

# Level of Predict-Observe-Explain (POE) Competencies Based on Gender Differences of High Schools Students Using (POE-PSIS) Instrument

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## Abstract

This study investigated the level of competencies in Predict-Observe-Explain (POE) skills among Junior High School and Senior High School students in performing science experiments, with particular attention to gender differences. Specifically, it sought to determine whether male and female students differ significantly in their ability to predict experimental outcomes, observe phenomena, and explain results. A quantitative research design was employed, utilizing a survey assessment tool of students' POE performance during science experiments. Using a researcher-developed survey questionnaire, the Predict-Observe-Explain Proficiency Self-Inventory for Students (POE-PSIS), the data collected were analyzed using Jamovi software V2.3.28. Data were gathered, analyzed, and compared across gender groups to determine variations in competency levels. The findings revealed that female students exhibited higher levels of POE competencies than male students. Females were more consistent in formulating accurate predictions, conducting systematic observations, and constructing logical explanations of experimental results. These results suggest that females display a more reflective and detail-oriented approach to scientific inquiry, while males may require additional support in developing such skills. Based on these findings, it was concluded that there exists a gender-related variation in POE competencies, favoring females. This implies the need for differentiated teaching strategies to strengthen male learners' inquiry skills while further enriching the learning opportunities of female students. The study also underscores the importance of gender-responsive instruction and the promotion of equity in science education to prepare all learners for future participation in science, technology, engineering, and mathematics (STEM) fields. The study recommends that teachers employ gender-responsive pedagogies and curriculum developers integrate inquiry-based activities. Future researchers are encouraged to investigate the underlying factors behind gender differences in POE competencies and to design interventions aimed at addressing these gaps.

**Keywords:** Predict-observe-explain competencies, science process skills, science education

## INTRODUCTION

In the dynamic realm of contemporary education, the constructivist approach stands tall, particularly in the domain of science education. This pedagogical philosophy emphasizes active knowledge construction within individuals' minds, underscoring the pivotal role of educators in employing effective methodologies. Özcan, G. E., & Uyanık, G. (2022) stated in their study that among the strategies, the Predict-Observe-Explain (POE) approach emerges as a vibrant method that nurtures active learning and cultivates profound conceptual comprehension among students. It promotes hands-on activities and requires application of logical thinking (Mtsi et. al., 2021).

Originally conceptualized by Champagne, Klopfer, and Anderson in 1983 and later coined as POE by White and Gunstone in 1992, this strategy encapsulates a sequence of steps involving prediction, observation, and explanation. Mtsi et al. (2021) mentioned in his paper that application of POE in science laboratories and classrooms intertwines scientific concepts with real-world occurrences, encouraging students for deep learning thus rendering it a vital tool for fostering enduring comprehension among students. Fundamentally, the POE strategy sparks students' prior knowledge, guiding them through conflict resolution processes that foster self-confidence, responsibility, and motivation according to Pagente, A. F. M. (n.d.). By involving students in predicting, observing, and explaining scientific phenomena, this approach facilitates the construction and articulation of knowledge, resulting in successful outcomes, particularly in subjects reliant on experimentation and observation, such as science (Jiang and Li, 2024). The paper of Ojo & Owolabi (2021) revealed that the POE instructional strategy in selected secondary schools has cultivated students' attitude towards Physics practical assessment and has shown positive effects on students' performance.

Despite its documented efficacy in enhancing student participation, confidence, and conceptual grasp, a critical gap exists—the absence of a self-inventory proficiency tool for measuring Predict-Observe-Explain (POE) competencies. This research endeavors to fill this void by developing a standardized measurement to gauge the effectiveness of this strategy comprehensively.

In the rapidly evolving landscape of education, where science teaching encounters challenges such as teacher confidence and knowledge on useful teaching approaches (Nurhayati et. al., 2025), resource limitations, and students' struggles with scientific concepts (Geverola et. al., 2022), the demand for innovative pedagogical approaches becomes increasingly pronounced. Educators, entrusted with nurturing students' interest and success in science, seek methodologies that harmonize with contemporary educational principles. Equally essential is the ability to gauge the quality and impact of these methodologies through standardized measurements, ensuring the delivery of high-quality science education (Samsudin et. al., 2021).

The student-centered nature of the POE approach positions it as a potential solution to these challenges. Acknowledged for its prowess in uncovering students' knowledge through prediction, observation, and explanation, the POE strategy resonates with the current emphasis on enhancing students' attitudes and achievements in science education (Yatmanto et. al., 2025; Jamaludin and Sriyanshah, 2023; Husna and Pranoto, 2024).

