

# Profile of Pre-Service Chemistry Teacher Self-Efficacy: A Case on Rate of Reaction Topic

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## ABSTRACT

This study aimed to analyze the self-efficacy profile of pre-service chemistry teacher on rate of reaction topic. This research was a survey research with cross sectional research design. This study involved 90 pre-service chemistry teacher at three year levels, i.e. second year, fourth year, and sixth year at Yogyakarta State University, Indonesia. The research sample was determined using convenience sampling technique. Self-efficacy data of pre-service chemistry teacher were collected using a questionnaire. The efficacy questionnaire includes Personal Science Teaching Efficacy belief (PSTE) and Science Teaching Outcome Expectancy (STOE). Theoretical validity was carried out to see the appropriateness of the instruments used. The theoretical validity was carried out by three chemistry education experts to provide suggestions that support the improvement of the quality of research instruments. Self-efficacy profile data analysis techniques were analyzed descriptively quantitative. The results showed that the self-efficacy of pre-service chemistry teacher who attended lectures in the second year was better than that of the fourth and sixth year. This study shows that the year level does not affect the high self-efficacy of pre-service chemistry teacher.

**Keywords:** Rate of reaction, Self efficacy

## 1. INTRODUCTION

Self-efficacy is important effective construct in chemistry education. Pre-service chemistry teacher not only need the competence, knowledge, and skills to succeed in learning chemistry, but they also need self-efficacy to use their knowledge and skills effectively. Pre-service teacher with good academic achievements in chemistry learning may still have doubts about their chemical abilities [1]. Pre-service teacher will be more effective in learning when they feel they are able to understand and learn material, and students don't become more effective in learning when they feel they are unable to understand and learn a material [2]. Prospective chemistry teacher with high self-efficacy have high self-motivation they tend last longer in facing the assignments they are given, but confidence in their ability to teach chemistry topics well in class is problem that is often experienced by prospective chemistry teachers. Prospective chemistry teacher with low self-efficacy can adversely affect their academic performance. Therefore, it's important

to evaluate the self-efficacy pre-service chemistry teacher which can then be used as a basis for information to determine future learning activities in improving the self-efficacy pre-service chemistry teacher.

Prospective chemistry teacher self-efficacy refers to pre-service belief in his or her ability to successfully perform certain chemical tasks or solve certain chemical problems. Self-efficacy is closely related to pre-service teacher perceptions of their capacity to respond the demands of campus life. Pre-service teacher who are confident and optimistic are more likely to see university experiences as a challenge than a threat [3]. Self-efficacy is the factor that most influences students in determining their career, and still likes learning chemistry [4, 5]. Educator plays an important role in the self-efficacy of students by implementing active and innovative teaching strategies so as to increase the self-efficacy of students in chemistry lessons. Educators with a high sense of self-efficacy in teaching show better professional to

commitment, application of diverse and innovative active strategies, compared to educators with low levels of self-efficacy who are more likely to do self-focused learning. Educators with high self-efficacy realize that they are able to guide students towards higher achievement [6]. Educators' high self-efficacy in learning can change their perceptions of learning practices in future teaching efforts [7]. Pre-service chemistry teachers have different levels of confidence in each chemistry topic. Especially in chemistry learning, chemistry teachers with high self-efficacy on the topic of reaction rates are unlikely to have high self-efficacy on the topic of chemical bonding or on other topics.

Prospective chemistry teacher very important role in the learning process that determines the success of students, therefore as a future chemistry educator candidate, pre-service chemistry teacher must have high self-efficacy. Educators who have high self-confidence are more effective at coping with various problem behaviors that arise, use a variety of strategies in a learner-centered classroom and are easier to build intimacy with students. Self-efficacy also contributes to the academic achievement of pre-service teacher. Pre-service teacher who have high self-efficacy are more confident in their abilities, while pre-service teacher who have low self-efficacy will experience a decrease in academic achievement [7] - [9]. The attitude of educators towards teaching science, especially chemistry, affects the way they convey information in the classroom to students. Educators who have high teaching self-efficacy are more comfortable teaching chemistry and enjoy learning chemistry more outside the classroom [6]. Educators with good self-efficacy can influence the actions that will be chosen to achieve goals, how much effort is spent to complete a given task, and how long they will survive the obstacles and failure [10]. A person is said to have high self-efficacy when they are able to accept all difficult tasks and complete difficult tasks [11].

