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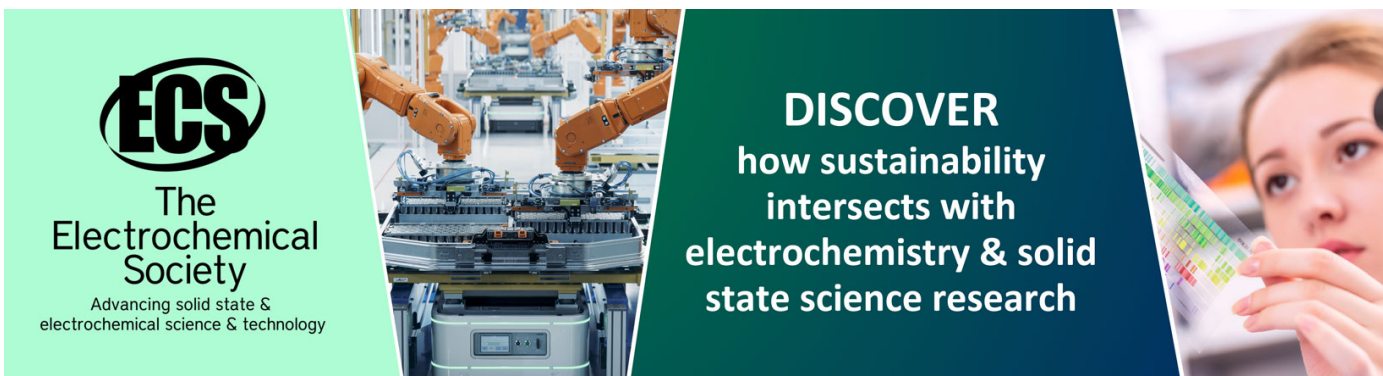
## The relationship between students' achievement of organic laboratory course with understanding about organic subjects including green chemistry

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# The relationship between students' achievement of organic laboratory course with understanding about organic subjects including green chemistry

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**Abstract.** Students' achievement of laboratory organic courses always relate with their understanding of organic subjects in a whole course. Students learn from their experiences in laboratory and their understanding of basic organic concepts to help them synthesize problems. This study aims at students' achievement of organic laboratory courses relate with their understanding of a whole organic subjects using descriptive method. The respondents of this research were students from chemistry education department from two different states universities in Indonesia (Bandung and Jayapura). The research use the result of student final grade of laboratory course compare with students' answers of synthesis organic problems, organic basic concepts and synthesis technique as the data. Therefore we were using a correlation statistic to analyze the data. We also have questionnaires to know students perceptions about the green chemistry. It was analyze using a correlation statistics. We found significant relationship between students' achievement of organic laboratory courses with their understanding of basic organic concepts and their ability in synthesizing organic compounds. Inversely, for the result of synthesis technique show there is no relation with the students' achievement of organic laboratory courses. Furthermore we found that student have a few information about green chemistry.

## 1. Introduction

Based on previous research, it is known that the implementation of organic synthesis experiment in the laboratory can help students in their learning process. Because the purpose of organic synthesis experiment in the laboratory can improve the affective, psychomotor and cognitive aspects. Moreover, it can evaluate the students on those aspects [1,2]

In addition, we known there is a continuous relationship between the concept with the other study synthesis of organic chemistry. It make student required a strategy that can be used to be scaffolding. This was caused students attend the achievement of desired conceptual understanding in learning [3,4,5]. In learning of organic synthesis, scaffolding of students achieved by the laboratory practice. By doing



the synthesis experiments of organic compounds will lead student to the guided inquiry learning [6,7,8,9]. It can lead student to know more about the important about green chemistry.

In fact, we do not know how the relationship obtained between students' achievement on organic chemistry course with their ability in all organic courses. Thus the study aims to determine whether the achievement of students in the organic chemistry laboratory course has a relationship with the ability of students to solve whole organic matter in all organic courses.

