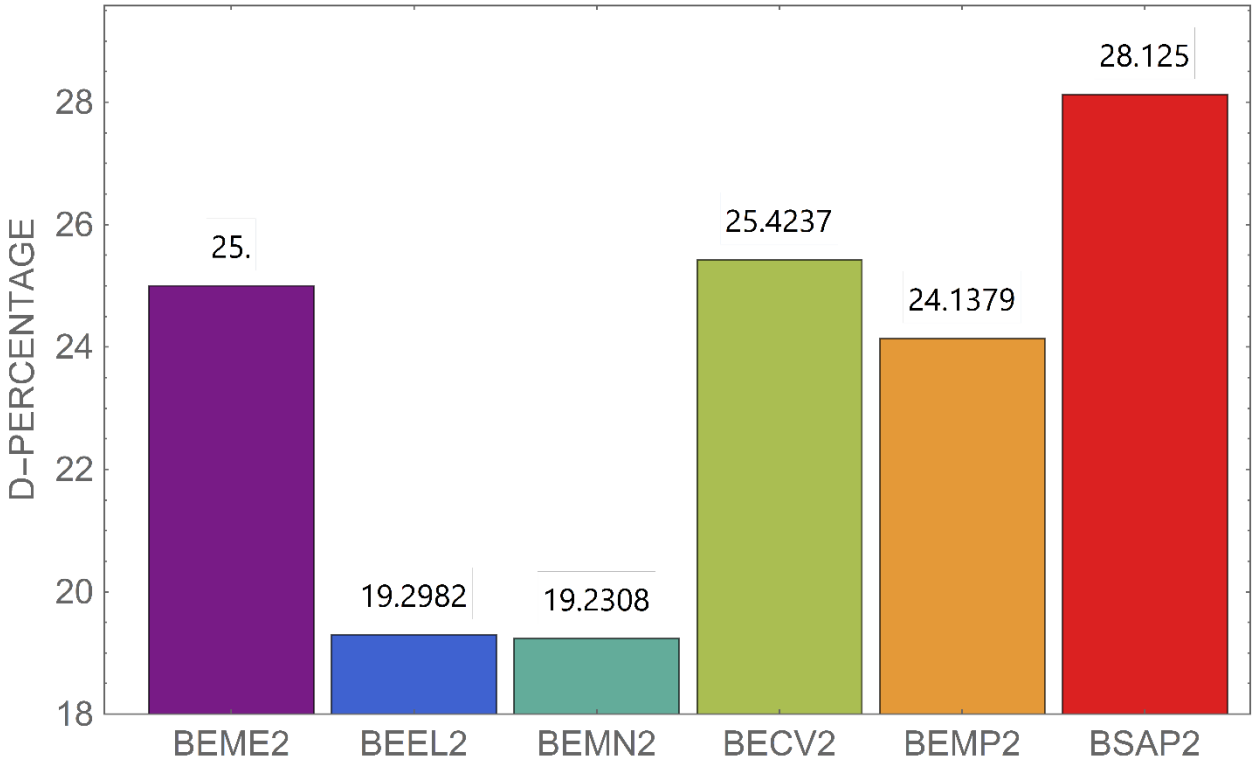

Figure 8: Comparison of D-grade for all departments

46.875 percent of applied physics students obtain grade E in this course while there was 31.25 percent of students in mechanical engineering department with E grade. The total percentage of students with E grade in this course was 39.7004 percent. For more information regarding the percentage of E-grade for each department see **Figure** 9.

