ATTITUDE TOWARDS SCIENCE AND SCIENCE PROCESS SKILLS OF JUNIOR HIGH SCHOOL STUDENTS

Angelie A. Cabande[1], John Edward R. Gerondio[2], Ethel May Metran[3], and Prof. Jemer A. Alimbon[4]

UM Tagum College, Philippines
[1,2,3]Students, Department of Engineering Education
[4]Faculty, Secondary Education Program
[1,2,3,4]rpctagum@umindanao.edu.ph

ABSTRACT

This paper incorporated attitude towards science and science process skills as the independent variable (IV) and dependent variable (DV), respectively. This study aimed was to determine the relationship of attitude towards science and science process skills of junior high school students of Bongabong National High School through employing quantitative non-experimental process using correlation technique, with 275 students enrolled for the academic school year 2020-2021 as respondents. Mean, Pearson (r), and Regression Analysis were used as the statistical tools for data treatment. Results revealed students' very high level of attitude towards science in terms of academic value, science activity, and classroom environment, and their science process skills at a moderate level in terms of basic process skills and integrated process skills. Accordingly, results showed no relationship between the students' attitude towards science and science process skills which depicts that no domains of attitude towards science that relates to the science process skills of junior high school students of Bongabong National High School.

Keywords: *BS Science process skills, attitude towards science, regression analysis, junior high school, quantitative study, Philippines.*

INTRODUCTION

Science education is a fundamental aspect of the Philippine Education System. Ideally, the main goal of science teaching is scientific literacy, which involves the development of the students' process skills (Corpuz & Salandanan, 2015). The inclusion of science as part of the curriculum helps the children improve their process skills, both basic and integral (Özgelen, 2012). In Programme for International Student Assessment (PISA) 2018, 15-year-old students in the Philippines scored lower in reading, mathematics and science than other countries that participated in the assessment and only 22% of students in the Philippines achieved higher score but almost of the students were not a top performer in science (Besa, 2018). In addition, the Science education rate at PISA 2018 for Filipino students has not yet reached the Organization for Economic Cooperation and Development (OECD) standard (Cordon & Polong, 2020). The OECD standard assessment and PISA impact the education policy in every country, especially in science education, in improving the students' scientific literacy (Froese-Germain, 2010).

Globally, a study in Indonesia showed that the Science Process Skills (SPS) of Madiun State Senior High School students was low (Atush Sholihah et al. 2020). Further, a study conducted in the Philippines revealed that the basic and integrated SPS of private secondary school students in Northern Luzon were average and low, respectively, implying that the students have not fully developed their science process skills yet (Derilo, 2019).

Furthermore, the attitude towards science of the student plays a significant role in the student's decision-making and achievements. Students' interests include science performance, disposition, and attitude towards science, which help close the gap between genders and pursue a career in STEM-related fields (Mostafa et al., 2018). Globally, a secondary school in Odeda Local Government Area of Ogun State Nigeria showed a high positive result of secondary school students' attitudes toward science, which affect their

performance in learning science (Sakariyau et al., 2016). However, a study in Israel stated that the junior high school student's interest in biology subjects was relatively positive but not high due to their negative opinion of science classes (Trumper, 2006). In Bandung, Indonesia, various secondary schools showed that students' attitude towards science was at a medium level, affected by the classroom environment (Sofiani et al., 2017). On a gender basis, girls commonly had lower performance than boys and had a less positive attitude towards science (Lau et al., 2020).Moreover, positive attitudes towards science, which is essential (Maranan, 2017), are never transformed into science process skills (Mirana, 2019). Science process skill and attitude toward science encourage students to develop the concept of science, which eventually builds the academic achievement of science (Zeidan & Jayosi, 2015). However, the result showed that the attitude towards science of the secondary students is highly positive, but the students' science process skills and academic achievement are relatively low (Zulirfan et al., 2018).

Given the above details, the researchers were motivated to carry out this study since the objective of science education is the development of a favorable attitude towards science and the improvement of process skills, both basic and integral. This research was also undertaken since no study has been conducted to assess the attitude towards science and science process skills of junior high school students of Bongabong National High School (BNHS).

The purpose of this study was to determine the significant relationship between the attitude toward science and process skills of junior high school students of Bongabong National High School. Specifically, this study was conducted to seek answers to the following objectives.

1. To describe the level of the attitude towards science of junior high school students in terms of:
    1.1 academic value;
    1.2 science activity; and
    1.3 classroom environment.

2. To describe the level of scientific process skills of junior high school students in terms of:
2.1 basic process skills; and
2.2 integrated process skills.

3. To determine the significant relationship between attitude towards science and process skills of junior high school students.

The hypotheses of the study were tested at a 0.05 level of significance, stating that there is no significant relationship between students' attitude towards science and science process skills and that there is no domain in the students' attitude towards science that significantly influences their scientific process skills.

This study is anchored on the social cognitive learning theory (SCLT), an expansion of social learning theory (SLT), which mentioned that students learn through the process of observing what others do and that the principal basis on understanding one's personality is their thought processes as humans (Bandura, 1999). Furthermore, Bandura's research had viewed everything as a whole rather than specific parts, where his analysis provided a more comprehensive general description of the human cognition with regards to the social learning context, and as he emphasizes that people are considered as the producers and products of a social system in agentic transactions (Bandura, 2001). As such, this theory provides a set of established standards regarding understanding, predicting, and changing human behavior (Green & Piel, 2009). Moreover, SCLT puts weight on the cognitive concepts, as it focuses on how friends and adults operate cognitively regarding their social experiences and how such operations influence their development and behavior (Nabavi, 2012).

In relation, Osborne et al. (2003) defined the term 'attitudes towards science' to be effective and consider the feelings, beliefs, and values one holds regarding a subject that can represent science

and its impacts. Such attitudes towards science – about holdings of an object representing science and school science – will fundamentally affect engagement with science itself, where scientific process skills are utilized (Howe et al., 2017). On the other hand, as cited in the paper of Juhji & Nuangchalerm (2020), science is identified as discovering the natural phenomena and an assortment of fact information that incorporates the scientific method and scientific attitudes (Bonney et al., 2016; Nuangchalerm & El Islami, 2018). This implies that students ought to be given direct experience in science learning through a learning cycle dependent on scientific skills and scientific attitudes. Both substantial definitions depict that the underlying point to connect learners to learn science reasonably is driven by scientific attitudes so that uplifting mentalities lead learners to have substantially more accomplishment and science process skills (Juhji & Nuangchalerm, 2020).

Furthermore, Zeidan & Jayousi (2015) claim to find a meaningful connection between science process skills and attitude towards science. The outcome of their study shows that the positive attitude towards science catches the students' enthusiasm and urges the students to be the center of the science learning process.

The findings of this study would serve as the basis for formulating interventions to enhance the students' attitude towards science and science process skills, both basic and integrated process skills. This study benefits the macro to micro-level institutions or people concerning the gradual change in education. This research will provide insights to the Department of Education on Filipino learners' attitudes and process skills in science. It may serve as a basis in the formulation of more functional education programs that foster positive attitudes and develop process skills among students.

Furthermore, this study may help the Science teachers identify which part of their instruction needs to be strengthened to develop the students' connection to science. It lays out what aspect's teachers may give more importance in enhancing how the students may take

science as a subject and press more to improve students' science process skills. Parents will also benefit from the results of this study, for they have an idea of the track of their child's learning and challenges as well. Information about this can induce parents to make interventions even at home to help their children enhance their science process skills (e.g., letting them help cook or wash clothes to develop measuring and classifying skills, respectively) and attitudes towards learning science. These activities will equip their children with knowledge and skills that are useful for future endeavors.