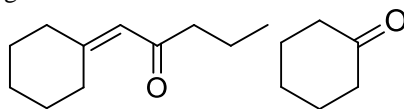
## 2. Method

In this research we used descriptive statistic method then analyze by using two type of correlation. It was a Pearson parametric correlation test and Kruskal Wallis non parametric correlation test. We using correlation test to know the relation between the students' achievements of organic laboratory course with their ability to solve the problem of synthesize organic compounds. This research involved students from two different universities in Indonesia. The students enrolled in Advanced Organic Chemistry courses in the fifth semester of the third year. They already took Organic Laboratory courses. The number of students that involve 14 were students at one of the university in Papua (Jayapura) and 33 students from one states university in West Java (Bandung).

We also used two different instruments. The instruments used for basic organic concepts and synthesis organic matter using essay test. The instrument used for test likewise in figure 1.

Examples of organic synthesis problems:

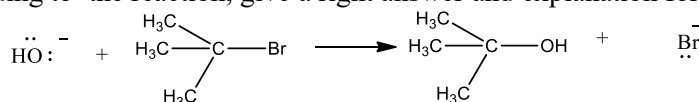
Write down the synthesis of the target molecule of the starting compound of the following materials:



Target molecule    Starting material

Example of essay test of organic basic concepts:

According to the reaction, give a right answer and explanation for the question



below:

Is the reaction that shown above through  $S_N1$  or  $S_N2$  ?

( Explain your answer)

**Figure 1.** The examples of organic synthesis problems and organic basic concepts.

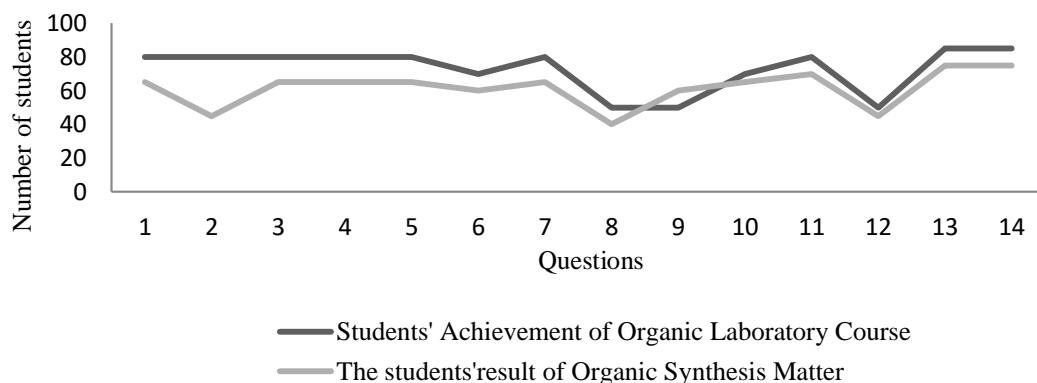
We collected of students' answers in organic synthesis problems and in organic basic concepts. Then we find the connection between the results of students' in doing synthesis organic problem or organic basic concepts with their achievement in organic laboratory courses. We used students' final grades to know their achievement for organic laboratory courses. We also take data from student ability in using organic experiment technique and students understanding about green chemistry.

## 3. Result and discussion

### 3.1. The relationship of students' achievement of organic laboratory courses and students ability in organic synthesis problems.

In the beginning of this research we want to find out the subjects that students have when they learning organic laboratory courses. As we recognize that the subjects in organic laboratory courses in are relevant for student when they are doing synthesis organic compound in laboratory.

Furthermore, we recognize the students' achievement on organic chemistry course with students' abilities to solve organic synthesis problems (figure 2).



