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# CORRELATION BETWEEN STUDENTS' ACADEMIC PERFORMANCES IN CHEMISTRY FOR ENGINEERS LECTURE AND LABORATORY

**Aileen I. Atienza**[1]
[1]Assistant Professor,
Department of Physical Science,
Pamantasan ng Lungsod ng Maynila,
Manila,
Philippines

**Marivic G. Molina**[2]
[2]Assistant Professor,
Department of Mathematics,
Pamantasan ng Lungsod ng Maynila,
Manila,
Philippines

**Maculeta E. Omiles**[3]
[3]Assistant Professor,
Department of Physical Science,
Pamantasan ng Lungsod ng Maynila,
Manila,
Philippines

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## ABSTRACT

***As mandated by the Commission on Higher Education (CHED), one of the core subjects being taken by the engineering students at tertiary level in any academic institutions, whether private or government is the Chemistry for Engineers which is offered as lecture and laboratory classes. This study primarily focused on the identification of the association between the academic performances of the engineering students in the subjects Chemistry for Engineers Lecture and the corresponding Chemistry for Engineers Laboratory. Five hundred eighty five (585) engineering students from the nine (9) different fields who enrolled the said subjects in the Academic Year 2019-2020, 1st semester served as respondents in the study, namely Civil Engineering, Chemical Engineering, Computer Engineering, Electronics and Communications Engineering, Mechanical Engineering and Manufacturing Engineering. The overall grades were gathered and subjected to Spearman's rho Correlation analysis aside from the analysis made under descriptive statistics. Results show that there is a significant but weak positive association in the academic performances of the students in the lecture and laboratory subjects.***

**KEYWORDS:** ***Chemistry for Engineers, Correlation, Laboratory class, Lecture class***

## INTRODUCTION

Science is considered to be an essential component in the basic foundation of education of the students (1). Through science, students learn to identify fact from fiction, assess several sources for the needed information, develop problem-solving skills, increase awareness about technology and preserve natural resources (2).

The science subjects such as Chemistry, Physics and Biology are usually offered as lecture and laboratory classes. Usually conducted inside the classrooms, lecture classes discuss and explain the concepts and theories behind certain principles involved. In support of the lecture, students in the laboratory classes perform hands-on laboratory experiments and activities that enhance skills by following procedures, formulating hypotheses, validating, analyzing and evaluating data as well as

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forming data-based conclusions (3). At the collegiate level, science laboratories and the corresponding lectures are offered as separate courses, and students are required to concurrently enroll in both.

Chemistry for Engineers is one of the core subjects at tertiary level that is being taken by the engineering students as mandated by the Commission on Higher Education (CHED). In a particular local university located in Manila, Philippines, Chemistry for Engineers Lecture and Laboratory subjects are being offered every 1st semester of the school year. The said lecture is a 3-unit, 3-hour subject while the corresponding laboratory is a 1-unit, 3-hour subject that are both offered for first year engineering students. The major topics covered are energy from chemical and nuclear reactions, chemistry of engineering materials and chemistry of environment.

## OBJECTIVE

The aim of this study was to determine the association between the academic performances of the engineering students in the subjects Chemistry for Engineers Lecture and the corresponding Chemistry for Engineers Laboratory.

## METHODOLOGY

Permission and approval from the concerned department of the university was sought in order to access and gather the initial data pertinent to the subjects Chemistry for Engineers Lecture and Laboratory. These data include the course syllabi, grading system, transmutation table, class lists as well as the number of students enrolled in the said subjects. After the final examination schedule, the overall grades of each student were accessed through the Computerized Registration System utilized by the said local university.

## SAMPLING DESIGN

All engineering students from a certain local university who concurrently enrolled and were included in the official class lists of both subjects of Chemistry for Engineers Lecture and Chemistry for Engineers Laboratory for the Academic Year 2019-2020/ 1st semester, served as respondents in this study. A total of five hundred eighty five (585) students from the different discipline of engineering namely Civil Engineering, Chemical Engineering, Computer Engineering, Electronics and Communications Engineering, Mechanical Engineering and Manufacturing Engineering comprised the respondents except those students who officially and unofficially dropped any of the two or both subjects.

### Statistical Design

Descriptive statistics as well as Spearman's rho Correlation were used in the analyses of the relationship between the academic performances of engineering students in Chemistry for Engineers Lecture and Laboratory

### Geographical Area

The local university where the study was conducted and where the students belonged is primarily located in Manila, the capital of the Philippines.

