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Article

Challenges of Science Teachers in Improving Students' Rational Thinking Abilities through Socioscientific Issue Based LearningKarisma Anggi Sofiana^{1*}, Syaiful Arif²^{1,2}Institut Agama Islam Negeri Ponorogo, Indonesia**Corresponding Address: karismaanggisofiana@gmail.com***Article Info**

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ABSTRACT

Reasoning is one of the cognitive abilities developed to gain knowledge. Students must have the ability to reason so that they can solve a problem through common sense. They can see accurate information. However, in most communities, many myths or issues are spread among the public, some of which are not even true, so it would be better if science learning were connected to socioscientific issues. This research aims to explore the challenges of junior high school teachers in improving students' rational thinking abilities when they design and facilitate learning of socioscientific issues in the classroom. This research was conducted at SMPN 1 Mlarak with research samples, namely science teachers at SMPN 1 Mlarak Ponorogo and class 7C students at SMPN 1 Mlarak. This research uses a qualitative approach, applying in-depth interview and observation methods. This research uses the N VIVO application to analyze data. From this research, the results showed that several things were challenges for teachers in improving students' rational thinking abilities through socioscientific issue-based learning, namely students' abilities, limited time, and difficulty finding relevant examples. Knowing the challenges teachers face in teaching provides an idea of finding the right solution to overcome the problems.

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INTRODUCTION

Science education is a learning that studies human life and the natural environment. The development of IPA education in Indonesia in the 21st century has become one of the modern transformations that aim to develop the quality of education (Pratiwi et al., 2019; Zubaidah, 2020). Learning in this century is known for changing learning strategies from what was initially only centered on educators. Now it shifts to students who must be active and are expected to be able to master high-level thinking skills which include critical thinking, creative thinking, communication and collaboration skills. (Ramdani et al., 2019; Redhana, 2019; Septikasari, 2018). Apart from that, in 21st century learning, students are able to develop their competencies in terms of creativity independence and responsibility (Purwandari et al., 2022).

The quality of education greatly influences students in improving their high-level thinking abilities (Arifin & Fauziyah, 2021). Currently, the world of education in Indonesia is

being intensified by changes to the new curriculum, namely the independent curriculum. The independent curriculum is identified as a curriculum used to assist the government in improving the quality of education in Indonesia. Through implementing this curriculum, it is hoped that learning can be delivered optimally with various content so that students will deepen the competency of the learning objectives (I Made Tri Pramana Putra, 2022). The independent curriculum is characterized by the application of flexible learning, meaning that it is adapted to existing facilities and infrastructure at the school and also adapts to the needs of students. So there is no need to provide new facilities or infrastructure, which might burden the school. One example of implementing an independent curriculum adapted to school conditions is that when learning science, teachers can immediately explain the relationship of the material to their lives or experiences contextually because science is implemented in everyday life. That way, students will understand more about the substance being studied. As we know, the current curriculum emphasizes integrated science learning, which includes physics, chemistry, and biology material. So, by connecting several materials, it is easier for students to think complexly and rationally. One of the skills needed in science learning is thinking skills (Putri & Fadly, 2022). According to previous research, it is explained that integrating several materials into one discussion can develop psychomotor, cognitive, and affective abilities (Rahayu et al., 2013).

The aim of science education emphasizes students understanding various natural phenomena, concepts about nature, and all things related to nature, which was studied through scientific (Panggabean et al., 2021; Sulthon, 2017). so that in implementing science learning, students will be guided on specific ways of thinking and learning styles (Maghribi & Aristiawan, 2023). However, one of the factors that can hinder me from achieving the goals of science education is the teacher's strategy in teaching. For example, the teacher's efforts in selecting and preparing the learning model that will be applied. Based on several literatures, it explains that the teacher's role in learning is very dominant, without teacher creativity, learning will feel boring and have an impact on students' understanding (Zayas & Rofi'ah, 2022). Not only that, but even the characteristics of students are also factors that can influence the achievement of science education goals. This is also no less important to pay attention to because when a teacher has tried his best when teaching, but his students are challenging to manage, this will also hinder the achievement of learning objectives. The teacher, as someone who transfers knowledge to students, must have four competencies, which include pedagogical abilities, personality competencies, social competencies, and professional competencies, where these four competencies have been determined in Law Number 14 of 2005 (Nurarfiansyah et al., 2022; Sayekti & Kinasih, 2018; Warneri, 2019). Not only that, a teacher's responsibility is also to support students to be active in the classroom to engage in interactive learning. Then, invite students to contribute during group discussions combined with the application of today's advanced technology (Aprianto et al., 2023). However, only 37% of the total number of teachers with these four competencies is based on teacher statistical data from the PMPTK (Directorate General of Educator and Education Quality Improvement) census of the Ministry of National Education. This is caused by various backgrounds, which include teaching standards that still need to be higher, lack of mastery of the material, and weak technology response skills (Arisandy et al., 2022).

