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Influence of Attitude towards Science to the Science Process Skills of Grade 10 Online Learners

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ABSTRACT

The study investigates the influence of attitudes toward Science on the Science Process Skills (SPS) of Grade 10 online learners in Victoria Tarlac. Using descriptive and correlational research designs, data were collected from 120 respondents and analyzed through ANOVA and multiple linear regression. Findings revealed that self-concept positively predicts SPS, while anxiety negatively affects SPS. Additionally, significant differences were observed in SPS based on socio-demographic factors including sex, family income, and birth order. Female learners, students from higher-income families, and first-born children demonstrated better SPS performance. This study emphasizes the importance of fostering positive attitudes toward Science, such as self-concept, to enhance students' SPS and reduce science-related anxiety. These results provide actionable insights for educators and policymakers aiming to improve science education and develop scientifically literate learners. By addressing these attitudinal and sociodemographic factors, the findings contribute to the broader goals of equipping students with essential skills for personal and societal development.

1. INTRODUCTION

In the 21st century, science education plays a pivotal role in equipping learners with the skills necessary for personal, social, and global advancement. These skills, collectively known as Science Process Skills (SPS), are essential for producing and applying scientific knowledge, conducting research, and solving problems. However, despite its importance, the current state of Philippine science education reveals significant challenges.

The 2018 Programme for International Student Assessment (PISA) results reveal Filipino students' low performance in scientific literacy, ranking second to last among 78 countries (Bernardo et al., 2023). This stresses the urgent need to enhance students' scientific literacy skills (Cordon & Polong, 2020). Factors contributing to poor performance include metacognitive awareness, social experiences, aspirations, and family or home factors (Bernardo et al., 2023). Similarly, Amini & Sinaga (2021) found very low scientific literacy abilities among students in terms of explaining various scientific phenomena. In another study, it is mentioned that while the availability of digital resources in schools and their sufficiency at home positively predicted science scores, school support for teachers' digital instruction and the availability of digital resources at home negatively predicted scores (Rodriguez et al., 2023). These findings elaborate on the importance of considering personal and contextual factors beyond typical instructional and curricular aspects when implementing science education reforms in the Philippines (Bernardo et al., 2023).

Recent studies explore the relationship between attitudes toward science, student engagement, and academic performance in the Philippines. Positive attitudes toward science and higher course engagement are found to be significant predictors of science literacy among Filipino undergraduate students during the COVID-19 pandemic (Adarlo et al., 2022). Although Filipino high school students demonstrate a highly positive attitude toward science, their science process skills are not well-developed, suggesting the need for improved teaching approaches, school resources, and learning environments. (Mirana, 2019). Meanwhile, Filipino tertiary science education students show moderate levels of online student engagement and high levels of self-regulated learning and online learning self-efficacy in the context of online learning (Briones et al., 2023). More recently, a study by Rayton (2023) reveals that higher digital skills are associated with improved academic performance and attitudes toward science in the new normal of online learning.

Moreover, research indicates a positive correlation between students' SPS and attitudes toward science (Juhji & Nuangchalerm, 2020). Other factors like gender and residence may also affect SPS, with some studies showing advantages for females and village students (Zeidan & Jayosi, 2014). On the other hand, implementing contextual teaching and learning models has been shown to improve both SPS and scientific attitudes (Kadmayana et al., 2021). Teachers must provide engaging science lessons that develop critical thinking skills to enhance SPS and foster positive attitudes (Mirana, 2019). Additionally, integrating technological pedagogical content knowledge (TPCK) may positively interplay with basic SPS and scientific attitudes (Juhji & Nuangchalerm, 2020).

With these challenges in science education, this study was carried out to determine how attitudes towards science influence the science process skills of Grade 10 online learners in Victoria, Tarlac. Specifically, it investigates the role of self-concept and anxiety as predictors of SPS and explores demographic differences in SPS, such as those related to sex, family income, and birth order. Through its findings, this study contributed to the broader goal of strengthening science education in the Philippines by equipping students with skills necessary for lifelong learning and informed decision-making in a scientifically complex world.

2. METHODS

The study utilized descriptive research design which was used in describing the respondents' socio-demographic profile, attitude towards Science, and their Science process skills. In addition, the correlational research method was used in determining the influence of attitudes toward Science in terms of self-concept, anxiety, fear, and aspiration to the Science process skills. On the other hand, correlational research is research designed to discover relationships among variables and to allow the prediction of future events from present knowledge. It allows testing of expected relationships between and among variables and the making of predictions. Furthermore, the study also utilized a comparative research design to determine the difference between attitudes toward Science and Science process skills of respondents when grouped according to socio-demographic characteristics such as sex, type of school, parent's educational attainment, monthly family income, number of siblings, and birth order.