In pursuit of establishing a vigorous self-inventory proficiency tool for measuring POE competencies, this study endeavors to make a substantial contribution to science education enhancement. Focused on exploring the practicality and effectiveness of the POE strategy at the high school level, this research aims

to yield findings that not only enrich the existing literature but also inform pedagogical practices, enabling more effective science teaching and learning methodologies in the contemporary educational landscape.

**Method**

This study is a survey research that uses a quantitative methodology. The details of the participants, the instruments, the data gathering procedure, and the analysis of the results of the study are described in the succeeding sections.

**Participants**

The participants in the study were 763 students from 4 DepEd high schools in Antipolo City consisting of 449 JHS students and 314 SHS students. As shown in Table 1, the participants are 448 female students and 315 male students. Most of them have age ranges of 13-16 years old with 493 participants, while 264 students have age ranges of 17-20 years old. SINHS has the greatest number of participants with 445 students as respondents in this research.

**Table 1 Distribution of Participants by School, Year Level, and Gender**

Frequencies: School			
skul	Counts	% of Total	Cumulative %
ACSHS	144	18.9 %	18.9 %
MNHS	41	5.4 %	24.2 %
SINHS	445	58.3 %	82.6 %
SJoNHS	133	17.4 %	100.0 %

Frequencies: Yr Level			
Yr Level	Counts	% of Total	Cumulative %
JHS	449	58.8 %	58.8 %
SHS	314	41.2 %	100.0 %

Frequencies: Gender			
Gender	Counts	% of Total	Cumulative %
Female	448	58.7 %	58.7 %
Male	315	41.3 %	100.0 %

The total number of respondents in this research is 835 students but only those students with laboratory classes were included in the analysis of the result of the survey on their level of Predict-Observe-Explain (POE) competencies using the Predict-Observe-Explain Proficiency Self-Inventory for Students (POE-PSIS) instrument. Some of the respondents in the SHS level who belonged to ABM, HUMSS, and GAS strands were excluded because only those students in the STEM strand were included in this study, leaving a total of 763 participants.

**Instrument**

The instrument used in this study is the Predict-Observe-Explain Proficiency Self-Inventory for Students

(POE-PSIS). This instrument is a researcher-developed survey questionnaire derived from the study about the competency standards based on chemistry stakeholders' typology, structure, and process of prediction, observation, and explanation (Mirabueno, et. al., 2022). This instrument was developed by subjecting the collected data to a factor analysis using Jamovi software V2.3.28. The instrument was validated through factor analysis. This validated POE-PSIS was the one used as a survey questionnaire to the respondents of this study.

The final instrument consists of 3 parts: perceptions on the types of POE, perceptions on the process of POE, and perceptions on the structure of POE. The first part of the instrument is the type of prediction-observation-explanation, which consists of 4 perceptions on the type of prediction, 4 perceptions on the type of observation, and 2 perceptions on the type of explanation. These items were analyzed using factor analysis. The KMO-MSA results showed that samples are adequate for factor analysis (0.902 overall; 0.839 to 0.925 by item). Bartlett's test of sphericity indicates that the correlation between items is significant. In terms of Cronbach's reliability, Jamovi's value is 0.898, meaning, the items have high reliability. The normality test showed that the data set is normally distributed. The total % of variance explained that it is not so high but at least 80% is good enough. The component correlation is acceptable, 0.519 to 0.605 which justifies the use of an oblique rotation approach like promax.

The second part of the instrument consists of 10 perceptions on the process of prediction, 5 perceptions on the process of observation, and 13 perceptions on the process of explanation. For the process of POE, the KMO-MSA overall result is 0.954 while the result by items is 0.869-0.979 which means the samples are very adequate for factor analysis. Bartlett's test of sphericity indicates that a correlation between items is significant. The Cronbach's reliability of items is 0.969, meaning a high reliability. The data set is normally distributed, and the total % of variance explained is not so high but at least 80% is good enough. The component correlation is 0.644 to 0.759, that is, an acceptable component correlation and it justifies the use of promax for the rotation approach.

The third part of the instrument consists of 8 perceptions on the structure of prediction, 11 perceptions on the process of observation, and 15 perceptions on the process of explanation. The KMO-MSA results showed that samples are adequate for factor analysis (0.965 overall; 0.947 to 0.984 by item). Bartlett's test of sphericity indicates that the correlation between items is significant. In terms of Cronbach's reliability, Jamovi's value is 0.977, meaning, the items have high reliability. This is the final iteration since no additional items need to be removed. The normality test showed that the data set is normally distributed. The total % of variance explained (64.8%) is not so high but at least 80% is good enough. The component correlation is acceptable, 0.742-0.793 which justifies the use of an oblique rotation approach like promax.