An education will progress when human resources perform well, which is influenced by the school principal's strategy in managing educational institutions (Syahrudin, 2019). On the other hand, an institution needs experience developing teachers' abilities to plan and facilitate learning in classroom management to meet educational standards. Classroom management depends on the teacher's level of ability and competence in carrying out their duties (Affandi & Amir, 2022). Especially in science learning, because this material has significant implications in everyday life, with various existing problems, teachers are expected to

understand and apply the four teacher competencies to realize students' character as the nation's next generation.

Based on initial preliminary data conducted by researchers, it was found that students' ability to answer questions that refer to rational thinking skills is still relatively poor. This is proven by the presence of several students whose answers did not match what was asked. There were even students who did not answer the questions. Students are less able to remember learning about the process of rain falling, less able to analyze the effect of deforested forests on reduced rainfall, and less able to classify the water cycle. So the indicators of the ability to think rationally have not yet been achieved perfectly. Therefore, here the role of a teacher is really needed to bring about change so that students have the ability to think highly.

One of the thinking patterns that must be developed in this century is rational thinking skills. Students must have the ability to reason so that they can differentiate between accurate information and mythical or hoax information. Rational thinking is the ability to consider a problem based on facts and find a solution or answer that makes sense. Meanwhile, in education, reasoning is a way of reviewing information, which is then analyzed correctly using common sense or logic to obtain relevant conclusions (Zahro & Hadi, 2022). In rational thinking, there are several indicators that you need to pay attention to including grouping, synthesizing, imagining, analyzing, generalizing, remembering, comparing, deducing, evaluating, and drawing conclusions (Galuh, 2020; Putriyani & Irawan, 2021; Zahro & Hadi, 2022).

Seeing the increasingly rapid development and progress of knowledge and technology, it is necessary to prepare students who can reason. This includes knowing basic concepts in considering the pros and cons by proposing a solution or decision that benefits the future. The middle school level is a level of change from childhood to adolescence, so at this level, character education is needed. One way to instill character education in junior high school students involves moral and ethical rules in science learning. For example, students learn about social issues around them, argue based on scientific findings, and still respect the customs or culture adhered to by the surrounding community. This proves that students' responses follow the rules of norms and ethics, namely, still respecting other people's cultures or customs. This ethical behavior will further develop with the influence of personal experience, the environment, and community life (Husamah et al., 2018).

Then, there are several other ways to improve students' rational thinking abilities, namely through a socioscientific science approach. The Socioscientific approach can be interpreted as a learning process that collaborates between subject matter and social issues and can find solutions or truths (Hanifah et al., 2021). SSI is a controversial issue with social importance and strong links to scientific concepts. Socioscientific Issues are descriptions of problems in social life that are related to science, and the level of truth is relative (Pandela et al., 2019). Since the Socioscientific model is related to the social elements of society, learning can enable students to understand the concepts of fairness, responsibility, having high empathy, and concern for morals/ethics in a universal society (Kinskey & Zeidler, 2021). Socioscientific issues are considered capable of helping students improve high-level thinking skills such as argumentation, creativity, scientific process skills, and development (Sari et al., 2021).

