

Readiness of SMAN Biology Teachers in West Sumatera of Critical Thinking Skills of Learning in the Era of 4.0 Industrial Revolution

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Abstract – This research aims to describe the readiness of SMAN biology teachers in West Sumatera of critical thinking skills of learning in the era of the 4.0 industrial revolution. The research method uses *mixed* method by combining quantitative and qualitative research methods. Quantitative data is obtained with questionnaires and qualitative data is obtained through the interview process. Data analysis is performed using descriptive analysis techniques. The results showed that high school biology teachers in West Sumatra belong to the category of highly prepared with an average value of 4.32 on all aspects of critical thinking. The indicator of interacting with others has the highest contribution with a value of 4.48 and the indicator of deducting and considering the results of deduction has the lowest contribution to the readiness value of biology teachers in state high schools in West Sumatra with a value of 4.18.

Keywords – Industrial Revolution 4.0, Critical Thinking, Readiness, Biology Teachers.

I. INTRODUCTION

Education is one of the important factors for building a nation. Education must be improved so that quality human resources (HR) are available. Based on Law number 20 of 2003 concerning the National Education System, education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have knowledge intelligence, attitude intelligence (emotional and spiritual) and the skills needed by themselves, the community, the nation, and country. Quality education can be seen from the quality of education. According to Fadhl (2017: 216), the quality of education is an important part to be considered and continuously pursued in order to obtain quality and relevant education.

One of the quality of education in Indonesia can be seen from the position of Indonesia which is still relatively low

among the *Organization for Economic Cooperation and Development (OECD)* countries in the results of the research *International Program for Student Assessment (PISA)*. Indonesia's position in the research results *PISA* 2015 is ranked 62 out of 70 countries for the aspect of scientific literacy (OECD, 2016). Results *TIMSS* Indonesia 2015 obtained an average value of 397 in the field of science which is also still below the international average value (TIMSS, 2015).

Based on data from the Education Office of West Sumatra Province, the average value of the Biology National Examination (UN) for State High Schools in West Sumatra with a value of 52.58 with the highest UN / district score is 69.36 obtained by the city of Padang Panjang and the value of the lowest of 42.45 was obtained by the Mentawai Islands district. Based on the average national examination scores, it proves that the quality of education in state high schools in West Sumatra is

low.

According to Fadhli (2017: 218), the quality of education has a close relationship with the learning process and the learning process is the goal of an educational organization. The learning process at school is carried out by teachers and students. According to Wena (2009: 2), teachers are an important component of education personnel who have the task of carrying out the learning process. Mean while, according to Thoifuri (2008: 1), teachers are people who have a lot of knowledge, want to practice it seriously, be tolerant, and make their students better in everything through learning activities.

Teachers and students are not only faced with the low quality of education, but also faced with the industrial revolution 4.0. According to Permana (2019: 1), students are faced with the rapid development of science and technology in the era of the industrial revolution 4.0, so students must have the ability to adapt to this development. In order to have these abilities, students need help from the teacher. So the teacher must be willing and ready to help students.

The industrial revolution 4.0 requires education to prepare students to be able to face global economic competition, so students must have four competencies, namely *critical thinking*, *communication*, *collaboration*, and *creativity* (Hidayah, et al. 2017: 128). One of the competencies that must be mastered by the learner is *critical thinking skills*. According to Hidayah, et al. (2017: 128), critical thinking skills include the ability to access, analyze, synthesize information that can be learned, trained, and mastered.

The learning process must support students to think critically (*critical thinking*). Students' critical thinking skills become an important goal in education. This is related to the perceived need to deal with the information explosion in this era. But these skills are not innately born or obtained naturally, but must be trained on students.

Critical thinking skills are widely known as important skills (Karakoc, 2016: 82). Graduates of students without critical thinking skills will have difficulty competing in the work environment and in the midst of society (Permana, 2019: 2). According to Roekel (2015: 8), teaching critical thinking and effective problem solving in class is very important for students. Learning critical thinking leads students to develop other skills, such as higher levels of concentration, deeper analytical skills, and better thought processing. In accordance with the opinion of Karakoc (2016: 82), states that critical thinking is an ability that goes beyond rote learning.