## Procedure

The respondents answered the POE-PSIS instrument with the help of their science teachers. Before conducting the survey, the researchers sought permission from the Division Office of the Department of Education in Antipolo City, Philippines. The endorsement from DepEd Antipolo School's Superintendent to the School Principals of the public high schools was issued to the researchers for the gathering of the data in the DepEd schools. The request to survey the JHS and SHS students was coursed through the school principals who endorsed the same request to the science teachers. Thus, the four DepEd schools namely, ACNHS, MNHS, SINHS, and SJNHS were surveyed on the level of POE competencies of these students using the POE-PSIS instrument. The data gathering was done using a Google form in the 2nd quarter of SY 2023-2024. The teachers and students were assured that their answers to the survey

questionnaire may not necessarily reflect the views of any individual or their school. No personal information was obtained from the students other than their name, grade level, age, gender, and name of their school. All respondents consented to participate in this study voluntarily and have their data used in this research. The results of the survey were also analyzed using the Jamovi software V2.3.28.

## Results and Discussion

### Overview of the Data Analyses

This study was conducted to determine the level of POE competencies of high school students. The data was gathered by administering the Predict-Observe-Explain (POE) Proficiency Self-Inventory for Students (POE-PSIS) instrument to expand the understanding of the various ways in which some science process skills (predicting, observing, and explaining) are integrated into the practices for laboratory science learning. The survey data results conducted with the JHS and SHS students in DepEd schools in Antipolo City were presented in the succeeding tables.

### Level of Competencies of the Predict-Observe-Explain (POE) Skills

The level of the competencies of POE skills was grouped based on the types, processes, and structures of POE skills. The types, processes, and structures of POE skills using the POE-PSIS instrument are as follows:

#### POE Competencies based on Types of Prediction, Observation, and Explanation

- PT1. Using my senses, chance, and intuition in predicting the outcome of the experiment.
- PT2. Visualizing the possible action/outcome of the experiment.
- PT3. Noticing the details of the experiment that is close to my prior experience.
- PT4. Identifying the reasonable outcomes based on my prior knowledge.
- OT1. Seeing what is happening at the moment of the experiment.
- OT2. Following the set guidelines and procedures of the experiment.
- OT3. Experiencing a firsthand knowledge of the event or behavior being investigated.
- OT4. Using other media or machines during the experiment.
- ET1. Identifying patterns to create higher generalization and drawing out the key idea/s from cause and effect.
- ET2. Presenting statistical probability, current and recurrent data.

#### POE Competencies based on Processes of Prediction, Observation, and Explanation

- PP1. Comprehending the possible outcomes based on individual/group understanding.
- PP2. Characterizing the possible outcomes of the experiment based on real situation, set-up, materials/sample.
- PP3. Theorizing the reason for the outcome based on associated and applicable theories.
- PP4. Describing the possible outcome.
- PP5. Analyzing the questions for possible outcomes.
- PP6. Characterizing the experiment based on senses.
- PP7. Identifying the products' effects.
- PP8. Appraising possible outcomes based on the sample.
- PP9. Planning alternative options/solutions in conducting the experiment.
- PP10. Relating the possible outcomes of the experiment based on prior knowledge through readings and research.
- OP1. Devising new methods in doing the experiment.

- OP2. Examining the parameters affecting the experiment.
- OP3. Describing intrinsic and extrinsic properties of matter based on senses.
- OP4. Finding patterns.
- OP5. Comparing the result obtained to other's results of the experiment.
- EP1. Making a conclusion of the experiment based on data gathered from the experiment.
- EP2. Illustrating the series of steps in the experiment.
- EP3. Interpreting the results of the experiment based on observations done.
- EP4. Supporting the results with data.
- EP5. Applying science concepts in the experiment to describe correct data.
- EP6. Organizing data through tabular and graphic presentations.
- EP7. Building patterns.
- EP8. Connecting gained insight to real-life experience.
- EP9. Defending the idea with supporting study and literature.
- EP10. Determining the effectivity of the result.
- EP11. Describing the result of the experiment from macromolecular level to micromolecular level.
- EP12. Generating cohesive reports from the data gathered.
- EP13. Using statistics to describe the result of the experiment.

