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The Dominant Science Process Skills Practiced by Pupils During Teaching and Learning of Science

Nuraini Abu Bakar, Siti Salina Mustakim, Aminuddin Hassan, Fazilah Razali
Faculty of Educational Studies, University Putra Malaysia, Malaysia

Abstract
Children must be scientifically knowledgeable to succeed in an increasingly technology society. Therefore, the science curriculum is designed to educate pupils in science so they can become scientifically literate. Science Process Skills (SPS) are essential to solve problems or make decisions systematically. Pupils that actively participate in science learning by utilising process skills, conversations, and experiments attain a greater level of meaning and dispel stereotypes about rote learning. Thus, this study focuses on the dominant of SPS practised by pupils' during teaching and learning of a science in elementary school based on classroom assessment. The triangulation for a qualitative method is employed and analysed using NVIVO 12 Plus software. Data were gathered from six teachers and twelve fifth-grade pupils selected purposively. The findings show three themes related to the dominant of pupils' science process skills for: i) Pupils most favourite SPS, ii) The easiest SPS and iii) Frequency of pupil using SPS in Science lesson. As a conclusion, based on their responses and sharing session during the interview, the majority of pupils consider that observation skills are the most dominant SPS in comparison to other skills. To determine the impact on student learning, additional study on the relationship between the dominant SPS and the level of pupil understanding in Science learning should be conducted.
Keywords: Science Process Skills, Dominant, Primary Science Curriculum, Observation.

Introduction

To keep pace with the global Industrial Revolution 4.0, all stakeholders must act quickly to keep up with the rapid development of technology products and smarter automation systems. Human capital's capacity, which is based on scientific literacy, is the critical factor that serves as a catalyst for this revolution, elevating the development of high-tech products. As a result, educational reforms are required to place a greater emphasis on science knowledge for students beginning in primary school. Science education was introduced to all primary school students in the first grade using the Standard-based Curriculum Primary School. The primary objective of Standard-based Curriculum Primary School for Science is to develop students' scientific and critical thinking abilities.

Background of the Study

Standard-based Curriculum Primary School for Science places a premium on inquiry and problem solving within the Malaysian curricular framework. For inquiry and issue solving, scientific and critical thinking abilities are essential. Scientific skills are required for activities that require the use of scientific methods, such as experimentation and project management. There are two types of scientific skills: science process skills (SPS) and manipulative skills. SPS are specifically defined at the primary school level as learning requirements that pupils must meet before continuing their studies at the secondary level.

Science Process Skills

(Duruk et al., 2017) define SPS as tools for learning about the world. These characteristics are required for pupils to conduct scientific investigations as part of the learning process (Tilakaratne & Ekanayake, 2017). As we believe, SPS develop naturally and spontaneously in the majority of our unique minds. Pupils engaged in active investigation and development of their own natural science concepts are unable to separate their learning process from their SPS. Throughout their tasks, the SPS enables pupils to locate pertinent science concepts. Pupils that actively participate in science learning using process skills, dialogues, and experiments have a deeper understanding of the subject and disprove misconceptions about rote learning (Choirunnisa et al., 2018). Furthermore, pupils are more active if exercises or games are involved in their learning process. It is because learning only happens when students understand what it is taught (Mat & Mustakim, 2021). Beginning in primary school, pupils must get familiar with the SPS in order to develop the essential concepts and other higher-level thinking skills. The greater the SPS, the more satisfactory the children's conceptual status. As a result, this study will concentrate on the dominance of SPS practices by pupils during Science teaching and learning.

Methodology

This paper applied a qualitative research design with a primary focus on a case study. Twelve fifth-grade students were chosen for this study using a purposive sampling technique. Year five pupils are the most qualified candidates since they have been exposed to all twelve SPS since fourth grade. Pupils are chosen for this study based on their attitude and varied degrees of academic achievement, specifically in Science. The data for this study were exclusively acquired through in-depth interviews. The interview sessions were performed virtually due to the movement control order (MCO), with the researcher meeting each of the twelve participants separately via the Google Meet platform.

Results and Discussions

The term "dominant" in this study refers to one of the SPS that has the greatest influence on children and is regularly applied in their Science learning. Three themes are associated with the dominant SPS used by pupils during science teaching and learning:

1. Pupils' most favorite SPS
2. The easiest SPS to pupils
3. Frequency of pupil using SPS in Science lesson

a. Pupil most favorite SPS

Based on the excerpts, there are four SPS were named by the pupils as their favorite SPS; making inferences, observation, measuring and using numbers and experimenting. There are two pupils mention on the skills of making inferences as their favorite SPS.

