

# Profile of Critical Thinking Skill Students' Analytical Aspect in Excretory System

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**Abstract.** Analytical thinking is a complex skill because it uses element of knowledge, understanding thinking. The skill is essential in learning excretory system which demands them to understand the concept, principle and application in life. This research was carried out to investigate the students' analytical thinking in doing excretory system concept. Method used was quantitative descriptive with 120 students as the subject. The instrument used was test based on total score in every indicator. The result showed that students' error percentage in doing the items in every indicator of analytical thinking was: 10.5 % Examining Ideas, 14% Identifying Argument, and 25.5% Analyzing Argument. Therefore, it can be concluded that students' analytical thinking skill was relatively low. Therefore, teachers must train students to do analytical questions or use appropriate strategy.

**Keywords:** *Analytical Thinking, Biology Learning*

## 1 INTRODUCTION

In knowledge era needs intellectual capital that is HOTS (High Order Thinking skill)[1][2] HOTS relates with seven skills (critical thinking and problem solving, creativity and innovation, collaboration and team work, cross-culture understanding, communication and literature media, computer and ICT, and career and independence) needed in the 21th century[3][4]. One of the HOTS needed in this 21th era is critical thinking[5]. It has some aspects such as analytical thinking skill which has three sub-skills; they are: 1) Examining Ideas 2) Identifying argument 3) Assessing Argument [6].

Analytical thinking skill is a skill in identifying objective and relation of conclusion between statement, question, concept, description or other aspects reflecting belief, reason, information and opinion needed to fulfill the true 21th century challenge . Analysis action is defined as an act of data solving to be some parts, and then relate the parts in meaningful and useful relation to solve problem [7]. Scumamer states that it is very important for students to optimize their critical thinking skill in solving daily life and long life problems[8].

Analytical thinking skill is important to have, for it makes students easy to think logically, analytically, and critically, they have high curiosity and can place situation, problem and decision in deep investigation; students who have analytical skill can test the questions based on objective standard and find source of the problem[9]. Analytical thinking has characteristic with multiple thinking consisted of three processes: 1) decreasing relevant information, 2) deciding point of view about relation among relevant elements (being able in correlating concept) and 3) deciding point of view about objective in learning something [10].

In fact, students' analytical thinking in Indonesia is still low. It can be seen from Indonesia achievement in Trends in International Mathematics and Science Study (TIMSS). Scoring in TIMSS was scored in two domains: content and cognitive domain. Content domain is used to determine learning material, meanwhile cognitive domain was used to determine thinking process used by the students related to know, comprehend, apply, analyze, evaluate and create. Another domain is analyzing. Based on five-time Indonesia participation in TIMSS in 1999, 2003, 2007, 2011 and 2015, Indonesia university students' achievements were always in the low country rank [11].

Students' analytical thinking in Indonesia was still low identified by the study result of Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) which decreased from year to year. PISA is a study developed by some developed countries in the world which included in Organization for Economic Cooperation and Development (OECD) scoring education achievement based on working framework started from literacy concept which is care about students' capacity to apply knowledge and skill, and to analyze, think out, and communicate effectively if they are faced in a problem in which the students are demanded to be able to solve and interpret the problem in various situations [12].

Students' problem in analytical thinking also has become attention of recent researches, in which education system moving to the other one which is more inclusive-exclusive thinking skill learning in all grades will be very important [13]. This is in accordance to the findings of Yee Mei Heong [14]. Of the five components of thinking taxonomy, rising analytical thinking obtained the lowest. In addition, it is similar to Ergul' finding [15] in which analytical thinking has contributed highly towards 13.69% university students' achievement included analytical comprehension and explanation.

Analytical thinking can be applied in excretory system material in learning biology because it is very complex and is closely related to phenomenon faced in reality. The excretory system material concept is quite abstract and complex. Therefore, only memorizing theories is not enough. It is not simple, so it demands students to have analytical thinking skill to comprehend theories and compares with indication in daily life [16]

Analytical thinking skill is integral in problem solving of excretory system that the students are able to make appropriate decision to determine solution and another impact of the problem found [17]. This skill can appear when the students face unusual problem, uncertainty, questions or dilemma [18]. The application of the skill is successful viewed from the explanation, decision, performance and result which occur for knowledge and experience [19]. Hence, the number of students using critical thinking skill in analyzing excretory system problem needs to be taken into account.