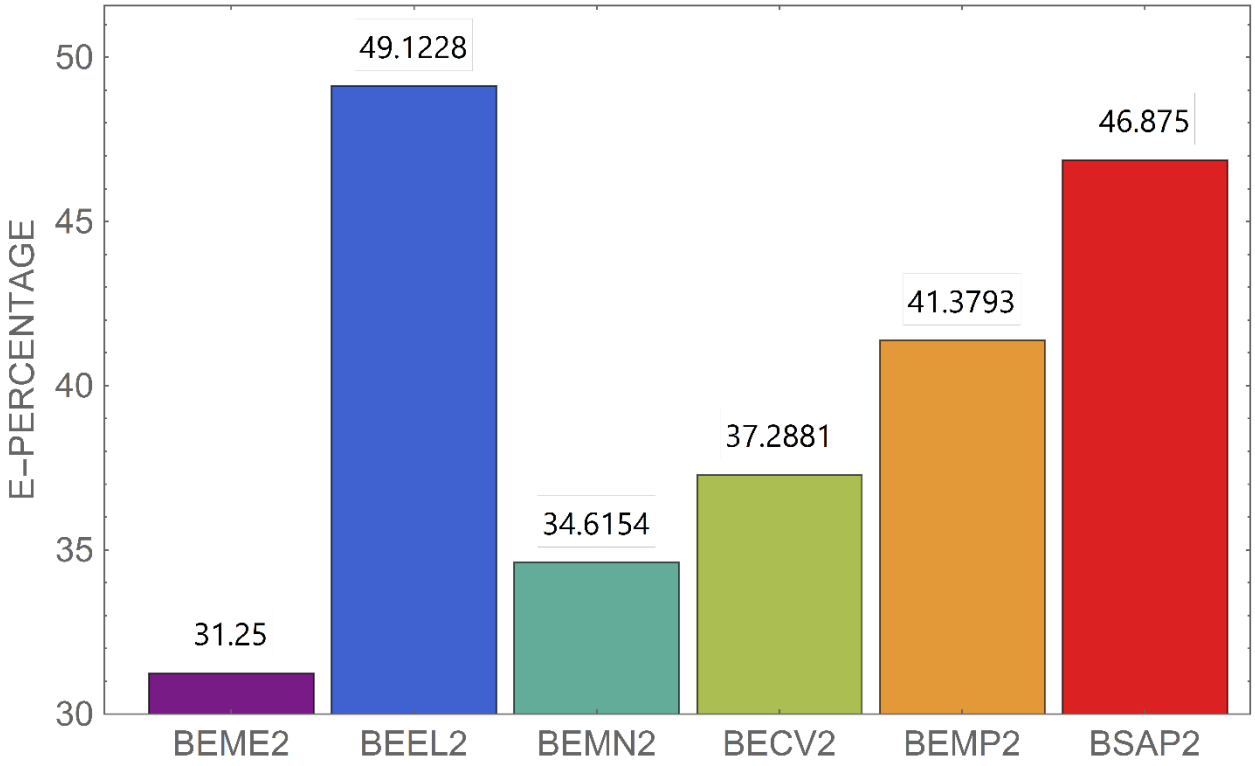

Figure 9: Comparison of E-grade for all departments

87.93 percent of male students in mechanical engineering department passed this course while this percentage for the female in this department was 100 percent. It means all female students from mechanical engineering department that enrolled in EN212, have succeeded to pass this course. 94.23 percent of male students in electrical engineering department passed this course while just 80 percentage of the female students in electrical engineering department have succeeded to pass this course. For the other department, information regarding this matter is mentioned in the **Figure** 10.