> "My favorite science process skill is making inferences. This is because I have the opportunity to study reasonable reasons for the results of an experiment." [IV:Ainul:26.11.20]

> "The SPS that I like the most is making inferences. This is because I can study the logic reasons on the results of experiments. Sometimes, I think that it's quite tough, but I love making inference." [IV:Aisyah:26.11.20]

Making inferences can be defined as arriving at a rational conclusion based on observations or on facts in the absence of observations (Duruk et al., 2017). The first pupil stated that she enjoys the ability to make conclusions because it enables her to investigate each experiment's unique rationale. As a result, she will gain a better understanding when she observes for herself. Turiman et al (2012) supported this finding by stating that students must master science process skills in order to learn about the world of science and technology in more detail. Students can study science in a meaningful way through an investigation of constructivist-based science process skills. Additionally, teachers cannot force students into believing in anything other than their own developing understanding of the subject. Another pupil agrees with this evaluation, despite her difficulty with making inference.

The next pupil's favorite SPS is observations. Observation refers to the result of observation, which is evidence or fact in the end, as a basic method of collecting knowledge about phenomena via the senses in an analytical context (Darmaji et al., 2019). This skill is considered as the first and most crucial phase in the SPS process, as it lays the groundwork for following skills (Hafizan et al., 2010). It's unsurprising that pupils choose this skill as their favorite SPS, given how frequently they utilize it in science projects and activities.

> "I prefer to observe because observing is the easiest SPS to do, and at the same time, I have also mastered those skills. We have to examine the material or specimen using the senses of the eye, the sense of smell, the ears, the sense of taste and the sense of touch."
> [IV:Irdina:17.12.20]
> "I like observing...because we can see ...we can use our five senses… sight, hearing, taste, smell and touch to obtain the necessary information."
> [IV:Haziq:26.11.20]

According to the extract, the pupil chose observation skill as her favorite since it appeared to be uncomplicated. When a pupil truly understands the SPS, they gain confidence in investigating further SPS and have an easier time comprehending the Science subject. While another pupil responds that he enjoys observation since it enables him to use his senses to obtain valuable information about the investigation.

The next most favored SPS among pupils is the skill to measure and use numbers. Pupils must demonstrate their skills to measure using a measuring tool, obtain answers using formulas, and perform calculations. This skill is not appropriate for many pupils because it typically requires a working knowledge of Mathematics.

> "The SPS that I like are measuring because I will know the size or length of the item when measuring an item. I measure length, volume, weight."
> [IV:Idi Amin:18.12.20]

On the other hand, this pupil may be doing well in Mathematics and enjoy working with numbers. However, based on experience, this skill is more focused on pupils using the device and reading measurements in the appropriate unit of measurement. The teacher should create opportunity for pupils to acquire this skill during their science session by selecting relevant teaching methods and activities. The greatest ways to practice this skill is through guided activities and teacher facilitation. The final SPS that was highlighted as a favorite skill by the pupil was experimenting.

> "Like experimenting, it is difficult, but I like that kind of activities."
> [IV:Aisyah:26.11.20]

According to the extract above, the pupil admits that while experimenting is a tough skill to master, she enjoys it tremendously. Experimenting is defined in the context of the primary Science curriculum as employing fundamental science process skills to gather and interpret data, summaries to support the hypothesis, and create a report. A pupil must follow certain steps in order to perform an experiment, and the pupil must be able to master nearly all of the SPS. Without an understanding of the relevant SPS, it will be difficult for a pupil to do an experiment correctly. What the pupil is attempting to convey is that she is only interested in the hands-on activities and not in the more important scientific skills. As such, the term "tough" alludes to the scientific skills SPS; she is supposed to acquire. Teachers must acknowledge that their pupils still require extensive coaching in order to learn the skill of experimenting, rather than simply engaging in enjoyable activities. Despite the fact that this skill requires a deeper understanding and involves the majority of the basic and integrated SPS, pupils have their own reasons for making their choices.

> "I love experiments. Because I like to do experiments, this activity is a lot of fun. It's fun to go to the science lab, and the teacher rarely brings me..it's great; I can see his stuff. At home, I do experiments like planting

> trees; we plant those trees from seedlings to trees, for example, onion plant, curry plant."
> [IV:Harraz:17.12.20]

Pupils like his experimenting skills since he enjoys participating in science activities in the science room. He is unsatisfied, though, because his teacher rarely brings him to the science room. This suggests that experiential learning is more practical and appears to have a longer memory for learners' cognitive abilities. SPS are critical for students to understand science topics through an inquiry-based process. Pupils are supposedly needed to demonstrate by hands-on experimentation (Rustan et al., 2020) or investigation, not to choose from a list of options when presenting the hypothesis, defining it operationally, and identifying variables (Balanay, 2013). According to [4], a written test cannot determine if pupils will be able to exhibit the required process competence unless the pupils demonstrate it. Additionally, [5] demonstrated that the inquiry laboratory teaching technique is more successful at establishing scientific process skills in biology secondary school students.

b. The Easiest SPS

The easiest SPS might be defined as the one that is the most straightforward and appears to pupils to be the simplest. It's unsurprising to discover that the pupil's favorite SPS has reappeared and is seen as the easiest skill. The first SPS that has been identified as easy for pupils is observation. This skill is viewed as the first and most critical stage in SPS since it serves as the foundation for all subsequent skills.