Educators in higher education not only play a role in transferring knowledge to pre-service chemistry teacher, but also are required to conduct evaluations to gather information about the success of learning that has been carried out. Therefore, important for an educator in college to continue assessment the self-efficacy of pre-service chemistry teacher. Information about the achievement prospective teacher self-efficacy can be a basis for consideration for educator's higher education to determine chemistry learning strategies in the future. Educators higher education can use an assessment of the ability prospective teacher for minimize the occurrence of mistakes in pre-service teacher. Information about pre-service teacher self-efficacy can provide information for educators in higher education for increase quality of learning that

prospective teachers can increase self-efficacy in teaching in class [12]. Measuring the self-efficacy of students can provide information to chemistry educators and researchers in determining tasks and appropriate learning strategies to increase self-efficacy [13], [14]. Research on self-efficacy needs to be done to determine the learning to be carried out [7]. Pre-service chemistry teacher who have high self-efficacy have a strong desire to do difficult tasks such as chemical literacy, compared to prospective teachers who have low self-efficacy tend not to want to try to achieve predetermined goals.

Chemical kinetics is important concept when pre-service chemistry teacher study chemistry at the college level. Rate of reaction topic is very important to be taught to pre-service chemistry teacher because of its very contextual nature. Chemical kinetics is one of the important chemistry topics for chemistry teacher candidates to understand how reactions occur (collision theory) and the factors that affect rate of reaction [15]. Rate of reaction topic is not only mathematical, but very contextual material, so that many applications of the concept of rate of reaction can be found in life such as corrosion of ship hulls, decomposition of ozone by chlorofluorocarbons, use of a catalytic converter to reduce pollutants generated by vehicles, calcium carbide for raw fruit, enzymes as a catalyst. Therefore, the self-efficacy prospective teacher very important to analyze in order to improve the performance prospective teacher the chemistry learning process. Research on the achievement of self-efficacy for pre-service chemistry teacher on the topic of reaction rates can be used as a basis for information in making learning practice decisions in order to continue to facilitate the achievement of self-efficacy and minimize errors in chemistry teacher candidates. The research question is how is the self-efficacy profile of prospective chemistry teacher at the three year level for rate of reaction topic? The aimed of this study was to know self-efficacy profile of pre-service chemistry teacher on rate of reaction topic at three year levels

## **2. RESEARCH METHODS**

### **2.1 Research Design and Sample**

This research was a survey research using a cross sectional research design [16], this design was chosen because this study aimed to compare and describe the self-efficacy profile pre-service chemistry teacher on rate of reaction topic in second year, fourth year, and sixth year. This research was conducted in the Chemistry Education Study Program of FMIPA

Yogyakarta State University. This study does not provide any treatment to the sample.

This study involved 31 pre-service chemistry teacher in the second year (5 males and 26 females) with age ranges from 18-19 years. 29 pre-service chemistry teacher in the fourth year (5 males and 24 females) with age ranges from 19-20 years and 30 pre-service chemistry teacher in the sixth year (6 males and 24 females) with age ranges from 20-21 years. The sample distribution are presented in Table 1.

**Table 1.** Sample distribution in each college year

Gender	College Year		
	Second year	Fourth year	Sixth year
Male	5	5	6
Female	26	24	24
Total	31	29	30

Pre-service chemistry teacher in the sample of this study came from the Chemistry Education Study Program of FMIPA Yogyakarta State University. The technique of determining the location in this study is by convenience sampling, because the author is an educator at the university and the permission has been obtained from the college. Furthermore, the determination of the class of pre-service chemistry teacher was carried out using random sampling techniques so that 90 students were obtained to be sampled.