#### **POE Competencies based on Structures of Prediction, Observation, and Explanation**

- PS1. Comparing and contrasting the materials based on characteristics and structure using senses.
- PS2. Localizing and contextualizing the experiment by using accessible materials.
- PS3. Devising possible pathways and matrices in performing the experiment.
- PS4. Describing the possible outcomes based on individual/group understanding.
- PS5. Organizing the materials to relate to the outcome.
- PS6. Interpreting the procedure for the possible result of the experiment.
- PS7. Developing a general idea based on objectives, materials and procedures.
- PS8. Comparing and contrasting the materials based on characteristics and structure using senses.
- OS1. Focusing on details during the experiment.
- OS2. Synthesizing the general idea from observation.
- OS3. Executing the prescribed procedure and templates of the experiment.
- OS4. Establishing mastery of the skills involved in the experiment.
- OS5. Modifying the environment to obtain accurate results.
- OS6. Demonstrating the integration of other subjects to a certain concept.
- OS7. Performing the experiment using instrumentation.
- OS8. Applying the basics of science in a guided inquiry approach.
- OS9. Justifying the circumstances happening through practice.
- OS10. Justifying the strategies and techniques of instrumentation for data gathering.
- OS11. Appraising the result of experiment based on acceptance limit or range.
- ES1. Narrating the experience while doing the experiment.
- ES2. Synthesizing experiments' outputs and related studies.
- ES3. Verifying the result by doing a validation process.
- ES4. Identifying the results of the experiment using senses.
- ES5. Relating experience with the scientific concept seen in the experiment.

ES6. Establishing an idea based on the relationship between the predicted outcome and the observed results.

ES7. Establishing relationships between experiment experience and objectives.

ES8. Criticizing the results of the experiment including the valid errors and problems that occur during experimentation.

ES9. Collaborating with colleagues in establishing a general idea.

ES10. Designing the process and criteria based on experiment results.

ES11. Building a new understanding after the experiment.

ES12. Evaluating data through visual presentations.

ES13. Formulating ideas with supporting details.

ES14. Comparing the obtained data to the accepted values.

ES15. Evaluating results to prove or disprove the hypothesis.

To determine the level of POE competencies of the students, the results generated from the survey conducted to the JHS and SHS students using the POE-PSIS instrument are interpreted using the scales below:

- 1.00-1.80 Poor
- 1.81-2.60 Fair
- 2.61-3.40 Good
- 3.41-4.20 Very Good
- 4.21-5.00 Excellent

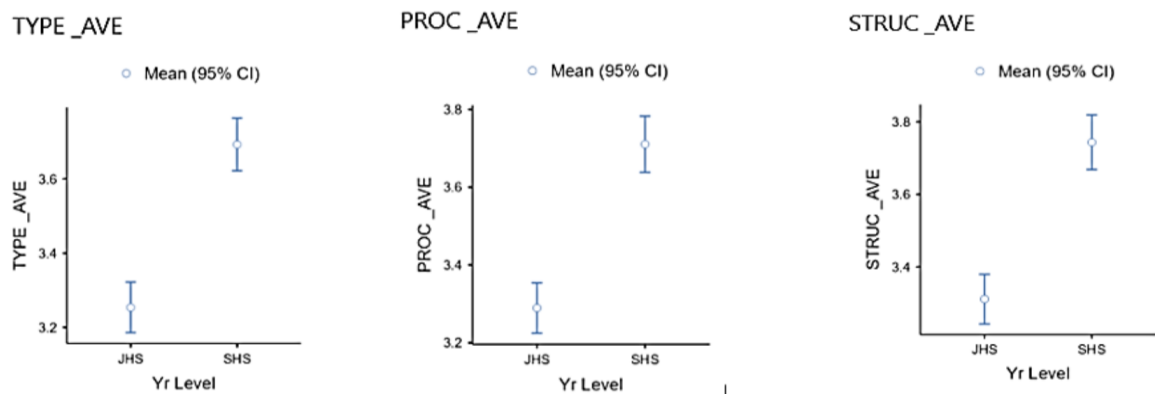
The study was able to identify the levels of the competencies of the POE skills of the JHS and SHS students on the types, processes, and structures of their skills on prediction, observation, and explanation. Table 2 shows the mean scores for the type, process, and structure (TPS) of POE competencies for each group of the students– the JHS students and SHS students.