The study of foration conducted on several biological

teachers in West Sumatra shows that biology teachers do not fully understand the 4.0 industrial revolution. Teachers only know the meaning, but do not know about the challenges facing the future and the important role of teachers in preparing students to face the industrial revolution 4.0. The teacher has not implemented learning that can bring out students' skills *critical thinking*, because the teacher does not fully understand how to apply and improveabilities *critical thinking* students'in the learning process. Based on this, a study was conducted on the readiness of SMAN biology teachers in West Sumatera of critical thinking skills of learning in the era of 4.0 industrial revolution .

II. METHODOLOGY

This research is a descriptive study using *mixed* methods combination. Sugiyono, (2013:19) said that combination research methods combine between quantitative and qualitative research methods to be used jointly in a research activity.

The population in this study is all of the biology teachers of SMA Negeri in West Sumatera. Sampling was carried out using the *Stratified Cluster Random Sampling* Technique by determining the number of samples using the Slovin formula so that a sample of 80 biological teachers was obtained.

Primary Data is obtained through kesioner and interviews. The Development of the questionnaire began by formulating indicators and selling them in the form of statements. The scale used in this questionnaire is the Likert scale. The Kesioner used are valid and reliable.

The teacher'S readiness will be classified into five modified categories of purwanto (2010:103) as follows.

Table 1. Teacher Readiness Category

Range of values	Category
4.20-5.00	Very prepared
3.40-4.19	Ready
2.60-3.39	Simply ready
1.80-2.59	Less ready
1.00-1.79	Very unprepared

III. RESULTS AND DISCUSSION

1. Result

This study used a questionnaire consisting of 25 statements. From the 25 statements, we get the value of the readiness of biology teachers in the State High School in West Sumatra in facing learning in the era of the industrial revolution 4.0 towards each aspect of critical thinking skills, as follows.

Table 2. The Readiness of The West Sumatra High School Biology Teachers to Each Aspect of Critical Thinking

No	Group	Aspects of Critical Thinking	Value	Readiness Category
1.	Provide a simple explanation	Focus questions on biological material	4,44	Very ready
2.		Analyzing arguments	4,35	Very ready
3.		Ask and answer questions	4,42	Very ready
4.	Build basic skills	Consider the credibility of learning resources on biological material	4,24	Very ready
5.		Observe and consider observational reports	4,19	Ready
6.	Conclude	Deduce and consider the results of deduction	4,18	Ready
7.		Induce and consider the results of induction	4,33	Very ready
8.		Evaluation	4,34	Very ready
9.	Provide further explanation	Defining terms or a definition in biological material	4,41	Very ready
10.		Identifying assumptions	4,30	Very ready
11.	Set strategy and tactics	Define an action	4,23	Very ready
12.		Interact with other people	4,48	Very ready
Amount			51,89	
Average			4,32	Very ready

2. Discussion

Based on the data above, the readiness of biology teachers in SMA Negeri in West Sumatra in facing learning in the industrial revolution era 4.0 on aspects of critical thinking skills, classified as very ready with value of 4.32. Indicators of collaboration with others become indicators that have the greatest contribution to the readiness of biology teachers. Indicators that have the smallest contribution to the readiness of biology teachers are deducing and considering the results of the deduction with the ready category.

The following will discuss the readiness of high school biology teachers in West Sumatra in facing learning in the era of the industrial revolution 4.0 on critical thinking skills by describing each indicator of critical thinking which is grouped into five major groups.

1. Providing simple explanations

Providing simple explanations is the basis that teachers must master in developing students' critical thinking skills (Sunardjo, et al., 2016: 137). In groups providing simple explanations there are three indicators of critical thinking that are analyzed namely focusing the questions on biological material, analyzing arguments, asking and answering questions. Asking questions is a very common thing to do in the learning process. Teachers often ask questions for various purposes, for example to measure students' understanding, to get information from students, to stimulate students' thinking, and to control class (Widodo, 2006: 2). The questions given by the teacher to

students should focus more on the material or concepts in the learning process. Widodo (2006: 9) states that the discussion of concepts or materials in the learning process takes precedence over other aspects.

