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Research Artikel

ANALYSING THE LEVEL OF ORGANIC CHEMISTRY ANXIETY OF PRE-SERVICE EDUCATION STUDENTS

ANALISIS TINGKAT KECEMASAN KIMIA ORGANIK MAHASISWA PRA JASA PENDIDIKAN

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Abstract

Several studies have reported that poor performance of organic chemistry among students has been attributed partly to organic chemistry anxiety. The purpose of this study is to investigate the level of organic chemistry anxiety among chemistry education students. Sequential explanatory mixed methods approach employed in the study. Due to COVID-19 Pandemic, 142 pre-service education students from four universities were chosen using the convenience sampling technique. The questionnaires were distributed to the participants using google form. This quantitative data generation was followed by a semi-structured interview with 2 students from each university. Quantitative data gathered were analyzed using descriptive statistics meanwhile qualitative data from interviews were analyzed using thematic analysis. The results show that 5.63% of students have low anxiety, 81.69% of students have moderate anxiety levels, while 12.68% of students have high anxiety levels. On average the anxiety level of chemistry education students is at a moderate level with a score was 62. According to students, this anxiety was influenced by the complexity of organic chemistry lesson materials, lecturer strategies in teaching organic chemistry, and their previous knowledge of chemistry. Further study should be carried out to analyze the factors that influence students' anxiety.

Keywords: Science anxiety; organic chemistry; organic chemistry anxiety; chemistry education; pre-service education

Abstrak

Sejumlah penelitian telah melaporkan bahwa buruknya performa mahasiswa pada mata kuliah kimia organik berkaitan dengan kecemasan mereka terhadap kimia organik. Tujuan dari penelitian ini adalah untuk mengetahui tingkat kecemasan mahasiswa Pendidikan Kimia terhadap perkuliahan Kimia Organik. Pendekatan metode campuran eksplanatori sekuensial digunakan dalam penelitian ini. Akibat Pandemi COVID-19, sebanyak 142 mahasiswa Pendidikan kimia dari empat universitas dengan menggunakan teknik convenience sampling. Kuisisioner dibagikan kepada peserta menggunakan google form. Penyebaran kuisisioner ini dilanjutkan dengan wawancara semi struktur dengan 2 mahasiswa dari masing-masing universitas. Data kuantitatif yang terkumpul dianalisis menggunakan statistik deskriptif sedangkan data kualitatif dari wawancara dianalisis menggunakan analisis tematik. Hasil penelitian menunjukkan 5,63% siswa memiliki tingkat kecemasan rendah, 81,69% siswa memiliki tingkat kecemasan sedang, sedangkan 12,68% siswa memiliki tingkat kecemasan tinggi. Rata-rata tingkat kecemasan mahasiswa pendidikan kimia berada pada tingkat sedang dengan skor 62. Menurut mahasiswa, kecemasan ini dipengaruhi oleh kompleksitas materi pelajaran kimia organik, strategi dosen dalam pembelajaran kimia organik dan pengetahuan sebelumnya tentang kimia. Studi lebih dapat dilakukan untuk menganalisis faktor-faktor yang mempengaruhi kecemasan siswa.

Kata Kunci: Kecemasan terhadap sains; kimia organik; kecemasan terhadap kimia organik; pendidikan kimia; pendidikan guru

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INTRODUCTION

Organic chemistry is branch of chemistry that studies the structure, properties, changes, composition, reactions and synthesis of compounds containing carbon atoms and other elements. This field is basically not only limited to compounds produced by living things through metabolic processes, but also to man-made synthetic compounds such as polymers. Since organic compounds form the basis of all life and they affects every aspects of human life, organic chemistry became an important course taught in the field of chemistry, biology, health sciences, agriculture, pharmacy, medical, and mining and oil (Aydogdu, 2017; Kurbanoglu & Akin, 2012)

A number of researchers have reported that organic chemistry is a difficult subject. Many students failed to see the important of this chemistry branch (O'Dwyer & Childs, 2017). One study identified three main difficulties in learning organic chemistry; it has an extensive new vocabulary, no algorithmic problem solving, and it requires three-dimensional thinking- macroscopic, submicroscopic and symbolic- (Ellis 1994). Moreover, students feel that almost all organic chemistry topics are difficult. Some of the difficult topics are properties and synthesis of organic compounds, isomerism, reaction mechanism, and drawing and representation organic compounds (Anderson & Bodner, 2008; Ferguson & Bodner, 2008; Johnstone, 2006; O'Dwyer & Childs, 2015; Taagepera & Noori, 2000)