The researcher collected the data from 120 Grade 10 online learners in Victoria, Tarlac. All of them attended online classes. Purposive sampling was the sampling procedure used in the study. Grade 10 students were chosen as the respondents of the study because the junior high school students already have a lot of experience in the spiral curriculum of Science and they are expected to have learned already the different levels of Science process skills than the lower grades junior high students. Although the mode of learning today is online where students rely only on the availability of internet connection, the

researcher has expected that a substantial response was given by the Grade 10 online learners based on their current and past experiences in studying Science.

The instruments used to collect data in this study were three sets of questionnaires: the Socio-demographic Profile of the Respondents, the Science Process Skills Test (SPST), and the Attitudes toward Science Questionnaire (ATSQ). Part I inquired about the socio-demographic profiles of the respondents in terms of sex, type of school, parent's educational background, number of sibling/s, family income, and birth order were included in the first part of the research survey instrument. The students must provide their personal, financial, and educational information. They must also be able to estimate the actual amount of their family's monthly income, the actual number of siblings, and ordinal data such as birth order. Part II was about the Science Process Skills Test adopted (Zeidan & Jayosi, 2014). This was an 18-item question about science process skills. SPS categories such as observing, measuring, inferring, classifying, communicating, controlling variables, hypothesizing, experimenting, and data interpreting consist of two item questions each from number 1 to number 18, respectively (e.g., questions 1 and 2 measure the students; observing skill). The questions were composed of tables to be interpreted by the students and situational scientific phenomena. It also required Grade 10 students' background knowledge of scientific methods, basic information about experimental research and research variables, metric systems, and other basic science contexts and applications. Part III, Attitude towards Science Questionnaire, was adapted from (Kamba, 2018) which was divided into four constructs: self-concept, anxiety, fear, and aspiration based on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

The instruments were validated through expert review and pilot testing with 30 Grade 10 students from a nearby school. The SPST demonstrated a Cronbach's alpha of 0.85, indicating high reliability, while the ATSQ had a Cronbach's alpha of 0.87, ensuring its suitability for measuring attitudes toward science.

3. RESULTS AND DISCUSSION

Difference on the Respondents' Attitude towards Science when Grouped According to Socio-demographic Profile

Table 1 presents the difference in the respondents' attitudes towards science when grouped according to their socio-demographic profile. A series of analysis of variance (ANOVA) at 0.05 level was performed to differentiate the respondents' attitude towards Science when grouped according to socio-demographic characteristics in terms of sex, type of school, educational attainment of parents, family income, number of siblings, and birth order. Preliminary assumption testing to check for normality and homogeneity of variance among others was conducted and no serious violation of homoscedasticity was noted.

ANOVA found a significant difference in the respondents' attitude towards Science when grouped according to birth order $F_{(2,117)} = 1.33$, $p < 0.05$. Post hoc analysis using Scheffe showed that the oldest student respondents in their family (Mean = 3.81, SD = 0.48) tend to show a more positive attitude towards science compared to the middle student respondents (Mean = 3.34, SD = 0.42) and youngest student respondents (Mean = 3.50, SD = 0.42) in their families. This implies that firstborns are most likely passionate about science as they can able to manage their stress by studying the subject. Gaining a lot of attention and discipline while growing up, first-born children tend to have a more positive outlook in life than middle or later-born children and they are taught to be role models for their younger siblings. Although the study on birth order is limited, these results are somehow supported by the research on birth order effects that shows varied results regarding academic achievement and personality traits. Some

studies found firstborns to be more achieving and conscientious (Paulhus et al., 1999), but others reported no significant difference between birth order and early scientific attainment (Datta, 1967). However, firstborns were found to be more emotionally stable, persistent, and socially outgoing, with a higher likelihood of assuming leadership roles (Black et al., 2018). They also show better overall adjustment in university settings (Aloka, 2023). These differences may stem from firstborns' initial experience of undivided parental attention and subsequent need to maintain that status. Birth order effects are not solely determined by ordinal position but are influenced by various family dynamics and environmental factors (Gilmore, 2016). Understanding these influences can help parents better prepare children for changes in family composition and promote harmonious relationships among siblings (Huang et al., 2022).