Moreover, through the findings of this study, students may be able to identify which category of science process skills they are strong in. It may give them an idea of what specific science process skills they need to develop further and provide them insights into the different aspects that affect their learning of science. Subsequently, future researchers may benefit from the results of this study, for they could use this as their reference for future studies. They could use this as their substantial basis for studies concerning the students' attitude towards science and science process skills.

METHOD

Research Respondents

The study respondents were the 275 Junior High School students of Bongabong National High School enrolled for the academic year 2020-2021. The distribution of respondents was as follows: 68 students from Grade 7, 69 from Grade 8, 69 from Grade 9, and 69 from Grade 10.

Research Instrument/Material

This study utilized two sets of research instruments to determine the students' levels of attitude towards science and the science process skills. An adapted research instrument from Maranan

(2017) assessed the students' attitudes towards science, the independent variable of this study. The students' attitude towards science has three indicators: academic value, science activity, and classroom environment. Moreover, the questionnaire was modified and was contextualized to suit the locale of the study. After that, the modified questionnaire underwent content validation and gained an overall rating of 4.4 or very good.

Furthermore, a researcher-made test was developed to determine students' science process skills, the dependent variable of this study. Science process skills have two indicators, namely: basic process skills and integrated process skills. This researcher-made test has 50 items in multiple-choice format, 25 items intended to measure the basic process skills. In comparison, 25 items are intended to measure the integrated process skills of the students. Each item formulated was carefully aligned with the learning competencies indicated in the curriculum guide issued by the Department of Education (2016) to ensure content validity. Like the questionnaire, the test also underwent content validation and gained an overall good rating of 4.4 or very good.

Research Design and Procedure

Upon the approval of the panelists of this study, the researchers took the following steps and procedures in gathering the data to be used in the study.

Firstly, the researchers routed the letter of permission to conduct the study to the research adviser, the research coordinator, and the college dean. Upon the approval of the said personnel, the researchers sought permission from the Principal of Bongabong National High School to conduct the study by sending the said letter to the Office of the School Principal. After the Principal approved the conduct of the study, the researchers took the next step by contacting the respondents through Facebook messenger with the help of the science teachers at the school since there should be no

face-to-face interaction between the researchers and the respondents due to the current health crisis.

Secondly, the researchers made an online questionnaire through Google Forms for both questionnaires, and then, the researchers sent the link to group chat in the messenger. After sending the Google form link, the researchers hold a virtual meeting for the orientation on how to answer the said questionnaire. Furthermore, after answering the said form, the researchers immediately gathered the responses of the respondents.

Finally, the researchers tabulated the data collected. Then, the tabulated data was sent to the statistician for the analysis. Interpretation of the results followed and was carried out by the researchers.

The following were the tools used to analyze the data gathered in this study. *Mean*. This statistical tool was used to determine the levels of attitude towards science and science process skills of JHS students of Bongabong National High School. *Pearson-r*. This statistical tool was utilized to determine the significant relationship between the attitude towards science and the science process skills of the JHS students of Bongabong National High School. *Regression Analysis*. This statistical tool was employed to find out the domain in the attitude towards science of JHS students that significantly influences their science process skills.

RESULTS AND DISCUSSION

This part of the paper presents the data and results of the study. Tables are arranged in the following subheadings: Level of Attitude towards Science of JHS students of Bongabong NHS, Level of Science Process Skills of JHS students of Bongabong NHS, and Significant Relationship between Attitude towards Science and Science Process Skills of JHS students of Bongabong NHS.

Level of Attitude towards Science of JHS Students of Bongabong National High School

Shown in Table 2 are the mean scores for the indicators of attitude towards science of JHS students of Bongabong NHS, with an overall mean of 4.62, which is described as very high with a standard deviation of 0.615. The very high level could be attributed to the very high rating given by the respondents in all indicators. This means that the respondents' response to the attitude towards science of JHS students of Bongabong NHS is very positive in most cases regarding the academic value, science activity, and classroom environment.

Table 2. Level of Attitude towards Science of JHS students of Bongabong NHS

Indicators	Mean	SD	Descriptive Equivalent
Academic Value	4.67	0.679	Very high
Science Activity	4.60	0.791	Very high
Classroom Environment	4.60	0.760	Very high
Overall	**4.62**	**0.615**	**Very high**

The cited overall mean score was the result gathered from the following computed mean scores, arranged from highest to lowest: 4.67 or very high for academic value with a standard deviation value of 0.679; 4.60 or very high for science activity with a standard deviation value of 0.791; and 4.60 or very high for a classroom environment with a standard deviation value of 0.760.

The attitude towards science that was very positive among JHS students of Bongabong NHS is on *Academic Value*, being the indicator with the highest mean, which principal goal is to help the students assess improvement or strengthen their knowledge during

their training period and to provide quality opportunities for their critical thinking, and their ability to learn in through their life. The data shows that students know the importance of science and its role in society and everyday life.

Regarding the *Science Activity* that also has a very high mean, or as described to have a very positive attitude towards science among JHS students of Bongabong NHS, the data shows that the respondents are interested in science activities and enjoy working in groups.

Finally, the attitude towards science that is also very positive among JHS students of Bongabong NHS is *Classroom Environment*. The data shows that students exhibit a positive attitude towards their laboratory equipment, consider their classroom a conducive learning environment, and show contentment with their library books and other reading materials. The result shows that the school provides the students with an environment suitable for students' conducive learning.

The respondent's level of attitude towards science is very high. This means that a different attitude towards science is very positive among JHS students of Bongabong NHS. This further means that the JHS students of Bongabong NHS always manifest all the attitude towards science as to the academic value, which means they were able to know and understand the importance of science on the societal basis; science activity which means they enjoy performing science activities and learning with their small groups; and classroom environment which means that students consider their classrooms as a conducive learning environment and exhibit a positive attitude towards school facilities.

This result is similar to the findings of Lovelace and Brickman (2013), Zeidan and Jayosi (2015), and Astalini et al. (2019), which also revealed that students have a positive attitude toward science. According to Zulirfan et al. (2018), the secondary students of

Merbau Island possess a positive attitude towards science but with a relatively low level of scientific skills and academic performance. Having a favorable attitude towards science enables students to develop their interest in learning science and increase attention and participation in science class activities (Germann, 1988; Jarvis & Pell, 2005; Akcay et al., 2010). This positive attitude towards science could be attributed to a variety of factors, including scientific attitude adaptation, enjoyment of science class, and interest in a career in science (Astalini et al., 2019), teaching strategies (Jach & Cervato, 2004; Aguilera & Perales-Palacios, 2019), interactive lecture demonstrations (Ananda, 2019), and learning strategies that focus more on the cognitive domain and hands-on practice (Zeidan and Jayosi (2015). Other reasons could be employing deductive strategy in class (Aguilera & Perales-Palacios, 2018) and teacher's qualification, skill, and a good knowledge of technology (Naiker et al., 2020).