The questioning skill is a skill that must be mastered by the teacher in the form of speaking skills that ask students to respond to answer questions so as to require students to think. The high enthusiasm of students in answering questions cannot be separated from the teacher's skills in giving questions during the learning process, so that students understand what will or are being learned in the classroom. According to Fuadi (2016: 137) focusing questions is the first step to make a decision about what to believe or what to do.

The ability of teachers to ask questions in different learning. This ability is seen starting from the teacher arranging questions, asking questions, to getting answers from students. There are teachers who are only able to arrange questions. There are also teachers who are able to ask and arrange questions to get answers from students. The results showed that the readiness of biology teachers in state high schools in West Sumatra on the indicators focusing questions on biological materials was classified as being very ready. This indicator has two statements, namely formulating questions and considering possible answers to questions.

Questions asked by teachers in learning activities can develop students' critical thinking skills. The questions aim to open insight into thinking about a problem at hand. Questions

that open up insight into thinking are types of questions that are clarifying, the reasons and evidence of the investigation as well as points of view and perceptions (Sholihah and Shanti, 2017: 2). Through questions from the teacher, students are required to explore and analyze their own understanding so that students will come to a conclusion of the right or wrong answers (Sholihah and Shanti, 2017: 2).

The results showed that the readiness of biology teachers in state high schools in West Sumatra on the indicators of analyzing the arguments was classified as being very ready. The teacher has the task of analyzing the arguments conveyed by students, so that from these arguments can be drawn conclusion. According to Retno, et al. (2018: 526) argument analysis is the ability to analyze the strength and relevance of an argument related to a particular issue or problem. Fahim and Eslamdoost (2014: 145) state that the types of activities that contribute to critical thinking skills such as analyzing arguments, evaluating and evaluating arguments, asking and answering questions.

Analyzing is the activity of arranging material parts into one unit (Saputra, et al., 2018: 86). Arguments play an important role in developing critical thinking patterns and adding a deep understanding of ideas and ideas. Arguments are series of statements that have inference statements. An important argument is developed in learning biology because it can improve thinking to test understanding. Arguments according to Mc. Neill and Krajcik (2006) contain three aspects including *claims*, *evidence*, and *reasoning*. *Claim* is a statement that answers the problem. *Evidence* is scientific data that supports a statement. *Reasoning* is a reason or justification that links statements with evidence.

Questions are very important in compiling a learning experience for students. Socrates believes that all knowledge will be known or unknown to students, only if the teacher can demonstrate good questioning skills in classroom teaching practice. Therefore, teachers must have skills in asking questions about the material taught in the learning process. Questioning skills are very useful for every individual. Asking questions is one of the activities used every day. A good teacher will instill their knowledge to students so that they are good at interacting, one of them is by asking questions. Asking questions will also arouse interest, develop thinking patterns, active learning, and students' curiosity about the problem being discussed.

The results showed that the readiness of biology teachers in state high schools in West Sumatra on the indicators asking and answering questions belong to the very ready. A good question is a question that has a short and clear sentence, the purpose is

clear, not too general and broad, each question is only for one problem (Faizah, et al, 2018: 254).

Asking is one of the verbal utterances that ask for a response from someone who is known, the response given can be in the form of knowledge to things such as effective stimulation that encourages thinking skills (Asril, 2013: 81). In order to think someone must be confronted with questions that stimulate his thinking. Widodo (2006: 12) states factual questions are more effective in increasing achievement for students. According to Fahim and Eslamdoost (2014: 146), states that the main requirement that must be possessed by teachers to be able to train students' thinking is that teachers must be talented in asking questions and answering questions. Supriyati, et al. (2018: 77) states that quality questions are questions that do not directly have a right or wrong answer or not just one right answer so that it requires students to think hard.