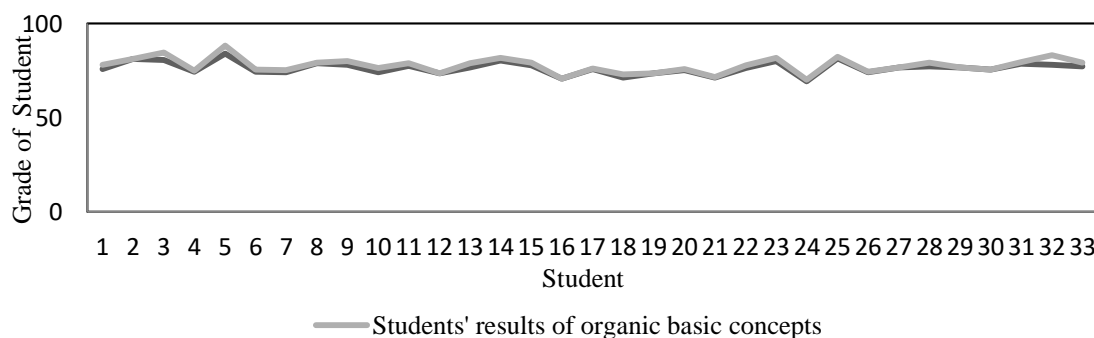
**Figure 2.** Students' achievement on organic chemistry course with students' abilities to solve organic synthesis problems.

Based on the chart in figure 2, it can be seen that the pattern of the students' achievement on organic chemistry course with students' abilities to solve organic synthesis problems are similar. From the graphic we recognize that between this the two variables have an intersection in some parts. Therefore, we use a statistic to analyze the correlation to know exactly about the relationship.

According to the result of Kruskal Wallis statistic, we find that significance value less than 0.01 which is concluded that there is a significant correlation between the students' results of lab work and the students' result of synthesis. The level of the relationship that seen from the correlation coefficient is 0.813 which shows a very strong relationship and it appears that there is a direct relationship between the results of the lab and the result of synthesis that means if the results of the practice increases the results of synthesis will also increase or vice versa.

### 3.2. The Relationship of students' achievement of organic laboratory courses and students' abilities in organic basic concepts

The next step in this research we also want to recognize the relationship between students' achievement of organic laboratory course and student ability in organic basic concepts. For organic basic concepts we just make the limit for the concepts that students have struggle in learn it. The concepts were substitution reaction; elimination reaction; type of substitution reaction ( $E^+$  substitution reaction); type reaction of nucleophilic substitution ( $S_N2$ ); type of elimination reaction ( $E1$ ). From the data we have found the graphic like in figure 3.



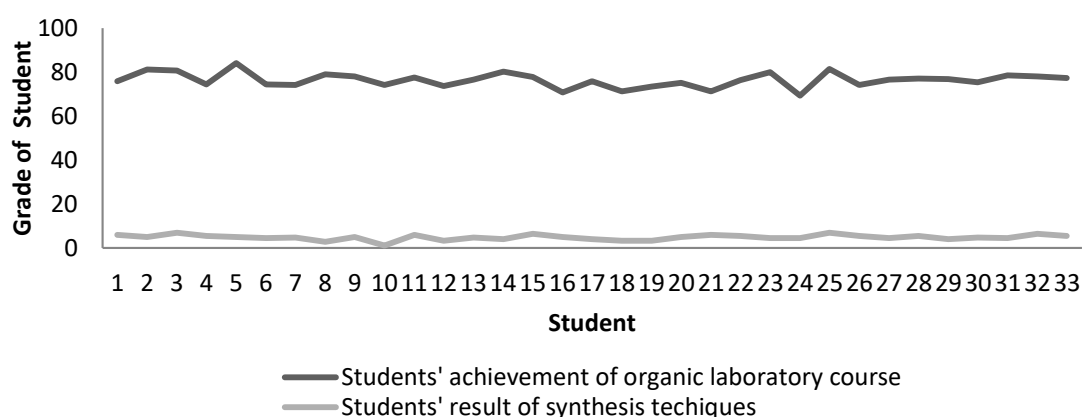
**Figure 3.** Graphic of relationship of students' achievement of organic laboratory courses and students' abilities in organic basic concepts.