> "The easiest SPS to understand are observation skills because they are only done by observing the material, object or specimen being tested."
> [IV:Irdina:17.12.20]

> "For me, observing is the easiest SPS because you have to use your sensed. It is easy. I can do that even if the teacher doesn't teach me."
> [IV:Aisyah:26.11.20]

According to one of the pupils, she is able to comprehend the skill of observation despite the fact that she has not received a formal lesson from a teacher. This indicates that the pupil views this skill as easy and uncomplicated. Another pupil's definition of observation through the eyes, on the other hand, indicated that she was forgetting the other senses.

> "The easiest skill for me to understand is observation because it use your eyes.."
> [IV:Syifa:25.11.20]

She is clueless that observation is a fundamental skill that enables information to be gathered through senses other than the eyes. This is a widespread misunderstanding among pupils regarding observation ability. They defined observation using the term "to observe or view with one's own eyes." Pupils have been introduced to the definition of observation as to see

in other related disciplines, such as language. Multiple concepts of observation will perplex pupils and finally result in misconceptions about what they are learning.

However, the second SPS that pupils claimed as easy is the communication skill.

> "I prefer communicating.. as it is easy to understand. We can communicate even through a WhatsApp. We communicate to interact with other people to present the findings of investigation."
> [IV:Haziq:26.11.20]

This pupil selected communication as a skill since it appears to be simple to him. He repeatedly refers to presenting the investigation's results. The second of the basic science process skills is communication, which is closely related to observation. Pupils must communicate in order to share their observations with another (Malik, 2017). If the other person is to comprehend the information, the communication must be clear and effective (Joseph et al., 2017). Besides that, one pupil highlighted the skill to experiment which he thought was easy.

> "The easiest is experimenting because I can see it "live" and the results can be discussed with teachers and friends."
> [IV:Harraz:17.12.20]

The excerpt highlights how the pupil views experimenting as the easiest skill for him. According to him, he can observe the process of any scientific inquiry 'live,' and he can discuss the findings with his peers and seek help from his teacher. According to (Joseph et al., 2017), investigation-based laboratory activities enable pupils to engage in meaningful learning, practise science process skills, and get familiar with the process by which they can construct the information acquired from science classes. The final SPS that the pupil rated as the easiest is the skill to classify and predict.

> "Classifying is also simple because I have to separate according to the groups, for example like pi ns, paper ... according to its similarity. No. 3 I choose predicting because sometimes I like to predict things..like weather..it's looked cloudy, right, we know it is going to rain."
> [IV:Aisyah:26.11.20]

The pupil regards this skill as simple since she has learned the skill to classify objects according to similar qualities. Classification is essential because it recognizes the basic concept that similarity in one area usually results in similarity in another. Additionally, grouping current or newly found objects or information into different categories keeps them from becoming obscure or lost [1]. Simultaneously, she preferred the ability to predict in order to apply it in daily situations.

Predictions can be made by conscientiously observing in order to collect data or by identifying the pattern of the data. Occasionally, pupils are taught to make appropriate predictions based on patterns or prior experiences (Joseph et al., 2017). In this excerpt, the pupil predicts that it will rain due to the 'cloudy day.' She made predictions based on her prior experience. This is the foundation upon which scientists conduct the majority of their scientific inquiry or investigation processes.

c. Frequency of applying SPS

The number of times teachers applied or practiced SPS with their pupils in the classroom or science lab is referred to as the frequency of implementing SPS. The teachers' reflections on their pupils' accomplishments lead to the theme. They discussed how frequently SPS was utilized in their classrooms and how they were attempting to persuade pupils to think about it. This theme is important because it will provide more information regarding pupils' participation in SPS, which will have an impact on SPS's dominance.

As per the excerpt, the majority of teachers indicated that they use the SPS on their pupils for more than half of their session. It implies that they are making every effort to instill the SPS in pupils' learning. Children learn how to learn by thinking objectively and using knowledge creatively, and they continue to learn by making discriminating observations, arranging, and examining facts or concepts, providing explanations for specific outcomes, assessing and interpreting findings, drawing justifiable conclusions, and practicing science process skills (Amnah et al., 2013). As a result, it is important to expose pupils to SPS on a regular basis. Each teacher, on the other hand, has their own justification for why they are putting up the effort to teach SPS to pupils. The first teacher explained how he teaches the SPS using science activities.