**Table 2 POE Level of Competencies as to the TPS Averages of POE Skills by Year Level**

	Year Level	N	Mean	SD	SE
TYPE_AVE	JHS	449	3.25	0.734	0.0346
	SHS	314	3.69	0.638	0.0360
PROC_AVE	JHS	449	3.29	0.700	0.0330
	SHS	314	3.71	0.651	0.0367
STRUC_AVE	JHS	449	3.31	0.742	0.0350
	SHS	314	3.74	0.679	0.0383

As shown in Table 2, the JHS’s level of competencies in TPS is good with mean scores of 3.25, 3.29, and 3.31, respectively. On the other hand, SHS’s level of competencies in TPS of the POE skills is very good as reflected in their mean scores of 3.69, 3.71, and 3.74 respectively. The results show that the SHS program, specifically the STEM strand, develops the science process skills of the students based on the

results of the competencies as to TPS of the POE. This findings can be attributed to the STEM curriculum with more science subjects compared to the JHS curriculum, that put the STEM students more exposed to science experiments, therefore making the STEM education improves the understanding of the students of the world, develops their analytical and critical thinking skills, and enhances their problem solving abilities (Nguyen, Phan, Tran 2024). To clearly show the deviation on the mean scores of these two groups, Figure 1 illustrates the mean score difference of the JHS and SHS students for their POE competencies based on TPS. This shows that a wide gap between the two groups can be seen on the average mean scores for the types, process, and structure of POE.



**Figure 1. Difference in competencies as to Types, Process, and Structure of POE by Year Level**

The competency levels of JHS and SHS students in performing the experiments using the POE skills based on TPS can be described as beginning, developing, proficient, and advanced. For JHS group, it is developing because most JHS students are able to make predictions about experimental outcomes by exemplifying these TPS prediction skills: using their senses, chance, and intuition in predicting the outcome of the experiment; visualizing the possible action/outcome of the experiment; comprehending the possible outcomes based on individual/group understanding; characterizing the possible outcomes of the experiment based on real situation, set-up, materials/sample; comparing and contrasting the materials based on characteristics and structure using senses; and localizing and contextualizing the experiment by using accessible materials.

Their observations are often descriptive and limited to what is visibly noticeable by seeing what is happening at the moment of the experiment. JHS students may overlook subtle changes or distinguish relevant from irrelevant observations because they are focused on following the set guidelines and procedures of the experiment. They are conducting observations using these TPS observation skills: seeing what is happening at the moment of the experiment; following the set guidelines and procedures of the experiment; devising new methods in doing the experiment; examining the parameters affecting the experiment; focusing on details during the experiment and synthesizing the general idea from observation. The JHS students' explanations rely on comprehending the possible outcomes based on individual/group understanding. Students struggle to reconcile their predictions with actual observations and have difficulty to connect results with underlying scientific principles. Their TPS explanation skills are on these competency levels: identifying patterns to create higher generalization and drawing out the key idea/s from cause and effect; making a conclusion of the experiment based on data gathered from the experiment; illustrating the series of steps in the experiment; narrating the experience while doing the experiment; and synthesizing experiments' outputs and related studies.

For the SHS group, they are proficient in exemplifying the POE skills based on TPS. The SHS students

demonstrate logical and evidence-based predictions supported by relevant scientific concepts and prior knowledge. Their responses often show an ability to justify expectations. Aside from these predictions skills, they exemplify these TPS predictions skills: noticing the details of the experiment that is close to my prior experience; identifying the reasonable outcomes based on my prior knowledge; describing the possible outcome; analyzing the questions for possible outcomes; interpreting the procedure for the possible result of the experiment; and developing a general idea based on objectives, materials and procedures.

The SHS students provide systematic and detailed observations. They are capable of recording data, finding patterns, and recognizing the significance of changes in the experiment. Their observations are more precise and often linked with measurable variables. Moreover, the TPS observations in the POE skills they also exemplified are: experiencing a firsthand knowledge of the event or behavior being investigated; finding patterns; comparing the result obtained to others results of the experiment; establishing mastery of the skills involved in the experiment; and modifying the environment to obtain accurate results.

The explanations skills of the SHS students are coherent, grounded in scientific theories, and logically connect prediction and observation. The SHS students show the ability to use appropriate scientific terminology and to integrate concepts into their reasoning. They are presenting statistical probability, current and recurrent data; interpreting the results of the experiment based on observations done; supporting the results with data; relating experience with the scientific concept seen in the experiment; and establishing an idea based on the relationship between the predicted outcome and the observed results. Therefore, the findings indicate that JHS students generally exhibit developing levels of competency in POE skills based on TPS, as their predictions, observations, and explanations are on the low level of POE skills in terms of scientific depth and accuracy. In contrast, SHS students demonstrate higher competencies from proficient to advanced levels, which can be attributed to their broader science exposure, enhanced critical thinking skills, and greater familiarity with scientific processes due to the kind of curriculum that they have.

The difference between the TPS in POE skills of the JHS and SHS students showed the integrated science process skills and academic performance they acquired in these grade levels to develop more advanced science process skills (Jardinico & Linaugo 2023).

