

# Student's Self-efficacy in Organic Chemistry Learning

**F Erika**

Chemistry Education Major, University of Mulawarman

Email: ikarafifa14@gmail.com

**Abstract.** This research is intended to adapt The Sources of Middle School Mathematics Self-Efficacy Scale, which is applied to different cultural context (as in Indonesian culture) and various age ranges (college students), focusing on organic chemistry learning. Questionnaire is then further used to investigate the self-efficacy beliefs in students from University of Mulawarman, in learning organic chemistry for the very first time. The results of early study in Chemistry Education Undergraduate Study in University of Mulawarman showed that in general, the student's self-efficacy could be categorized as sufficient. Only about 46.82% of students who believed that they are always going to be successful in organic chemistry learning; meanwhile the other 53.18% is still in doubt of their own abilities in learning organic chemistry; these students sometimes are exposed to stress and feeling nervous during the lesson is conducted. This finding showed the importance of students' self-efficacy in learning chemistry in university. Self-efficacy does not only impact on students' perseverance in general chemistry class, but also further to improve their perseverance in later advanced studies and workplace. This urges the need to measure student's self-efficacy.

## 1. Introduction

Organic chemistry is one of basic compulsory courses in chemistry education program. Organic chemistry learning also plays integral part in other undergraduate courses such as biology, biochemistry, medical school and pharmacy. Organic chemistry is a knowledge branch that is visual in nature, which emphasizes on the activity of generating and interpreting symbols and structural representation. Organic chemistry covers how a molecule being presented, rationalized mechanism and stereochemistry information. In learning organic chemistry, students are demanded to master the mechanism of a reaction, three dimensional structure of a molecule and naming of compound [1]. As a subject, organic chemistry has been known to possess tough reputation for students, as they do not see its vitality and relevancy in learning. There are many researches that showed that for the last 40 years, organic chemistry is reported to be a difficult field for second year college students. The concept of organic chemistry that is considered as difficult for students is mostly types of reactions, reaction mechanism and the synthesis of organic compounds [2].

Some researchers suggest that student's achievement in organic chemistry depends on their achievement in general chemistry, performance in chemistry, examination score and also cognitive variable such as knowledge structure and spatial-visual performance [3-5]. This also affected by non-cognitive variable such as attitude and anxiety [6-8], where anxiety is one of the factors that affect student performance in learning organic chemistry [9]. Anxiety in organic chemistry has strong relation with a broad spectrum of cognitive, psychological and behavioral problem. Another aspect which related to organic chemistry anxiety is self-efficacy. Self-efficacy is about one's belief on his/her ability to be able to success in doing certain task or behavior, which in this case, is the ultimate determinant factor whether one will try to do the given task, how much effort will be put on and also how much perseverance that will be shown to finish this certain task and in facing challenges [10].

## 2. Self-Efficacy

Self-efficacy is consisted of words "self" which is defined as the structural element of personality, and "efficacy" that means self-assessment whether one will be able to do good or bad deeds, right or wrong action, and also whether one can or cannot do something as predefined before. Self-efficacy theory is based on Bandura's social-cognitive theory which states that one's achievement or performance depends on the interaction of behavior, personal factor (such as belief and thinking) and environment. Bandura defines self-efficacy as one's consideration of his/her own ability to organize and conduct necessary actions to achieve certain goals. Self-efficacy is not merely an ordinary faith

about oneself, but more of a specific belief which leads to certain assignment. Self-efficacy can be seen as one's perception of his/her capability to organize and execute action in specific situation. Self-efficacy refers to the belief of his ability to motivate cognitive sources and series of needed action to meet the demand of situation.

The idea of self-efficacy has significant implication to implement ideas refinery in science class. This is the reason why several teachers from various subjects have used self-efficacy concept as theoretical framework to study teacher knowledge competency and performance in specific domain. Teacher's interest on self-efficacy originates from the fact that there is correlation between one's self-efficacy belief and his/her performance in certain task [11]. Student's science self-efficacy belief is included in 2015 PISA assessment. This is considered important to be measured since positive self-efficacy is strongly related to student's motivation, learning behavior, common expectation in the future and also performance [13]. Self-efficacy is also a predictor to enter university in each domain [14]. Teacher's professional belief is also measured in 2015 PISA which in this case is teacher's self-efficacy belief in class management, giving instructions and maintaining good relationship with students. Science teachers will be required to report their self-efficacy beliefs which related to science content and learning [13]. PISA data shows how student's self-efficacy, which is defined as their belief to their own abilities, has significant influence to their academic achievement and behavior. There is also another evident that teacher's self-efficacy, which is interpreted as their beliefs in their teaching abilities, involving students and class management, has impacted on student's motivation and achievement, and also impacted their own teaching practices such as enthusiasm, commitment, work satisfaction and in-class behavior. Meanwhile, low self-efficacy belief is correlated to teacher who has more difficulties with student behavior, and becomes more pessimistic in student learning, and also experiences higher stress level in working and less work satisfaction [15]. Jerald states that teacher who has high self-efficacy intends to show higher level in planning and organizing, more open-minded for new ideas and more willing to experiment with new method in order to meet the student needs [16].