Table 1. The difference in the respondents' attitudes towards science when grouped according to socio-demographic profile

Socio-Demographic Characteristics	Mean	SD	Df	F	P
Sex					
Male	3.46	0.46	1,118	0.12	0.732
Female	3.49	0.45			
Type of School					
Public	3.48	0.51	1,118	0.01	0.971
Private	3.48	0.38			
Mother's Educational Attainment					
without Bachelor's Degree	3.43	0.49	1,118	1.54	0.225
with Bachelor's Degree	3.53	0.38			
Father's Educational Attainment	3.47	0.47	1.118	0.06	0.816
without Bachelor's Degree	3.49	0.38			
with Bachelor's Degree					
Family Monthly Income					
< the Mean Family Income	3.42	0.44	1,118	2.84	0.094
≥ The mean Family Income	3.55	0.45			
Number of Siblings					
< the Mean Number of Siblings	3.47	0.49	1,118	0.05	0.831
≥ The mean Number of Siblings	3.49	0.42			
Birth Order					
Youngest	3.50_b	0.42	2,117	1.33*	0.027
Middle	3.34_b	0.42			
Oldest	3.81_a	0.48			

Note: Means with the same subscript do not differ using Scheffe post hoc analysis.
Ho: There is no significant difference in the respondents' attitudes towards science when grouped according to socio-demographic profile.
Ha: There is a significant difference in the respondents' attitudes towards science when grouped according to socio-demographic profile.

However, there is no significant difference found in students' attitudes towards Science and their sex, type of school, parents' educational attainment, family income, and number of siblings. This is supported by the study Sofiani et al. (2017) on the student's attitude towards science and the effect of gender on students' attitudes which showed that there was no significant difference in attitude towards

science between the female and male students. In contrast, a study is conducted to determine the relationship between primary school students' attitudes towards science between their demographic variables such as gender, class level, and their families' income levels. According to the results of the analysis of students' points of attitude towards science in terms of gender, a significant difference was found in favor of female students (Mihladiz et al., 2011). This is contradicted by the findings of (Hussaini et al., 2015) who showed that there was a significant difference between the attitudes of public and private students. They also concluded that school type affects student's attitudes toward biology. Students in private schools are said to have more positive attitudes than students in public schools.

In a more recent study, it was found that parents' educational level did not significantly contribute to students' attitudes towards science. The results of the present study supported that independent of parents' educational level, the quality of the school's educational resources was the contributing factor to more positive attitudes of students developed toward science (Hacıeminoğlu, 2019). Another study he conducted with two other colleagues revealed that the students, whose mothers only had received primary education or less, had significantly lower scores in their attitude toward science than other students. There were no significant differences in the attitude scores of students whose mothers had received secondary and tertiary education, undergraduate and graduate level of education. They noted that the action of fathers and mothers to encourage and motivate their children to enter higher education has a positive impact on their attitude towards Science (Hacıeminoğlu et al., 2015).

The results also conformed to the literature stressing that parents' socio-economic status did not significantly contribute to students' attitudes towards Science. It supported the idea that, even if the students have a low socio-economic level, they can be encouraged by their parents to perform well if their families see the value of science and display a positive attitude toward science (Perera, Bomhoff & Lee, 2014). In contrast, the study of Mihladiz et al. (2011) revealed that there were significant differences found in favor of the families who have medium income levels based mainly on the analysis of students' points of attitude towards Science. In addition, (Hacieminoglu, 2019) also revealed that parents' income had a significant effect on students' attitudes toward science. This means that the level of income influenced the students' attitude toward science. Students from families with a high income had higher attitude scores than those from medium-income families.

With the above results, the hypothesis states that there is no significant difference in the respondents' attitude towards Science when grouped according to socio-demographic profile is retained except for birth order which has a significant difference in respondents' attitude towards Science.

Difference on Respondents' Science Process Skills when Grouped According to Socio-demographic Profile

Table 2 presents the results of the series of analysis of variance (ANOVA) at 0.05 level. It was performed to differentiate the respondents' science process skills when grouped according to socio-demographic characteristics in terms of sex, type of school, educational attainment of parents, family income, number of siblings, and birth order. Preliminary assumption testing to check for normality and homogeneity of variance among others was conducted and no serious violation of homoscedasticity was noted. ANOVA found a highly significant difference in the respondents' science process skills when grouped according to sex $F(1,118) = 8.65$, $p < 0.01$. It means that females scored higher in the science process skills test compared to males. Females tend to be more patient, persistent, serious and committed when it comes to studying than males. Males get easily distracted by sort of things around them like mobile or computer games and sports that make them less focused in studying their lessons. Contrary to the initial claim, research shows varied findings regarding gender differences in science process skills.

