# Students' Critical Thinking Skills Profile: Constructing Best Strategy In Teaching Chemistry

**Utami, B.[1], Probosari, R.M.[1], Saputro S.[1], Ashadi[1], Masykuri M.[1], Sutanto A.[2]**
[1] Science Education Doctoral Program, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A Surakarta, Indonesia
[2] SMA Negeri 2 Karanganyar, Surakarta, Indonesia

Corresponding e-mail: budiutami@staff.uns.ac.id

## ABSTRACT

The purpose of this study was to determine the profile of critical thinking skills of senior high school students. The paper-based essay questions and the questionnaires were used as the instruments to measure critical thinking skills in daily chemistry problems, which is based on Facione's critical thinking aspects included interpretation, analysis, evaluation, inference, explanation, and self-regulation. The research was conducted in one of government senior high school in Central Java, Indonesia. The descriptive-qualitative method was used for the research method. The qualitative approach was used to analyze the data by using essay questions and questionnaires. The criteria for critical thinking skills were categorized as null, low, medium, and high. The result showed that most of the students have weak or low skill in critical thinking, especially in analysis, evaluation, explanation, and self-regulation whether their skill of interpretation and inference are medium. This finding can be used to develop a new strategy in teaching chemistry related to critical thinking skill.

**Keywords**: analysis; critical thinking skill; evaluation; explanation; inference; interpretation; self-regulation; student profile

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## INTRODUCTION

Critical thinking should be not only an educational option but an integral part of education practices (Zhou, Huang, & Tian, 2013). Critical thinking is a reasonable and reflective thinking that focuses on determining what to believe or do (Ennis, 2011). Critical thinking includes the ability to draw valid conclusions, identify relationships, analyze probabilities, make logical predictions and decisions, and solve complex problems (Halpern, 2010).

The goals of learning are the students can learn critical thinking, reasoning analysis and solving problems (Halpern, 2013). The critical thinking skills were defined as the skills to give important questions and issues, formulates them clearly and properly, collects and assesses relevant information, uses abstract ideas to interpret them effectively to achieve clear conclusions and solutions, test them against relevant, open-minded criteria and standards in the system of alternative thinking, recognizing and assessing their needs, assumptions, implications, and practical consequences, and communicating effectively with others to seek solutions for the complex problems (Elder & Paul, 2009).

Good critical thinking includes the Critical Thinking Skills (CTS) and the disposition dimension (Critical Thinking Disposition, CTD). Critical Thinking skills include 1) interpretation, 2) analysis, 3) evaluation, 4) conclusion, 5) explanation, and 6) self-regulation. Critical Thinking Disposition contains 1) truth-seeking; 2) curiosity; 3) purity; 4) analysis; 5) openness; 6) systematic; and 7) confident. The core of critical thinking is interpretation, analysis, evaluation, conclusion, explanation, and self-regulation (Facione, 2013).

In high-level thinking skills, these thought processes, not limited to reflection, inference, and synthesize the information, to allow individuals to make reasoned judgments not only in the classroom but also in everyday life (Beaumont, 2010). Learning strategies that support critical thinking skills are active learning as strategies that make students better thinkers and better arguers. Active learning can improve students' critical thinking skills (Nelson & Crow, 2014). When thinking skills are explicitly taught for the transfer, using multiple examples from several disciplines, students can learn to improve how they think in ways that transfer across academic domains (Halpern, 1999). Critical thinking refers to the use of skills or cognitive strategies which increases the likelihood of the desired result. Critical thinking is the goal, reasoned, and purpose directed thinking.

This is the kind of thinking involved problem solving, formulate the conclusions, counting possibilities, and making the decision. Critical thinkers use these skills properly, without encouragement, and usually with conscious intent, in various settings. When we think critically, we are evaluating the results of our thought processes—how good a decision or how well a problem is solved (Halpern, 1998) Critical thinking can be taught as an argument analysis (Kahane, 1997), and problem-solving strategy (Mayer, 1998).

The results showed the teachers' teaching strategies with problem-solving gave meaningful influences to improve students' critical thinking skill. Research showed problem-solving strategies in inductive constituencies, deductions, assumptions, identification, and observations have significant effects to improve

the students' critical thinking. The study was conducted on the control class and experimental class, using the Cornell Level X (1985) as the critical thinking test instrument (Azaditablab & Veyseh, 2015).

There are many challenges in developing critical thinking skills existed as long as critical thinking skills are taught separately from ordinary subject matters (Ennis, 1985). The accompanying hope is that instilling critical thinking skills in the subject matter across the various domains will help the acquisition of critical thinking skills and ease their transfer to other daily life issues.