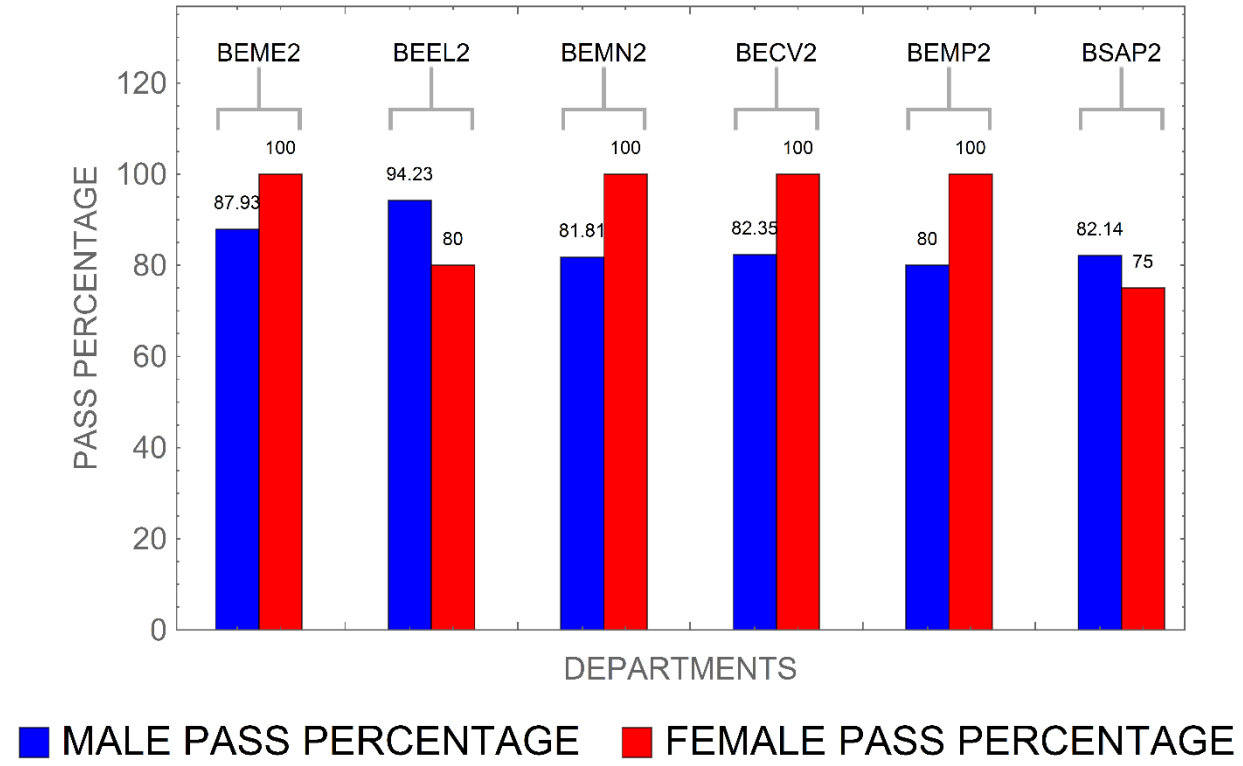

Figure 10: Comparison of gender pass percentage for each departments

Total average for male students from mechanical engineering department in this course was 58.9 while for the female students from mechanical engineering department average in this course was 68.83. Similarly, Total average for male students from

applied physics department in this course was 53.03 while for the female students from applied physics department average in this course was 52.5. For the other department, information regarding average based on gender is mentioned in the **Figure** 11.