Some studies found that female students outperformed males in science process skills and critical thinking (Darmaji et al., 2022), while others reported that male students performed better in certain aspects, such as observation, controlling variables, and making conclusions (Yamtinah et al., 2017). It suggests that gender differences in science process skills are complex and may vary depending on specific skills, contexts, and measurement methods. In addition, Widdina et al. (2018) studied students' basic science process skills based on gender and their results showed that male groups outperformed female groups in some indicators and categories of Science process skills, but there is no substantial evidence to conclude that males are significantly better than females because students learn the concept in the same class and with the same teacher. Therefore, there are no explicit findings that indicate that there is a significant difference in the Science process skills between males and females. With this, many studies have reported that there is no significant difference in the students' Science process skills when grouped according to sex or gender (Ekon & Eni, 2015).

Table 2. Differences in the respondents' science process skills when grouped according to socio-demographic profile

Socio-Demographic Characteristics	Mean	SD	Df	F	P
Sex					
Male	8.69	3.83	1,118	8.65**	0.004
Female	10.48	3.33			
Type of School					
1 – 2	9.31	3.16	1,118	2.69	0.104
3 – 5	10.30	3.45			
Mother's Educational Attainment					
without Bachelor's Degree	9.39	3.43	1,118	2.74	0.100
With Bachelor's Degree	10.40	3.12			
Father's Educational Attainment					
without Bachelor's Degree	9.72	3.24	1,118	0.22	0.644
with Bachelor's Degree	10.03	3.58			
Family Monthly Income					
< the Mean Family Income	9.03	3.38	1,118	9.17**	0.003
≥ The mean Family Income	10.83				
Number of Siblings					
< the Mean Number of Siblings	10.23	3.09	1,118	1.48	0.226
≥ The mean Number of Siblings	9.49	3.50			
Birth Order					
Youngest	9.63_b	3.39	2,117	2.33*	0.012
Middle	8.73_b	3.48			
Oldest	10.51_a	3.12			

Note: Means with the same subscript do not differ using Scheffe post hoc analysis.
**-highly significant at 0.01 level of significance, *-significant at 0.01 level of significance
Ho: There is no significant difference in the respondents' science process skills when grouped according to socio-demographic profile.
Ha: There is a significant difference in the respondents' science process skills when grouped according to socio-demographic profile.

Similarly, student respondents with monthly family income greater than or equal to the average performed higher than those student respondents with below-average monthly family income $F_{(1,118)}$ = 9.17, $p < 0.01$. This may be because students who belong to average or above average income levels are said to have more educational learning resources like mobile phones, laptops, books, journals, and internet connections than the students who belong to the low-income level, not financially stable and cannot afford to buy essential learning materials. Research indicates that students' science process skills and academic achievement are influenced by various socio-economic factors. Studies have found that parental education levels, family income, and access to resources like computers and study rooms are positively associated with students' SPS levels (Öztürk, N., Tezel, Ö., Acat, M.B., Student, D., & Fen, T., 2010). Higher family income is linked to better performance in SPS, possibly due to increased access to educational resources (Asio & Modejar et al., 2022). This is also in line with the literature provided by (Martina, 2007) stating that a family's socioeconomic status is one of the factors that influence students' acquisition of SPS. More specifically, found that there is a statistically significant difference in 8th-grade students' science process skills when grouped according to their family monthly income. Between students whose family income levels are high, students whose family income levels are medium, and students whose family income levels are low, it was determined to be in favor of students who have high-income levels. They further inferred that while the family income level increases, students' science process skills level also increases (Karar & Yenice 2012).

Finally, ANOVA also found significant differences in the birth order of the student respondents, $F_{(2,117)}$ = 2.33, $p < 0.01$. Post hoc analysis using Scheffe disclosed that the oldest student respondents in their family (Mean = 10.51, SD = 3.12) scored higher in the process skills test compared to the middle student respondents (Mean = 8.73, SD = 3.48) and youngest student respondents (Mean = 9.63, SD = 3.39) in their families. This is because oldest children or first-born and only-child students are more academically inclined than middle-born and later-born students. Being taught by the parents to set an example and be a role model to the younger siblings, first-born or oldest student respondents tend to do better and excel in academics.