The level of competencies as to the TPS averages of POE Skills by gender shows a difference in the POE level of competencies as per TPS averages. The results of the analysis showed that there was a difference between the male and the female students' science process skills in terms of prediction, observation, explanation based on types, process, and structure (Irma Dahlia Yuliskurniawati et al, 2019). For the types of POE, the female mean average is 3.55 which is higher than the male, 3.44. Similarly, the process of POE for females is higher with a mean average of 3.60 than the male which is 3.46. Moreover, the structure of POE for females is consistently higher than the males with values of 3.64 and 3.43 respectively. It can be concluded that the POE level of competencies as to the TPS is higher for females than the males which supports the findings that the science process skills and critical thinking skills of female students are higher than male students (Darmaji, A. A., et.al, 2022).

**Table 3 POE Level of Competencies as to the TPS Averages of POE Skills by Gender**

	Group	N	Mean	Median	SD	SE
TYPE_AVE	Female	316	3.55	3.50	0.704	0.0396
	Male	235	3.44	3.42	0.687	0.0448
PROC_AVE	Female	316	3.60	3.52	0.707	0.0398
	Male	235	3.46	3.46	0.648	0.0423
STRUC_AVE	Female	316	3.64	3.57	0.733	0.0412
	Male	235	3.49	3.43	0.689	0.0449

The finding that female students exhibit higher levels of Predict-Observe-Explain (POE) competencies compared to male students in performing science experiments has implications in science education. It shows that females have greater attentiveness to detail and are more systematic in constructing explanations from observed phenomena. It suggests that female learners demonstrate stronger analytical, reflective, and communicative skills when engaging in experimental tasks indicating a possible gender-based difference in learning approaches. It supports the need for differentiated teaching strategies for male students that may require additional scaffolding and support in making accurate predictions, conducting careful observations, and formulating coherent explanations, while, female students, who already demonstrate high levels of competence, should be provided with more advanced inquiry-based activities to further enrich and challenge their scientific reasoning skills.

In equity in science education, the result is important in addressing gender gaps in competencies. While females’ strong performance in POE tasks may serve as an encouraging indicator for their potential in science-related fields, it is equally important to strengthen the skills of male learners to ensure balanced opportunities for both groups. Addressing this disparity may prevent the reinforcement of stereotypes and promote inclusivity in science learning.

Also, the finding of this study promotes STEM careers. Since POE skills are foundational to scientific inquiry, the higher competencies demonstrated by females may increase their likelihood of pursuing science, technology, engineering, and mathematics pathways. This could contribute positively to the ongoing efforts of encouraging female participation in STEM, a field traditionally dominated by males.

Some studies on POE in relation to gender such as the works of Ajayi, Negedu, & Agamber (2024) who investigated the effect of gender on students’ attention and academic performance in analytical chemistry using Collaborative-Predict-Explain-Observe-Explain (CPEOE) found that the CPEOE method improved performance overall and there was no statistically significant difference in academic performance between male and female students. This suggests that POE-based (or variants like CPEOE) instruction may benefit both genders similarly but doesn’t directly confirm female advantage in POE competencies, pointing to the need for more focused gender comparison in POE tasks. Another study on high school students found that female students had significantly higher grades than males in both science and language subjects. Although this is broader than POE competencies, it supports the idea that female students often outperform males in academic areas that require comprehension, reflection, and process-oriented tasks—traits that are also relevant in POE models (Dubuc, et al., 2020). The study “Factors Influencing Scientific Reasoning Ability in Junior Secondary Students: Examining Gender and Grade-Level Predictive Differences” by Luo, Sun, Zhu, Zhu, & Jia (2025) examined how variables like science achievement, spatial ability, reading comprehension, interest in science, etc., predict scientific reasoning ability (which is related to POE competencies). They found that these predictors vary in strength across gender and grade level. Some underlying factors behind gender differences in POE competencies may include cognitive abilities like

spatial reasoning, reading comprehension, differences in previous science achievement, and interests. These are fertile areas for future research. The study, “A Comparison by Gender: Interest and Science Process Skills” (Retni Sulistiyoning Budiarti et al., 2022) compared male and female students on science process skills and found relationships between interest and SPS; though not always large, differences exist in how interest correlates with process skills. Similarly, “Gender differences: Students' science process skills based on gender homogeneous class” (Darmaji, Astalini, Kurniawan, & Wirayuda, 2022) looked at science process skills (SPS) between male and female students in homogeneous settings in Indonesia. They found that while overall SPS were “good,” there was no significant difference in basic or integrated science process skills between genders in that specific context.