Table 1. Basic Skills Framework

Teacher's pedagogical knowledge and skills	SSI Implementation Planning
Teachers can understand more deeply the context of knowledge related to SSI and can help students connect current social conditions with subject matter	Determine social issues that will be used in scientific-based learning .
Teachers can master knowledge in	Determine conflicts or problems that can

Teacher's pedagogical knowledge and skills	SSI Implementation Planning
considering students' morals and ethics in dealing with a conflict; they can become facilitators in developing students' morals and ethics.	improve student development at school
Teachers can master knowledge about argumentation concepts and carry out evaluations at the end of the meeting; they can facilitate discussions and arguments in the classroom.	Determine several social issues that are not private but take general issues so that students are active in discussing and arguing.
Teachers can master knowledge about the nature of science and have the ability to relate the nature of science to SSI.	Plan activities that involve students in a problem so that they can apply science skills in solving the problem.

Source : <https://doi.org/10.1080/1046560X.2020.1826079>

These basic skills are fundamental for a teacher to support the development of SSI learning. Especially for prospective science teachers who do not have teaching experience, they must understand this basic framework when they want to implement SSI-based learning (Kinskey & Zeidler, 2021). These basic skills are a pedagogical framework that science teachers must carry out in learning activities. Applying this basic skills framework greatly encourages students to think intensively to improve their reasoning. The SSI model is a model that uses issues or problems that exist around us in learning to stimulate the development of students' minds and developing morals, and ethics so that they are aware of the relationship between society and science (Hanifah et al., 2021). According to Wuri Utami's research, it can be proven that the use of a socioscientific issue approach in the teaching and learning process can develop students' high-level thinking skills in solving various problems faced by finding the best solution (Sismawarni et al., 2020).

This research aims to analyze the challenges experienced by junior high school science teachers in improving students' rational thinking abilities when they design and facilitate SSI lessons in the classroom. Several literatures emphasize that facilities that support the implementation of Socioscientific Issues learning are still limited. Even now, prospective teachers ready to accept and develop learning based on Socioscientific Issues are still relatively low, or no one is interested. In secondary contexts, challenges identified in SSI teaching include teachers' doubts about traits controversial about SSI, and teachers' knowledge of content regarding SSI is still relatively low.

METHODS

To answer our research questions, we used a qualitative approach. Because qualitative research allows researchers to obtain in-depth and detailed data based on actual or direct experiences from the sources themselves while using SSI, this research focuses on the challenges science teachers face in improving rational thinking skills through learning based on socioscientific issues. This is important because of the various background problems that exist and is focused on several problem variables so that the discussion of this research is not ambiguous and remains by the flow.

This research was conducted at SMPN 1 Mlarak. The interview meeting was held at the library of SMPN 1 Mlarak Ponorogo. The research subjects were a science teacher at SMPN 1 Mlarak Ponorogo and class 7C students at SMPN 1 Mlarak with a total of 33 students. Data sources collected for this research consisted of interviews and classroom observations. For observation, namely observing learning in class for 30-45 minutes. Furthermore, semi-structured interviews were conducted to explore in detail teacher professionalism when implementing Socioscientific Issues learning.

In this research, the structure of the interview meeting with the teacher was carried out with the discussion recorded audio and the recording was transcribed and coded for analysis. Second, interview each participant individually about their experiences. each data source for each participant is analyzed and interpreted to construct meaning of the experience. In data processing there are several steps such as data collection, data reduction, data presentation and conclusions. Using these multiple data sources allows us to gain in-depth insight into teacher expertise by increasing trust through source triangulation. In analyzing data, this research uses the NVivo application. The aim of using this application is to make it easier to process data and then make it more empirically accountable and consistent (Adisti Yuliasrin et al., 2023).

Data Analysis

The data was analyzed by transcribing the interviews word for word, and adding punctuation to make it legible. The following are the output results from coding the interview transcript using Nvivo.