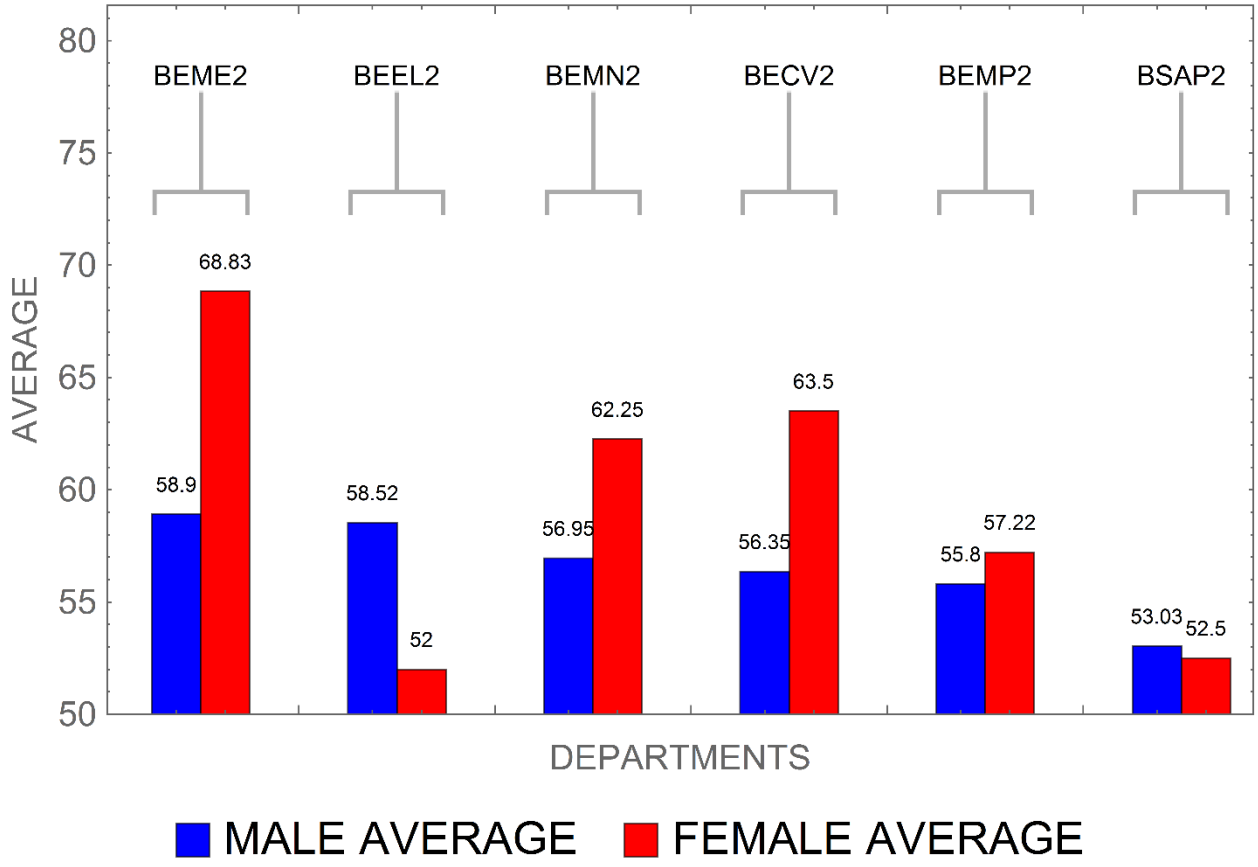

Figure 11: Comparison of average based on gender for each departments

There were totally 36 female students from different departments that enrolled in this course. 94.45 percent of female students have succeeded to pass this course while just 86.14 percent of male students enrolled in this course passed it (see **Figure** 12).

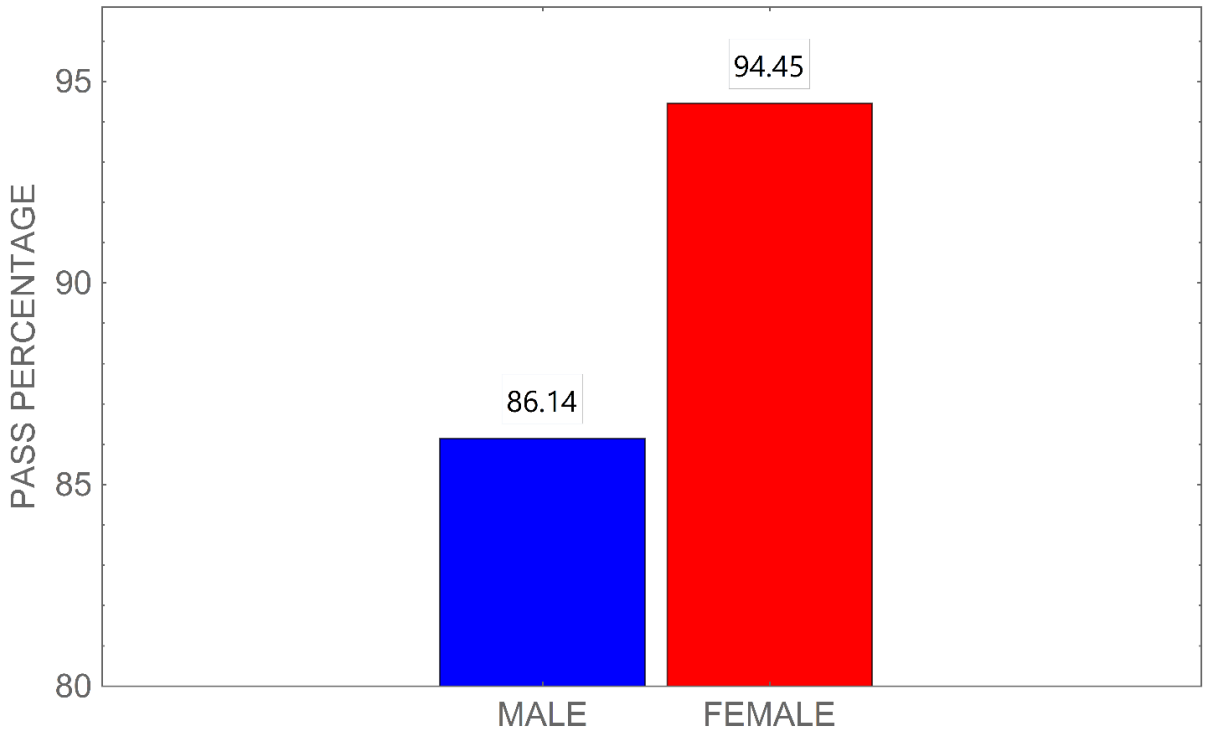

Figure 12: Comparison of total gender pass percentage

Total average for male students in this course was 57.08 while total average for female students in this course was 59.86(see **Figure** 13).

