LEVEL OF INFORMAL REASONING (IR) OF STATE SENIOR HIGH SCHOOL STUDENTS THROUGHOUT SEMARANG CITY BASED ON RATIONAL PATTERNS

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Abstract: This aiming of the research is to know about the level Informal Reasoning (IR) of Senior High School in Semarang City based on Rational. This is Qualitative Descriptive research. The population of this research is students of XI class of all Senior High School in Semarang city. Sample was found out by used proportionate random sampling technique. Sample of the research was the students of XI MIPA from 10 schools in Semarang City which total was 340 students. The method of collect data used by Informal Reasoning test, interview by teacher and the students and also observation. The highest percentage of Informal Reasoning according to Rational Pattern (44,81%).

🎯 Introduction

The current globalization of the 21st century demands developments in various fields. One of them is the development in the field of science and technology (science and technology). At this time, to follow the progress of science and technology is a necessity for everyone. Quality is a big demand, especially Human Resources. Quality human resources can be measured through cognitive ability, problem solving, and ability to use technology. These abilities can be trained at the school level, especially at the high school level. Globalization in the field of education also demands the ability of students, how students can solve a problem and be able to make decisions from this problem. According to Anat and Dori in Saad (2017), progress in the field of education begins with students' ability to solve problems by associating facts that have been taught by the teacher.

Efforts to improve and develop human resources can be done by applying science learning (Asniar, 2006). Learning science that is applied in schools is expected to be a means for students to learn about themselves and the environment so that they can apply concepts in everyday life.

The developments and demands of the 21st century must be balanced with qualified human resources, especially in the world of education. The government has issued policies as a measure to improve the quality of education, including the formulation of

the 2013 Curriculum. The science learning contained in the 2013 curriculum aims to make students competent in developing reasoning abilities in thinking inductive and deductive analysis by using scientific concepts and principles to explain natural events and solve problems qualitatively and quantitatively (Permendikbud, 2013). Another policy that has been implemented by the government is to evaluate externally such as TIMSS (Trends in International Mathematics and Science Study) and internally such as the National Examination.

The results of publications from the IEA regarding the TIMSS evaluation results in 2011, the ability of Indonesian students in science was ranked 40th out of 42 countries. In 2015 the achievement results of Indonesian students in the field of science at TIMSS were ranked 44 out of 47 countries. Based on the IEA publication, the lowest average percentage achieved by Indonesian students is in the cognitive domain with a reasoning level of 17%. Internal evaluation conducted by the government to determine the level of student ability is carried out in the form of a national exam. Based on data from the Central Java national exam results from the Provincial Education Office in the 2015/2016 academic year, high schools in Semarang City have not yet reached the 5th highest ranking in Central Java (Radar Kampus.com, 2016).

According to Siregar in Natalliasari (2013) revealed that reasoning ability is one part of the ability to think mathematically, part of communication, metacognitive, and problem solving, also consists of the ability to make decisions from various situations that are more specific and more urgent by linking them in various schemes. .

Based on the 2013 Curriculum Implementation Module published by the Ministry of Education and Culture, the 2013 curriculum uses the essence of a scientific approach as a golden point in the development and development of students' attitudes, skills and knowledge. This scientific approach relies on students' reasoning to be able to emerge and develop a scientific attitude, so that the main thing that forms the basis of a scientific approach is students' reasoning abilities.

Means & Voss (in Venville & Dawson, 2010) reveals that the type of thinking that occurs when considering socio-scientific issues is called informal reasoning. In informal reasoning, students draw conclusions from uncertain premises when contemplating an unstructured, open-ended problem, and is debatable without a definitive solution (Kuhn, 1991).

Based on the opinion put forward by Topçu et.al., (2011) that although the results of science can be presented in the language of formal reasoning and logic, the results of thinking themselves come from informal reasoning. Informal reasoning is considered important when information is less accessible, or when problems are more open, debatable, complex and unstructured (Sadler, 2004a). Informal reasoning is individual, meaning that each individual in thinking about something must use the reasons that underlie these thoughts differently (Sadler & Zeidler, 2005a).

Informal reasoning at the SMA/MA level has not been widely developed. According to the researchers, SMA is the level that is in the spotlight because it is at this level that people assume that students have acquired enough knowledge so that they can apply it in everyday life.