Based on figure 3 we see the same pattern of graphics from students' achievement of organic laboratory courses and students' abilities in organic basic concepts. We can wish that there is a connection from students' achievement of organic laboratory courses and students' abilities in organic basic concepts.

The result of Pearson statistic, we find that correlation from students' achievement of organic laboratory courses and students' abilities in organic basic concepts is 0.01 that more less than 0.05. It means that there is a correlation between students' achievement of organic laboratory courses and students' abilities in organic basic concepts.

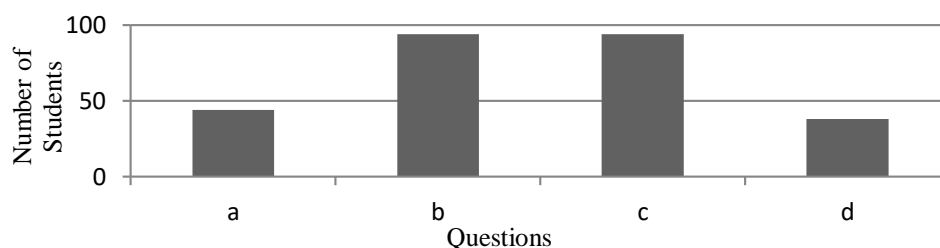
### 3.3. The Relationship of students' achievement of organic laboratory courses and students' abilities in organic technique experiments and students' perceptions about the green chemistry experiments

We demand to know the relationship of students' achievement of organic laboratory courses and students' abilities in organic technique experiments. Like the graphic we make in Figure 4:



**Figure 4.** Relationship of students' achievement of organic laboratory courses and students' abilities in organic technique experiments.

From the graphic in Figure 4, we know that there is no intersection between students' achievement of organic laboratory course and students' abilities in organic technique experiments graphic. We can demand that there is no correlation from both graphics. Similarly, the result of Pearson statistic shows that the correlation of students' achievement of organic laboratory courses and students' abilities in organic technique experiments is 0.11 more high than 0.05. It means there is no correlation, so we can conclude that between students' achievement of organic laboratory courses do not have relationship with students' abilities in organic technique experiment.



**Figure 5.** Relationship of students' perceptions about the green chemistry.

Furthermore, we want to know student's perceptions about green chemistry in the laboratory experiment. From the questionnaires that we share to the student we know that 43.8% student know the alternative compound that more amiable in the environmental (code a); 94% students know that there are some dangerous and risk to use the chemical compound in organic synthesis (code b); 94% students perhaps can have used the more environmental friendly compounds for the experiment in laboratory; and just about 38% students that know about the green chemistry. This means that students just know a few information about green chemistry.

We find that there is a strong relationship from what students understanding from learning synthesis organic subjects in the class and what experiences they get in doing experiment in laboratory organic course. Because from experiences that the students get providing them to use the theory that they get it before. Students think critically about how to synthesis the organic compound through the experiment in laboratory. Eventually it makes them become more expert in doing synthesis of organic compound in laboratory. They can also develop their understanding of green chemistry in the laboratory.

The development of learning organic through laboratory practice can lead the students to the synthesis experiments of organic compounds [10,11,12]. Problem Based Learning (PBL) format using problem solving strategy that used to develop learning in the laboratory of organic synthesis and drugs strategy [13]. The other development is by using mini project model which is known to have impact on conceptual change and beside it is on improving students' critical thinking skills [14,15].

Even according to previous research through the experiment of synthesis organic compounds in the laboratory, students are involved in an authentic problem in a specific domain. This kind of learning process can improve students' critical thinking skills and develop generic science skills in the laboratory. This learning process is considered as an acculturation process of a student to become a practitioner in the field of organic synthesis. It is realized that the process is useful for the student [16].