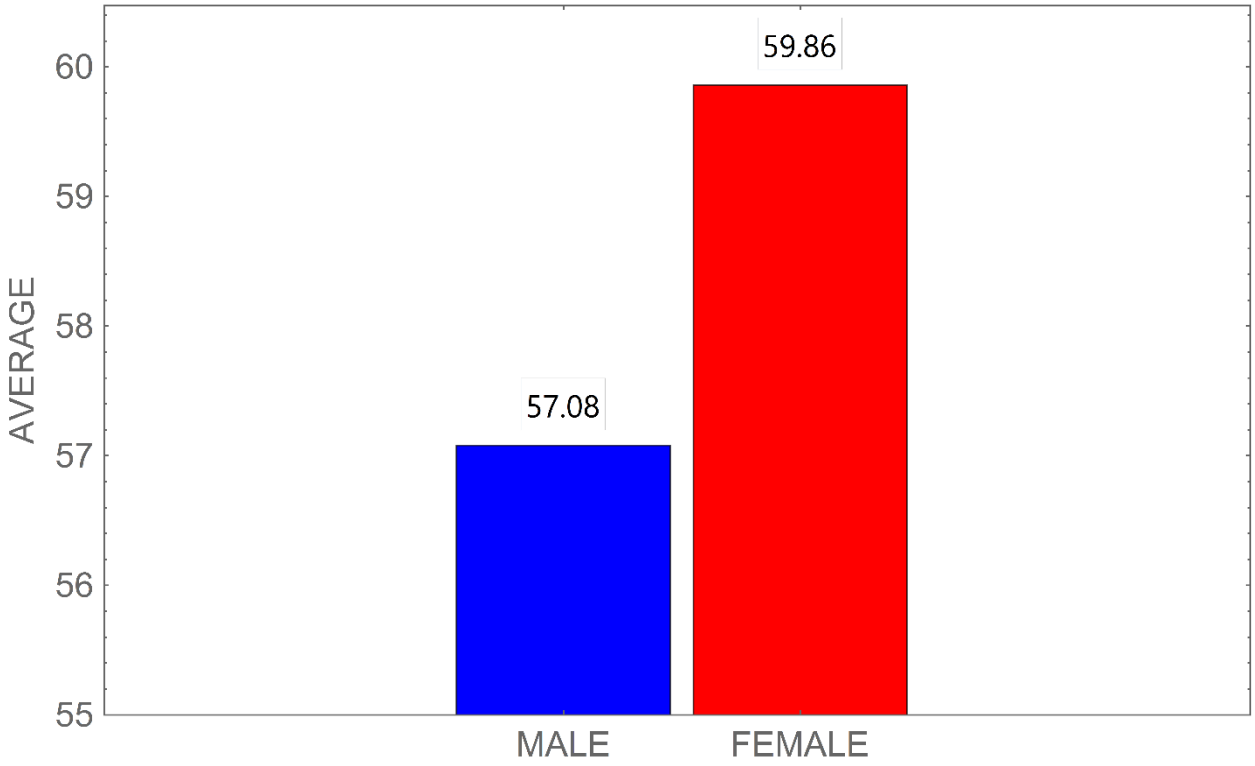

Figure 13: Comparison of total average based on gender

CONCLUSION

Some relation between mathematics courses and other engineering subjects have been found in (Easter, 2010) and (Potolsky, Cohen, & Saylor, 2003). Performance of all students in different departments at this course, can be arrange in the following order, respectively from the best to worse:

1. Students from mechanical engineering department had the best performance in this course,
2. Students from electrical engineering department had the second best performance in this course,
3. The third department in this arrangement is mineral processing,
4. The fourth department in this arrangement is mining department,
5. The fourth department in this arrangement is civil engineering department,
6. The worse department in term of performance in this course was applied physics department.

In term of gender, generally females were better than male in both average and pass percentage in this course.

Of course, these results cannot be extended and generalized for using and applying in the other universities or schools around the world but it can be replicated at the other universities or institutions.

Additional studies that are included more mathematical subjects in engineering departments and also students from different institution can be used to extend this work.

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