University students' achievement in organic chemistry course is relatively low (Mahajan & Singh, 2005). There are lots of factors that influence student performance in this challenging subject. Some studies identified that students' achievement in general chemistry, knowledge structure, and spatial ability have strong relation to students' performance in organic chemistry (Ellis, 1994; Ferguson & Bodner, 2008; Lopez et al., 2011; Taagepera & Noori, 2000). Teaching strategies also affects students' achievement, however only few studies on teaching organic chemistry which focus on the learning experience from students' point of view (Ferguson & Bodner, 2008). Another important factor that influence

students' performance is anxiety (Kurbanoglu & Akin, 2012; Mahajan & Singh, 2005).

Anxiety, feelings of apprehension about what to come accompanied by physiological arousal, has been studied in the field of science education within the last four decade. Likewise, in the field of chemistry education anxiety has been one of research focuses lately. Some researchers define chemistry anxiety as a fear of chemistry courses and subjects or chemicals (Eddy, 2000; Turner & Lindsay, 2003). Others define chemistry anxiety as a feeling worry and nervous about learning chemistry that make students lose interest in the chemistry and science (Alkan, 2017; Kurbanoglu & Akin, 2015; McCarthy & Widanski, 2009). Moreover, anxiety is one factor that reduce students' achievement in organic chemistry (Mahajan & Singh, 2005).

Even though research on anxiety in organic chemistry has been widely carried out in other countries, this is not the case with Indonesia. There is very little published research on this topic in Indonesia. For that, Researcher carried out the study on analysing pre-service education students' anxiety level in organic chemistry course. The study investigates the level of organic chemistry of chemistry education and students' perception their anxiety.

METHOD

Sequential explanatory mixed method approach employed in this study. The participants for the study were chosen using a convenience sample technique due to the pandemic. Researcher asked colleagues from the chemistry education department at four universities to distribute a link of the online questionnaires to their students who have completed organic chemistry course. 142 pre-service chemistry education students from four universities filled the questionnaire and participated in this study voluntarily. The sequential explanatory mixed method design in this study briefly described and illustrated in the figure 1.

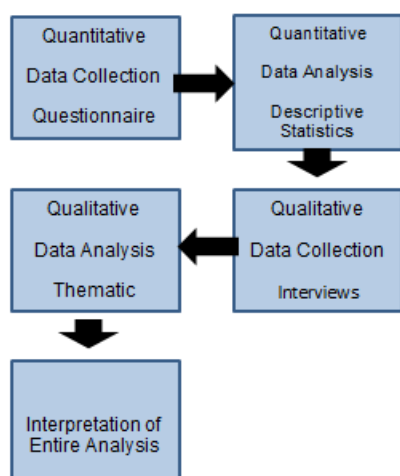


Figure 1. Sequential explanatory mixed method design, adapted from (Creswell, 2009)

As can be seen from the illustration above, the study begins with the collection of quantitative data. The Organic Chemistry Anxiety Scale developed by Kurbanoglu and Akin (2015) used in this study. The instrument that has value of 0,95 Cronbach's reliabilities measured the anxiety of three aspects; (1) writing bond type of carbon compounds, formulas and naming carbon compounds (seven items, e. g., write the type of carbon atom bond in organic molecules), (2) writing the types of carbon compounds and their isomers (ten items, e. g., write the type of isomer of an organic molecule), and (3) writing the reaction mechanism of carbon compounds (seven items, e. g., write the steps of the reaction mechanism). Every item is evaluated on a 5-point Likert scale ranging from 1 (never makes me anxious) to 5 (always makes me anxious) (Kurbanoglu & Akin, 2015). Data gathered from the questionnaire examined using descriptive statistics to view mean or average score of anxiety level. The anxiety level then categorized into three group; low (score <41%), moderate (score 41%-76%), and high (score>76%).

After researcher analysed quantitative data, researcher collected qualitative data using semi structure interview to gain in-depth knowledge on students' anxiety on organic chemistry. By carrying out interview researcher be able to produce situational and contextual knowledge based from the interview when researcher succeeds in ensuring the relevant context is brought into focus (Mason,

2002). Researcher run semi structure interviews with 8 students (2 students from each university). Each interview last for about 30 minutes, and in total researcher have for about 4 hours of interviews with pre-service chemistry education students. Data gathered from semi structured interviews were analysed using thematic analysis approach developed by Ramli (Ramli, 2015).