## 2.2 Research Instrument and Data Collection

Self-efficacy data were obtained from the results of the pre-service chemistry teacher responses to

**Table 2.** Indicators self-efficacy

Self-Efficacy Aspects	Self-efficacy Indicators	Number of items
Personal Science Specific Teaching Efficacy (PSTE)	Open to Question	2
	Answering Question	2
	Desire to Explain	2
	Confident Teaching	2
	Teach Effectively	2
	Student Interest	2
	Classroom Management	4
	Instructional Strategies	2
	Student Engagement	2
	Learning Evaluation	3
	Self-efficacy for Chemistry Laboratory	4

statements in the questionnaire regarding the confidence of chemistry teacher candidates who were attending lectures in second year, fourth year, and sixth year in teaching rate of reaction topic in the classroom. There are two aspects of self-efficacy measured in this study in expressing the confidence of pre-service chemistry teacher in their ability to teach the rate of reaction topic. The first aspect of self-efficacy the Personal Science Teaching Efficacy belief (PSTE) which refers to the belief of pre-service chemistry teacher that their chemistry learning will work well. The second aspect of self-efficacy is the Science Teaching Outcome Expectancy (STOE) which refers to the belief of pre-service chemistry teacher that they can demonstrate their ability to teach the rate of reaction topic successfully [17, 18, 19]. Each indicator of the self-efficacy aspect was developed into several statements of confidence in chemistry teacher candidates in learning, i.e. Personal Science Teaching Efficacy belief consists of 27 statement, Science Teaching Outcome Expectancy consists of 23 statemen. The next stage was to carry out theoretical validity to see the appropriateness of the instruments used. The theoretical validity was carried out by three chemistry education experts to provide suggestions for improvements in terms of material, construction, and language (item readability). The judgments by experts are qualitative. After getting suggestions or comments related to material, construct, and language aspects, improvements were made to the research instrument so that 50 prospective chemistry teacher self efficacy statements were obtained. The results Cronbach's Alpha reliability analysis of 0.901 are in the very good category. Self-efficacy indicators are presented in Table 2.

Self-Efficacy Aspects	Self-efficacy Indicators	Number of items
Total PSTE		27
Science Teaching Outcome Expectancy (STOE)	Improved Student Achievement	4
	Teach Well	2
	Required Skills	2
	Difficult to Explain	4
	Teach Something Else	2
	Anxious in Explaining	2
	Self-efficacy for Everyday Applications	4
	Understand Concept	3
Total STOE		23
Total		50

### 2.3 Data Analysis

The self-efficacy data pre-service chemistry teacher were analyzed of quantitative descriptive with the aim to describe the data from the responses to the self-efficacy questionnaire for pre-service chemistry teacher who attended lectures in second year, fourth year, and sixth year in rate of reaction topic. The responses to the self-efficacy questionnaire for pre-service chemistry teacher were scored using a 5 scale i.e. 1 = very unsure, 2 = unsure, 3 = uncertain, 4 = sure 5 = very sure [20]. Stages in analyzing the quantitative descriptive self-efficacy profile are as follows. 1 recapitulates the self-efficacy questionnaire scores from the research data used, 2 makes the score ranges and ideal assessment categories, 3 categorizes the recapitulated self-efficacy scores according to the ideal assessment category. Self-efficacy profiles were described based on the ideal assessment category, i.e. very good, good, sufficient, less good, and bad. The ideal category values are presented in Table 3.

Table 3. Ideal category values

Score Range	Category
$210 < X$	Very Good
$170 < X \leq 210$	Good
$130 < X \leq 170$	Sufficient
$90 < X \leq 130$	Less Good
$90 \geq X$	Bad

### 3. RESULTS AND DISCUSSION

Self-efficacy profile was described based percentage of ideal categories which was carried out by calculating the percentage prospective chemistry teacher who have very good until very poor efficacy categories. The ideal percentage that has been determined was then compared with the data at each year level used as the sample. The percentage of categories prospective chemistry teacher self-efficacy are presented in Figure 1.