Furthermore, this study can be related to a global context of science education in terms of the importance of POE on the effect of inquiry-based learning (IBL) on students' critical thinking skills. The IBL is effective in cultivating higher-order thinking and critical reasoning in science, though the success of IBL depends on which components of IBL such as questioning, scaffolding, and reflection are emphasized (Arifin et al., 2025).

## Conclusion

This study examined the level of competencies in Predict-Observe-Explain (POE) skills among Junior High School and Senior High School students in performing science experiments, with particular attention to year level and gender differences. The findings revealed that the SHS students and female students demonstrated a higher level of POE competencies compared to the JHS students and the male students. This result indicates that females tend to be more systematic, reflective, and communicative in their approach to experimental tasks, while males may require further support in developing these inquiry-based skills. It also indicates that SHS students, particularly the STEM strands are more likely to exemplify the POE competencies as to the types, process, and structure of prediction, observation, and explanation.

Therefore, based on the findings of the study, the teachers can use differentiated instructional strategies to provide scaffolding for male students in prediction-making, careful observation, and explanation-building while for female students, they can provide enrichment activities to further strengthen their higher-order thinking skills. However, we encourage mixed-gender group activities to promote collaboration and peer learning. Since the POE competencies imply an impact to the science process skills, the science education curriculum can incorporate more inquiry-based and process-oriented activities in science lessons to strengthen POE skills among learners. To further understand the difference for these results, it would be better to investigate the factors contributing to gender differences in relation to POE competencies, such as motivation, study habits, and teacher expectations.

This study recommends that teachers employ gender-responsive pedagogies and curriculum developers integrate inquiry-based activities as a response to sustained emphasis on gender responsive pedagogy in teacher training and policy (Losioki, 2025).

## References

1. Ajayi, V. O., Negedu, S. A., & Agamber, T. S. (2024). Effect of gender on students' attention and academic performance in analytical chemistry using collaborative-predict-explain-observe-explain (CPEOE). *Journal of Advanced Research in Education*, 3(5), 25-35.
2. Arifin, Z., Sukarmin, S., Sulistyono Saputro, & Kamari, A. (2025). The effect of inquiry-based learning on students' critical thinking skills in science education: A systematic review and meta-analysis.

- Eurasia Journal of Mathematics, Science and Technology Education, 21(3), Article em2592. <https://doi.org/10.29333/ejmste/15988>
3. Budiarti, R. S., Kurniawan, D. A., & Rohana, S. (2022). A Comparison by Gender: Interest and Science Process Skills. *Journal of Education Research and Evaluation*, 6(1), 88–97. <https://doi.org/10.23887/jere.v6i1.37723>
  4. Champagne, Klopfer, and Anderson (1983). Naive Knowledge and Science Learning. 23p.; Paper presented at the Annual Meeting of the American Association of Physics Teachers (New York, NY, January 24-27, 1983). <https://files.eric.ed.gov/fulltext/ED225852.pdf>
  5. Darmaji, D., Astalini, A., Kurniawan, D. A., & Wirayuda, R. P. (2022). Gender differences: Students' science process skills based on gender homogeneous class. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, 6(2), 239–250. <https://doi.org/10.21831/jk.v6i2.42654>
  6. Dubuc MM, Aubertin-Leheudre M, Karelis AD. Gender Differences in Academic Performance of High School Students: The Relationship with Cardiorespiratory Fitness, Muscle Endurance, and Test Anxiety. *Int J Prev Med*. 2020 Dec 30;11:201. doi: 10.4103/ijpvm.IJPVM\_258\_18. PMID: 33815725; PMCID: PMC8000241.
  7. Erdem Özcan, G. & Uyanık, G. (2022). The effects of the “Predict-Observe-Explain (POE)” strategy on academic achievement, attitude and retention in science learning. *Journal of Pedagogical Research*, 6(3), 103-111. <https://doi.org/10.33902/JPR.202215535>
  8. Geverola, I. J. R., Mutya, R. C., Siason, L. M. B., & Bonotan, A. (2022). Challenges and struggles of public senior high school science teachers during the new normal. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, 12(1), 49–68. <https://doi.org/10.37134/jrpptte.vol12.1.4.2022>
  9. Irma Dahlia Yuliskurniawati et. al (2019). Science Process Skills Based on Genders of High School Students. *J. Phys.: Conf. Ser.* 1241 012055.
  10. Jamaludin, A. J. & Sriyansyah, S. P. (2023). An Experimental Comparison of a Problem-Based Learning and a POE-Assisted Project-Based Learning Model of Teaching Scientific Literacy. *Journal of Natural Science and Integration*, 6(1), 80–80. <https://doi.org/10.24014/jnsi.v6i1.13279>
  11. Luo, M., Sun, D., Zhu, G., Zhu, L., & Jia, F. (2025). Factors influencing scientific reasoning ability in junior secondary students: Examining gender and grade-level predictive differences. *Thinking Skills and Creativity*, 57, Article 101824. <https://doi.org/10.1016/j.tsc.2025.101824>
  12. Nurhayati, N., Rusyati, L., & Rustaman, N. (2025). Teachers' Perception on the Implementation of Problem-Based Learning Integrated with Predict Observe Explain on Students' Critical Thinking Skills. *Journal of Educational Sciences*, 9(5), 3281-3292. <https://doi.org/10.31258/jes.9.5.p.3281-3292>
  13. Losioki, Erasto B. (2025). Adherence to a gender responsive pedagogy for teaching and learning in secondary schools in Temeke District, Tanzania. *International Journal of Educational Research & Social Sciences*, 6(1), 87-95. <https://doi.org/10.51601/ijersc.v6i1.959>
  14. Pranoto, H. (2024). Comparative Analysis of Critical Thinking Using Problem-based Learning (PBL) and Predict-Observe-Explain (POE) models in Cell Material. *Jurnal Pelita Pendidikan*, 12(2). <https://doi.org/10.24114/jpp.v12i2.60249>
  15. Jardinico III, E. C., & Linaugo, J. D. (2023). Acquired Basic and Integrated Science Process Skills and Academic Performance in Earth Science of Grade 11 Students in a Philippine Public High School. *Philippine Social Science Journal*, 6(1), 63-73. <https://doi.org/10.52006/main.v6i1.704>
  16. Jiang, A., & Li, G. (2024). Enhancing cognitive abilities through the POE teaching strategy in a virtual