### *2.1. The Sources of Self-Efficacy*

According to Bandura, self-efficacy can be gained, changed, increased or decreased by doing one or combining four sources of performance experiences, vicarious experiences, verbal persuasion and also physiological and affective behavior [17]. Self-efficacy continues to grow for lifetime by integrating information from these four main sources:

#### *2.1.1. Performance Experiences.*

Performance experience gives the largest opportunity to develop self-efficacy since it "gives the most authentic proof whether one can collect anything necessary for success" in given achievement. Success and failure will influence one's efficacy, but sustainable effort to certain goal will help to produce "resilient sense of efficacy". One's perception of failure and success of something will generally weaken or strengthen his/her self-efficacy. The more often one experiences success in his/her life, the higher level of self-efficacy she/he will have, and vice versa.

#### *2.1.2. Vicarious Experiences*

Self-efficacy is also influenced by one's observation towards other people behavior. This is based on observational learning theory which states that one can learn continuously by observing other people behavior. He/she will use the information obtained from the observation to make a hope on behavior and its consequences, especially depends on his/her self-belief in having things in common with the person being observed. The person being observed is usually referred as model. Another person experience is usually obtained through models in social interactions. Vicarious experience gives one chance to see colleague's experience and henceforth visualizes his/herself in identical or similar situation, which results in "another person experience which is similar to his/herself is assessed as own ability diagnostic". This experience in general has lesser influence to self-efficacy compared to experiencing it on the first place. This experience is usually gained by observing, imitating, imagining and by using other medias. Self-efficacy will be increased when observing other people success and on the other hand, will be decreased as watching person who has similar ability to one's self experiencing failure.

### 2.1.3. Verbal Persuasion

Self-efficacy can also be increased by giving motivation and support to one's ability to finish his/her task successfully. Verbal persuasion is an approach that is conducted to convince someone whether he/she has the necessary ability or not. This source has limited effect on self-efficacy, but in the right condition will be able to affect self-efficacy. This right condition being discussed is the trust to the persuasion giver, the skill of the giver and also realistic nature of the persuasion. Negative statement on one's competency in certain areas will strongly give bad effect for those who already lose their self-confidence. By doing so, "people who are persuaded verbally that they have the ability to complete the given tasks will tend to mobilize greater effort and maintain it."

### 2.1.4. Physiological and Affective Condition

The last thing to be considered in self-efficacy development is the role of physiological and affective condition. Physical and emotional state will influence self-efficacy; in general success or failure will induce physiological reaction, either the pleasant one or vice versa. Unpleasant physiological reaction can cause someone to doubt his/her ability to finish something. Strong emotion such as fear, worry and stress can reduce one's self-efficacy. But, emotional improvement (which is not overrated) can increase self-efficacy. Behavioral changes will take place if other sources of efficacy expectation (one's perception about how good his/her self can function in certain situation) change. Stress level or one's feeling about certain activity will take role in the belief whether he/she will be effective so that "people will tend to expect success when they do not experience stress or being depressed compared to when they feel nervous and worry" [18].

## 3. Related Research

The result of Prat-Sala and Redford research has supported the importance of self-efficacy concept with its relation to student performance [12]. Self-efficacy has direct positive influence toward student's science behavior in chemistry [19]. Student's self-efficacy belief is found to be positively related significantly with achievement in analytical chemistry. This finding is surely indicate the importance of self-efficacy influence on science academic achievement and cannot be underestimated [20]. Significant positive relation is also found between self-efficacy, constructive problem solving and insistent-persistent approach [21]. Other findings suggest that communication and interpersonal problem solving skill are important predictor of social self-efficacy [22].

Some researchers have investigated self-efficacy in chemistry, especially in university level [23-28]. Taasobshirazi and Glynn reported that students who have high self-efficacy have tendency to use strategy in working and obtaining solution of problems compared to those who have low self-efficacy [25]. In related research, Zusho et al investigated the role of several motivational processes toward achievement in chemistry and their correlation. They found that self-efficacy is the best predictor of final examination score [24]. Villafane et al. explored student's self-efficacy in general chemistry course. The result showed that individual characteristic (race/ethnicity and gender) might affect how far the improvement of student's self-efficacy by the end of the semester [27]. Meanwhile, Ferrell and Barbera reported that student's self-efficacy and interest toward chemistry was higher compared to non-science course [28].

Self-efficacy does not only affect student's perseverance in general chemistry course, but also further in later life for their perseverance in learning advanced courses and in workplace, so it is considered necessary to measure their self-efficacy. In this research, self-efficacy is seen as student's belief toward his/her ability in organic chemistry course. Self-efficacy measurement is focused on four sources, namely performance experience, vicarious experience, verbal persuasion and physiological and affective condition, which then differentiated into indicators.

