PROFILE OF INFORMAL REASONING (IR) OF STATE SENIOR HIGH SCHOOL STUDENTS IN DEMAK REGENCY

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Abstract

This study looks at the Informal Reasoning profiles of state high school students in the Demak Regency. Informal Reasoning is a type of thinking used by students in considering socio-scientific issues, which involves considering causation, pros and cons, and alternatives. The research was conducted at 10 state high schools in Demak Regency using the Proportionate Stratified Random Sampling method. The research data was obtained through tests in the form of multiple-choice questions and essays that tested students' mastery of Informal Reasoning regarding issues such as HIV-AIDS, GMOs, and cloning. The results showed the rational pattern with a percentage of 48.40%, the emotive pattern was 27.46%, and the lowest pattern is in the intuitive pattern with a percentage of 24.24%. Among the several factors that influence reasoning include personal experience, social considerations, which can come from educational, economic, or religious aspects, moral-ethical considerations, and their attention to technological developments as they are involved in social and technological issues, seen to be influential.

Keywords: *Informal Reasoning (IR), High School, Demak Regency*

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A. Introduction

Based on technological developments, the 21st-century education system that is currently developing is increasingly important to ensure students have learning skills, skills in using IT (Information and Technology), skills in social relations and communication, working together, and solving problems by thinking critically (Rahmah, 2008). Therefore, students are more active in the process of technological development. Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential. Education currently places more emphasis on critical thinking that prioritizes students as subjects in learning. Students' critical thinking can be applied to one of them with science education (ALBOIN, 2021). Science education is seen as an initial step to train students to think more critically, creatively, and logically and take the initiative in dealing with the development of science.

Knowledge of science or Natural Sciences (IPA) (Wisudawati & Sulistyowati, 2022) is a development process in various aspects of life to prepare students with a high intellectual level by understanding science and have multidimensional competencies to overcome all kinds of life challenges independently, intelligently, critically, rationally, and relevant. Therefore, to meet the demands of improving the quality of science education, it is necessary to prepare quality students as well.

However, the reality on the ground shows that the quality of education, especially science in Indonesia, still needs to be improved. As an example of the results of evaluating student abilities nationally, data on the results of the Demak Regency National Science Examination results from the Kemendikbud have experienced a decline in the last two years. In the 2016/2017 school year, the average score was 49.16; in the 2017/2018 academic year, the average score dropped to 48.92. In full, we can see the quality of Natural Sciences (IPA) education in Indonesia, seen from the Trend in International Mathematics and Science Study report (2011), which shows that in 2003, especially in science, Indonesia was ranked 36th out of 45. In 2007 Indonesia was ranked 35th out of 49, and in 2011 Indonesia was ranked 40th out of 42 countries. The lowest average

percentage achieved by Indonesian students is in the cognitive domain, with a reasoning level of 26% (Rosnawati, 2013). Indonesian students are generally weak in all content and cognitive aspects, both mathematics and science. Based on this statement, it can be seen that the high-level thinking skills of Indonesian students, especially in science, are still relatively low. Students still cannot address scientific problems that exist in the surrounding environment. Students still have conjectural thoughts related to an existing problem.

According to Wardani and Rumiati (2011), one of the causes of the low reasoning of Indonesian students is that they are generally less trained in solving questions with characteristics such as the questions on TIMMS whose substance is contextual, reasoning, argumentation, and creativity in solving problems. Problem-solving is based on cognitive activity in learning. According to Piaget, cognitive learning takes place based on the individual's mental structure, which develops according to the level of one's cognitive development. The higher the level of a person's cognitive development, the higher the ability and skills in processing various information or knowledge he receives from the environment towards problem-solving. Problem-solving cannot be separated from the reasoning process. Reasoning is a mental process that allows people to build new representations of existing knowledge.