> "More than 50%. While pupils are conducting experiments, pupils need to make observations, measure, making inferences and communicate. Not only in the science room, SPS is also used in the classroom when pupils are required to interpret information, finding variables and making hypotheses."
> [IV:Azizi:21.11.20]

According to the excerpt above, the teacher assigned the investigation with a greater percentage of SPS to his pupils for practice on purpose. He noticed that pupils enjoy conducting experiments and that by utilizing this approach, he can introduce his pupils to SPS more thoroughly. According to (Amnah et al., 2013), if teachers believe that pupils will eventually grasp the concept in a science class, the purpose of science education may be missed. Science teaching should be planned and delivered concurrently with the goal of instilling science process skills in pupils and ensuring their development. Additionally, the teacher stated that his pupils are familiar with the skill to observe.

> "It is always more than 50% in each teaching and learning session. For example, when an issue or question arises from a pupil about an event or

> observation from an activity carried out, I will return to the pupil to think and predict the cause or reason of something happened. Pupils will be motivated to think and make observations and then make predictions or conclusions about the event on their own."
> [IV:Siti Roha:19.11.20]

The teachers used SPS in Science activities at a rate of more than 50% on average, as seen in the excerpt. This suggests that the SPS was only exposed to the pupils for 32 hours if the teacher spent at least 64 hours a year teaching Science. The teacher twisted the pupils' questions in order for them to be debated with the rest of the kids in the class. Pupils may have a lot of questions on their minds at times, especially when doing hands-on activities. It's not rare for 11-year-old children to ask a lot of questions. Furthermore, for children who are always asking questions, watching, touching, and tasting, science is a natural challenge. It includes self - awareness of living things, and awareness of the entire environment as a result of our senses and investigations (Ghazi & Karim Ullah, 2015). As a result, in order to improve their thinking skills, the Science teacher must be eloquent enough to influence their responses as a facilitator.

On the other side, the third teacher states the exact opposite of her pupils' views on the SPS. Despite the fact that her pupils are from the weak category and that her class is the last, she is working hard to instill the SPS in the classroom. Learning is difficult in this situation, and the teacher must be very motivated to deal with this unique group of pupils.

> "About 50% in each teaching and learning session, because pupils are quite difficult to understand. A large number of pupils in my classroom are not really active and relatively weak in lessons."
> [IV:Laila:2.12.20]

As the teacher explained, she is responsible for a large number of pupils who are incompetent in science. Pupils that are weak in the subject area may not be able to apply these science process skills at all, according to (Ong Saw Lan et al., 2007). This is because, in an inquiry-based approach, science process skills are required for pupils to master the content of science knowledge. If pupils struggle with the SPS, it may have a major impact on their science knowledge acquisition. Nonetheless, the teacher acknowledges that her pupils are well-versed in observation and communication skills, which she believes will be beneficial to them.

> "My pupils are good in observing and communicating, maybe it's easier for them to understand."
> [IV:Laila:2.12.20]

Her belief is that by learning at least the fundamental SPS, her pupils will gain a better knowledge of science. Regardless of her pupils' low levels of achievement in Science, she intends to boost their interest and understanding of the topic by implementing more hands-on activities.

This shows that not only do pupils appreciate observation skills, but some teachers also place a high value on them. They believe it is the most basic skill and the most straightforward for pupils to apply into their daily life. If, on the other hand, the teacher focuses solely on basic SPS without emphasizing integrated SPS, the pupils will struggle when they need those skills in the future.

Conclusion

The SPS that are dominantly practiced by pupils are also influenced by pupils' most favorite SPS, the easiest SPS to pupils and the frequency of pupil using SPS in Science lesson. Majority of pupils preferred the skill of observation as their favorite in almost each theme. Observation is the most fundamental skill in science process skills when pupils conduct experiments. They receive information about items or occurrences in their environment using all their senses. Through hands-on activities such as science experiments, children engage their various senses by touching, feeling, moving, observing, listening, and smelling, as well as occasionally testing objects in a controlled environment (Ongowo, 2017). This assists pupils in progressing from concrete to more complex thinking levels (Wood et al., 2007), hence promoting higher order thinking abilities necessary for 21st century success. Knowing that the majority of pupils are confident in this skill, the teacher can use it to connect it to other SPS, ensuring that all SPS are learned equally by all pupils.

Corresponding Author

Dr., Siti Salina Mustakim
Universiti Putra Malaysia, Faculty of Educational Studies
Email: mssalina@upm.edu.my

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