The research that has been done using Bloom's taxonomy of educational goals to define critical thinking, develops a process whereby (a) questions were put forward with both content and critical thinking ability in mind, and (b) a scoring rubric first set up that determined how to evaluate both the content aspect and critical thinking answer (Bissell & Lemons, 2006). The purpose of this research was to find out the profile of critical thinking skills of high school students by compiling chemical questions developed based on Facione's critical thinking indicator including interpretation, analysis, evaluation, conclusion, explanation, and self-regulation (Facione, 2013).

## METHOD

Population in this research was 38 students of class XII IPA 3 in one of public school in Karanganyar, Central Java. Characteristics of students were always to follow the lesson well, actively discussing with friends, doing the teachers' tasks well. This research used the descriptive method. The instrument for assessing critical thinking skills was the daily chemistry problems developed based on Facione's critical thinking component, interpretation, analysis, evaluation, inference, explanation, self-regulation. The data were analyzed using the descriptive-quantitative method. The research used essay questions and questionnaires. Criteria for critical thinking skills are null, low, medium, and high.

## RESULT AND DISCUSSION

The profile of students' critical thinking skill in interpretation, analysis, evaluation, inference, explanation, and self-regulation can be seen in Figure 1.

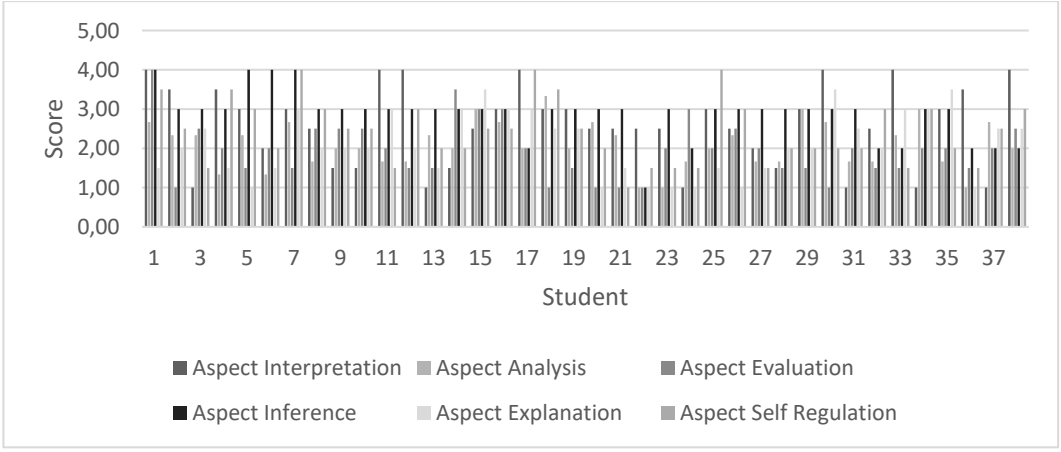

Figure 1 Results of students' thinking skills based on Facione's critical thinking components.

Figure 1 showed the most of the students have low critical thinking skills. The results of interviews with some students who have difficulty show the relationship between the chemistry concepts needed to answer the teacher's questions. Students were still less able to answer questions on aspects of analysis, evaluation, explanation, and self-regulation. On the other hand, it turns out that students have the high score in aspects of interpretation, and inference.

Students were generally difficult to understand commands unrelated to daily life reality, but students were more comfortable when answering questions related to daily life, such as how chemical reactions occurred on compost making (interpretation), what components undergo structural changes when organic waste becomes compost (analysis), what needed precursors to speed up the composting reaction (evaluation), what proposed recommendations to make inference, explanation and the actual action that will be taken to process waste into compost (self-regulation).

When troubled about the phenomenon of apple browning, students who have high levels of critical thinking skills responded by reviewing the cause of apples turning brown, they can explain the chemical reactions occurred and how to prevent it. Students can them from experiences observing the parents who often peel apples and experienced browning. And students will be more motivated to pay more attention to everyday phenomena and try to solve problems, for example, to prevent apples from immediate browning. There are still many students who have low critical thinking skills because of their lack of care to observe the daily life events, and unable to relate to accepted theories in learning and daily life. Students easily absorb knowledge when students feel involved in it both in the form of personal experiences and experiences of others who are known.

Students still have difficulty in the analysis because of difficulties in connecting with relevant chemical concepts. Students have difficulty in explaining aspects because there are less confident students and different levels of mastery of students' knowledge. For students who have less knowledge, difficulty in explaining, otherwise for students who have enough knowledge then can explain well. Students were also less able to use evidence or reasoning, also because of their incomprehension in explaining. Students who still have low self-regulation were because of low motivation to achieve something, or less experienced.

## CONCLUSION

Results of students' critical thinking skills on aspects of analysis, evaluation, explanation, and self-regulation are low based on Facione's assessment. The students' critical thinking skills on the interpretive and conclusion aspects are medium. It is recommended that teachers design lessons that can stimulate critical thinking skills especially focused on problem-solving.

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