This reasoning includes cognitive processing to solve problems by drawing conclusions based on logical rules or rational procedures ("Handb. Educ. Psychol.," 2012). Students reasoning abilities will increase if students can build their knowledge through an in-depth understanding of learning activities in class. Students deep understanding of learning activities will be applicable in everyday life. According to Moore and Rubbo (2012), scientific reasoning has an important role in problem-solving. Students who have high problem-solving skills can have an impact on achieving more optimal student learning outcomes. Students with good scientific reasoning can solve everyday problems and make the right decisions using scientific concepts. Scientific reasoning is a cognitive skill necessary for understanding and evaluating scientific information, which often involves understanding and evaluating theoretical, statistical,

and causal hypotheses. Therefore, educational research focuses on the development and assessment of student learning, which captures two components of construction: formal and informal reasoning. Students tend to be more active in scientific reasoning with problems in the surrounding environment and social issues (Bao et al., 2009).

Some educational experts argue, such as Means & Voss (Venville, Grady J. Dawson, 2010), that the type of thinking that occurs when individuals consider social issues is called informal reasoning or Informal Reasoning (IR). In informal reasoning, students conclude from uncertain premises as they ponder unstructured, open, and debatable problems with no definite solutions. Learners engage in informal reasoning when dealing with controversial social issues influenced by social norms and conceptually related to science (Zeidler et al., 2005). As stated by Topçu et al. (2010) that although the results of science can be presented in the language of formal reasoning and logic, the results of thinking itself come from informal reasoning. Individuals who engage in informal reasoning will contemplate causes and effects, pros and cons, and alternatives in addressing these social issues.

According to Sadler & Zeidler (2009), informal reasoning is individual, meaning that each individual in thinking about something must use the reasons that underlie these thoughts differently. Therefore, an initial study is needed to explore this and see the profile of students' informal reasoning. Based on the description of the problems in Informal Reasoning, a study is needed to see the profile of informal reasoning abilities in an area. The purpose of conducting this research is to describe the Profile of Informal Reasoning (IR) on Socio Scientific Issues (SSI) Problems of High School Students in Demak Regency. The results of this study are expected to assist teachers in determining the methods, instructional materials, and media that will be used to help students think critically and understand the subject matter being taught.

B. Method

The type of research conducted in this study is descriptive research. This research aims to describe the profile of Informal Reasoning (IR) on

Socio Scientific Issues (SSI) problems of high school students in Demak Regency. The place or location of this research was carried out in public high schools in Demak Regency, which were selected using the Proportionate Stratified Random Sampling technique to obtain 6 Senior High Schools and 4 Islamic Senior High Schools. The target of this research is class XI because it represents the character of high school students. The time of the research was carried out in May-August 2019.

The assessment instrument in the form of a test was used to obtain data on Informal Reasoning profiles for state senior high schools in Demak Regency. The test questions are in the form of multiple-choice questions and descriptions. The questions contain cases regarding HIV-AIDS, GMOs, and cloning. Each point's answer options for the multiple-choice questions contain one of the Informal Reasoning patterns. According to Sadler & Zeidler (2005), there are three patterns of Informal Reasoning: intuitive, emotive, and rational.

Table 1. Informal Reasoning (IR) Pattern Assessment Categories

| Category	Description
Rational (Category 3)	If the answers are logical, use scientific understanding and language, and consider the risks, benefits, disadvantages, and advantages. (various considerations).
emotive (Category 2)	Suppose the answer considers the emotional response of people related to the issue, concern, empathy, sympathy, and concern for the fate of those affected. (judgment based on the concern).
Intuitive (Category 1)	If the answer is based on a hunch, the response is direct, often responds negatively, is personal, often precedes rational or emotional, and always leaves the results to God. (respond directly without considering anything)

Source: Sadler & Zeidler (Venville, Grady J. Dawson, 2010)

The data collected was then carried out by a qualitative descriptive analysis by calculating the mean data. As additional data, observation,

and interview methods were used to obtain more in-depth information from respondents regarding issues related to research.