Since there are no direct studies found on birth order and Science process skills, it must be taken into account to include related studies on birth order and educational outcomes to somehow expand the general views and insights regarding the present study. Birth order has been shown to have significant effects on academic performance and personality development in children. Multiple studies have found that firstborn and earlier-born children tend to perform better academically in both reading and mathematics compared to later-born siblings (Arshad et al., 2020; Houmark, 2023). This academic advantage is observed across different countries and cultures (Arshad et al., 2020). These differences are attributed to variations in parental investment, with firstborns receiving more attention and resources (Houmark, 2023). However, some research has found no significant relationship between birth order and academic performance or personality factors (Khan et al., 2018)

However, there is no significant difference found in the student respondents' Science process skills and their type of school, parents' educational attainment, and number of siblings. In contrast to the result, Özgelen (2012) indicated that there is a significant difference between students' SPS and their school type. Private school students had higher scores compared to public and bussed school students.

(Tanık & Saracoglu 2012) found a different result on the difference between parents' educational attainment and students' Science process skills. They have found that there is no significant difference among students whose mothers' education levels are different. On the other hand, they have found that the father's education level causes significant differences in terms of students' basic process skills. This

means that parents' education level specifically with that of fathers' education level plays an important role in the development of students' SPS. Educated fathers tend to influence their children to do the same when it comes to studying.

This is consistent with the findings of Böyük et al., (2011) revealing that there was a significant difference between the SPS level of the students whose fathers are university graduates and those of the students whose fathers are primary school graduates. However, the results of different studies revealed that mothers' education level was a significant predictor of students' SPS (Ocak & Tumer, 2014). The studies by Karar & Yenice (2012) also reported that the SPS of students differed according to their parent's education level. As opposed also from the obtained result, the study of Güden & Timur (2016) revealed how students' science process skills level changes based on the number of siblings. The level of the scientific process skills of the secondary school (5th, 6th, 7th, and 8th grade) students with five siblings was higher than that of the students with less than five siblings. The level of the scientific process skills of the students with four siblings was equal to that of those with 8 or more siblings.

With the above results, the hypothesis stating that there is no significant difference in the respondents' attitude towards Science when grouped according to socio-demographic profile is rejected.

Table 3. Multiple linear regression predicting the respondents' science process skills

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error	Beta		
Constant	7.77	2.45		3.17	0.002
Self-concept	1.51	0.61	0.25	2.49*	0.014
Anxiety	-1.42	0.43	-0.32	-3.32**	0.001
Fear	0.39	0.35	0.10	1.12	0.265
Aspirations	-0.52	0.38	-0.13	-1.38	0.169

Note: $F(4, 115) = 6.93$, $p < 0.001$, $R^2 = 0.194$
Ho: Attitude in terms of self-concept, anxiety, fear, and aspirations towards Science do not influence their science process skills.
Ha: Attitude in terms of self-concept, anxiety, fear, and aspirations towards Science influence their science process skills.

Table 3 shows the result of a multiple linear regression analysis performed to determine whether respondents' attitude in terms of self-concept, anxiety, fear, and aspirations toward Science influence their science process skills. Results show that the model is significant $F(4, 115) = 6.93$, $p < 0.001$, which indicates that the model fits the data. The coefficient of determination $R2 = 0.194$ means that about 19.40% of the variance in the respondents' science process skills is explained or accounted for by the independent variables combined and 80.60% is explained or accounted for by other variables not included in the model.

The value of the constant is 7.77, which is the average science process skills score when all other variables are zero. Self-concept is a positive predictor of science process skill, t-value is 2.49, $p < 0.05$. It means that students with higher self-concept tend to score higher in science process skills tests. Students who are more motivated to learn and confident about their abilities may tend to develop and improve better their SPS than students who are doubtful and less motivated. This is why showing a positive attitude towards Science would lead to good performance in science achievement. These results conformed to the study conducted on the effect of the science process skills teaching approach (SPSTA) on students' self-concept in chemistry among secondary school students in the Nyando district of Kenya (Abungu et al., 2014). The results revealed that the science process skills teaching approach (SPSTA) had a significant effect on students' self-concept in chemistry.

On the other hand, anxiety is a negative predictor of science process skills, $t = -3.32$, $p < 0.01$, implying that apprehensive students are more likely to have lower scores in science process skills tests. Students who are easily discouraged, stressed, and helpless may have poor SPS. Showing a negative attitude towards Science would only lead to low performance in science achievement. In the study conducted by Kamba et al. (2018), they noted that students' knowledge of science process skills is poor while the students' attitudes towards physics are good. They have also indicated that there is a significant positive relationship between students' knowledge of science process skills and their attitudes towards physics. It was concluded that students should be exposed to science process skills for the betterment of their future life and society as well, the level of students' attitudes toward physics is good but not enough, as such, positive attitudes of students should be improved so that they can be able to think, to reflect and to associate with ideas related to physics. Also, the researcher believed that the positive attitudes toward Science make students more interested in focusing on the science process. This means that displaying a negative attitude towards Science does not help students improve and develop their Science process skills. It would only actually lead them to become less motivated and disappointed in studying Science. In other words, when the students understand the science process skills, physics becomes more interesting to them, which increases their positive attitudes toward physics. Meanwhile, fear and aspirations do not predict the science process skills of the student respondents. With the above results, the hypothesis stating that attitude towards Science does not influence their science process skills is retained except for self-concept and anxiety constructs.