## RESULTS

As depicted from Table 1, the highest mean performance in Chemistry for Engineers Lecture was obtained by both the BS Chemical Engineering students (M = 2.19, SD = 0.420) and BS Manufacturing Engineering students (M = 2.19, SD = 0.327). It is expected that Chemical Engineering students should have a strong foundation in Chemistry since several Chemistry subjects are included in the curriculum of the said degree program (4). On the other hand, the lowest mean performance was obtained by the BS Mechanical Engineering students (M = 3.27, SD = 1.107). In general, the overall mean performance of the 585 engineering students in Chemistry for Engineers Lecture was 2.46 (SD = 0.738). This shows that the engineering students are going to have a mean performance that is between 0.738 points lower or 0.738 higher than the overall mean of 2.46 in Chemistry for Engineers Lecture. This also shows that, in general, the engineering students' performance in Chemistry for Engineers Lecture is interpreted as "Good" based on the transmutation table.

These results are supported by the findings in the study of Sanchez. In his study, he found out that the average Chemistry achievement of the Asian countries was significantly higher than the world achievement. Through exploratory analysis, it was revealed that high achievers among the Asian countries have moderate to high perspective towards school climate, instructional considerations and student affective aspects. The study confirmed that, out of the 15 factors included in the study, nine had positive correlation yet only prior achievement in science, home educational resources, science laboratory resources, computer use and prevalence of bullying could significantly determine the achievement of learners in Chemistry (5).

Academic performance of the students may also be affected by some factors like class size, classroom environment, teaching strategy, etc. This is supported by a number of studies. The study of Williams, Brown, and Etherington confirmed that there is a positive link between students' learning style and

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their academic performance (6). This was verified by the study of Olic and Adamov . In their study, they have proven that students who preferred convergent learning style had the highest achievements in chemistry (7). In the study of Paniagua, et al., it was disclosed that engineering students are usually exposed to stress and anxiety situations during a university period, and incorporating a new method for solving engineering problems like PWD (problems without data) significantly improves comfort and stress level of the students (8). The study of Sambasivan, Williams, and Foley used a hybrid method of course delivery and found out that incorporating elements of both the traditional classroom style recitations and web-based instruction provides optimal blend for student learning and show better performance in chemistry (9). Freshmen and sophomores are historically at risk of disengaging with general and organic chemistry. Study of Zavala, et al. implemented Utility Value intervention to increase students' curiosity, and confirmed that UV intervention increases students' self-confidence in applying independent scientific thinking and higher-order problem-solving skills (10).

From Table 2, the highest mean performance in Chemistry for Engineers Laboratory was obtained by the BS Manufacturing Engineering students (M = 1.31, SD = 0.253). Conversely, the lowest mean performance was obtained by the BS Electrical Engineering students (M = 2.40, SD = 0.551). In general, the overall mean performance of the 585 engineering students in Chemistry for Engineers Lecture was 1.90 (SD = 0.695). This indicates that the engineering students are going to have a mean performance that is between 0.695 points lower or 0.695 higher than the overall mean of 1.90 in Chemistry for Engineers Laboratory. This also indicates that, in general, the engineering students' performance in Chemistry for Engineers Laboratory was good.

These results support the study of Al-Zyoud, et al, in which students demonstrated fair to good in the familiarity and understanding of chemical hazard warning signs, and have poor to fair attitudes towards chemical laboratory safety (11). These attitudes may be attributed to the transition from high school to tertiary education since Chemistry is often offered during their first year of college in most colleges and universities. The view of laboratories and unfamiliar environment often increase levels of anxiety of the students (12). At the start of the semester, the level of anxiety is high which results to a low self- efficacy. This often results to a poor academic performance, but when the students begin to adapt to the kind of environment in the institution, they get to regain self-efficacy and the level of anxiety lowers. Moreover, laboratory climate and culture often influence individual's productivity and motivation to participate in the activity (13). Unmotivated students to academically succeed is often manifested in two ways: either students are disengaged from the start of the semester because they do not see the importance of the subject matter, or they are motivated at the start and then they become demotivated after a while due to some factors (14). Completion of the verification experiments is also one of the factors in the laboratory performance of the students.