#### 4. Conclusion

We concluded that there is there is a significant correlation between the students' result of lab work and the students' results of synthesis. The level of the relationship that we have seen from the correlation coefficient shows a very strong relationship. It appears that there is a direct relationship between the results of the lab and the result of synthesis that means if the results of the practice increases the results of synthesis will also increase or vice versa. Similarly, we find significant relationship between students' achievement of organic laboratory courses with their understanding of basic concepts in organic chemistry. Inversely, for the result of synthesis techniques show there is no relation with the students' achievement of organic laboratory courses. We also find that student have a few information about green chemistry. Students must involve in an authentic problem in a specific domain. This kind of learning process can improve students' critical thinking skills and develop generic science skills in the laboratory through laboratory practice of synthesis organic. Therefore, we need to lead the students to work in inquiry project so they will develop all their capability in synthesis organic compound but also consider about the green chemistry.

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#### References

- [1] Bretz S L 2013 What faculty interviews reveal about meaningful learning in the undergraduate laboratory - Supplement *J. Chem. Educ.* **90** 5–7
- [2] Galloway K R and Bretz S L 2015 Using cluster analysis to characterize meaningful learning in a first-year university chemistry laboratory course *Chem. Educ. Res. Pract.* **16** 879–92
- [3] Graulich N 2015 The tip of the iceberg in organic chemistry classes: how do students deal with the invisible? *Chem. Educ. Res. Pr.* **16** 9–21
- [4] Flynn A B 2014 Research and Practice How do students work through organic synthesis learning activities? *Chem. Educ. Res. Pract.* **15** 747–62
- [5] Carlisle D and Nieswandt M 2015 Research and Practice Fostering spatial skill acquisition by general *Chem. Educ. Res. Pract.*
- [6] Sloop J C and Coppock P 2016 Benefits of Using a Problem-Solving Scaffold for Teaching and Learning Synthesis in Undergraduate Organic Chemistry I Benefits of Using a Problem-Solving Scaffold for Teaching and Learning **10**
- [7] Iler H D, Justice D, Brauer S and Landis A 2012 Discovering <sup>13</sup>C NMR, <sup>1</sup>H NMR, and IR

- Spectroscopy in the General Chemistry Laboratory through a Sequence of Guided-Inquiry Exercises
- [8] Thomas R M and Shea K M 2013 Synthesis of Di- and Trisubstituted Azulenes Using a Danheiser Annulation as the Key Step: An Advanced Organic Laboratory Experiment
  - [9] Bott T M and Wan H 2013 Using Essential Oils To Teach Advanced-Level Organic Chemistry Separation Techniques and Spectroscopy 2–4
  - [10] Maria B, Marjan G, An L, Parappilly M B, Siddiqui S, Zadnik M G and Shapter J 2013 An Inquiry-Based Approach to Laboratory Experiences : Investigating Students ' Ways of Active Learning **21** 42–53
  - [11] Balija A M and Reynolds A M 2013 A Mixed-Aldol Condensation Reaction with Unknown Aldehydes and Ketones: Employing Modern Methods To Improve the Learning Process for Second-Year Undergraduate Organic Chemistry Students 2012–4
  - [12] Mackay J A and Wetzel N R 2014 Exploring the Wittig Reaction: A Collaborative Guided-Inquiry Experiment for the Organic Chemistry Laboratory
  - [13] Flynn A B and Biggs R 2012 The Development and Implementation of a Problem-Based Learning Format in a Fourth-Year Undergraduate Synthetic Organic and Medicinal Chemistry Laboratory Course 52–7
  - [14] Hakim A, Liliyasi, Kadarohman A and Syah Y M 2016 Making a Natural Product Chemistry Course Meaningful with a Mini Project Laboratory *J. Chem. Educ.* **93** 193–6
  - [15] Hakim A, Liliyasi, Kadarohman A and Syah Y M 2016 Effects of the natural product mini project laboratory on the students conceptual understanding *J. Turkish Sci. Educ.* **13** 27–36
  - [16] Bhattacharyya G and Bodner G M 2014 Culturing Reality : How Organic Chemistry Graduate Students Develop Into Practitioners **51** 694–713