

Scientific Skill Development In Kindergarten Education Post-Covid-19

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Abstract

This study aims to analyse scientific skill development at kindergarten level post covid 19. Nevertheless, this early finding required further investigation as classes were conducted online during the covid breakout, while science classes command experiments. This study was conducted in Pekanbaru, Riau Province, Indonesia. 400 kindergarten students from 3 different schools were recruited in this investigation. The data were analysed using descriptive quantitative and a t-test was conducted. The findings suggest that the average of kindergarten students in scientific skills is in a good category. It also illustrates that students have the ability to activate their senses to commence an observation, classification, comparison, measurement and communication on things they visualise. The figure shows that students scored higher in the comparison category (88.54%), while the measurement category witnessed the lowest number, accounting for 72.28%. To identify if there is a difference in scientific skill in gender and parents' socio-economic status, a hypothesis test was conducted. The test shows that there is no difference in gender in scientific development among students. Nonetheless, there is a correlation between scientific skills and parents' social status. The hypothesis test indicates that children of social status have higher science skills compared to those from lower social status.

Keywords : Scientific skill development, kindergarten, gender, economic status, Post-Covid-19.

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Introduction

The scientific process is an approach employed to recognise and acquire knowledge about science. Abruscato (1996) states that mastery of the scientific process is aimed at planning and science activities that can assist students in comprehending science skills holistically. While Asy'ari (2006) implies that the scientific process is a way of thinking and problem-solving. In attaining information and sciences a person will commence ways of working or scientific methods to come to a conclusion or solution. In line with that, Bundu (2006) indicates that the scientific method is divided into two domains; basic and integrated science. The scientific skills that can be developed or trained for kids are included in basic skills.

The introduction and acquisition of scientific skills are one of the learning objectives at the kindergarten level. Science lesson at this school level does not only emphasise acquiring information from teachers but provides discovery learning for pupils. Monks (2001) states that children will learn better if they discover the knowledge instead of the teacher's dictation. To add on, Bruner (1997) emphasises that acquiring knowledge through discovery learning can help students stimulate their intellectual capacity, improve their intrinsic motivation, comprehend how the knowledge is attained, and improve memories. The involvement of students in the discovery of knowledge and information with proper procedures is one of the indicators of holistic science learning. Inevitably, scientific development skill in essence is to figure out an important science product to be introduced and mastered by children. This skill development is aimed at students' capacities in exploring knowledge and information and solving problems that might appear.

Learning sciences at the Kindergarten level should be inspired by kids' surroundings, interesting and less complex. Apart from that, the topic chosen must be familiar or consist of things that children knew, are well-prepared, and simple. Science classes at the kindergarten level should pay attention to learning methods. The selection of learning methods should be considered in offering students to be actively engaged, have fun and facilitate them to explore their surroundings. Science lessons at school can be introduced through simple experiments. These activities are commenced by combining and integrating some methods that enable students to engage actively in activities such as conversation and experimentation. Surrounding topics from their lives, interesting and simple can be introduced by several

scientific experiments such as object motion, water, air, fire, sound, light, magnet, etc. Inevitably, in those simple experiments, kids will actively construct knowledge and information by following proper techniques and procedures. Hence, these experimental measure students' scientific ability and develop critical thinking (French, L. A., & Woodring, 2013) (Akgündüz, D. & Akpınar, 2018) (Alabay, E. & Özdoğan, 2018).

Scientific development skills observed in this study are basic science concepts synthesised from experts and adapted based on students' abilities. These skills include observation, measurement, communication and classification (Soylu, 2016). In line with that, Ayunda and Safira (2020) also highlight five indicators to measure students' scientific skills including observing, classifying, comparing, measuring and communicating. Hence, scientific skills taught at school should be aligned with lesson themes. For instance, when teachers conduct experiments on floating and sinking, students are required to achieve observation skills. Other than that, these pupils will also learn how to measure, communicate and classify.

According to Suyanto (2003), Akgündüz, D. & Akpınar (2018) activities involved in scientific classes promote the idea of highlighting the process instead of the final product. This aims to train children in critical thinking. For children at a kindergarten level, scientific skills that can be developed are observation, measurement, communication and classification. Observation trains their senses on their surroundings and develops their curiosity. In terms of communication, scientific skills help them to enunciate ideas from the entire process and re-share the piece of information with others. Lastly, classification trains them to oversee the similarities and differences of certain objects and how these things are correlated.