RESULTS AND DISCUSSION

142 students participated in this study were semester 5,7 and 9 students. The level of their anxiety level can be seen from the table 1 and figure 2.

Table 1. Students' level of Anxiety

Level of anxiety	Percentage
Low	5.63%
Moderate	81.69%
High	12.68%

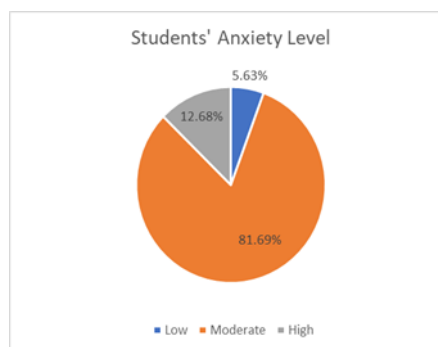


Figure 2. Students' Anxiety Level

As can be seen from the table and figure above that most of students namely around 81.89% have the anxiety at the moderate level. The average score of the anxiety for each item can be seen in the table 2.

Table 2. Average score of each items of organic chemistry anxiety scale

Item	Score
1 Taking organic chemistry course	65
2 Listening to the organic chemistry course in the classroom	57
3 Writing the type of carbon atom bond in organic molecules	55
4 Writing the type of carbon atom hybridization in organic molecule	58
5 Writing the formula of organic molecule from its given name	57
6 Writing the name of an organic molecule from its given formula	55
7 Writing the type of formula of an organic molecule	56
8 Writing the type of isomer of an organic molecule	62

Item	Score
9 Writing the structural isomers of an organic molecule	63
10 Thinking and write three-dimensional structure of an organic molecule	67
11 Determining the geometry of an organic molecule	69
12 Writing conformational isomers of an organic molecule	66
13 Writing the configurational isomers of an organic molecule	65
14 Determining the priority groups at stereoisomerism	61
15 Writing the geometric isomers of an organic molecule	65
16 Determining chiral and achiral carbons in an organic molecule	50
17 Determining the enantiomers of a chiral molecule	58
18 Determining the type of nucleophile and solvent for the reaction	58
19 Writing which products can occur in reaction	63
20 Writing the rate of products of reaction	65
21 Writing the type of reaction mechanism	66
22 Writing the steps of the reaction mechanism	70
23 Writing how the mechanism of the reaction occurs	70
24 Determining the structure of organic molecule with Spectroscopic method	72
Average score	62

As can be seen from the table 1 above, the anxiety level of pre-service chemistry education students is moderate with the score of 62. Top five items with the highest score are thinking and write three dimensional structure of an organic molecule, determining the geometry of an organic molecule, writing the steps of the reaction mechanism, writing how the mechanism of reaction occurs and determining the structure of organic molecule with spectroscopic method. As for the average score of the three aspects investigate in this study is illustrated in Table 3below.

Table 3. Average score of each anxiety aspects

No	Aspect	Score	Anxiety Level
1	Writing bond type of carbon compounds, formulas and naming carbon compounds	58	Moderate
2	Writing the types of carbon compounds and their isomers	63	Moderate
3	Writing the reaction mechanism of carbon compounds	66	Moderate

As can be seen from the table 3 above that although students anxiety level for all aspects are at moderate level, the students' anxiety towards the third aspect is higher than the other two aspects. Meanwhile the anxiety about the first aspect, writing bond type of carbon compounds, formulas and naming carbon compounds, is the lowest.

Moreover, Table and Table 3 indicate that the greatest anxiety felt by students is related to drawing and representation of organic compounds and reaction mechanisms. This may happen because these two topics are very difficult according to students in many countries (Ferguson & Bodner, 2008; Johnstone, 2006). In order to be able to draw the organic compounds and understand the reaction mechanism, students should understand chemical principle, abstract and theories and numerous facts on the organic compounds and reaction. They felt more anxious because they have poor understanding of the concepts, theories, and rules that were relevant to mechanism of reaction and they cannot make sense of the reaction processes (Ferguson & Bodner, 2008). This result also accords with the interviews as can be seen from the excerpt below.