One indicator of attitude toward science is *academic value*, which results in a very high equivalent. This means that the academic value of JHS students of Bongabong NHS is positive. Accordingly, academic value is one of the major factors affecting students' academic accomplishments. It can be affected by external influences (Perfilieva, 2016), such as government schools' demographic variables like gender, parental education and occupation, and family size (Shah et al., 2013). This very high academic value among students could also be attributed to their perspectives, beliefs, behavior, and attitudes of the institution's staff (Wilson & Corr, 2016), parents' job and educational background (Shah et al., 2013), and academic interest (Sasway & Kelly, 2021). Ananda (2019) noted that students believe that science education is essential in everyday life, especially in seeking a career related to science.

Another indicator of attitude toward science is *science activities*, which has a very high descriptive equivalent. This means that the JHS students of Bongabong NHS have a very positive attitude toward science activities. Maxwell et al. (2015) noted that

activities in science classrooms include understanding books, dissecting information, and solving problems. Further, Foley & McPhee (2016) stated that hands-on activities are inevitably included to understand better natural science rather than just learning from science textbooks. Students' very positive attitude towards science could be due to instruction, aspiration, and school atmosphere (Papanastasiou & Papanastasiou, 2010) and employment of class activities such as inquiry and experiment (Maxwell et al., 2015).

Lastly, the *classroom environment*, as an indicator, posted a very high equivalent. This indicates that students have a very positive attitude towards their classroom environment. One of the most important elements influencing students' perceptions of science is having a highly positive attitude toward the classroom setting (Maranan, 2017). Notably, several studies (e.g., Hayden et al.,2015; Kausar et al., 2015; Kayacan & Sonmez Ektem, 2019) found that a positive classroom atmosphere enhanced students' attitudes toward learning science and academic achievement. Musengimana et al. (2020) and Koç, & Böyük (2012) mentioned that classroom settings influence student learning and increase favorable attitudes toward science. This very positive attitude towards the science classroom environment could be due to several reasons, such as a sense of belongingness inside the classroom (Smith, 2019), the use of multiple intelligence instruction (Kaya & Kaya, 2020), and technology application in science learning (Hayden et al., 2015).

Level of Science Process Skills of JHS students of Bongabong National High School

Shown in Table 3 are the mean scores for the indicators of science process skills of JHS students of Bongabong NHS with an overall mean of 30.63, described as moderate with a standard deviation value of 8.38. The moderate level could be attributed to the moderate rating given by the respondents. This means that the JHS students' science process skills are satisfactory in terms of the

basic process skills, while moderate or satisfactory in terms of the integrated process skills.

The cited overall mean score was the result gathered from the following computed mean scores arranged from highest to lowest: 16.66 or high for basic process skills with a standard deviation value of 3.958; and 13.97 or moderate for integrated process skills a standard deviation value of 4.425.

Table 3. Level of Science Process Skills of JHS students of Bongabong NHS

Indicators	Mean	SD	Descriptive Equivalent
Basic Process Skills	16.66	3.958	High
Integrated Process Skills	13.97	4.425	Moderate
Overall	**30.63**	**8.38**	**Moderate**

The main process skill that is high or very satisfactory for the JHS students of Bongabong NHS is the *Basic Process Skills*, being the indicator with the highest mean. The data shows that students somehow developed this type of science process skills. Students find the questions easy to answer.

On the other hand, the process skill that is moderate or satisfactory for the JHS students of Bongabong NHS is *Integrated Process Skills*. It is the indicator having the lowest mean score. As shown in the data, the students need to improve and develop their integrated process skills. The students find some of the questions difficult and are hard to understand. Furthermore, students need to develop their ability to think at a higher level and have multiple thoughts simultaneously.

The level of science process skills of JHS students of Bongabong NHS is moderate. This means that science process skills, including observing, classifying, communicating, measuring,

predicting, inferring, controlling variables, formulating hypotheses, interpreting data, and making conclusions are satisfactory. A satisfactory science process skills of students can be attributed to various reasons such as employment of cognitive style-based learning strategy (Sholahuddin et al., 2020), implementation of problem-based learning model and engagement in practicum activities or authentic tasks (Duda et al., 2019), group interactions (Ping et al., 2020), teacher's knowledge and efficiency (Gürses et al., 2015), and participation in laboratory experiments (Kalemkuș et al., 2021).

Science process skills are an essential part of the inquiry process (Juhji & Nuangchalerm, 2020) and enable students to understand how it can support the mastery of science concepts which help them develop their learning process through various experiences (Duda et al., 2019). These skills are primarily learned when students are actively involved in discovering concepts from existing environmental phenomena (Darmaji et al., 2020). Several studies (Mahanal et al., 2019; Darmaji et al., 2020; Kurniawan et al., 2020; Tanti et al., 2020) even found that science process skills affect the critical thinking skills of students.

The result seems to be in congruence with Zeidan and Jayosi's (2015) findings, which revealed the average science process skills of Palestinian secondary students. In connection, Siahaan et al. (2017) and Inayah et al. (2020) also showed that the process skills of the grade 7 and senior high school students are at a relatively good level and are in the sufficient category. Furthermore, Suryanti et al. (2020) found out that the students' improvement of science process skills could be attributed to implementing the guided discovery problem-posing model. In the same manner, problem-solving models (Alberida et al., 2019), guided inquiry models (Yunianti et al., 2019), and conceptualization models (Halim et al., 2020) are also helpful in the improvement of the students' science process skills.

An indicator of SPS is the *basic process skills* of students which registered a high-level equivalent. This means that their skills in observing, classifying, communicating, measuring, predicting, and inferring are very satisfactory. Similarly, the results of other studies also indicated that students were very good at predicting, observing, and measuring and good for communicating (Sukardiyono et al., 2019) and inferring (Inayah et al., 2020). Zeidan & Jayosi (2015) also revealed that most students have good performance in observing, predicting aspects of basic SPS. Students' moderate level of process skills could be attributed to their ability to actively use their senses, express an object or event accordingly, and estimate an event according to their observation (Sukardiyono et al., 2019).

On the other hand, the *integrated process skills* of students posted a moderate result. This means that their skills in controlling variables, formulating hypotheses, interpreting data, and making conclusions are satisfactory. Consequently, studies found that the level of SPS of high school students in hypothesizing, data interpreting, and controlling variables is moderate or good (Tilakaratne & Ekanayake, 2017; Inayah et al., 2020). Students' moderate level of integrated process skills could be attributed to their less exposure to these skills, due to traditional teaching methods employed by the teachers (Zeidan & Jayosi, 2015). On the other hand, Gultepe & Kilic (2015) found that the implementation of argumentative-based teaching approaches contributed to developing students' integrated process skills.

Significant Relationship between Attitude towards Science and Science Process Skills of JHS students of Bongabong National High School

A critical purpose of this study is to identify whether or not the attitude towards science has a significant relationship with the science process skills of JHS students of Bongabong NHS. Therefore, Pearson r was employed to determine the correlation between the two variables. The results of the computation were shown in Table 4.

The result revealed that the attitude towards science versus the science process skills yields an r-value of -0.097, which is not significant. The result is due to the p-value of 0.11, which is greater than the 0.05 level of significance. This leads to the decision that the null hypothesis, which states that there is no significant relationship between students' attitudes towards science and science process skills, is not rejected.

Table 4. Significant Relationship between Attitude towards Science and Science Process Skills of JHS students of Bongabong NHS

Variables	Mean	SD	R-value	P-value
Attitude towards Science	4.69	0.611		
Science Process Skills	30.63	8.380		
			-0.097	0.11

This further means that there is no relationship between the two variables. Moreover, since there is no significant relationship between the two variables, no regression analysis was done. The second null hypothesis, which stated that there is no domain in the students' attitude towards science that significantly influences their scientific process skills, is not rejected.