Departing from this view, the researcher is interested in examining the Informal Reasoning (IR) level of Semarang City State Senior High School students with the title "Informal Reasoning (IR) Level of Semarang State Senior High School Students based on Rational Patterns".

Method

This research is a qualitative descriptive study conducted in 10 public high schools in the city of Semarang from October to November 2018. The population in this study was students of class XI MIPA of public high schools in Semarang, totaling 2375 students, then 342 students were taken as a sample. The sampling technique used is proportionate random sampling. Data analysis used instruments in the form of observation sheets, teacher and student interview sheets, and student question sheets related to understanding Socio Scientific Issues (SSI).

The questions presented contain material related to HIV-AIDS, cloning, and GMOs. The research procedure includes the preparation stage, the implementation stage, and the completion stage using 4 techniques namely, Informal Reasoning tests, teacher and student interviews, observation. In order for the data obtained to be easy to understand, it is necessary to process the data from the answers to student questions, descriptive analysis, and qualitative analysis.

Result

The rational pattern of public high school students in Semarang as a whole has the highest percentage of 44.81%. It can be said that the majority of public high school students in the city of Semarang use a rational pattern in their reasoning. The following data is presented:

Table 1. Percentage of Overall Informal Reasoning (IR) Ability of State Senior High School Students in Semarang City in Each Pattern

Indikator *Informal Reasoning* (IR)	Frekuensi	Presentase (%)
Intutif (1)	1136	27,68
Emotif (2)	1129	27,51
Rasional (3)	1839	44,81
Jumlah	4104	100

Based on Table 1 it can be presented in the form of a bar chart as follows:
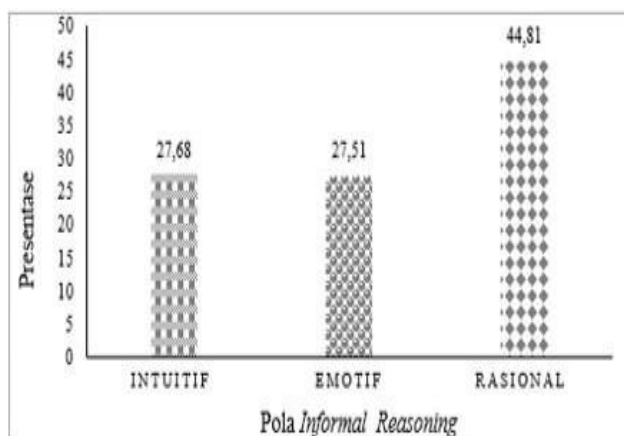

Figure 1. Percentage of Overall Informal Reasoning (IR) Ability of State Senior High School Students in Semarang City in Each Pattern

The following table presents the pattern of Percentage of Informal Reasoning (IR) Ability of State Senior High School Students in Semarang City on the Rational Pattern:

Table 2. Percentage of Informal Reasoning Ability (IR) of State Senior High School Students in Semarang City on Rational Patterns

Kode Sekolah	Jumlah Sampel	Jumlah Soal	Frekuensi	Presentase (%)
A	36	12	206	47,69
B	36	12	212	49,07
C	26	12	131	41,99
D	36	12	154	35,65
E	26	12	149	47,76
F	51	12	289	47,22
G	15	12	79	43,89
H	48	12	266	46,18
I	27	12	135	41,67
J	41	12	218	44,31

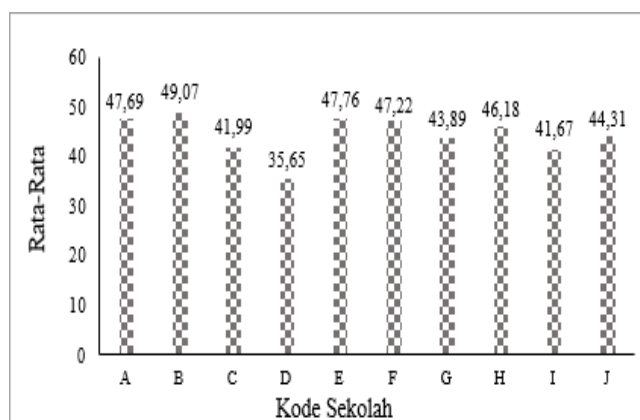Based on Table 2, it can be presented in the form of a bar chart as follows:

Figure 2. Percentage of Informal Reasoning Ability (IR) of Semarang State Senior High School Students in the Rational Pattern

Based on the table, the percentage of IR ability in the highest rational pattern is owned by SMA B at 49.07%. Rational reasoning is when the answer is logical, uses

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scientific and understanding, takes into account the risks and benefits as well as the advantages and disadvantages (Sadler and Zeidler, 2005). This shows that students can answer Informal Reasoning questions related to SSI (socio scientific issues) based on students' cognitive abilities.