By understanding the underpinning idea of the scientific lesson at kindergarten, selecting the appropriate methods that focus on students centred learning is crucial in order to attain a good result. Besides, the selected methods should facilitate students to learn and attain knowledge and information simultaneously. The experimental method is an alternative to science learning for children. This method provides opportunities for children to carry out various experiments both individually and in groups. In practice, the experimental activities were carried out by combining several interrelated methods, such as the question-and-answer and observation methods.

However, experimental methods require interactions between teachers and students. In fact, during the covid-19 breakout, all classes were conducted online. This circumstance directly affects how science classes are conducted; adaptation is highly demanded and has been

shown very challengingly, especially during the early of covid-19 breakout. At that time, online lessons are new things and educational institutions are concerned about whether they can provide the same quality of education as before the pandemic and movement control took place. In response, the government and all related parties had a joint effort to address this challenge.

After years of studying from home, children are returned to schools for face-to-face classes by following strict health protocols such as using face covering and social distancing. This situation undoubtedly causes inconvenience for students and teachers and will not directly make teaching and learning run smoothly as before the pandemic. Teaching and learning can be disturbed as individual needs to keep other safe from the disease. The health protocol measurement is implemented in order to stop the pandemic.

Based on the description above, this study aims to

1. To analyse the level of students' scientific skills at the kindergarten level post-covid 19.
2. To examine the difference in the level of science process skills by gender.

To examine the effect of economic status on the ability of kindergarten students' scientific skills after Covid 19.

Literature Review

Definition of Science Process Skills

According to Charlesworth (2010), science process skills enable children to process new information through concrete experiences. Scientific process skills are skills that mean the ability to use thought, reason, and action efficiently and effectively to achieve a certain result, including creativity.(Setyaningrum & Husamah, 2020). While the process can be defined as a set of complex skills used by scientists in conducting scientific research.(Rahmawati, 2020). The process can also be broken down into components that must be mastered by someone when doing research.(Viyanti et al., 2018). Science process skills are skills that involve all children's abilities in acquiring knowledge based on phenomena. The child's abilities in question are the skills of observing, grouping, interpreting, predicting, asking questions,

hypothesizing, planning experiments, applying concepts, communicating and carrying out experiments.(Guswita et al., 2018).

Furthermore Mayar (2018), stated that learning from sources in the surrounding environment and other supportive environments will encourage children to show their learning activities. Children will try to observe, seek and find various important knowledge and concepts related to various fields of development so that children's development develops in line. Learning science in nature or the use of natural materials is expected to be able to develop process skills which are important tools for scientific education. According to Mayar (2020), education is one of the necessities of life that is very necessary to develop human competence through learning.

In detail, science process skills are skills performed by scientists. This is seen from the level of complexity in its use, science process skills are divided into two parts, namely basic process skills (basic skills) and integrated process skills. (Land, R in Ibrahim, 2019).

Science process skills are intellectual skills that are owned and used by scientists in researching natural phenomena. The science process skills used by these scientists can be learned by children in simpler forms according to the developmental stages of elementary school-age children. (Usman in Sulistyani Puteri Ramadhani, 2019).

Furthermore, science process skills are skills that involve cognitive or intellectual, manual and social skills.(Sari et al, 2017). Cognitive skills are involved because by doing science process skills, children use their minds. Manual skills are involved because science process skills involve the use of tools and materials, measurement and preparation or assembly of tools and materials. Science process skills can also be interpreted as the ability or skill to carry out an action in learning science so as to produce concepts, theories, principles, or laws or evidence.(Kristyowati & Purwanto, 2019).

Based on the definition above, it can be concluded that science process skills are: acquired processing skills, so that children will be able to discover and develop concepts, theories, and principles of law and facts. Process skills also involve children in achieving conceptual understanding by engaging directly in an experiment related to understanding concepts, such as: the child's abilities include determining hypotheses, predicting, interpreting, concluding, and communicating.

Science Process Skills Component

The science process skill component consists of a number of skills that cannot be separated from each other, but there is a special emphasis on each of these process skills. This scientific process is a cycle in forming hypotheses, collecting data, accepting or rejecting hypotheses, making generalizations, and repeating the cycle. However, concluding and applying requires more abstract thinking, so children should not be required to be formally competent in these skills. According to Charlesworth (2010), the process follows: (1) observing, (2) classifying, (3) comparing, (4) measuring, (5) communicating.