The present study reveals that there is no significant relationship between attitude towards science and scientific process skills of JHS students of Bongabong NHS. This implies that attitude towards science is not related to the scientific process skills of the JHS students. This result is similar to the findings of Kareem (2020) which revealed that no significant relationship existed between scientific attitude and process skills. Daniela-Luminița (2016) also noted a non-linear relationship between scientific literacy and attitudes toward science. However, the result contradicts Zeidan and Jayosi's (2015)

proposition, which claimed a meaningful connection between the students' attitude towards science and science process skills.

Further, this study opposed the findings of Papanastasiou and Zembylas (2004), Özgelen (2012), and Maranan (2017) that established the positive correlation between the variables being studied. Moreover, Wirassa (2019) even revealed a negative correlation between attitude toward science and scientific process ability among secondary students, yet the relationship was significant. Overall, the result does not conform with the SCLT theory wherein this study is anchored.

Conclusion

Based on the findings of the study, conclusions are drawn in this section.

The level of student's attitude towards science is very high for academic value, very high for science activity, and very high for classroom environment. As a result, the level of attitude towards science of JHS students of Bongabong NHS is very high. This means that students' attitudes towards science are very positive.

The students' level of basic process skills is high, while the level of integrated process skills is moderate. Subsequently, the level of science process skills of JHS students of Bongabong NHS is moderate. This means that the measures described in science process skills items are interpreted as satisfactory.

Overall, results showed no significant relationship between the attitude towards science and science process skills of the JHS of Bongabong National High School. This means that attitude towards science does not influence the science process skills of JHS students of Bongabong National High School.

Recommendations

In the foregoing findings and conclusion, the following recommendations are presented.

It was found that the students have a satisfactory level of science process skills. With this, it is recommended that students' science process skills are raised to an excellent level. To attain this, the Department of Education should revisit the science curriculum and ensure that the set content and performance standards enable learners to develop their science process skills. Also, the department should capacitate teachers by, for example, conducting training and seminars that would help them be more equipped with pedagogies that are found to influence students' SPS development. In addition, in the delivery of appropriate science content, teachers should adapt teaching approaches, strategies, methods, and techniques that are proven to be helpful in the development of students' SPS. Furthermore, students should increase their participation in hands-on and inquiry-based learning activities as these can help them develop both their basic and integrated SPS.

Since this study found no relationship between students' attitudes towards science and science process skills, it is hereby recommended that future researchers explore factors that could potentially influence students' development of science process skills.

In addition, the researchers recommend that future studies examine the relationship of the variables studied in the context of elementary or higher education. Having a larger sample size is also highly encouraged. Lastly, more studies that will assess the achievement of scientific literacy in the country are recommended. Doing this enables stakeholders, especially legislators and regulatory agencies, to be informed of the current state of scientific literacy among Filipino learners. Hence, the effectiveness of the current curriculum can be known, and necessary up-gradation can be forwarded, if necessary.

REFERENCES

Aguilera, D., & Perales-Palacios, F. J. (2019). Learning biology and geology through a participative teaching approach: the effect on student attitudes towards science and academic performance. *Journal of Biological Education*, *54*(3), 245-261. https://doi.org/10.1080/00219266.2019.1569084

Aguilera, D., & Perales-Palacios, F. J. (2018). What effects do didactic interventions have on students' attitudes towards science? a meta-analysis. *Research in Science Education*, *50*(2), 573-597. https://doi.org/10.1007/s11165-018-9702-2

Akani, O. (2015). Levels of possession of science process skills by final year students of colleges of education in southeastern states of Nigeria. *Journal of Education and Practice, 6*(27), 94-101.

Akcay, H., Yager, R. E., Iskander, S. M., & Turgut, H. (2010). Change in student beliefs about attitudes toward science in grades 6-9. *Asia - Pacific Forum on Science Learning and Teaching, 11*(1), 1-18. https://www.proquest.com/scholarly-journals/change-student-beliefs-about-attitudes-toward/docview/1955897149/se-2?accountid=3125

Aktamis, H., & Ergin, Ö. (2008). The effect of scientific process skills education on students' scientific creativity, science attitudes and academic achievements. *Asia Pacific Forum on Science Learning and Teaching, 9*(1), 1-21. https://www.proquest.com/scholarly-journals/effect-scientific-process-skills-education-on/docview/1957088230/se-2?accountid=31259

Alberida, H., Lufri, Festiyed, & Barlian, E. (2019). Enhancing student's science process skills through problem solving model: an effectiveness study. *Journal of Physics: Conference Series, 1317*(1), 1-13. https://doi.org/10.1088/1742-6596/1317/1/012181

Allen, L. (1973). An examination of the ability of third grade children from the Science Curriculum Improvement Study to identify experimental variables and to recognize change. *Science Education, 57*(2), 123-151. https://doi.org/10.1002/sce.3730570204

Alisir, Z. N., & Irez, S. (2020). The effect of replicating historical scientific apparatus on high school students' attitudes towards science and their

understanding of nature of science. *Science & Education*, *29*(5), 1201-1234. https://doi.org/10.1007/s11191-020-00148-0

Alkan, F. (2016). Experiential learning: Its effects on achievement and scientific process skills. *Journal of Turkish Science Education, 13*(2), 15-26. https://doi.org/10.12973/tused.10164a

American Association for the Advancement of Science [AAAS] (1993). *Project 2061: Benchmarks for Science Literacy*. New York: Oxford University Press. http://www.project2061.org/publications/bsl/online/index.php

Ananda, S. R., Suhandi, A., & Rahman, T. (2019). Students' attitude toward science in junior high school after follow science learning used ILD model assisted science magic. *Journal of Physics: Conference Series, 1157*(2). https://doi.org/10.1088/1742-6596/1157/2/022060

Andini, T., Hidayat, S., Fadillah, E., & Permana, T. (2018). Scientific process skills: preliminary study towards senior high school students in Palembang. *Indonesian Journal of Biology Education, 4*(3), 243-250. https://doi.org/10.22219/jpbi.v4i3.6784

Apaivatin R., Srikoon S., & Mungngam P. (2021). Research synthesis of STEM education effected on science process skills in Thailand. *Journal of Physics: Conference Series, 1835* (1). https://doi.org/10.1088/1742-6596/1835/1/012087

Astalini, A., Kurniawan, D. A., Kurniawan, N., & Anggraini, L. (2019). Evaluation of student's attitude toward science in Indonesia. *Open Journal for Educational Research*, *3*(1), 1-12. https://doi.org/10.32591/coas.ojer.0301.01001a

Atush Sholihah, N.A., Sarwanto & Aminah, N.S. (2020). Analysis of science process skill in high school students. *Journal of Physics:*

Baldwin, K., & Wilson, A. (2017). Acting like rain: PreK students engage in science talk and head outside to build earth science knowledge and process skills. *Science and Children, 54*(6), 29-35.

Bandura, A. (1999). A social learning theory of personality. In L. Pervin & O. John, *Handbook of Personality* (pp. 154-196). New York: Guildford Publications.

Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Annual Review on Psychology, 52*, 1–26.

Besa, F. (2018). Programme for International Student Assessment (2018). Philippines. https://www.oecd.org/pisa/publications/PISA2018_CN_PHL.pdf

Bond, T., & Hughes, C. (2015). *Singapore lower secondary science critical study notes (Yellowreef)*. Singapore: Themis Publishing.

Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science, 25*(1), 2–16. https://doi.org/10.1177/0963662515607406

Broughton, V. (2015). *Essential Classification*. London: Facet Publishing.

Çalişkan , I., & Kaptan, F. (2012). Reflections of performance assessment on science process skills, attitude and retention in science education. *Hacettepe Egitim Dergisi* (43), 117-129.

Çakiroğlu, Ü., Güven, O., & Saylan, E. (2020). Flipping the experimentation process: influences on science process skill. *Educational Technology Research and Development, 68*(1), 3425-3448. https://doi.org/10.1007/s11423-020-09830-0

Campbell, C., & Chealuck, K. (2015). Approaches to enhance science learning.

Cermik H., & Fenli-Aktan A., (2020). Primary school students' attitudes towards science. *International Journal of Educational Methodology, 6*(2), 355-365. https://doi.org/10.12973/ijem.6.2.355

Charlesworth, R. (2015). *Math and science for young children* (8th ed.). Boston: Cengage Learning.

Cities and Municipalities Competitive Index- Department of Trade and Industry [CMCI-DTI] (2020). Davao de Oro Profile. https://cmci.dti.gov.ph/prov-profile.php?prov=Davao%20de%20Oro&year=2020

Cordon, J. M., & Polong, J. D. B. (2020). Behind the science literacy of Filipino students at PISA 2018: A case study in the Philippines' educational system. *Integrated Science Education Journal, 1*(2), 72-78. https://doi.org/10.37251/isej.vli2.59

Corpuz, B.B., & Salandanan, G.G. (2015). *The teaching of science. Principles of teaching 2 (with TLE)*. Lorimar Publishing, Inc.

Creswell, J. (2012). *Research design: Qualitative, quantitative, and mixed method approaches* (4th ed.). SAGE Publication, Inc.

Dahsah, C., Seetee, N., & Lamainil, S. (2017). The use of interview about events to explore children's basic science process skills. *New Perspectives in Science Education,* 498-503.

Daniela-Luminița, B. (2016). Attitudes toward science and scientific literacy among romanian young adults. *The European Proceedings of Social and Behavioural Sciences, 12*(7), 48-58. https://doi.org/10.15405/epsbs.2016.12.7

Darmaji, D., Kurniawan, A., Astalini A., Perdana, R., Kuswanto, O., & Ikhlas, M. (2020). Do a science process skills affect on critical thinking in science? differences in urban and rural. *International Journal of Evaluation and Research in Education,* 9(4), 874-880. https://doi.org/10.11591/ijere.v9i4.20687

Darmaji, D. (2019). Effectiveness of basic physics ii practicum guidelines based on science process skills. *Jurnal Ilmu Pendidikan Fisika, 4*(1), 1-7. https://doi.org/10.26737/jipf.v4i1.693

Darmaji, D., Kurniawan, D., & Irdianti, I. (2019). Physics education students' science process skills. *International Journal of Evaluation and Research in Education,* 8(2), 293-298. https://doi.org/10.11591/ijere.v8i2.28646

Delen, Ý., & Kesercioðlu, T. (2012). How middle school students' science process skills affected by turkey's national curriculum change? *Journal of Turkish Science Education,* 9(4), 3-9. https://www.proquest.com/scholarly-journals/how-middle-school-students-science-process-skills/docview/1659748825/se-2?accountid=31259

Department of Education (2016). K to 12 Curriculum Guide (Grade 3 to 12). https://www.deped.gov.ph/wp-content/uploads/2019/01/Science-CG_with-tagged-sci-equipment_revised.pdf

Derilo, R. (2019). Basic and integrated science process skills acquisition and science achievement of seventh-grade learners 6. 281-294. https://doi.org/10.5281/zenodo.2652545.

Desy, E., Peterson, S., & Brockman, V. (2011). Gender differences in science-related attitudes and interest among middle school and high school students. *Science Educator, 20*(2), 23-30.

Downing, J., & Filer, J. (1999). Science process skills and attitudes of pre-service elementary teachers. *Journal of Elementary Science Education, 11*(2), 57-64. https://doi.org/10.1007/BF03173838

Duda, H., Susilo, H., & Newcombe, P. (2019). Enhancing different ethnicity science process skills: problem-based learning through practicum and authentic assessment. *International Journal of Instruction, 12*(1), 1207-1222.

Eshach, H., & Fried, M. (2005). Should science be taught in early childhood?. *Journal of Science Education and Technology, 14*(3), 315-336. https://doi.org/10.1007/s10956-005-7198-9

Foley, B. J., & McPhee, C. (2016). Students' attitudes towards science in classes using hands-on or textbook-based curriculum. *American Educational Research Association*, 1-12.

Froese-Germain, B. (2010). The OECD, PISA and the impacts on educational policy. *Canadian Teachers' Federation (NJ61)*.

Fulmer, G.W. Ma, H., & Liang, L. (2019). Middle school student attitudes toward science, and their relationships with instructional practices: a survey of Chinese students preferred versus actual instruction. *Asia-Pacific Science Education, 5(1), 9*. https://doi.og/10.1186/s41029-019-0037-8

Germann, P.J. (1988). Development of the attitude towards science in school assessment and its use to investigate the relationship between science achievement and attitude towards science in school. *Journal of Research in Science Teaching, 25*(8), 689-703. https://doi.org/10.1002/tea.3660250807

Goldston, J., & Downey, L. (2015). *Your science classroom: Becoming an elementary/middle school science teacher*. SAGE Publications. https://doi.org/10.4135/9781544308623

Green, M., & Piel, J. (2009). *Theories of Human Development: A Comparative Approach* (2nd ed.). Prentice-Hall, Inc.

Greenfield, D. B., Jirout, J., Dominguez, X., Greenberg, A., Maier, M., & Fuccillo, J. (2009). Science in the preschool classroom: A programmatic research

agenda to improve science readiness. *Early Education & Development, 20*(2), 238-264. https://doi.org/10.1080/10409280802595441

Gultepe, N. (2016). High school science teachers view on science process skills. *International Journal of Environmental and Science Education, 11*(5), 779-800. https://doi.org/10.12973/ijese.2016.348a

Gultepe, N., & Kilic, Z. (2015). Effect of scientific argumentation on the development of scientific process skills in the context of teaching Chemistry. *International Journal of Environmental and Science Education, 10*(1), 111-132. https://eric.ed.gov/?id=EJ1060989

Gunawan, K.D.H., Harjono, A., Hermansyah, & Herayanti, L. (2019). Guided inquiry model through virtual laboratory to enhance students' science process skills on heat concept. *Cakrawala Pendidikan, 38*(2). https://doi.org/10.21831/cp.v38i2.23345

Gunawan, K.D.H., Liliasari, S., & Kaniawati, I. (2019). Investigation on integrated science course process and opportunities to implement CSCL learning environments. *Journal of Physics: Conference Series, 1157*(2). https://doi.org/10.108/1742-6596/1157/2/02051

Gürses, A., Çetinkaya, S., Doğar, Ç., & Şahin, E. (2015). Determination of levels of use of basic process skills of high school students. *Procedia-Social and Behavioral Sciences, 191*(1), 644-650. https://doi.org/10.1016/j.sbspro.2015.04.243

