



# Analysis of Higher Order Thinking Skills and Science Process Skills in 21<sup>st</sup> Century Education

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**Abstract.** An important demand of 21st century education is to improve students' cognitive abilities. Higher-order thinking skills (HOTS) and science process skills (SPS) emphasize knowing facts, relating them to other relevant information, and using them to solve new problems. Based on the data, more than 50% of the implementation of learning is not principled in the nature of science. In fact, the changes to the independent curriculum have not fully supported good learning practices. This paper aims to review the factors that influence the application of HOTS and SPS in science learning in schools. Information was collected by purposive sampling using a qualitative methodology. This study revealed that three out of nine school principals stated that they had never conducted socialization on the implementation of HOTS and SPS. planning, implementing, and evaluating learning that is not yet mature and the teacher's limitations in understanding are the main factors in not implementing HOTS and SPS in schools. The principal has a central role in motivating teachers in their implementation so that teachers' perceptions of HOTS and SPS have an impact on students' cognitive abilities.

**Keywords:** Cognitive Abilities, Higher Order Thinking Skills, Science Process Skills, 21<sup>st</sup> Century Education

## 1 Introduction

Science learning in SD/MI must use scientific inquiry to teach students to think, work, and behave scientifically and communicate it as a life skill. is a process, the key to scientific progress? Thus, SD/MI science education emphasizes process skills and scientific attitudes. The basic science skills competency explains HOTS and SPS mastery. Higher-order thinking skills (HOTS) must be maximally developed in the education system to prepare students for 21st century situations [1] [2] [3] [4] [5] [6]. School teachers and curriculum creators must accurately interpret and use curriculum supports. These parties are very important for optimizing HOTS and SPS because they construct learning with the paradigm and nature of science learning recommended by the curriculum. First, mapping students' HOTS and SPS knowledge to optimize their development. Teachers can create the best scientific lesson plans for students based on their understanding [7].

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However, the implementation of science learning at SD/MI in Magelang Regency violated science, especially HOTS and SPS. Data shows less than 50% of SD/MI adopt HOTS and SPS-based scientific curricula. The government socialized HOTS and SPS-based science learning before pushing it. Reviewing the opinion of the science instructor on the implementation of SD/HOTS MI and SPS could be an improvement. Students' thinking skills depend on the teacher's HOTS application skills. The teacher teaches thinking skills to students. The teacher's knowledge in teaching thinking encourages students' thinking, so student achievement depends on the teacher [8].

According to Law Number 14 of 2005, teachers must have four skills to achieve national education goals. Professional education can develop pedagogic, personality, social, and professional competencies [9]. Herlen recommends watching (gathering data, measuring), planning (asking questions, predicting, constructing questions), hypothesizing (suggesting, explaining), interpreting (examining evidence, evaluating), and communicating (presenting reports, making use of secondary sources). Rezba simplifies essential science process skills into 6 categories. Scientists observe, classify, measure, infer, predict, and communicate [10].

It is very interesting to learn teachers' opinions about HOTS and SPS because of the varied application of curricula and learning approaches. Scientists use SPS to conduct research. Direct experience in developing SPS because children appreciate processes or actions. Process skills are intellectual, manual, and social. SPS requires students to think. Demanding learning using tools, materials, and tools. Social skills are needed to discuss observations, ask questions, and communicate during the teaching and learning process. Process skills must be learned through doing. Hands-on experience enhances understanding [11].

There is a lot of research that has been done to analyze higher order thinking skills (HOTS) and science process skills (SPS) today. Most of the researchers focused on developing HOTS and SPS assessment instruments. This, of course, has not fully analyzed the main factors regarding HOTS and SPS in 21st century learning. This research originates from previous studies conducted [12] regarding the development of HOTS assessment of learning instruments. The author reveals that HOTS serves to assess whether students already have higher-order thinking skills such as: C4 (analyzing), C5 (evaluating), and C6 (making). HOTS he quality of thinking ability which is conceptually based on the thinking level of Bloom's Taxonomy. development of HOTS assessment instruments that can be used in learning.

A study on the development of a two-level multiple-choice test to assess Indonesian elementary school students' HOTS. The author reveals that the assessment of higher order thinking skills (HOTS) provides little opportunity for students to develop deeper knowledge, serving students' abilities to identify and solve their problems [13].

Testing the effectiveness of the tools used to measure students' higher-order thinking skills when studying physics, the authors explain that many students are currently still considered to lack high-order cognitive skills [14]. Regarding efforts to advance education, higher order thinking skills (HOTS) in the teaching and learning process are indispensable in accordance with the developments and demands of the evolution of education today.

Subsequent studies have focused on developing tools to assess teachers' higher-order thinking skills. HOTS identification as one of the important talents of the 21st century for future generations [5]. Investigation of how scientific mindset and scientific method abilities interact with understanding of technological content. The author communicates a scientific attitude and basic scientific process ability using a quantitative approach, which interacts well with technological pedagogical subject knowledge. This needs to be improved and expanded in the process of making the science curriculum for prospective teachers as well as in the science learning process in the classroom by teachers and lecturers [15].

Study of instructor tendencies to use scientific method knowledge when teaching science to elementary school students. Teachers have created lesson plans that integrate science process skills into the learning process, according to the author's qualitative analysis. The teacher plans all the basic components of science process skills, including observing, classifying, measuring, predicting, drawing conclusions, and communicating[9].