Method

Research Subject

This study is a descriptive quantitative design that aims to investigate kindergarten students' scientific development and compare these skills from several factors. The subject of this research were 410 kindergarten school students and 410 parents. This investigation was conducted in three different public schools in Pekanbaru, Riau Province, Indonesia. The rationality of selecting these schools is based on their reputations as exemplary schools in Riau Province. Data were collected using saturated sampling. The sample consisted of 202 male students and 208 females. The range of age of the students is 4-6 years old.

Data Collecting Procedures

This study was conducted in three public kindergartens from August until December 2022. First, researchers formed an observation team consisting of 15 school teachers and they were recruited based on their academic qualification; bachelor of education kindergarten. The main task of the team is to commence initial first-hand observation in science classes. The team was trained to conduct observation on student scientific skills development. This aims to set a common perception in assessing the score. The training for the team including to determine standard learning processes such as lesson plans and teaching aids. Then, the team was also

informed of the observation sheet and how to fill it.

Data Collection And Analysis

This study aims to investigate students scientific skills and how it compared using distinguish factors. To attain the data, an observation sheet from Ayunda and Safira (2020) was adopted. This observation employed five different indicators including observation, classification, comparison, measurement, and communication. The justification for choosing this form is based on the researcher's stances to depth-observe the subject. For validation, the form was assessed by three qualified experts in the kindergarten school area. The form can be seen in the following table;

Table 1. *An observation sheet of students' scientific skills*

No	Indicator	Assessment criteria		
		Good	Enough	Poor
1	Observing	Students are careful in seeing and paying attention.	Students are quite careful in seeing and paying attention.	Students are less careful in seeing and paying attention.
2	Classifying	Students are good at organizing the information received; distinguish the characteristics of objects based on objects or information.	Students are quite good at organizing the information received; distinguish the characteristics of objects based on objects or information.	Students are less able to organize the information received; distinguish the characteristics of objects based on objects or information.
3	Comparing	Students are good at carrying out the process of examining objects and events in terms of similarities and differences.	Students are quite good at carrying out the process of examining objects and events in terms of similarities and differences.	Students are less able to carry out the process of examining objects and events in terms of similarities and differences.
4	Measuring	Students are good at calculating using both standard and non-standard measuring instruments.	Students are quite good at calculating using both standard and non-standard measuring instruments.	Students are less able at calculating using both standard and non-standard measuring instruments.
5	Communicating	Students are good at sharing observations and data in various ways.	Students are quite good at sharing observations and data in various ways	Students are less able at sharing observations and data in various ways

The data analysis techniques used in this study are divided into the following three categories:

- a. Descriptive percentages are employed to analyse the level of science process skills in kindergarten post of Covid 19.
- b. a t-test was conducted to analyse the different levels of science process skills based on gender.
- c. A chi-square test was conducted to analyse the influence of social-economic status on students' scientific skill levels post Covid-19.

Results

Scientific Skills

Table 2 above represents the scientific process skills of kindergarten students post-covid 19. It can be seen clearly that the comparing indicator obtained the highest score with a percentage of 88.54% (SD = 0.49). This figure shows that children's ability to compare objects based on their observations is quite good. In contrast, the measuring indicator obtained the lowest score with a percentage of 72.28% (SD = 0.48). This shows that children are less able to measure the objects used during the learning process. Children are less able to use their fingers to span the object to be measured.

Table 2. *Scientific Skills Indicators*

No	Indicator	Percentage	Mean	SD	Category
1	Observing	87.07%	2.61	0.54	Good
2	Classifying	73.74%	2.21	0.80	Enough
3	Comparing	88.54%	2.66	0.52	Good
4	Measuring	72.28%	2.17	0.82	Enough
5	Communicating	87.24%	2.62	0.49	Good

The table indicates that there are differences in the achievement of children's science process skills between indicators. However, it is not significant.

Table 3. *Score category of scientific skills of research subject*

Category	Frequency	Percentage
Good	273	66.59%
Enough	132	32.44%
Poor	4	0.97%
Total	410	100.00%

The table above indicates the score category of the research subject. The figure shows that 273 students (66.59%) scored in the good category. In contrast, 4 students, accounting for 0.97% were in the poor category. This statistic implies that on average students have good scientific skills.