Halim, A., Farada, S., Hamid, A., Mustafa, Nurulwati, Mahzum, E., & Irwandi, I. (2018). Effect of concept attainment model on student's science process skills. *Journal of Physics: Conference Series, 1882*(1), 1-7. https://doi.org/10.1088/1742-6596/1882/1/012157

Harahap, M. B., Manurung, S. R., Marbun, M. A., & Mihardi, S. (2016). Effect model

inquiry training on student's science process skill. *Advances in Social Sciences Research Journal, 3*(11), 38-42. https://doi.org/10.14738/assrj.311.2288

Hayden, K., Ouyang, Y., Scinski, L., Olszewski, B., & Bielefeldt, T. (2015). Increasing student interest and attitudes in STEM: Professional development and activities to engage and inspire learners. *Contemporary Issues in Technology and Teacher Education, 11*(1). https://citejournal.org/volume-11/issue-1-11/science/increasing-student-interest-and-attitudes-in-

stem-professional-development-and-activities-to-engage-and-inspire-learners

Howe, A., Collier, C., McMahon, K., Earle, S., & Davies, D. (2017). *Science 5-11: A Guide for Teachers (3rd ed.)*

Hutapea, A., Bukit, N., & Manurung, S. R. (2021). Improvement science process skills of high school students through learning models scientific inquiry. *Journal of Physics: Conference Series, 1811*(1). http://doi.org/10.1088/1742-6596/1811/1/012005

Inayah, A., Ristanto, R., Sigit, D., & Miarsyah, M. (2020). Analysis of science process skills in senior high school students. *Universal Journal of Educational Research, 8*(4), 15-22. https://doi.org/10.13189/ujer.2020.081803

Irwanto, E. R., & Prodjosantoso, A. K. (2018). The investigation on university students' science process skills and chemistry attitudes at the laboratory course. *Asia - Pacific Forum on Science Learning and Teaching, 19*(2), 1-22.https://www.proquest.com/scholarly-journals/investigation-on-university-students-science/docview/2335664800/se-2?accountid=31259

Jach, J., & Cervato, C. (2004). Attitude toward learning science of students in introductory geology courses. *Geological and Atmospheric Sciences Publications.* 13. https://lib.dr.iastate.edu/ge_at_pubs/13

Jarvis, T., & Pell, A. (2005). Factors influencing elementary school children's attitude towards science, before, during, and after a visit to the uk national space centre. *Journal of Research in Science Teaching, 42*(1), 53-83. https://doi.org/10.1002/tea.20045

Johnston, J. (2009). What does the skill of observation look like in young children? *International Journal of Science Education, 31*(18), 2511-2525. https://doi.org/10.1080/09500690802644637

Juhji, J., & Nuangchalerm, P. (2020). Interaction between scientific attitudes and science process skills toward technological pedagogical content knowledge. *Journal for the Education of Gifted Young Scientists, 8*(1), 1-16. https://doi.org/ 10.17478/jegys.2020.XX

Kalemkuș, J., Bayraktar, Ş., & Çiftçi, S. (2021). Comparative effects of argumentation and laboratory experiments on metacognition, attitudes,

and science process skills of primary school children. *Journal of Science Learning, 4*(2), 113-122. https://doi.org/10.17509/jsl.v4i2.27825

Kara, Y. (2018). Science process skills: Learning through scientific method. In F. Güneş & Y. Söylemez (Eds.), *The Skill Approach in Education: From Theory to Practice* (pp. 338-356). Cambridge Scholars Publishing.

Kareem, A., Adeleke, M., & Salami, M. (2020). Process skills application and scientific attitudes of Biology students in colleges of education in southwestern Nigeria. *African Journal of Teacher Education, 9*, 80-103. https://doi.org/10.21083/ajote.v9i0.6049

Kausar, A., Almas, I., Kiyani, & Suleman, Dr. (2017). Effect of classroom environment on the academic achievement of secondary school students in the subject of pakistan studies at secondary level in Rawalpindi district, Pakistan. *Journal of Education and Practice, 8*(24), 56-63. https://www.researchgate.net/publication/320234642

Kaya, Z., & Kaya, O. N. (2020). Comparison of inclusive and traditional science classrooms: middle school students' attitudes towards science. *International Journal of Inclusive Education*, 1-22. https:// doi.org/ 10.1080/13603116.2020.1841839

Kayacan, K., & Sonmez Ektem, I. (2019). The effects of biology laboratory practices supported with self-regulated learning strategies on students' self-directed learning readiness and their attitudes towards science experiments. *European Journal of Educational Research, 8*(1), 313-299. https://doi.org/10.12973/eu-jer.8.1.313

Koç, A., & Böyük, U. (2012). The effect of hands-on science experiments on attitude towards science. *Journal of Turkish Science Education, 9*(4), 102-118. https://www.proquest.com/scholarly-journals/effect-hands-on-science-experiments-attitude/docview/1659749079/se-2?accountid=31259

Koch, J. (2000). *Science stories: teachers and children as science learners* (1st ed.)

Kuhn, D., Black, J., Keselman, A., & Kaplan, D. (2000). The development of cognitive skills to support inquiry learning. *Cognition and Instruction, 18*(4), 495-523. https://doi.org/10.1207/S1532690XCI1804_3

Kurniawan, W., Darmaji, D., Astalini, A., Kurniawan, D., Hidayat, M., Kurniawan, N., & Farida, L. (2019). Multimedia physics practicum reflective material based on problem solving for science process skills. *International Journal*

of Evaluation and Research in Education, 8(4), 590-595. https://doi.org/10.11591/ijere.v8i4.20258

Kurniawan, W., Pathoni, H., Muliawati, L., Kurniawan, D., Romanoda, D., Ningsi, A., & Dari, R. (2020). Relationship of science process skills and critical thinking of students in physics subject. *Universal Journal of Educational Research, 8*(11), 5581-5588. https://doi.org/10.13189/ujer.2020.081162

Lamanauskas, V., & Augiene, D. (2018). Scientific research activity organisation and improvement in a primary school. *Review of Science, Mathematics and ICT Education, 12*(2), 5-20. https://doi.org/10.26220/rev.2938

Landicho, C. J. B. (2020). Secondary school students' attitudes and practices toward research writing and reporting in science. *Issues in Educational Research.*

Lau, K., & Ho, S. (2020). Attitudes towards science, teaching practices, and science performance in PISA 2015: multilevel analysis of the chinese and western top performers. *Research in Science Education.* https://doi.org/10.1007/s11165-020-09954-6

Leonor, J. P. (2015). Exploration of conceptual understanding and science process skills: a basis for differentiated science inquiry curriculum model. *International Journal of Information and Education Technology, 5*(4), 255-259. https://doi.org/10.7763/IJIET.2015.V5.512

Lovelace, M., & Brickman, P. (2013). Best practices for measuring students' attitudes toward learning science. *CBE—Life Sciences Education, 12*(4), 606– 617. https://doi.org/10.1187/cbe.12-11-0197

Machira, S. M. (2017). *Students' characteristics, Teachers perceptions and achievement in Science subject among students in public secondary schools in Laikipia County, Kenya* (Unpublished dissertation). Kenyatta University

Mahanal, S., Zubaidah, S., Sumiati, I., Sari, T., & Ismirawati, N. (2019). Ricosre: a learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction, 12*(2), 417-434. https://doi.org/10.29333/iji.2019.12227a

Mailita, S. P., Nasution, D., & Rahmatsyah. (2021). The effect of scientific inquiry learning model and scientific attitude on students' science process skills. *Journal of Physics: Conference Series, 1811*(1). http://doi.org/10.1088/1742-6596/1811/1/012003

Maranan, V. (2017). Basic process skills and attitude toward science: inputs to an enhanced students' cognitive performance. San Pablo, Laguna: Laguna State Polytechnic University. *Online Submission*.