Moreover, research consistently shows a positive relationship between students' attitudes toward science, their science process skills, and their academic achievement in science. Studies across different countries, including Malaysia, Singapore, and the Philippines, have found that students with more positive attitudes towards science tend to perform better academically (Lay & Chandrasegaran, 2016; Mirana, 2019). However, while students often display highly positive attitudes toward science, their science process skills are crucial for effective science inquiry and critical thinking (Derilo, 2019). Factors influencing cognitive performance in science include observing, measuring, making inferences, predicting, communicating, and using time-space relationships, as well as attitudes such as finding science fun and having supportive classroom teachers and families. To improve students' science achievement, educators should focus on developing SPS through inquiry-based activities and create engaging, supportive learning environments (Araes et al., 2024).

4. CONCLUSION

The study reveals significant insights into the relationships between attitudes toward science and Science Process Skills (SPS), as well as the influence of socio-demographic factors. Self-concept appeared as a positive predictor of SPS, emphasizing the importance of confidence and motivation in developing scientific competencies. Conversely, anxiety negatively affects SPS, stressing the need for supportive educational environments. Additionally, female learners, students from higher-income families, and firstborn children demonstrated better SPS performance, suggesting the influence of socio-demographic contexts on students' scientific abilities.

To enhance SPS among learners, educators should implement strategies that build self-concept, such as hands-on and inquiry-based learning activities, while reducing anxiety through stress-management techniques and a positive classroom atmosphere. Policymakers should address resource disparities by providing financial and material support to low-income students, ensuring equitable access to quality science education.

Despite these findings, this study is not without limitations. The focus on a specific group of Grade 10 online learners may limit the generalizability of the results. Additionally, the relatively small sample size and reliance on self-reported data could introduce biases. Future research should explore these relationships in more diverse populations, including senior high school students and in-person learning environments. Investingating interventions to reduce anxiety and improve SPS across different socio-demographic groups would further enhance the understanding of these dynamics.

By addressing attitudinal and socio-demographic factors influencing SPS, this study contributes to the broader goal of fostering scientifically literate learners. These findings provide actionable insights for educators and policymakers striving to improve science education and prepare students to thrive in this every-changing world.

5. REFERENCES

Abungu, H. E., Okere, M. I. O., & Wachanga, S. W. (2014). The Effect of Science Process Skills Teaching Approach on Secondary School Students' Achievement in Chemistry in Nyando District, Kenya. *Journal of Educational and Social Research*. https://doi.org/10.5901/jesr.2014.v4n6p359

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*.

Adarlo, G., De Leon, M., & Favis, A. M. (2022). *Exploring Students' Attitudes Toward Science and Course Engagement as Predictors of Science Literacy*. 39–44. https://doi.org/10.54808/IMSCI2022.01.39

Aloka, P. J. (2023). Birth Order Differences and Overall Adjustment among First Year Undergraduate Students in One Selected University. *Athens Journal of Education*, *10*(3), 523–538. https://doi.org/10.30958/aje.10-3-9

Amini, S., & Sinaga, P. (2021). Inventory of scientific literacy ability of junior high school students based on the evaluation of PISA framework competency criteria. *Journal of Physics: Conference Series*, *1806*(1), 012017. https://doi.org/10.1088/1742-6596/1806/1/012017

Araes, S. G., Apad, P. M., Bacalto, E. O., Cabrera, M. L. D., Dellosa, J. T., Garcia, M. L. D., Guisingmadali, K. C. I., Lucero, A. M., Manonggal, K. A. R., Pantaleon, C. E., Santonia, D. A. A., Clamares, K. J. M., & Pelandas, A. M. O. (2024). Process Skills and Attitude towards Science as the Contributing Factors in Cognitive Performance among Special Science Class Students: A Quantitative Study. *International Journal of Research and Innovation in Social Science*, *VIII*(IV), 2470–2479. https://doi.org/10.47772/IJRISS.2024.804243