## **RESEARCH METHOD**

This research aimed to investigate the first profile of critical thinking skill on analytical aspects based on Facione towards students in two schools: SMA A and SMA B Surakarta. This research applied quantitative-descriptive method to gather information from the subject of the research, consisting of 120 grade XI IPA students of SMA in Surakarta in the academic year of 2018/2019 from two schools.

The analytical thinking skill test with Facione indicator, excretory system indicators, and scoring guide referring to M. Brokhart's book [20] were used as the instruments. Excretory system material was divided into three sub-material; they were: 1) human excretory system, 2) problem and dysfunction of excretory system, and 3) animal excretory system, so material

division for each analytical thinking skill was average for each indicator. Before applied to the research subject, the validation of the analytical thinking essay test by the expert lecturer and education practitioner was carried out. The test consisted of 9 items in which question number 1, 2, and 3 were sub-material about human excretory system, number 4, 5, and 6 were sub-material about dysfunction and illness of human excretory system, and number 7, 8, and 9 were sub-material about animal excretory system. The competence scored in this test consisted of 3 indicators of critical thinking on analytical aspects based on Facione [21], they were: examining idea showed in the questions number 1, 4 and 7; identifying argument showed in the questions number 2, 5 and 8; and analyzing argument showed in the questions number 3, 6 and 9. The teacher gave a set of questions to every student to test his or her analytical thinking skill of excretory system material. The time allocation was 60 minutes. The students' analytical thinking skill profile can be seen from the students' correct answer. Top score for each answer of examining idea was 25, for identifying argument was 30, and for analyzing argument was 45. The difference was because analytical thinking aspects were with characteristic of thinking order, so they had different level of difficulty. Each top score above was gotten from the three total criteria based on the measurement way of analytical thinking from Susan M. Brokhat which was seen from 3 aspects: 1) statement of clear and appropriate main point, 2) proof suitability, and 3) logic health and argument clearness. The total score of those 3 indicators would result top score in each indicator of analytical thinking. Therefore, the total score resulted could achieve 300, then to change the score to be mark, the following formula was used.

$$\text{Mark score} = \frac{\text{total score}}{3} = 100 \quad (1)$$

After getting the score from each indicator, the group of the research subject was in categories of very low, low, good and very good, based on the percentage of incorrectness level in answering the questions. Taking the conclusion temporarily used the percentage of incorrectness level in answering the questions, not from score gotten which was become reference to take conclusion, for each indicator of analytical thinking had different score.

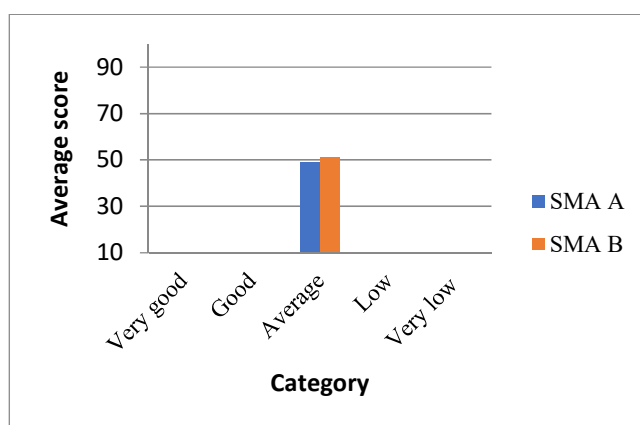
## RESULT AND DISCUSSION

Achievement result of analytical thinking indicator can be seen from the percentage of students' incorrectness level in doing the items described in following table 1:

**Table 1.** Achievement result of analytical Indicators in SMA A and SMA B Surakarta

Analytical thinking skill indicator	Achievement percentage of SMA A (%)	Achievement percentage of SMA B (%)	Average (%)
<i>Examining Idea</i>	11	10	10,5
<i>Identifying Argumen</i>	14	14	14
<i>Analyzing Argumen</i>	26	25	25.5
<b>TOTAL</b>	<b>52</b>	<b>49</b>	<b>50.5</b>

Based on the data above, it is seemed that students' incorrectness level in answering the items of analytical thinking achieved 50.5%. Incorrectness level in answering questions of each indicator with the highest incorrectness was obtained from analyzing argument indicator, and then followed by identifying argument and examining ideas. This was because analyzing argument indicator had the highest level of difficulty of identifying argument and examining ideas. Although most students had been able to build the skill on examining ideas and identifying argument, analyzing argument indicator was still less, so the students' analytical thinking skill was still low. In examining idea question, the students were trained to be able to define term, compare or contrast idea, concept or question, identify problem and decide which parts of component were, identify conceptual relation of one to all others. In identifying argument question, the students were trained to express supporting reason or opposition reason towards some claims, opinion or point of view. Meanwhile, in analyzing argument skill question, it was the skill to express reason or to propose the reason meant to support or oppose some claims, opinions or points of view.