Mathiyazhagan, T. (2010). Survey research method.

Maxwell, D., Lambeth, D., & Cox, J. T. (2015). Effects of using inquiry-based learning on science achievement for fifth-grade students. *Asia-Pacific Forum on Science Learning and Teaching*, *16*(1). https://www.eduhk.hk/apfslt/download/v16_issue1_files/cox.pdf

McGlathery, G. (1970). An assessment of science achievement of five and six-year-old students of contrasting socio-economic background. *Research and Curriculum Development in Science Education, 7023*, 76-83.

Mirana, V. (2019). Attitude towards science and process skills of junior high school students. *Asia Pacific Journal of Multidisciplinary Research*, 16-23.

Mostafa, T., Echazarra, A., & Guillou, H. (2018). The science of teaching science: An exploration of science teaching practices in PISA 2015.

Municipal Statistics Office (2017). https://www.pantukan.gov.ph/population/

Murugan, P. V (2019). A study on scientific attitude of elementary teacher education students. *Psychology and Behavioral Science International Journal, 11*(1). https://doi.org/10.19080/PBSIJ.2019.11.555805

Musengimana, J., Kampire, E., & Ntawiha, P. (2020). Factors affecting secondary schools students' attitudes toward learning chemistry: a review of literature. *EURASIA Journal of Mathematics, Science and Technology Education, 17*(1), 19-31. https://doi.org/10.29333/ejmste/9379

Mushtaq, I., & Khan, S. (2012). Factors affecting students' academic performance. *Global Journal of Management and Business Research*, 2249-4588.

Nabavi, R. T. (2012). Bandura's social learning theory & social cognitive learning theory. *Theories of Developmental Psychology*, 1-23.

Naiker, M., Sharma, B., Wakeling, L., Johnson, J. B., Mani, J., Kumar, B., Naidu, A., Khan, NMGM., & Brown, S. (2020). Attitudes towards science among senior secondary students in Fiji. *Waikato Journal of Education, 25*(1), *57–72*. https://doi.org/10.15663/wje.v25i0.704

National Association for Research in Science Teaching [NARST]. (2018). *Research Matters - To The Science Teacher*. https://narst.org/research-matters/science-process-skills

National Research Council (1996). *National Science Education Standards*. Washington, DC: The National Academies Press. https://doi.org/10.17226/4962.

Nuangchalerm, P., & El Islami, R. A. Z. (2018). Comparative study between indonesian and thai novice science teacher students in content of science. *Journal for the Education of Gifted Young Scientists, 6*(2), 23–29. https://doi.org/10.17478/JEGYS.2018.75

Nugraha, M., Utari, S., Saepuzaman, D., & Nugraha, F. (2017). Redesign of students' worksheet on basic physics experiment based on students' scientific process

skills analysis in Melde's law. *Journal of Physics: Conference Series*, *1013*(1), 1-8. https://doi.org/10.1088/1742-6596/1013/1/012038

O' Dwyer, L. M., & Bernard, J. A. (2013). *Quantitative research for the qualitative researcher*. Sage.

Ong, E. T., Ramiah, P., Ruthven, K., Salleh, S. M., Yusuff, N. A., & Mokhsein, S. E. (2015). Acquisition of basic science process skills among malaysian upper primary students. *Research in Education, 94*(1), 88–101. https://doi.org/10.7227/RIE.0021

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049-1079. https://doi.org/10.1080/0950069032000032199

Özgelen, S. (2012). Students' science process skills within a cognitive domain framework. *Eurasia Journal of Mathematics, Science & Technology Education, 8*(4), 283-292. https://doi.org/10.12973/eurasia.2012.846a

Padilla, M., Okey, J., & Dillashaw, F. (1983). The relationship between science process skills and formal thinking abilities. Journal of Research in Science Teaching, 20(3), 239-246. https://doi.org/10.1002/tea.3660200308

Papanastasiou, C., & Papanastasiou, E. (2010). Major influences on attitudes toward science. educational research and evaluation. *Educational Research and Evaluation, 10*(3), 239-257. https://doi.org/10.1076/edre.10.3.239.30267.

Papanastasiou, E., & Zembylas, M. (2004). Differential effects of science attitudes

and science achievement in Australia. *International Journal of Science Education, 26*(3), 259-280. https://doi.org/10.1080/0950069022000038277

Perfilieva, Olga. (2016). Academic value added in the evaluation of the effectiveness of the university. *Series: Economics and Management Law*, *16*(4). 380-384. https://doi.org/10.18500/1994-2540-2016-16-4-380-384.

Philippine Statistics Authority (2020). 2020 Census of Population and Housing (2020 CPH) population counts declared official by the president. https://psa.gov.ph/content/2020-census-population-and-housing-2020-cph-population-counts-declared-official-president

Ping, I., Halim, L., & Osman, K. (2020). Explicit teaching of scientific argumentation as an approach in developing argumentation skills, science process skills, and biology understanding. *Journal of Baltic Science Education, 19*(2), 276-288. https://doi.org/10.33225/jbse/20.19.276

Prayitno, B. A., Corebima, D., Susilo, H., Zubaidah, S., & Ramli, M. (2017). Closing the science process skills gap between students with high and low level academic achievement. *Journal of Baltic Science Education, 16*(2), 266-277. https://www.proquest.com/scholarly-journals/closing-science-process-skills-gap-between/docview/2343744484/se-2?accountid=31259

Programme for International Student Assessment (2018). Philippines. https://www.oecd.org/pisa/publications/PISA2018_CN_PHL.pdf

Quinn, M., & George, K. D. (1975). Teaching hypothesis formation. *Science Education, 59*(3), 289-296. https://doi.org/10.1002/sce.3730590303

Rauf, R., Rasul, M., Mansor, A., Othman, Z., & Lyndon, N. (2013). Inculcation of science process skills in a science classroom. *Asian Social Science, 9*(8), *47-57*. https://doi.org/10.5539/ass.v9n8p47

Saçkes, M. (2013). Children's competencies in process skills in kindergarten and their impact on academic achievement in third grade. *Early Education & Development, 24*(5), 704-720. https://doi.org/10.1080/10409289.2012.715571

Şad, S., & Şahiner, Y. (2016). Students' teachers' and parents' views about transition

from basic education to secondary education (BESE) system. *Elementary Education Online, 15*(1), 53-76. https://doi.org/10.17051/io.2016.78720

Sakariyau, A. O., Taiwo, M. O., & Ajagbe, O. W. (2016). An investigation on secondary school students' attitude towards science in Ogun State, Nigeria. *Journal of Education and Practice*, *7*(28), 125-128.

Sari, U., Duygu, E., Şen, Ö., & Kirindi, T. (2020). The effect of STEM education on scientific process skills and STEM awareness in simulation-based inquiry learning environment. *Journal of Turkish Science Education, 17*(3), 387-405.