Arshad, H., Husky, M. M., Goelitz, D., Bitfoi, A., Carta, M. G., Koç, C., Lesinskiene, S., Mihova, Z., Otten, R., Fermanian, C., & Kovess-Masfety, V. (2020). Birth rank as a determinant of academic achievement: results from a European survey of primary school children. *European Journal of Developmental Psychology*, *17*(5), 629–648. https://doi.org/10.1080/17405629.2019.1700108

Bernardo, A. B. I., Cordel, M. O., Calleja, M. O., Teves, J. M. M., Yap, S. A., & Chua, U. C. (2023). Profiling low-proficiency science students in the Philippines using machine learning. *Humanities and Social Sciences Communications*, *10*(1), 192. https://doi.org/10.1057/s41599-023-01705-y

Black, S. E., Grönqvist, E., & Öckert, B. (2018). Born to Lead? The Effect of Birth Order on Noncognitive Abilities. *The Review of Economics and Statistics*, *100*(2), 274–286. https://doi.org/10.1162/REST_a_00690

Böyük, U., Tanık, N. & Saraçoğlu, S. (2011). Investigation of elementary school second-level students' science process skills in terms of different variables. *Turkish Science Research Foundation Journal*, *4*(1), 20–30.

Briones, M. R., Prudente, M., & Errabo, D. D. (2023). Characteristics of Filipino Online Learners: A Survey of Science Education Students' Engagement, Self-Regulation, and Self-Efficacy. *Education Sciences*, *13*(11), 1131. https://doi.org/10.3390/educsci13111131

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.v1i2.59

Darmaji, D., Astalini, A., Kurniawan, D. A., & Putri, W. A. (2022). Science Process Skills and Critical Thinking Ability Assessed from Students' Gender. *Jurnal Pendidikan Fisika Indonesia*, *18*(1), 83–95. https://doi.org/10.15294/jpfi.v18i1.30534

Datta, L.-E. (1967). Birth Order and Early Scientific Attainment. *Perceptual and Motor Skills*, *24*(1), 157–158. https://doi.org/10.2466/pms.1967.24.1.157

Derilo, R. C. (2019). Basic and integrated science process skills acquisition and science achievement of seventh-grade learners. *European Journal of Education Studies*, *6*(1).

Ekon, E., & Eni, E. (2015). Gender and Acquisition of Science Process Skills among Junior Secondary School Students in Calabar Municipality: Implications for Implementation of Universal Basic Education Objectives. *Global Journal of Educational Research*, *14*(2), 93. https://doi.org/10.4314/gjedr.v14i2.3

Güden, C., & Timur, B. (2016). Ortaokul Öğrencilerinin Bilimsel Süreç Becerilerinin İncelenmesi (Çanakkale örneği). *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *16*(1). https://doi.org/10.17240/aibuefd.2016.16.1-5000182916

Hacieminoglu, E. (2019). Student and School Level Variables Related to Elementary School Students' Attitudes towards Science. *Eurasian Journal of Educational Research*, *19*(80), 1–30. https://doi.org/10.14689/ejer.2019.80.4

Hacıeminoğlu, E., Ertepınar, H., Yılmaz-Tüzün, Ö., & Çakır, H. (2015). Students and school characteristics related to elementary school students' views of the nature of science. *Education 3-13*, *43*(6), 700–721. https://doi.org/10.1080/03004279.2013.865655

Houmark, M. (2023). First Among Equals? How Birth Order Shapes Child Development. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4627068

Huang, C.-Q., Han, W., & Hu, S.-L. (2022). Factors affecting the first-born child's attitude toward the second child in Shanghai. *European Review for Medical and Pharmacological Sciences*, *26*(9), 3206–3211. https://doi.org/10.26355/eurrev_202205_28739

Hussaini I., Foong, L., and Kamar Y. (2015). Attitudes of secondary school students towards biology as a school subject in Birninkebbi metropolis, Nigeria. *International Journal of Research and Review*, *2*(10), 596–600.

Juhji, J., & Nuangchalerm, P. (2020). Interaction between Science Process Skills and Scientific Attitudes of Students towards Technological Pedagogical Content Knowledge. *Journal for the Education of Gifted Young Scientists*, *8*(1), 1–16. https://doi.org/10.17478/jegys.600979

Kadmayana, K., Halim, A., Mustafa, M., & Ilyas, S. (2021). Impact of Contextual Teaching Learning Model to Science Process Skills and Scientific Attitudes of Students. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 375–380. https://doi.org/10.29303/jppipa.v7i3.714

Kamba, A. H. (2018). The relationship between science process skills and student attitude toward physics in senior secondary school in Aliero metropolis. *African Educational Research Journal*, *6*(3), 107–113. https://doi.org/10.30918/AERJ.63.18.038

Kamba, A. H., Giwa A. A., Libata I. A., & Wakkala G. T. (2018). The relationship between science process skills and student attitude toward physics in senior secondary school in Aliero metropolis. *African Educational Research Journal*, *6*(3), 107–113. https://doi.org/10.30918/AERJ.63.18.038

Karar, E. E., & Yenice, N. (2012). Analysis of the scientific process skill level of primary school 8th grade students based on different variables. *Çukurova University Faculty of Education Journal*, *21*(1), 83–100.