C. Finding and Discussion

Based on the data from the written test research in the form of multiple-choice questions regarding the Informal Reasoning ability of State Senior High School students in Demak Regency based on the pattern can be seen in the following table;
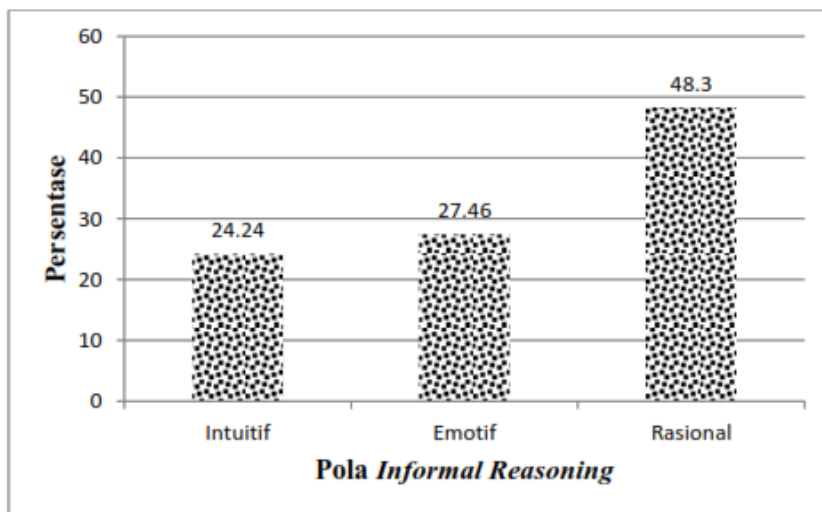
Figure 1. Percentage of Informal Reasoning (IR) Ability of State Senior High School Students in Demak Regency in Each Pattern

The biggest gain in Informal Reasoning Ability (IR) rational pattern is equal to 56.75%. Followed by emotive and intuitive, respectively, 27.4 and 24.2. The number of emotive and intuitive patterns that are quite a lot can be a plausible reason for the acquisition of National Examination results for the Science major in Demak Regency, which has an average of below 50 and even decreased from the 2016/2017 academic year to 2017/2018. Natural Science Education (IPA) emphasizes how to think and investigate or conduct experiments which are part of the nature of natural science as a way of investigating (Chiapetta, Eugene L & Koballa, 2010).

To learn more about the causes of the Informal Reasoning Ability (IR) scores of State Senior High School students in Demak Regency, we can analyze each in more detail at each school. The following is the Percentage of Informal Reasoning (IR) Ability of State Senior High School Students in Demak Regency in Each School

Table 2. Percentage of Informal Reasoning (IR) Ability of State Senior High School Students in Demak Regency in Each School

School code	Informal Reasoning (IR) Pattern Frequency			percentage of Informal Reasoning (IS) Patterns		
	Intuitive	Emotive	Rational	Intuitive	Emotive	Rational
A	36	43	655	25,00	29,86	45,14
B	93	101	213	22,85	24,82	52,33
C	110	148	222	22,92	30,83	46,25
D	171	197	316	25,00	28,80	46,20
E	75	82	131	26,04	28,47	45,49
F	121	115	220	26,54	25,22	48,25
G	147	137	220	29,17	27,18	43,65
H	58	51	143	23,11	20,24	56,75
I	127	143	222	25,81	29,07	45,12
J	54	55	129	22,69	23,11	54,20

Based on the Informal Reasoning ability test results for State Senior High Schools in Demak Regency, the highest average score was SMA H, with the largest achievement in the rational pattern, which was 56.75%. Meanwhile, the school with the lowest rational Informal Reasoning (IR) score was SMA G at 43.65%, with the most intuitive at 29.17%.

The Informal Reasoning (IR) study reports that several factors that influence reasoning are grouped into four main categories, namely personal experience, social considerations which can come from educational, economic, or religious aspects, moral-ethical considerations, and their attention to technological developments as they get involved in social issues. (Topcu et al., 2010)