Sarmiento, C. Q. (2010). Teaching strategies to enhance science learning among diverse and multicultural learners. *JPAIR Multidisciplinary Journal, 4*. https://doi.org/10.7719.jpair.v4i1.99

Sasway, H. M., & Kelly, A. M. (2021). Instructional behaviors affecting student attitudes towards science. *Community College Journal of Research and Practice*, *45*(6), 385-402. https://doi.org/10.1080/10668926.2020.1719937

Sethi, U. (2015). Study of attitude of the students towards science in relation to certain non-school factors. *International Journal of Education and Information Studies*, *5*(1), 75-80. Science: inputs to an enhanced students' cognitive performance. *Online Submission.*

Seetee, N., & Dahsah, C. (2017). Science process skills in kindergarten projects. *New Perspectives in Science Education,* 407-411.

Shah, Z. A., Mahmood, N., & Harrison, C. (2013). Attitude towards science learning:

An exploration of pakistani students. *Journal of Turkish Science Education, 10*(2) https://www.proquest.com/scholarly-journals/attitude-towards-science-learning-exploration/docview/1659748148/se-2?accountid=31259

Sholahuddin, A., Yuanita, L., Supardi, Z., & Prahani, B. (2020). Applying the cognitive style-based learning strategy in elementary schools to improve students' science process skills. *Journal of Turkish Science Education, 17*(2), 289-301. https://doi.org/10.36681/tused.2020.27

Siahaan, P., Suryani, A., Kaniawati, I., Suhendi, E., & Samsudin, A. (2017). Improving students' science process skills through simple computer simulations on linear motion conceptions. *Journal of Physics: Conference Series, 812*(1). https://doi.org/10.1088/1742-6596/812/1/012017

Sirajuddin, J., Herman, M., Sidin, A., & Abdul, H. (2018). Development and validation of science process skills instrument in physics. *Journal of Physics: Conference Series*, 1028, 012203. https://doi.org/10.1088/1742-6596/1028/1/012203

Smith, D. F. (2019). *Early Childhood Education.* Croatia: IntechOpen.

Sofiani, D., Maulida, A. S., Fadhillah, N., & Sihite, D. Y. (2017). Gender differences in students' attitude towards science. *Journal of Physics: Conference Series, 895* https://doi.org/10.1088/1742-6596/895/1/012168

Sukardiyono, Rosana, D., & Dwandaru, W. (2019). Measuring junior high school students' science learning and science process skills through an integrated science instructional assessment. *Journal of Turkish Science Education, 16*(4), 467-477. https://doi.org/10.36681/tused.2020.1

Suryanti, Widodo, W., & Budijastuti, W. (2020). Guided discovery problem posing: an attempt to improve science process skills in elementary school. *International Journal of Instruction, 13*(3), 75-88. https://doi.org/10.29333/iji.2020.1336a

Tanti, T., Kurniawan, D., Kuswanto, K., Utami, W., & Wardhana, I. (2020). Science process skills and critical thinking in science: urban and rural disparity. *Indonesian Journal of Science Education, 9*(4), 489-498. https://doi.org/10.15294/jpii.v9i4.24139

Tilakaratne, T.K., & Ekanayake, S. (2017). Achievement level of science process skills of junior secondary students: Based on a sample of grade six and seven students from Sri Lanka. *International Journal of Environmental and Science Education, 12*(9), 2089-2108.

Tosun, C. (2019). Scientific process skills test development within the topic "matter and its nature" and the predictive effect of different variables on 7th and

8th grade students' scientific process skill levels. *Royal Society of Chemistry*, 160-174. https://doi.org/10.1039/C8RP00071A

Trumper, R. (2006). Factors affecting junior high school students' interest in biology. *International Council of Associations in Science Education*, *17*(1), 31-48.

Turiman, P., Omar, J., Daud, A.M., & Osman, K. (2012). Fostering the 21st century skills through scientific literacy and science process skills. *Procedia- Social and Behavioral Sciences, 59*(1), 110-116. https://doi.org/10.1016/j.sbspro.2012.09.253

Tüzün, Ö. Y., & Özgelen, S. (2012). Preservice science teachers' reflections about application of science process skills: A case study. *Egitim Ve Bilim, 37*(164), 126-n/a. https://www.proquest.com/scholarly-journals/preservice-science-teachers-reflections-about/docview/1030383352/se-2?accountid=31259

Ugras, M. (2018). The effect of stem activities on stem attitudes, scientific creativity and motivation beliefs of the students and their views on STEM education. *International Online Journal of Educational Sciences, 10*(5), 165-182. https://doi.org/10.15345/iojes.2018.05.012

Ural, E., & Gençoğlan, D. M. (2020). The effect of argumentation-based science teaching approach on 8th graders' learning in the subject of acids-bases, their attitudes towards science class and scientific process skills. *Interdisciplinary Journal of Environmental and Science Education, 16*(1), *7*-22. httpsVartiai://doi.org/10.29333/ijese/6369

Usman M., Suyanta, & Huda K. (2021). Virtual lab as distance learning media to enhance student's science process skill during the COVID-19 pandemic. *Journal of Physics: Conference Series, 1882* (1). https://doi.org/10.1088/1742-6596/1882/1/012126.

Vartiainen, J. (2016). Science process skills in small children's science education. *LUMAT-B: International Journal of Math, Science and Technology Education*. https://www.lumat.fi/index.php/lumat-b/article/view/25/19

Walker, M. D. (2015). *Teaching inquiry-based science: A guide for middle and high school teachers* (1st ed.).

Wideen, M. (1975). Comparison of student outcomes for science - a process approach and traditional science teaching for third, fourth, fifth, and sixth

grade classes: a product evaluation. *Journal of Research in Science Teaching, 12*, 31-39. https://doi.org/10.1002/tea.3660120106

Wilson, M. R., & Corr, P. J. (2016). Managing "academic value": the 360-degreeperspective. *Perspectives: Policy and Practice in Higher Education, 22(1), 4–10*. https://doi.org/10.1080/13603108.2016.1181117

Wirassa, W. (2019). A study of relationship between attitude toward science and scientific process skill of grade 7 students under singburi the secondary school educational service area office 5. *Pathumthani University Academic Journal*, *11*(2),130-141.

Wright, E. (1981). The long-term effects of intensive instruction on the open exploration behavior of ninth grade students. *Journal of Research in Science Teaching, 18*(6), 557-561. https://doi.org/10.1002/tea.3660180610

Yamtinah, S., Masykuri, M., Ashadi, A., & Syahidul Shidiq, A. (2017). Analysis of students' science process skills in hydrolysis subject matter using testlet instrument. *Atlantic Press*. https://doi.org/10.2991/ictte-17.2017.36

Yilmaz, N. Y. (2019). An examination of the relationship between primary school students' environmental awareness and basic science process skills. *Educational Research and Reviews*, 140-151.

Yuliskurniawati, I. D., Noviyanti, N. I., Mukti, W. R., & Mahanal, S. A. (2019). Science process skills based on genders of high school students. *Journal of Physics: Conference Series, 1241*(1). https://doi.org/10.1088/1742-6596/1241/1/012055

Yunianti, A., Wasis, & Nur, M. (2019). The effectiveness of guided inquiry learning model to improve science process skill on heat matter. *Journal of Physics: Conference Series, 1417*(1), 1-7. https://doi.org/10.1088/1742-6596/1417/1/012080

Zulirfan, Z., Muhammad, R., Yennita, Y., Nina, K., & Muhammad, H. (2018). Science process skills and attitudes toward science of lower secondary students of merbau island: a preliminary study on the development of maritime based contextual science learning media. *Journal of Educational Sciences*, *2*(2), 90-99. https://doi.org/10.31258/jes.2.2.p.90-99