“anxiety was also influenced by the difficulty of organic chemistry course materials. Many difficult topics, one of which is about the mechanism of reaction. Sometimes I have to imagine the reaction but it's still difficult”

(Interview with student#1)

“I try to enjoy the organic chemistry to reduce my anxiety, but the material is really hard. In particular, the reaction mechanism. Up until now I did not understand the nucleophilic or electrophilic reactions. When we cannot understand the material, we will be more anxious.”

(interview with student#2)

In addition, students reveal that teacher strategies in delivering a subject also affects their level of anxiety.

“How the lecturer taught also affected my anxiety level. The materials are too much, and the lecturer teach them too fast. There are many topics that I do not understand and maybe my friends too. But the lecturer seems to ignore. Moreover, the lecturer could not explain the relationship between organic chemistry and daily life, so I did not understand the importance of organic chemistry at all”

(interview with student#8)

“The lecturer taught organic materials too fast, so we did not understand. This made me even more

anxious in the classroom. Lecturers try to reduce student anxiety by giving appreciation even though we answer the problem set incorrectly. But that is not enough to make our anxiety disappear. The lecturers are also too serious and never make jokes”

(interview with student#5)

“In my opinion, the lecturer should also ask whether the students understand what is being taught. Then, there are many abstract concepts in organic chemistry. I think teacher should play a video that helps us understand the materials. I think it might reduce my anxiety”

(interview with student#6)

As can be seen from the excerpt above, it is clear that how teaching strategies affects students’ anxiety toward organic chemistry. Lecturer should pay attention to their students understanding of the lesson. It is also important that lecturer explain the connection between what students learn in the classroom and their daily life. Lecturer should shift their approach from conventional to more contextual teaching. Moreover, what students conveyed in the excerpt above is in line with previous research. Studies suggested that how teacher deliver organic lessons and carry out the laboratory work influence students’ performance in the course and it leads to students’ anxiety. When student become more anxious with the lessons, they will perceive organic chemistry as difficult subject (Ferguson & Bodner, 2008; Kurbanoglu & Akin, 2012).

In addition, students reveal that their previous knowledge influence their anxiety level towards organic chemistry. Adequate knowledge they acquire while in high school or during general chemistry course to some extent affects their anxiety level. The more they understand of chemistry concepts, especially concepts related to organic chemistry, the less they worry about organic chemistry.

“I went to Islamic high school, so I think I learnt chemistry less than my classmates from general high school. I think I do not have sufficient knowledge after completed the general chemistry course, so this affects my performance in organic

chemistry. And of course I feel more anxious than if I had sufficient previous knowledge”

(interview with student#3)

“I believe that previous knowledge influence students’ anxiety. On some organic chemistry lesson, I have just felt ok because I have quite sufficient knowledge from high school and general chemistry course. However, when lecturer teach difficult topic, however, I feel anxious when the lecturer teaches a topic that is difficult to understand.”

(interview with student#7)

As can be seen from the excerpts above that students’ previous knowledge affects their anxiety level. It is very important for them to master the basic chemistry concepts before they take organic chemistry courses, so then they may become less anxious. This finding is in accord with previous studies indicating that one factor that affect students’ anxiety level towards organic chemistry is knowledge they acquired during high school or general chemistry course ((Mahajan & Singh, 2005; O’Dwyer & Childs, 2017). Then it is also important to make changes in organic chemistry course as suggested by Ferguson and Bodner (2018); organic lesson should focus on an explicit recognition of the core concepts and make a connection between microscopic level and macroscopic level.

CONCLUSION

Organic chemistry is a very important branch of chemistry. Organic chemistry discusses organic compounds that affects every aspects of human life, so that organic chemistry courses are offered in various study programs such as chemistry, chemistry education, biology, medical, and mine engineering. Unfortunately, students consider this course as a challenging and difficult subject, and students have relatively low performance on this course. One factor that affects students’ achievement in organic chemistry is anxiety. This study investigated chemistry education students’ anxiety level toward organic chemistry. From this study it can be concluded that the anxiety level of pre-service chemistry education students is moderate. Two difficult topics namely drawing and

representation of organic compounds and reaction mechanisms give more anxiety than other topics.

In addition to the conclusion, the researcher like to offer recommendation. There are aspects that have not been explored in this study that may need to be investigated in the future. This study did not focus on comparing aspects that may influence students' anxiety such as gender, students' grade on general chemistry, and students' major subjects. So then, further research should be carried out to analyse the influence of these factors towards students' anxiety. It may also interesting to study on lecturer strategies in delivering organic course and to what extent that the strategies affect students' anxiety.

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Ramli, M.

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