The problem that arises is that there is no analysis of HOTS and SPS which is used as the basis for the development of the current research. Many studies have developed HOTS and SPS assessment instruments [12] [13] [14] [16]. Apart from that, there was also much discussion on HOTS and SPS reviews from various aspects [17] [18] [1] [19] [20] [21]. However, there has been no in-depth discussion of HOTS and SPS analysis in 21st century learning. Therefore, this study shows the novelty of teachers' understanding of HOTS and SPS before implementing and developing from many aspects.

From some of the descriptions above, it is confirmed that in order to support 21st century education about HOTS and KSP, in-depth analysis is needed. For this reason, it is interesting to carry out analytical research on HOTS and science process skills in 21st century education. Several components that can measure the success of the science teaching and learning process, namely the variable quality of the science teaching and learning process, students' attitudes towards science, student learning interest, students' ability to solve science problems infrastructure variables, higher order thinking skills, and teachers regarding higher order thinking skills and science process skills.

## 2 Method

This type of research is qualitative, and the research design used is narrative. This research was conducted in the Muhammadiyah 9 Elementary School, Magelang Regency. Principals, students and science teachers were the main participants in this research project. Data collection in this study was carried out through observation, interviews, and documentation. The act of collecting field notes is known as observation. Observations were made by directly observing and documenting research objects, especially by looking directly at the science learning process at 9 Muhammadiyah Elementary Schools, Magelang Regency. This is done to collect research data.

In a qualitative interview, the researcher will ask one or more participants open-ended questions and document their responses. This can be done with more than one

person. Interviews were conducted to obtain information about SPS planting plans. RPP and other types of documents include the types of documentation used by researchers.

In this study the data were analyzed using an inductive descriptive approach. In particular, the analysis is based on the data obtained, and from it a definite pattern of association is generated. Research data is analyzed continuously from the beginning to the end of the project. According to Miles and Huberman's proposal, actions in qualitative analysis must be carried out both during data collection and immediately after completion within a predetermined amount of time. Data reduction, data presentation, and conclusion development and verification are the tasks performed during data analysis.

The source triangulation approach is used to determine whether the data under study can be trusted or not. The data obtained is checked using various sources to do source triangulation. These sources include students, science teachers, and principals. Checking data from the same source using multiple methods, such as observation, interviews, and documentation, is an example of methodological technical triangulation. If the results of the three methods of credibility testing are not the same, the researcher will conduct additional discussions about the relevant data source to ensure the most accurate data.

### 3 Result and Discussion

This research will discuss the factors that influence the implementation of HOTS and SPS in 21st Century Education. This research is limited to the main factors that can affect the learning process in the classroom which comes from the teacher. Higher Order Thinking Skills and Science Process Skills in 21st Century Education are inseparable from the role of the teacher in every learning process in the classroom. This is in accordance with the results of the research disclosed [22] that the teacher is one of the determining factors for the success of learning. However, teachers can also be the main factor causing misconceptions [23].

A learning atmosphere that has the nuances of HOTS and SPS is created when the initial concept of this is embedded in the personality of each teacher. However, this is inseparable from the role of the school principal when instilling HOTS and SPS values through the socialization that has been carried out.

Based on the results of the data obtained in the field, it shows that 50% of school principals have not socialized HOTS and SPS to teachers. The remaining 50% of school principals have carried out socialization on HOTS and SPS but have not implemented these values in practice. Some of the main problems are because students' HOTS abilities are still low [24].

The lack of teacher knowledge about HOTS and SPS, as a result of the lack of socialization of HOTS and SPS in schools prompted researchers' questions to respondents about the continuity of the socialization of the preparation of lesson plans which shows that 100% of teachers have received socialization on the preparation of lesson plans from the implementation of KKG activities. In principle, all teachers have prepared lesson plans which are approved by the principal on a weekly, monthly and semi-annual basis depending on the policy of the respective principal. The contents of the prepared

lesson plans do not fully contain and encourage students to make observations, interpret, classify, predict, communicate and hypothesize. Study of instructor tendencies to use scientific method knowledge when teaching science to elementary school students. Teachers have created lesson plans that integrate science process skills into the learning process, according to the author's qualitative analysis. The teacher plans all the basic components of science process skills, including observing, classifying, measuring, predicting, drawing conclusions, and communicating [9].

This shows that the impact of the lack of dissemination of HOTS and SPS to teachers results in teachers not integrating process skills in every step of the activity in each lesson plan. To support 21st century learning, teachers always identify and map students before implementing learning. In addition, the teacher always conducts assessments, ranks the final grades, and predicts the possibilities that will occur after applying learning media.

## 4 Conclusion

This research provides new findings about HOTS and SPS which will be implemented if the school principal socializes and oversees their implementation through the preparation and presentation of lesson plans and the results of student evaluations in each science lesson. If this is done, the research will provide new information that will be implemented. The findings of this study indicate that SD/MI principals have considerable control over 21st century educational practices such as HOTS and SPS. Thus, it can be concluded that the principal has a central role in mobilizing teachers in the implementation of HOTS and SPS so that it has an impact on students. Suggestions for further research, namely that HOTS and SPS assessment instruments can be developed in 21st century learning.

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