2. Building basic skills

Indicators of critical thinking skills in groups building basic skills consist of considering the credibility of learning resources on biological material, observing and considering observational reports. Indicators consider the credibility of learning resources in the biology of the teacher has a level of readiness that is very ready. The ability to consider the credibility of learning resources is very important for teachers to have because of the large amount of incorrect information.

Source credibility is defined as identifying a source of learning to be considered credible by the reader (Soenarno 2015: 4). According to Supriadi (2015: 129), learning sources are all sources such as messages, people, materials, tools, techniques, and settings that are used by students as sources for learning activities and can improve the quality of their learning. So the credibility of learning resources is anything or a credible power (can be trusted) can be utilized by teaching staff and students, both separately and in a combined form for the benefit of learning activities with the aim to increase effectiveness, efficiency, easy, and fun for the continuity of learning.

Through critical thinking, will help teachers to be able to focus and wisely use existing information, especially information that comes from the internet. Thus, not all information obtained is material for discussion, but the teacher can determine which are useful and not useful to discuss (Pratiwi, 2015: 15). In the era of digital literacy where the flow of information is very abundant, teachers need to have the ability to choose sources and relevant information, find quality sources, and make an assessment of sources from the aspects of objectivity, reliability, and expertise.

The second indicator seen in the group builds basic skills namely the indicator of observing and considering the

observation report. This indicator the teacher has a level of readiness that is ready. This indicator is one indicator that has a low grade so it must be improved by the teacher. Critical thinking directs us to look directly from various angles and then evaluate it through a rigorous process of intellectual activity. Strict intellectual activity is an observation and measurement of the phenomena that occur (Rahmawati et al., 2016: 1116).

Indicators of observing and considering observation reports have two descriptors, namely reporting clear and systematic observations and using technology in learning biology. The use of technology in the process of learning biology is important to do so as not to be left behind with technological advancements. The use of the internet as a source of learning has become a trend in the world of education and learning in the world. There have been many educational and training activities, as well as learning that utilize the advantages of the internet-based learning model, or better known as *online learning* (Surani, 2019: 464). When developing critical focus thinking skills from the learning process, students must be given freedom and responsibility to explore content, analyze resources, and apply information (Fitriani, et al, 2019: 386).

3. Conclusions (*inference*)

Conclusions (*inference*) is the ability to assess the probability level of accuracy / correctness of a conclusion based on available information (Retno, et al., 2018: 525). Fahim and Eslamdoost (2014: 145) state that the types of activities that contribute to critical thinking skills such as making conclusions, making decisions or solving problems, interpreting, and explaining. Indicators of critical thinking skills in the group conclusions consist of deducing and considering the results of deduction, inducing and considering the results of induction, and evaluation.

The first indicator is to deduce and consider the results of teacher deduction has a level of readiness ready. This indicator needs to be improved again by the teacher, because it must be able to make conclusions from things that are specific to the general not only from the general to the specific. Deduction is the ability to determine whether conclusions are made logically based on available information (Retno, et al., 2018: 525). Deductive reasoning refers to conclusions from specific to general (Rahmawati et al., 2016).

Indicators induce and consider the results of teacher induction has a level of readiness that is very ready. This means the teacher has been able to draw conclusions from the general to the specific. Inductive reasoning is drawing conclusions from specific to general (Rahmawati et al., 2016).

Teacher evaluation indicators have a level of readiness that is very ready. Critical thinking includes thinking processes that

test, question, link and evaluate all aspects of a situation or problem that occurs. Critical thinking aims to evaluate the best and believed actions. Thus, if the decision is not based on reliable information and assumptions, the conclusion does not have a correct basis. Students need to think critically when they face certain challenges because they must consider and carefully evaluate the information received before they can take decisive action (Saragih and Zuhri, 2019: 3). Biology teachers need to be equipped with critical thinking skills so that they have the ability to make decisions well and convincingly to do (Pratiwi, 2015: 14).