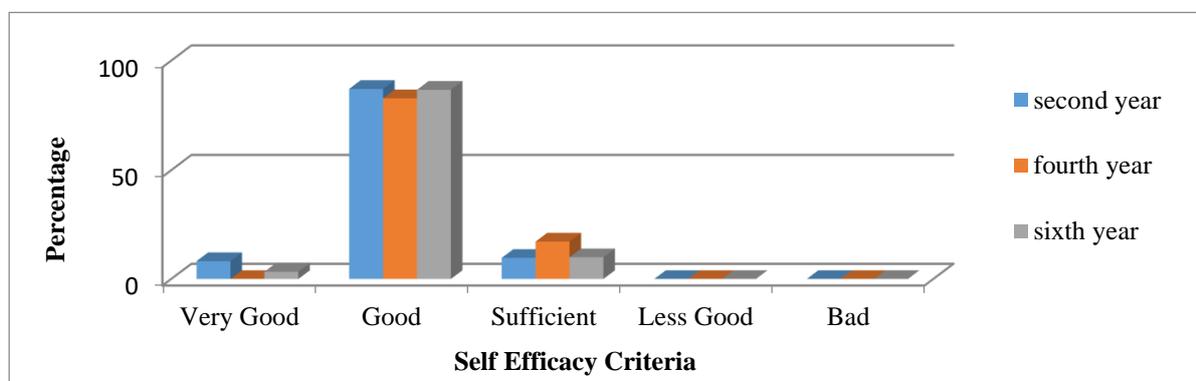


Figure 1 Percentage categories pre-service chemistry teacher self-efficacy

Based on data presented in Figure 1, it can be seen prospective chemistry teacher who take lectures in second year have more dominant self-efficacy in very good category, good category. Prospective chemistry teacher who took courses in fourth year showed the lowest self-efficacy compared to pre-service chemistry teacher who took courses in second and sixth year. Pre-service chemistry teacher who take lectures in the fourth year are only able to reach the high category and none of them reach the very good category. The results of this analysis can be concluded that the increase in self-efficacy of chemistry teacher candidates was not determined by the high year level, but was determined by experience and good mastery of chemical concepts which were effective factors of high self-efficacy.

The results of this analysis also indicate that average self-efficacy category prospective chemistry teacher in three year was in the good category for teaching rate of reaction topic in classroom. This study was in accordance with research which measured the level self-efficacy prospective teacher, results the study show overall prospective teachers self-efficacy was in average high category [21]. High self-efficacy prospective chemistry teacher was influenced by the knowledge and experience they have. There are two factors that influence self-efficacy, i.e. knowledge and experience [22]. A similar statement showed that there were several factors that contribute to self-efficacy including family members who come from scientists, chemistry courses in high school, chemistry courses in college, hard work, persistence, interests, fun, values, and goals science career [23]. Experience was an effective factor affecting self-efficacy [24], [25]. A similar statement showed that teaching experience determines the teacher candidate's self-efficacy [26]. Prospective teachers with longer teaching time have higher levels of self-efficacy in classroom management, compared to prospective teachers with less teaching time. Educators with high self-efficacy were more likely to build closer and warmer relationships with students, because they were more confident in their abilities and skills in effective classroom management and the ability to increase student activity [27].

High self-efficacy prospective teachers this study shows prospective teachers have high confidence in their ability to teach the rate of reaction topic well. High self-efficacy prospective teachers shows they believe in their ability to succeed, confidence in mastering difficult chemical concepts, belief in achieving learning goals, able to manage their class, able to complete difficult tasks, have the competence to guide students towards achievement. who were high, persist with the assigned task, have a great effort to deal with problems, and determine how pre-service

chemistry teacher face failure, compared to those who have low self-efficacy do not have confidence in their ability to succeed, do not have the ability to achieve learning goals and give up more easily when a task was considered difficult. High self-efficacy affects the mindset of pre-service chemistry teacher about their ability to complete assignments as professional chemistry teachers in schools [27]. High self-efficacy allows pre-service teacher to maintain their academic achievement in contrast to pre-service teacher with low self-efficacy tend to experience academic decline achieved [7], [8], [28]. A similar statement showed which revealed that prospective teachers with high achievement in examinations had high self-efficacy, while pre-service teacher with low performance had low self-efficacy [9]. Good self-efficacy also has a good contribution to scientific literacy skills, self-efficacy has a significant relationship with scientific literacy [29].

The high self-efficacy of pre-service chemistry teacher who are currently attending lectures in the second, fourth, and sixth year can continue to be improved through active and innovative learning strategies. By working in teams for communication tasks, pre-service teacher become more confident in professional and interpersonal skills [24]. Implementing problem-based learning can increase self-efficacy. The results showed that there was an increase in self-efficacy on several indicators, i.e. the ability to overcome difficulties, the ability to solve problems, the ability to get good results and the ability to work together and communicate [30].

#### 4. CONCLUSION

Based on the results of this study, it can be concluded that the self-efficacy of pre-service chemistry teacher attending the second year was better than the fourth and sixth year. This study shows that year level does not affect the high self-efficacy of pre-service chemistry teacher, but was determined by experience and good mastery of chemical concepts.

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