- learning environment. *Cognitive Systems Research*, 101295. <https://doi.org/10.1016/j.cogsys.2024.101295>
17. Mirabueno, D. C., Paderna, E. E. S., Calingasan, L. Y., Gregorio, C. G. C., & Oyzon, M. V. P. L. Competency standards based on chemistry stakeholders' typology, structure, and process of prediction, observation, and explanation.
  18. Mtsi, N., Chiphambo, S. M., & Mashologu, M.-W. (2021). Exploration of the Application of Predict-Observe-Explain as an Approach in Promoting the Teaching of Natural Science in Grade 9 Class. *INTED Proceedings*, 1, 10763–10766. <https://doi.org/10.21125/inted.2021.1421>
  19. Samsudin, A., Rusdiana, D., Efendi, R., Fratiwi, N. J., Aminudin, A. H., & Adimayuda, R. (2021). Development of Predict-Observe-Explain (POE) Strategy Assisted by Rebuttal Texts on Newton's Law Material with Rasch Analysis. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, 6(1), 103–115. <https://doi.org/10.24042/tadris.v6i1.7641>
  20. Ojo, O., & Owolabi, O. (2021). Effects of Predict-Observe-Explain in Instructional Strategy on Students' Learning Outcomes in Physics Practical in Secondary Schools. *European Journal of Education Studies*, 8(2). doi:<http://dx.doi.org/10.46827/ejes.v8i2.3548>
  21. Özcan, G. E., & Uyanık, G. (2022). The effects of the “Predict-Observe-Explain (POE)” strategy on academic achievement, attitude and retention in science learning. *Journal of Pedagogical Research*. <https://doi.org/10.33902/jpr.202215535>
  22. Pagente, A. F. M. (n.d.). The effects of Predict-Observe- explain (POE) approach on students' achievement and attitudes towards science. *Scribd*. <https://www.scribd.com/document/328907784/The-Effects-of-Predict-Observe-Explain-POE-Approach-on-Students-Achievement-and-Attitudes-Towards-Science>
  23. Nguyen,C.N., Phan T.T.H. Phan, T.K.O. Tran (2024). The Effect of Stem Education on Academic Performance: A Meta-Analysis Study. *International Journal of Learning, Teaching and Educational Research*. <https://ijlter.org/index.php/ijlter/article/view/11627>
  24. White, R., & Gunstone, R. (1992). *Probing understanding*. London and New York: The Falmer Press
  25. Yatmanto Yatmanto, Peduk Rintayati, & Mintasih Indriayu. (2025). The effectiveness of POE (Predict-Observe-Explain) Differentiated Learning in Science Learning. *Social Humanities and Educational Studies (SHEs) Conference Series*, 8(1), 51–51. <https://doi.org/10.20961/shes.v8i1.98837>