4. Provide further explanation

Indicators of critical thinking skills in groups provide further explanation consisting of defining terms in biological material and identify assumptions. The indicator defines the terms in the teacher's biological material having a level of readiness that is very ready. Indicators identify the assumptions that the teacher has a level of readiness that is very ready.

Biology is one of the lessons that requires the right strategy to study it, especially material that contains Latin terms (Amri and Jafar, 2018: 263). The term in learning biology is often felt difficult by students, so teachers must be able to explain the term in a language that is easily understood by students.

5. Managing strategies and tactics

Indicators of critical thinking skills in groups governing strategies and tactics consist of determining an action and interacting with others. Indicators determine an action that has a statement that is considering the solution of an issue based on existing data. The teacher has a level of readiness that is very ready. Indicators of interacting with others teachers have a level of readiness that is very ready.

Critical thinking skills can be improved through various learning strategies. One of them is through discussion with other people. According to Zubaidah (2016: 11) by discussing it can convey ideas to his friends, exchange different points of view, seek clarification, and participate with high levels of thinking think such as managing, organizing, critical analysis, solving problems, and creating learning and a new deeper understanding.

Thinking is said to make sense when thinkers try to analyze arguments carefully, look for valid evidence, and reach logical conclusions. So the teacher must be trained to critically understand further from the scientific issues that are expressed related to the material being taught, pour the problems contained in the issues into more specific questions, connect the basic concepts of the learning material they are learning, analyze the issues, and make decisions.

As a whole aspect of *critical thinking*, high school teachers in West Sumatra fall into the category of being very ready for quantitative research. The aspect that needs to be further improved is the use of the internet in the learning process. Based on interviews that have been conducted with several biology teachers, it is found that according to the teacher critical thinking is an important aspect in dealing with learning in the industrial revolution era 4.0. The method often used by teachers in the learning process is *Problem Based Learning* (PBL) and discoveries as well as scientific approaches. The questions teachers give to students are taken from the latest and factual problems or issues which are then linked to biological material.

However, in the implementation process, there are several obstacles in conducting critical thinking. Barriers felt by most teachers are students, where students are not accustomed to solving problems in the learning process. Another problem is because the input of students in schools is not good, the number of students who are lazy to read, learning resources are few because of the limited use of the internet at school, and short learning time. This makes it difficult for teachers to apply critical thinking skills to students.

Another discovery is related to the preparation of teachers to face challenges in the era of the industrial revolution 4.0. Teachers prepare themselves in various ways. The method taken by the teacher is by increasing the level of education, adding information through the internet, increasing competence, increasing the effectiveness of 4C implementation in schools, and there are those who are waiting for the socialization to come.

Regarding competency improvement, no teacher has received training on learning in the industrial revolution era 4.0. Neither from the Department of Education or the school, had never brought a speaker who discussed this topic. Teachers only often hear the term industrial revolution 4.0 without ever getting their training. Regarding 4C skills, teachers have long known about these skills during the 2013 Curriculum socialization. But in optimizing the implementation of 4C in the classroom, it is still difficult to do.

IV. CONCLUSION

After conducting research, high school biology teachers in West Sumatra are categorized as very ready for learning in the era of the industrial revolution 4.0 on aspects of skills *critical thinking* with a value of 4.32. Indicators of interacting with others make the greatest contribution to the readiness of biology teachers with a readiness value of 4.48. Indicators deduct and consider the results of deduction to make the smallest contribution to the readiness of biology teachers with a readiness value of 4.18. Reducing and considering the results of deduction

still needs to be increased by biology teachers.

The teacher is very ready to indicate that the teacher has the ability to think critically, so that it can be applied and taught to students. Viewed from 16 districts/cities, the region that has the highest level of readiness is Bukittinggi City with a value of 4.80. The area that has the lowest readiness level is Kota Pariaman with a value of 3.95. So teachers in Kota Pariaman need to improve their critical thinking skills demanded in the era of the industrial revolution 4.0.

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