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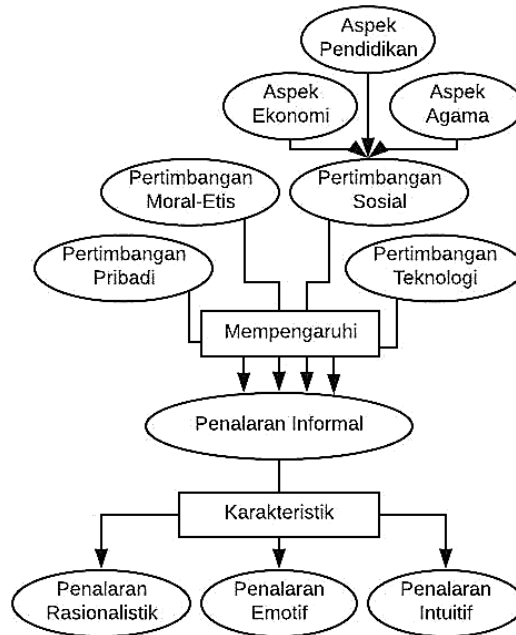
Figure 2. Factors that influence Informal reasoning (IR)

Based on the observations, the teachers of SMA H had carried out problem-solving type learning. SMA H students also chose and liked reasoning questions because, with reasoning, students more easily understood learning according to their thoughts or opinions. According to Valanides (1997), the relationship between a person's cognitive development stages with learning outcomes and reasoning abilities. Students with high cognitive development show better reasoning abilities and learning outcomes than others. Meanwhile, according to Bachtiar (Rayendra Wahyu, 2014), students with high problem-solving skills can value the aspirations of more effective student learning outcomes.

The same thing happened in SMA G for teacher learning using problem-solving methods, but students were still experiencing problems. This was possible due to other factors. If you look at the results of observations of infrastructure facilities, it is known that they look complete, such as green open spaces, laboratories, and classes; however, wifi internet access is not provided to all students. The existence of Wifi is

very important and closely related to learning outcomes. In his research, Hidayat, W. (2011) showed a positive and significant relationship between the intensity of using school Wifi facilities and student learning outcomes. Having wifi internet access opens opportunities for students to add reliable information so that students' reasoning is more rational.

In SMA C, there are more emotive patterns in Informal Reasoning (IR) than Rational and Intuitive patterns. Several external factors affecting students' emotions, such as social, cultural, and environmental factors, tend to be higher. External factors are factors that are outside the individual. According to Slameto (2010), social factors consist of the family, school, community, and group environment. The school environment is one of the social factors that can affect higher student emotive. The state of the school or school environment is an environment in which students learn systematically. These conditions include teaching methods, curriculum, teacher-student relationships, student-student relationships, and school discipline. The state of society will also affect students more because of their existence in that environment. Activities in society, the mass media, and friends hanging out can influence students; in interacting, many prohibit social norms and values about helping each other, admonishing each other, caring for others, cooperation, and other community values. Thus forming emotional intelligence. This follows the opinion of Fowler dkk (2019) that emotional intelligence develops from interactions in the community. Learning to improve emotional intelligence can be demonstrated in community activities, one of which is playing; when playing, a person will begin to learn to understand the existence of other people. Looking at the situation at SMA C, the activities seem thickest in terms of cultural factors. SMA C has a school culture that upholds the values of courtesy, responsibility, tolerance, and social care. In school activities such as habituation in life, nationalism songs are played, reading Asmaul Husnah before learning, and honesty canteen. So that with this culture, good emotional intelligence is formed in students and makes students able to use emotional patterns when facing a problem. Thus, when students present a socio-scientific problem, they use emotive rather than rational considerations. In addition to emotive

patterns, there are examples of attitudes given by the teacher to make students use their rational thinking and make considerations in their thinking to solve a problem they face. At the same time, the physical environment factors include school facilities, learning facilities, and climate.

E. Conclusion

Based on the results of research on the ability of Informal Reasoning Profiles of State Senior High School Students in Demak Regency, it can be concluded that overall they are in the rational pattern with a percentage of 48.40%, the emotive pattern is 27.46% while the lowest pattern is in the intuitive pattern with the percentage of 24.24%. Among the several factors that influence reasoning include personal experience, social considerations, which can come from educational, economic, or religious aspects, moral-ethical considerations, and their attention to technological developments as they are involved in social and technological issues, seen to be influential. As a suggestion, further studies need to be conducted to determine the extent to which these factors influence students' reasoning and learning outcomes. Meanwhile, teachers must continue to innovate to improve students' informal reasoning (IR) abilities to improve learning outcomes, especially in science.