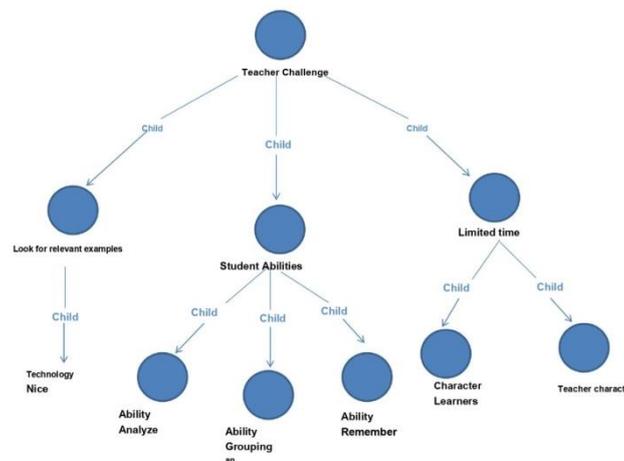


Figure 1. Coding Results of Interview Transcripts with Sources

Figure 1 shows that the challenges for teachers in teaching material based on socioscientific issues include several challenges, such as students' abilities, limited time, and looking for relevant or appropriate examples. The resource person said that the socioscientific issue approach is always present in every material. The teacher provides an initial apperception with concrete examples related to the sun that will be taught.

RESULTS AND DISCUSSION

Challenges with teaching based on socioscientific issues

Several studies attempt to identify and review the various challenges experienced by teachers in implementing Socioscientific Issues-based learning. However, we do not find many references that support and relate to Socioscientific Issues. As discussed above, the relationship between the application of Socioscientific Issues learning to science material is very realistic or relevant to life, so this is a common challenge widely discussed in educational circles. According to research conducted by Lee and Yang (2019), it was explained that a junior high school teacher had difficulty managing or supervising students in the classroom. In the same context, there is also research conducted by Bossér et al. (2015) explaining that teachers' difficulty in teaching is when they try to adapt to a new class, where they have to make the learning atmosphere more enjoyable.

Meanwhile, teachers still need to learn the characteristics of students in secondary schools; this is a challenge for teachers, according to Bosser's research. Usually, the character of students at the junior high school level will have more difficulty learning independently because they are used to relying on explanations given by teachers, and they only listen and

accept the information even though a teacher hopes that students will have the initiative during SSI-based learning. So these various problems become challenges for junior high school level teachers. (Bossér et al., 2021; Lee & Yang, 2019).

The challenges teachers face are not only centered on students' problems but are comprehensive in all learning contexts. Rydberg et al. (2018) explained that the things that junior high school teachers have doubts about are when there is a connection between learning about Socioscientific Issues and national assessments that are based on reality. So, it becomes a challenging task for teachers to improve their ability to achieve learning goals adapted to the Socioscientific Issues model (Rydberg et al., 2018). When applying Socioscientific Issues and Learning, A secondary school teacher was still unsure. Hence, their solution was to limit specific universal themes so that they could easily be connected to existing societal issues or myths. Rydberg also stated that junior high school teachers experience difficulties when integrating socioscientific issues with various interdisciplinary lessons. This challenge is often encountered at the middle school level because teachers handle specific subject matter, so it is difficult to connect it with other material. This is different from elementary school teachers who handle all subjects.

The analysis obtained from this research resulted in the identification of three important themes: (1) students' abilities, (2) time limitations, and (3) Difficulty finding relevant examples. The first theme is students' abilities, which includes the child's level of ability, which refers to the ability to reason and is related to learning socioscientific issues. The second theme, time constraints, relates to the teacher's ability to manage time while teaching using the Socioscientific Issue model. The third theme, namely the difficulty finding relevant examples, includes teachers' difficulty finding examples that align with teaching sociocultural issues

First theme: students' abilities

The secondary school-based reference refers to the challenges of student participation and involvement during Socioscientific Issues learning (Kinskey & Zeidler, 2021). By the experience of science teachers in socioscientific issue-based learning, one of the challenges is the different levels of ability of students. Throughout this research, interviewees expressed more concern about the academic level and behavior of their students. The reality found in the field is that students at SMPN 1 Mlarak have moderate ability to think rationally. This is proven by the number of scores below the average when working on socioscientific issue-based test questions. So they are less able to apply rational thinking indicators which include grouping, analyzing and remembering material that has been taught. This concern is common in teaching Socioscientific Issues, as found by Borgerding and Dagistan (2018) that prospective teachers' most significant concern in involving students in Socioscientific Issues is the student's ability to contribute to discussions regarding current learning topics, while Nida et al. 2020 also identified that the biggest concern of science teachers in their position is the lack of academic ability of their students in carrying out tasks that require students to think cognitively. This can be a basis for the fact that students' abilities are very influential in implementing learning based on socioscientific issues. Socioscientific issues have a strong connection with everyday life. They may often be found in our environment, so socioscientific issues must be addressed in the implementation of learning starting from elementary school (Dzulhidayat, 2022).