Furthermore, to investigate if there is a difference in students' scientific skills between gender, a test was conducted.

Table 4. *Descriptive Statistics Based on Gender*

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Scientific skills	Male	202	12.4158	1.56623	.11020
	Female	208	12.1202	1.60011	.11095

Table 4 above indicates the number of male students was 202 with a mean score of 12.42 and female students accounted for 208, with a mean score of 12.12. Hence, it can be concluded that male students obtained 0.3 higher than the average score of females. Nonetheless, this difference is not significant.

To investigate the difference in skills between males and females, a t-test was conducted.

The table shows that $t_{\text{value}}=1.890 < \text{than } t_{\text{table}}=1.96$ ($1.89 < 1.96$), $\text{sig}=.289$ $p>0.05$ meaning that there is no significant difference on scientific skill between males and females students.

Furthermore, to examine the influence of social economic status on students' scientific skills, a test was conducted to find out if there is a correlation between students' scientific skills and social economic status.

Table 5. *a t-test of students' scientific skill*

		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	T	Df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower Upper
Scientific skills	Equal variances assumed	.047	.829	1.890	408	.059	.29565	.15642	-.0118 .60315
	Equal variances not assumed			1.891	407.974	.059	.29565	.15638	-.0117 .60305

Table 6. *Descriptive Statistics of Social Economy*

		Economic status			Total
		Low	middle	high	
Scientific skills	Poor	1	2	1	4
	Enough	22	58	53	133
	Good	35	165	73	273
Total		58	225	127	410

The provided table indicates that students from middle-status families attained the highest in the “good” category. To identify the correlation between these two factors, a chi-square test was conducted.

Table 7. *Result of a chi-square test on the influence of economic status on students' scientific skills*

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.854 ^a	4	.028
Likelihood Ratio	10.758	4	.029
Linear-by-Linear Association	1.241	1	.265
N of Valid Cases	410		

Table 7 shows that sig 0.028 < 0.05 and *Pearson chi-square* 10.85 > 3.84, meaning that there is a correlation between social economic status and students scientific skills.

Discussion

Level of Students' Scientific Skill

The study finding indicates students' scientific skill was in a good category. The statistics show that 87,07% of students were classified in this category. This figure implies that students were able to use their senses to see and observe in detail. For instance, when there are outdoor activities, teachers instructed students to observe birds. Students stated that when a bird is on the ground, it jumps instead of walking. This simple observation shows that pupils are able to see and pay attention.

Apart from that, the classification indicator obtained a score of 73.74 % or in enough category. It implies that students are quite good to distinguish object characteristics or information. Teachers and parents are required to improve their kids to concretely think so they will be able to classify objects. This result is in line with previous research by Guo, Y., Piasta, S. B., & Bowles, (2015), Olgan, (2015), and Saçkes, (2014). Their investigations revealed kindergarten students tend to require specific stimulation to classify specific objects. They must be provided with a regular and structural experiment.

In terms of comparing skills, students obtained a score of 88.54% which put them in a good category. This result implies students are good at examining objects and events in terms of similarities and differences. The class observation revealed that students were able to distinguish objects' sizes and shapes during the learning process. (Gopnik, 2012)(Broström, 2015) (Piasta, S. B., Pelatti, C. Y., & Miller, 2014) in their studies also highlighted the same point. However, they highlighted that this happened as students received initial stimulation which made them easier to recall and identified.

For the measurement category, students attained a score of 72.78% or in the enough category. This result implies that students are quite good at measuring objects using standard and non-standard instruments. However, students still found employing these measurements quite confusing, particularly when they have to measure during cooking classes. Nevertheless, for the non-standard measuring instrument, the child is classified as good. This non - standardized measuring instrument, for example, is beating. This result is in line with studies by (Jirout, J., & Klahr, 2012)(Karamustafaoğlu, 2011)(Mutlu, M., & Temiz, 2013)(Can, B.,

Yıldız-Demirtaş, V., & Altun, 2017)(S. S. Elkeey, 2017). They stated that students' skills in measuring using non-standard instruments were good. However, students performed poorly when it came to measuring using the standard ones as they still could not figure out how to operate the instrument.