👥 Discussion

High school age is a mature age in the process of thinking. Maturity of students in thinking is a factor that contributes to rational reasoning, namely understanding the topic, understanding conceptual understanding of problems in helping students to develop higher reasoning (Sadler, 2004). The maturity of students in thinking will allow students to always think logically. Logical thinking is different from memorizing. Memorization only refers to the attainment of the ability to remember, while logical thinking refers more to understanding, application ability, analytical ability, synthesis ability, even evaluation ability to form skills (Kusumaningrum, 2012).

Based on the 12 test questions, questions 1-5 have the theme of HIV-AIDS, questions 6-8 are about cloning, and questions 9-12 are about GMOs. In question number 1 most of the students answered rationally as follows:

> 1. Seorang wanita terinfeksi *HIV-AIDS*, sebuah penyakit fatal yang menyerang sistem kekebalan tubuh manusia. Dia sekarang kesakitan dan harus hidup sendiri karena tidak ada yang mau berinteraksi dengannya. Orang takut apabila dekat dengan dia akan terinfeksi virus tersebut. Apakah Saudara setuju dengan orang-orang yang menghindari interaksi dengannya ? Jelaskan pendapat Saudara mengenai hal tersebut !
>   a. Tidak, saya tidak setuju karena manusia diajarkan untuk saling menghargai orang lain apapun itu keadaannya.
>   b. Tidak, saya tidak setuju karena dia juga manusia tidak sepantasnya diperlakukan seperti itu kita perlu mengasianinya.
>   c. Tidak, saya tidak setuju karena Virus *HIV-AIDS* dapat menular bukan melalui kontak fisik melainkan kontak tertentu.

Figure 3. Informal Reasoning Questions about HIV-AIDS

Based on Figure 3, 269 students out of 342 students answered rationally, namely "No, I do not agree because the HIV-AIDS virus can be transmitted not through physical contact but through certain contacts." These answers are rational because they are logical and provide scientific reasons. The question presents the case of a women living with HIV/AIDS. Students are asked to analyze the answers that are logical and in accordance with the theory.

The number of students who answered rationally at number one was because this theme had been studied at the previous level, namely junior high school, although it was

not specific. However, this can be a provision for students' basic knowledge about HIV-AIDS. The ability to reason and understand concepts is a basic ability that must be possessed by every student in conducting learning (Putri, 2006). This basic knowledge causes students to be able to answer questions rationally because students already understand what HIV-AIDS means and how it is transmitted. As in this case, students prefer not to stay away from sufferers because of the spread of HIV-AIDS through certain contacts. Likewise with cloning material, students have gotten the term cloning since they were in junior high school, even though they did not study it specifically, the term cloning is familiar to students.

Unlike number 11, this number has the least rational number, namely 44 out of 342 students.
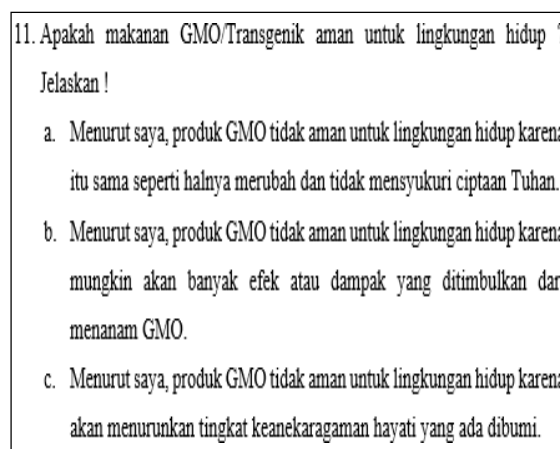

Figure 4. Informal Reasoning Questions about GMOs

Question number 11 Figure 4.17 has very little rational pattern because in class XI they have not received GMO (Genetically Modified Organism) material. This material will be studied by students in class XII on biotechnology material. Students' answers indicate that the knowledge given during learning and the knowledge possessed by students can influence informal reasoning patterns.