Source person

Based on the teaching experience of the science teacher at SMPN 1 Mlarak, his biggest concern is the students in class 7E. At the interview meeting, the resource person expressed his concern that, based on previous incidents, several students were noisy or fighting in class, and some used words that were not good. Then, many students are busy on their own. There

are even some children who cannot stay still. He often shares his students' negative experiences:

Interviewee: It may also be the students' abilities, where the students' abilities are not the same. For children whose abilities could be improved, understanding is slow, and it is difficult to accept the material. For example, in class 7E

Excerpts from interviews show that the resource person explained the participants' condition when taught and focused on preventing negative behavior so they would pay attention again. According to the resource person, differences in students' abilities to capture learning also challenge teachers to implement learning. He also explained:

Resource person: If the person being taught is class 7A, then it is easy for us to teach because the child is obedient and easy to understand. It was different when I entered 7E, where the children from class 7E were super. Whether they were boys or girls, they were all the same.

The opinions of the resource persons explain the different levels of children's understanding. Research conducted by Mauliddiani supports that a high IQ can make things easier for students to learn and understand various sciences. However, students whose absorption capacity is lacking will also need help understanding the material explained by the teacher (Afniola et al., 2020; Mauliddiani et al., 2023; Nashihun et al., 2023). However, when teachers apply to learn about socioscientific issues, students are more enthusiastic because it is connected to their daily lives

Resource Person: Children will be more interested if given examples of everyday life; they will be happy, and learning will be fun. So they know what it is used for, sometimes many students ask, why are you studying mathematics? What is the gun for?

Interviewee: If it is rational, then we will give examples from the material, for example, by asking questions about whether the rain charmer is a myth or a fact so that, in the end, the child knows whether it is true or not.

Based on this quote, we understand that students' abilities lead to positive things, where they are interested in listening to lessons which are of course related to their circumstances. However, on the other hand, if social issues are included in the test questions, students will be less able to do the exercises. Rational thinking itself has several indicators, which include remembering, grouping, and analyzing (Zahro & Hadi, 2022). Through tests based on socioscientific issues, students are less able to remember previous material they have studied, then students are less able to group the processes of rain falling in the water cycle material and students are also less able to analyze themscientific when presented with several myths that exist in their lives which are related to the myth of rain in Indonesia.

Second theme: time limitations

Time management is one of the strategies that a teacher must master. With appropriate time management, teachers can work on tasks that must be completed. This delays the material being taught, or the material can only be completed once finished (Susanto, 2021).

Source person

The next challenge experienced by science teachers at SMPN 1 Mlarak is time management. This challenge is one of the challenges that is often mentioned because teacher strategies are needed to develop and facilitate learning that focuses on sociocultural issues so that teachers have sufficient time to teach and ensure student learning can run in a directed manner. During learning, children are asked several questions, which include stories about social issues around them, and then students analyze the questions according to their level of understanding. According to the research we conducted, students need quite a long time to work on these questions due to several reasons. Firstly, because the question involves a long story; secondly, students are reluctant to read the analytical questions. Furthermore, thirdly,

many students are busy themselves, and some need help understanding the question's meaning.

From the research we have conducted, we can conclude that time management depends on 2 things, namely, the teacher and the students. Teachers, for example, only convey the material, not caring about children who still need help understanding. So, the time allocation is only short and simple. Sometimes, some teachers care about children's understanding, but the consequence is that they need to allocate more time. Time limitations need to be overcome by managing time properly. If you cannot manage your time well, then the teacher will not be able to teach the material he is teaching thoroughly, for example, in a science subject with water cycle material. If the teacher does not thoroughly teach the material, this will have a destructive impact on the students and, of course, will be detrimental to the students as well (Susanto, 2021). However, apart from that, students' abilities also influence time management; classes that have a high average IQ will quickly understand the material and have enough time. Meanwhile, classes with a low average IQ will find it difficult to understand, so the time allocated is less (Kurnia S, 2020). The interview with the science teacher stated that

Interviewee: Actually, that time depends on us and depends on the students, too. If it is an intelligent class, I will take the learning time, but if it is for children with low abilities, it will still need to be finished. Even if the teacher is only pursuing targets, some do not care whether they understand or not, and the important thing is that they complete the material. Yes, that goes back to us doing the conditioning.