Khan, R.M., Nawaz, K., Khan, R.M., Yaseen, S., Rouf, A., Maryam, M., & Tabassum, S. (2018). Relationship between birth order, personality and academic performance. *Rawal Medical Journal*, *43*, 39–44.

Lay, Y. F., & Chandrasegaran, A. L. (2016). The Predictive Effects of MotivationToward Learning Science on TIMSS Grade 8 Students' Science Achievement: A Comparative Study Between Malaysia and Singapore. *EURASIA Journal of Mathematics, Science and Technology Education*, *12*(12). https://doi.org/10.12973/eurasia.2016.02315a

Martina, E. N. (2007). *Determinants of J.S.S. students' level of acquisition of science process skills , Master Thesis,* [Master Thesis]. Nsukka: University of Nigeria.

Mihladiz, G., Duran, M., & Dogan, A. (2011). Examining primary school students' attitudes towards science in terms of gender, class level and income level. *Procedia - Social and Behavioral Sciences*, *15*, 2582–2588. https://doi.org/10.1016/j.sbspro.2011.04.150

Mirana, V. (2019). Attitude towards Science and Process Skills of Junior High School Students. *Asia Pacific Journal of Multidisciplinary*, *7*(2), 16–23.

Ocak, H., & Tumer, H. (2014). Levels of primary process 5th grade students having scientific process skills. *Afyon Kocatepe University Science and Engineering Science Journal*, *14*(2), 1–21.

Özgelen, S. (2012). Students' Science Process Skills within a Cognitive Domain Framework. *EURASIA Journal of Mathematics, Science and Technology Education*, *8*(4). https://doi.org/10.12973/eurasia.2012.846a

Öztürk, N., Tezel, Ö., Acat, M.B., Student, D., & Fen, T. (2010). Science Process Skills Levels of Primary School Seventh Grade Students in Science and Technology Lesson. *Journal of Turkish Science Education*, *7*(3), 15–28.

Paulhus, D. L., Trapnell, P. D., & Chen, D. (1999). Birth Order Effects on Personality and Achievement Within Families. *Psychological Science*, *10*(6), 482–488. https://doi.org/10.1111/1467-9280.00193

Research Development and Community Extension Service, Gordon College, Olongapo City, Philippines,2200, Asio, J. M., Mondejar, H. C., & Doctoral Student, Philippine Christian University, Manila, Philippines, 1000. (2022). Students' Level of Science Process Skills Acquisition and Academic Achievement during the Pandemic. *Central Mindanao University Journal of Science*, *26*(2). https://doi.org/10.52751/ZFHG2128

Rodriguez Jr, R., Bulanadi, M. G., & David, A. (2023). Digital Resources' Availability, Usage, and Sufficiency: Insights from Filipino Scientific Literacy Scores. *APJAET - Journal Asia Pacific Journal of Advanced Education and Technology*, *2*(2). https://doi.org/10.54476/apjaet/21358

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

Tanık, N., & Saracoglu, S. (2012). (2012). EXAMINATION OF SCIENCE AND TECHNOLOGY COURSE WRITTEN QUESTIONS ACCORDING TO THE REVISED BLOOM TAXONOMY. *TÜBAV Science Journal*, *4*(4).

Widdina, S., Rochintaniawati, D., & Rusyati, L. (2018). The Profile of Students' Science Process Skill in Learning Human Muscle Tissue Experiments at Secondary School. *Journal of Science Learning*, *1*(2), 53. https://doi.org/10.17509/jsl.v1i2.10146

Yamtinah, S., Masykuri, M., Ashadi, & Shidiq, A. S. (2017). *Gender differences in students' attitudes toward science: An analysis of students' science process skill using test instrument*. 030003. https://doi.org/10.1063/1.4995102

Zeidan, A. H., & Jayosi, M. R. (2014). Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students. *World Journal of Education*, *5*(1), p13. https://doi.org/10.5430/wje.v5n1p13