Interviews with students about closing cigarette factories:

Researcher: *Do you agree that cigarette factories in Indonesia are closed? Give your reasons!*

Narrator: *Agreed. In order to reduce smoking. (WS SMA H, 29/10/2018)*

The results of the interview students answered rationally by saying that students agreed if the cigarette factory was closed so that cigarette users would decrease. Even

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though the answers were not detailed, the students' answers pointed to the reduction of smoking users. Certainly, there is a reason why smoking users should decrease because smoking can cause coronary heart disease, and so on.

Conclusion

Based on the results of the study, it can be concluded that the highest average level of Informal Reasoning (IR) of State Senior High School Students in Semarang City based on the Rational Pattern is SMA B of 49.07%, while the overall average IR ability of State High School students in Semarang City included in the rational pattern with a percentage of 44.81%.

Acknowledgment

Based on the results of research on the pattern of Informal Reasoning (IR) for students of State Senior High Schools throughout the City of Semarang, the suggestions that the researcher can convey are:

1. The learning process should emphasize reasoning, so that students are able to train and improve their reasoning skills so that they can achieve the ability to think logically.

2. Mr./Mrs. teacher in the learning process can train students in solving problems through student reasoning and student arguments so that students can also think of solutions to these problems.

3. Mr./Mrs. teachers can apply Biology learning with the SSI (Socio Scientific Issue) approach as an effort to achieve achievements in forming student personalities who have strong scientific knowledge, are able to apply and utilize it in the context of social life problems.

4. This research is still temporary because the researcher only gives students test questions which are then analyzed to determine students' Informal Reasoning (IR) patterns. Further research can be developed on learning models and media so that they become perfect and sustainable research.

5. Further research is needed on the Informal Reasoning (IR) abilities of private high school students throughout Semarang City. This is in order to be able to compare the patterns of reasoning in public high schools and private high schools.

📕 Bibliography

Asniar. 2016. Profile of Scientific Reasoning and Arguing Ability of Science and Non-Science Students. Journal of Science Research and Learning. 2(1), 30-41.

Kusumaningrum, Maya & Saefudin, Abdul Aziz. 2012. Optimizing Mathematical Thinking Ability through Mathematical Problem Solving.

Natalliasari, I. 2013. Use of Cooperative Learning Model Think Pair Share (TPS) Type to Improve Mathematical Reasoning and Problem-Solving Ability of MTs Students. Jakarta: The Open University.

Putri, M. K. N. 2016. Improving Reasoning Ability and Understanding of Mathematical Concepts Through 5E Learning Cycle Learning in Class VII Students of SMP Negeri 1 Mojolaban Academic Year 2015/2016. Scientific Publications. Surakarta: FKIP Muhammadiyah University Surakarta.

Saad, Muhammad, et al. 2017. Scientific Reasoning Skills based on Socio-Scientific Issues in the Biology Subjects. International Journal of Advanced and Applied Sciences.

Sadler, T.D. 2004a. Moral Sensitivity and Its Contribution to the Resolution of Socio-scientific Issues. Journal of Moral Education. Vol. 33(3), 339-358.

Sadler, T. D., & Zeidler, D. L. 2005a. Patterns of Informal Reasoning in The Context of Socioscientific Decision Making. Journal of Research in Science Teaching, 42(1), 112–138.

Topcu, M. S., Yilmaz-Tuzun, O., & Sadler, T. D. 2011. Turkish Preservice Science Teachers' Informal Reasoning Regarding Socioscientific Issues and The Factors Influencing Their Informal Reasoning. Journal of Science Teacher Education. Vol. 22, 313-332.

Venville, G. J., & Dawson, V. M. 2010. The Impact of a Classroom Intervention on Grade 10 Students' Argumentation Skills, Informal Reasoning, And Conceptual Understanding of Science. Journal of Research in Science Teaching, 47(8), 952-977.