## 4. Method

The respondent of this research is the students of Chemistry Education Program of Faculty of Education and Teacher Training, Mulawarman University, which is 32 students. Questionnaire is used to collect self-efficacy data. The measurement of student's self-efficacy is conducted by using questionnaire that is developed by adapting The Sources of Middle School Mathematics Self-Efficacy Scale. This questionnaire has high reliability level and its sub-scale correlates with self-efficacy, self-concept, mastery objective and optimism. The result showed that the source of this questionnaire scale is very psychometric and can be adapted to be used in other domains [29]. There are six items for the

assessment of mastery experiences, six items for vicarious experience, six items for social persuasions and six items to assess the physiological state. These item statements are written as first person statement, and students are asked to assess their agreement or disagreement for each statement on scale ranges from 1 (strongly disagree) to 5 (strongly agree).

The data being analyzed is the result of student's final self-efficacy to obtain general picture of how is student's self-efficacy after taking Organic Chemistry I course. The student's self-efficacy data is obtained from questionnaire which is distributed at the end of the course. After the data is collected, it is then calculated and classified by using ideal criteria calculation as stated by Riduwan [30].

## 5. Result and Discussion

Based on the data processing from student's self-efficacy questionnaire, it is known that student's self-efficacy of Chemistry Education of Mulawarman University can be categorized as sufficient. Only about 46.82% students who believed that they are always going to be successful in organic chemistry learning; meanwhile the other 53.18% is still in doubt of their own abilities in learning organic chemistry; these students sometimes are exposed to stress and feeling nervous during the lesson is conducted.

After the student's self-efficacy data is analyzed in a whole, it is then analyzed based on measured source of self-efficacy. Below is the explanation for the result of self-efficacy data processing.

### 5.1 Mastery Experiences

Student's self-efficacy towards organic chemistry learning from the aspect of mastery experience source is categorized as sufficient. About 55.20% students doubt that mastery experience source affects their self-efficacy. They doubt that they will always obtain good score and be successful in organic chemistry course, although they are sure that they can finish the given organic chemistry task well. But, they are not sure that they can finish the most difficult task. This shows that although mastery experience strongly influences self-efficacy belief, but there is only very little known about the scope and the nature of mastery experience that is needed by students to be convinced of their abilities, especially when learning difficult concept. Self-confidence to learn these difficult concepts seemed to be the combination of how many time spent to study and whether the students have good learning strategy or not. It consumes more time and attention to understand abstract concept such as organic chemistry. Students with positive self-efficacy in learning concept usually have better learning strategy [31].

### 5.2. Vicarious Experiences

Vicarious experience influences student's self-efficacy belief and categorized as high. As many as 62.50% students believe that vicarious experience affects their success in organic chemistry course. Vicarious experience depicts the need of inexperienced students to observe the process and the result of reliable models, such as lecturer or peers [17, 32]. When they see lecturer solve an organic chemistry problem, they are convinced that they can also do the same. The same goes for when they watch their friend solving a chemistry organic problem, they are also sure that they can finish the given problem. In order to learn something that never seen before, models are needed not only as social comparison of personal task, but also as a method to learn about rule and strategy for success [17]. The students are likely to be more confident of their abilities to study difficult concepts if they observe and connect how the model works [31].

### 5.3. Verbal Persuasion

The source of verbal persuasion affects student's self-efficacy and categorized as sufficient. About 55.08% students doubt that verbal persuasion affects their success in organic chemistry course. They doubt the given compliments, either by peers or lecturer. This indicates that in organic chemistry course, feedback is rarely given by the students. Zeldin and Pajares state that lecturer has the most significant role to give influence towards student's self-efficacy by the means of verbal persuasion. When students become frustrated, then it is the time for the lecturer to supply enough encouragement so that students can bounce back from the pain of failure and find a way to try again [31].

### 5.4. Physiological and Affective Condition

Physiological and affective condition influence student's self-efficacy and categorized as sufficient. As many as 43.70% students believe that physiological and affective condition affects their success in

organic chemistry course. Students are still burdened; they feel stress and tense during the organic chemistry course. By just being in organic chemistry class makes them stress and nervous. Helping students to control their anxiety and fear, which in turns, will cause more positive attitude towards chemistry [33]. As suggested by Bandura, by creating positive and low risk learning environment, it will reduce several emotional and physiological responses for students who are unsure of their abilities [17]. Students with strong self-efficacy belief have better perspective and can overcome situational emotional fluctuation; meanwhile those with weak self-efficacy need more supportive emotional environment [34].

## 6. Conclusion

The result shows that student's self-efficacy of Chemistry Education of Mulawarman University towards Organic Chemistry course can be classified as sufficient. Students still feel nervous and tense during the course conducted. They also doubt when getting compliments from peers or lecturer for their ability in organic chemistry course. It is strongly suggested that lecturer can give students specific feedback regularly in instant for their achievements, since it is an indication that students are making progress in learning and it can encourage their self-efficacy belief, which in turns improve academic achievement. Besides, by helping students to control their anxiety and fear which related to organic chemistry course, can facilitate the development of positive self-efficacy. Therefore, a specific learning model that can train self-efficacy towards students is needed.

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