**Picture 1.** Average of analytical thinking test score of SMA A and SMA B students in Surakarta

Based on the diagram above, students' achievement in SMA A achieved score 49, and SMA B achieved score 51 with both average scores achieved 50.5 with average category meaning that there had been revision for the increase that had to be done to fulfill minimum score target 70 on excretory system based on the scoring standard used in the schools. Taking the decision to of revision was based on the modification of revision decision interpretation adapted from Suwastono 2011 as follows.

**Tabel 2.** Revision decision interpretation

Achievement level	Qualification	Explanation
81-100	Very good	Not need of revision
61-80	Good	Not need of revision
41-60	Average	Revised
21-40	Low	Revised
0-25	Very low	Revised

Source: [22]

Based on the decision above, score 50.5 was included in average category. Therefore, students' analytical thinking skill needed to be improved by noting the indicators of the analytical thinking themselves based on the excretory system material indicator. The students who learnt excretory system material were demanded not only to master the concepts, but also to correlate concepts gotten to learn phenomena in their daily life. In addition, high order thinking, like analytical thinking, is needed to lean overall[23]. Byrne [24] stated that analytical thinking skill, which is essential in science learning, is included in biology. Students' analytical thinking skill makes them very easy to correlate the information, to learn the concepts and its application in daily life [25]

Applying optimal non-analytical thinking can be seen especially in the low analytical thinking skill on the aspect of analyzing argument. This result can be resulted by the less of concept comprehension by the students when they faced problems related to the excretory system material. The students only tried low-level thinking by memorizing the concepts that makes it hard to lock the temporal answer and to sum up with general statement. This was due to many factors. Most teachers only gave routine questions and made the students unable to optimize their analytical thinking. Khasanah [26] stated that the use of routine questions causes the students' low curiosity. Thus, the students do not fully answer the questions orderly, which is higher than just standard thinking.

The percentage of students' analytical thinking skill is low due to the learning strategy that was used by the teacher, had not oriented to analytical thinking skill training, teacher-centred. This confirms with Kao[25] stating that if the students are usual with the strategy demanding them to memorize the learning material, they will find it difficult to expand their logic and critical thinking skill included analytical skill. Giving the opportunity to observe, research, and experiment using the problem conveyed by the teacher, looking for the literature and doing discussion [27] can enhance the students' analytical skills. For most university students, a learning analysis will assist them in planning their learning activity. Consequently, learning process should be increased again especially for analytical thinking skill.

Analytical thinking can be seen from the students' problem solving skill, so the problem solving-based learning can be used as the learning innovation that can improve the students' analytical thinking skill by providing problem for stimulating their order thinking. Problem solving is cognition, emotion, and attitude process trying to find the best solution forming the effective respond when an individual has certain problem in daily life. There are 4 stages of problem solving: 1) understanding the problem, 2) planning, 3) carrying out the plan and 4) looking back [28][29]. Based on the problem solving indicator, those stages can help students in process of analyzing. It is chosen as an effort to increase analytical thinking skill because according to Dewey [30] problem solving is a method in breaking problem or a way to provide learning to encourage the students to look for and solve the problem, and a thought about the possible ways to solve the problem to take in the case of achieving the learning objective. In this learning, the teacher gives a problem of unusual case about the fact around the life related to the excretory system. The teacher must guide their students to find out the answer and analyze with their own way based on the stages of problem solving-based learning. Hence, students' analytical thinking process is more ordered in every stage, so the problem solving-based learning enables the increase of SMA students' analytical thinking skill.

## 4 CONCLUSIONS

The students' analytical thinking skill on excretory system material could be said average although it was relatively low, for the minimum score achievement was in average category. The students' analytical thinking skill which is not trained optimally because the activity of the students in learning is low, the learning strategy or method used in the school has not facilitated the students' encouragement in material concept finding and solving problem about excretory system. Therefore, learning innovation using problem solving stages to increase the students' analytical thinking skill needs improved.

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