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Bibliography

Alboin, P. (2021). Hakikat Berpikir Kritis; Sebuah Tinjauan Filosofis. *JURNAL PIONIR*, *7*(2). Https://Doi.Org/10.36294/PIONIR.V7I2.2360

Bao, L., Cai, T., Koenig, K., Fang, K., Han, J., Wang, J., Liu, Q., Ding, L., Cui, L., Luo, Y., Wang, Y., Li, E., & Wu, N. (2009). Physics: Learning

And Scientific Reasoning. *Science*, 323(5914), 586–587. Https://Doi.Org/10.1126/SCIENCE.1167740

Chiapetta, Eugene L & Koballa, T. R. (2010). *Science Instruction In Middle And Secondary Schools*. Pearson Education Inc.

Handbook Of Educational Psychology. (2012). *Handbook Of Educational Psychology*. Https://Doi.Org/10.4324/9780203874790

Hidayat, W. (2011). Hubungan Antara Intensitas Dan Minat Penggunaan Fasilitas Wifi Sekolah Dengan Hasil Belajar Pelajaran TIK Siswa SMAN. 1 Jetis Bantul Tahun Ajaran 2011/2012. *Yogyakarta: Universitas Negeri Yogyakarta*.

Ina V.S. Mullis, Michael O. Martin, Pierre Foy, And K. T. D. (2011). *Pirls 2011 International Results In Reading*. TIMSS & PIRLS International Study Center.

Moore, J. C., & Rubbo, L. J. (2012). Scientific Reasoning Abilities Of Nonscience Majors In Physics-Based Courses. *Physical Review Special Topics - Physics Education Research*, 8(1), 010106. Https://Doi.Org/10.1103/PHYSREVSTPER.8.010106/FIGURES/4/MEDIUM

Rahmah, S. (2008). Teorikecerdasan Majemukhoward Gardner Dan Pengembangannya Pada Metode Pembelajaran Pendidikan Agamaislam Untuk Anak Usia Sekolah Dasar. *Bangka Belitung*, V(1), 1–22.

Rayendra Wahyu, B. (2014). *Pengembangan Instrumen Pengukuran Kemampuan Penalaran Ilmiah Fisika (Kajian Kemampuan Penalaran Ilmiah Mahasiswa Pendidikan FISIKA)*. Https://Repository.Unej.Ac.Id/Xmlui/Handle/123456789/59389

Rosnawati, R. (2013). Kemampuan Penalaran Matematika Siswa SMP Indonesia Pada TIMSS 2011. *Seminar Nasional Penelitian, Pendidikan Dan Penerapan MIPA*.

Slameto. (2010). *Belajar Dan Faktor-Faktor Yang Mempengaruhinya*. PT.Rineka Cipta.

Topcu, M. S., Sadler, T. D., & Yilmaz-Tuzun, O. (2010). Preservice Science Teachers' Informal Reasoning About Socio-Scientific Issues: The Influence Of Issue Context. *International Journal Of Science Education*, 32(18), 2475–2495. Https://Doi.Org/10.1080/09500690903524779

Valanides, N. (1997). Formal Reasoning Abilities And School Achievement. *Studies In Educational Evaluation*, *23*(2), 169–185.

Venville, Grady 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.

Wardhani, & Rumiati. (2011). *Instrumen Penilaian Hasil Belajar Matematika SMP: Belajar Dari PISA Dan TIMSS*. PPPPTK.

Wisudawati, A. W., & Sulistyowati, E. (2022). *Metodologi Pembelajaran IPA*. Bumi Aksara.

Zeidler, D. L., & Nichols, B. H. (2009). Socioscientific Issues: Theory And Practice. *Journal Of Elementary Science Education 2009 21:2*, *21*(2), 49–58. Https://Doi.Org/10.1007/BF03173684

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A Research-Based Framework For Socioscientific Issues Education. *Science Education*, *89*(3), 357–377. Https://Doi.Org/10.1002/SCE.20048