From the quote above, the resource person explains time management based on his teaching experience. Based on several references explain that time allocation determines the quality of learning (Kinskey & Zeidler, 2021). So, the teacher must master the correct strategy for managing time so that it does not affect the quality of learning to decrease. In this way, teachers can learn from experiences to apply learning based on socioscientific issues at the secondary school level.

We often encounter facts in the field that, in the efforts made by teachers to overcome time constraints, teachers only explain once and then give practice questions. This will result in students needing to understand the material being taught. In my opinion, the solution that can be applied to overcome time limitations is to limit certain universal themes so that the discussion remains focused on one theme and does not discuss other things that are not related to the material.

The third theme: difficulty finding relevant examples

Regarding the teacher development considerations that underlie this research framework, teachers choose socioscientific issues that are appropriate for their students and connect science content. Regarding the teacher's scientific discourse/argumentation, it is acknowledged that another challenge faced is the teacher's difficulty in finding relevant examples. Here, teachers have the responsibility to look for social issues in the community that are related to the material. Apart from that, examples of material application must also be appropriate to current circumstances or conditions. As we know, digital technology is currently developing rapidly. So what the teacher is fighting for is that they must understand current technology so that they are not technologically illiterate and can master it thoroughly. Advances in Technology, Information, and Communication are currently very influential and have positive implications in the world of education (Ningsih et al., 2023).

Source person

The difficulty for science teachers at SMPN 1 Mlarak is to look for examples that suit the students' current situation. Currently, the development of digital technology is increasingly rapid, and it is difficult for teachers to adapt learning to current advances.

Interviewee: The challenge is the teacher's difficulty in finding specific examples. This means looking for examples that are appropriate to current technology and, of course, those that are related to the material that will be taught. Moreover, we have to adapt to today's advanced technologies. For example, the development of digital technology is increasingly rapid, so children are more interested in it. In the past, traditional examples were enough.

Researcher: Oh yes, because in my mother's time, there was no advanced technology like now.

Interviewee: Yes. In the past, it was different. It was different. Back then, it was the radio era, whereas now, almost all children have cell phones that they can carry everywhere. So, that is our challenge in this digital technology era.

From the quote above, the resource person explains that teachers need help adapting material to examples based on technological advances. Looking at the present, development and progress over time is increasingly rapid, which has implications for the development of sophisticated technology adapted to the needs and demands of society in general. Meanwhile, in the past, there was no sophisticated technology that was as ubiquitous as it is now. With the existence of such technology, it is hoped that this development will also increase the quality of Indonesian education.

CONCLUSION

According to observations and interviews we conducted, it turns out that there are three challenges that teachers experience during learning by applying socioscientific issues, including the first, students' abilities, time constraints and difficulties in finding relevant examples. aspects of students' level of understanding greatly influence the progress of learning, while students at SMPN 1 Mlarak are less able to work on test questions that refer to indicators of remembering, analyzing and grouping. Apart from that, the challenge of limited time can also interfere with in-depth learning regarding science content related to learning socioscientific issues. Time limitations are caused by the different characters of teachers and students. The final challenge is the difficulty of finding relevant examples, this is because teachers are less able to master today's advanced technology. This makes SSI learning planning difficult to implement.

Suggestions for the future: There should be an exceptional learning community for science teachers. The community is designed to provide a facilitative learning environment, assisting junior high school science educators in developing new skills and perfecting their teaching practice over time. So that the community is used to share experiences and carry out ongoing evaluations. However, because the development of socioscientific issues learning is something new for each teacher, they must adapt first to adjust to the existence of this supporting community. Apart from that, Socioscientific Issues are rarely applied in the middle class, Therefore, it is natural that a teacher must still be more explicit about implementing Socioscientific Issues learning.

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