From Table 3, a Kolmogorov-Smirnov test indicates that both the students' performances in Chemistry for Engineers Lecture ($D(585) = 0.180$, $p = 0.000$) and Laboratory ($D(585) = 0.129$, $p = 0.000$) do not follow a normal distribution. Hence, a non-parametric test in determining the correlation between the two performances must be used specifically the Spearman's rho correlation.

As can be gleaned from Table 4, the results of the Spearman's rho correlation indicated that there was a significant weak positive association between the students' performance in Chemistry for Engineers Lecture and Laboratory ($r_s(585) = 0.380$, $p = 0.000$). The weak positive correlation would indicate that while the students' performances in both lecture and laboratory tend to move on the same direction, whether carried out well or not, the association is not that strong. Additionally, squaring the correlation coefficient ($r^2 = 0.1444$) indicated that only 14.44% of the variance in the percent of students' performance in Chemistry for Engineers Laboratory was explained by the students' performance in Chemistry for Engineers Lecture. Similarly, only 14.44% of the variance in the percent of students' performance in Chemistry for Engineers Lecture was accounted for the students' performance in Chemistry for Engineers Laboratory.

This result supports the finding in the study of Khamali, Mondoh, and Kwena. In their study, it was found that there is also a significant positive relationship between the use of Chemistry laboratory and students' performance in Chemistry ($t(80) = 0.690$, $p = 0.000$). However, the correlation coefficient was found to be strong (15).

## SUGGESTIONS

Association in the academic performances between lecture and laboratory classes must be strengthened in order to reinforce the learnings and optimize the benefits to the students that are brought about by the presence of both classes as compared to only a single class. The existence of both classes should enhance the academic achievements of the students. Chemistry for Engineers Lecture and Laboratory classes

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should go hand-in-hand with each other. The discussions of concepts, theories, principles and laws must be well-established in the lecture classes while demonstrations of the said concepts must be conducted in the laboratory through in-depth hands-on experiments.

## CONCLUSION

The correlation between the students' academic performances in Chemistry for Engineers lecture and laboratory is significant but positively weak.

## TABLES

**Table 1**
***Means and Standard Deviations on Students' Performance in Chemistry for Engineers Lecture***

| Course | *n* | Mean | Standard Deviation |
|---|---|---|---|
| BS CE | 196 | 2.28 | 0.700 |
| BS CHE | 61 | 2.19 | 0.420 |
| BS CpE | 151 | 2.43 | 0.438 |
| BS ECE | 60 | 2.86 | 0.981 |
| BS EE | 34 | 2.70 | 0.691 |
| BS ME | 44 | 3.27 | 1.107 |
| BS MfgE | 39 | 2.19 | 0.327 |
| Overall | 585 | 2.46 | 0.738 |

**Table 2**
***Means and Standard Deviations Students' Performance in Chemistry for Engineers Laboratory***

| Course | *n* | Mean | Standard Deviation |
|---|---|---|---|
| BS CE | 196 | 1.60 | 0.382 |
| BS CHE | 61 | 1.82 | 0.383 |
| BS CpE | 151 | 2.37 | 0.902 |
| BS ECE | 60 | 1.81 | 0.731 |
| BS EE | 34 | 2.40 | 0.551 |
| BS ME | 44 | 2.01 | 0.280 |
| BS MfgE | 39 | 1.31 | 0.253 |
| Overall | 585 | 1.90 | 0.695 |

**Table 3**
***Kolmogorov-Smirnov Test for Normality***

| | Statistic | df | Sig. |
|---|---|---|---|
| Performance in Chemistry for Engineers Lecture | 0.180 | 585 | 0.000 |
| Performance in Chemistry for Engineers Lecture | 0.129 | 585 | 0.000 |

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**Table 4**
***Spearman's rho Correlation***

| | | | Performance in Chemistry for Engineers Lecture | Performance in Chemistry for Engineers Laboratory |
|---|---|---|---|---|
| Spearman's rho | Performance in Chemistry for Engineers Lecture | Correlation Coefficient | 1.000 | 0.380** |
| | | Sig. (2-tailed) | | 0.000 |
| | | *n* | 585 | 585 |
| | Performance in Chemistry for Engineers Laboratory | Correlation Coefficient | 0.380** | 1.000 |
| | | Sig. (2-tailed) | 0.000 | |
| | | *n* | 585 | 585 |

**$p < 0.01$

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