In terms of communication, students scored 87.24% which means they are able to reshare the observation result with the teachers and classmates. For example, in an activity where students had to observe the birds, they were excited to tell to the teachers that birds were jumping instead of walking. This result is supported by studies from (Kalemkuş, J., Bayraktar, Ş., & Çiftçi, 2021)(Ping, I. L. L., Halim, L., & Osman, 2019) (Ravanis, 2017)(Solé-Llussà, A., Aguilar, D., & Ibáñez, 2020)(Solé-Llussà, A., Aguilar, D., & Ibáñez, 2020) that suggest that students' skill in resharing information and knowledge was good. This happened as students are figures who enjoy telling things to others including what they learned and observed.

The findings from this study were unexpected as teaching and learning processes were conducted online for two years during the covid outbreak. Online learning in Indonesia in essence is not the one that was implemented before covid-19 pandemic. The shifting from face-to-face to online teaching and learning required adaptations from the educational institution. Similarly, the unprecedented way of learning affects students at a kindergarten level. Students at this level are prone to distraction and lack of focus, making teaching can be challenging.

Apart from the obstacles mentioned above, teaching scientific skills during a pandemic is really challenging especially in kindergarten school as these skills are normally taught in offline schemes. However, the Indonesian government responded to this situation by implementing an emergency curriculum. It aims to facilitate teachers to run the learning session and to maintain the quality of education during the breakout. This curriculum is designed in more simple structure than the curriculum during pre-covid 19. The emergency curriculum emphasises teachers' focus on teaching and learning instead of administration. As a result, learning objectives are still achievable including teaching scientific skills at the kindergarten level.

Furthermore, the study shows another contributing factor to the high level of students' scientific skills is their environment which is their families. Inevitably, parental guidance and

observation are required in assisting students learning especially those who lack concentration. This parental supports become more crucial in science classes especially when students are assigned to conduct an experiment. Parents' roles during the covid-19 in science class are unavoidable such as preparing the tools. Hence, this support assists students in science classes during covid-19 outbreak.

Differences in The Level of Scientific Skills by Gender

Then, based on the results of the study there were 202 boys with an average score of 12.42 and the number of girls was 208 with an average score of 12.12. Thus, it indicates males scored 0.34 higher than females. However, it is not a significant difference. To add on, based on the t-test result shows that there is no significant difference in students' scientific skills in gender.

The aforementioned statistics are surely related to the findings of the level of kindergarten students' scientific skills which are in the good category. There is no significant difference between male and females score as both categories followed the class during the covid 19. According to the observation, students were enthusiastic during the online lesson specifically during the experimental topic. Despite some differences in learning tools prepared by parents such as laptops and handphones, the result shows there is no significant difference.

Parents who provided children's facilities during online sessions and high children's enthusiasm led to no significant differences in the development of the scientific process of male and female students. This condition certainly affects the readiness of students when carrying out face-to-face learning in post-covid 19 classes. Children are expected to easily participate in science classes as they did during the online classes.

The Influence of Economic Status on Students' Scientific Skills Post-Covid-19

The chi-square test in this study indicates that there is a correlation between parents' socio-economic status and students' scientific skills. Students who are from middle-class families scored higher in those five skills. This can be a result of parents' abilities to identify and address children's curiosity, and also the ability to provide for students' needs.

The work of parents in this study was quite varied. on average parents work as employees with a salary of two million rupiah to 5 million rupiah. a small number of parents work as entrepreneurs with incomes above 5 million rupiah and a small number of parents work as laborers with relatively low incomes.

Children raised in a good economy will surely have the ability to get the facilities they want. When a child has the desire to try new things in life even though it requires a large amount of money to fulfil this, the child tends to get it. In contrast, children from low-income families cannot afford such a thing. Explore new things, is restricted especially those that require large funds to acquire scientific knowledge.

This investigation indicates that the economic status of parents tends to vary. However, the difference in the development of children's science process skills is relatively insignificant. Basically, children who are economically disadvantaged participate in online learning only by using mobile phones whose screens tend to be small, so these children are less able to see in detail the experimental activities carried out by the teacher. This circumstance will make a difference in obtaining information even though the difference is not significant. The results of this study are in line with research conducted by (Spektor-Levy, O., Baruch, Y.K., & Mevarech, 2013)(Ambross J., Meiring L., Blignaut S., 2014)(Andersson K., 2014)(Andiema N. C, 2016)(Brostrom S., 2015)(S. Elkeey, 2017).

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