The Effect of Phenomenon –Based Progamin in Scientific Argumentation Skills Development for Intermediate School Students

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Abstract.

The aim of the current study was to explore the effect of a proposed instructional program based on phenomena to develop scientific argumentation skills in the science curriculum among a sample of intermediate school students. The instructional program was developed around the phenomena related to environmental balance and climate change, among first-grade intermediate school female students in Saudi Arabia. . The experimental approach was used with a quasi-experimental design. Data was collected using the scientific argumentation skills test. The results emphasized the effectiveness of the proposed program in developing scientific argumentation skills related to assertions, evidence, and justification. This shows that learning based on phenomena can contribute to the development of scientific argumentation skills, as it involves the development and analysis of claims by learners, examination of evidence, and providing appropriate justifications for the phenomena. This contributes to deepening their understanding of these phenomena and their ability to predict them. The study recommended utilize the proposed program based on phenomenon-based learning in teaching science to first-grade intermediate school students in Saudi Arabia and expand its use across different educational stages. Incorporate phenomenon-based learning as a component of professional development programs for science teachers at all educational levels. Train science teachers to develop scientific argumentation skills.

Keywords: Phenomenon-based program, Scientific argumentation skills, Science education, Intermediate school.

Introduction:

The current era is characterized by scientific advancement in all scientific fields, with widespread and continuous expansion of scientific knowledge in various branches and specializations. Diverse scientific phenomena are observed by learners, both in natural and designed systems, which pique their curiosity and inspire them to ask questions. Thus, it is essential to develop learners' skills, to train them on using their cognitive and skill-based abilities to explore these phenomena, to collect information about them, to find explanations for their occurrence, and to predict the development of these phenomena.

Transformations in science teaching and learning have also taken place, emphasizing the transition from treating science as part of knowledge to considering it as a pathway to acquiring and building knowledge. Shifts have occurred from specialized field-specific learning standards to modern science standards that focus on specialized ideas, scientific and engineering practices, and comprehensive concepts that unify most specializations. There has been an interest in scientific and natural phenomena, making learning through them a primary approach for acquiring and understanding science in light of modern science standards, rather than relying solely on pre-packaged scientific knowledge and predetermined activities provided to learners. This approach supports learners in comprehending the natural world around them, rather than just memorizing facts. Students individually and collaboratively formulate causal explanations for the phenomena around them, deepening their understanding of these phenomena and grasping scientists' ways of understanding the universe and its occurrences (Lowell et al., 2022; Reiser et al., 2021).

Edelson and his co-researchers (Edelson et al., 2021) point out that science education should focus on students' learning through an ongoing process of constructing meaningful understanding. This involves investigating complex phenomena, enabling them to build understanding and develop new and diverse capabilities. It includes explaining and interpreting phenomena, designing solutions to surrounding problems, and transforming the learner's role into an active investigator who constructs understanding collaboratively with peers under the guidance of the teacher. This shift challenges the traditional role of the teacher as a transmitter of ready-made information in today's schools. The teacher's role transforms from delivering prepared knowledge to creating a context for phenomenon-based learning within the learners' environment. This includes designing learning experiences and facilitating productive social interactions, wherein students ask questions, plan investigations, share expectations and observations, engage in scientific discourse, gather evidence, build models, propose and discuss causal relationships.

Sliander and Mattila (2015) define phenomena-based learning as "a comprehensive approach that directs the learner to study 'phenomena' comprehensively in the real world, considering them as complete entities in the real context. These phenomena serve as the starting point for learners to learn information and skills related to them, through the elimination of subject boundaries according to inquiry-based learning" (p.7).

Scientific argumentation is closely linked to the natural sciences and to modern science standards such as the Next Generation Science Standards (NGSS), which emphasize active learner engagement in evidence-based argumentation. Students work with evidence-based arguments to reach the best interpretation of natural phenomena. They defend their interpretations, formulate evidence based on solid data, evaluate their understanding in light of evidence and comments from others, and collaborate with peers in the search for the best interpretation of the investigated phenomena. Bruce and his co-researchers (Bruce et al., 2015) define scientific argumentation skills as: "The ability to develop and analyze scientific claims, support them with evidence derived from investigations in the natural world, and the ability to explain and evaluate the reasons associated with the evidence for the claims" (p.12). Therefore, scientific argumentation, with its diverse practices, represents a fundamental pillar in phenomenon-based science learning. Through it, appropriate and sufficient evidence is utilized, and scientific reasoning is employed to refute and discuss claims and explanations about natural or designed scientific phenomena. Learners compare and evaluate competing arguments in light of explanations and evidence derived from scientific phenomena, assess and critique claims and evidence, all with the aim of reaching the best arguments that are most suitable for explaining the scientific phenomenon (Frey et al., 2015).

Considering the state of the art of science education and science curricula in the Kingdom of Saudi Arabia, we observe that there are certain difficulties that hinder the achievement of desired goals. The results of the Trends in International Mathematics and Science Study (TIMSS) in its recent cycle indicated a decline in students' achievement in the science subject. The Kingdom ranked 35 out of 39 participating countries (Education and Training Evaluation Commission, 2019). The results of the 2018 Program for International Student Assessment (PISA) also revealed that students' science performance reached 386 points, which is below the average set for the test (489 points) (Education and Training Evaluation Commission, 2019). This may be due to the limited use of activities and educational scenarios that foster scientific practices and diverse thinking skills. The delivery of scientific knowledge tends to be superficial without focusing on its application and connection in natural and realistic contexts that stem from the students' environment and life. Several studies indicate the weaknesses in scientific practices related to questioning, scientific argumentation, planning scientific investigations related to scientific phenomena, and the execution of those investigations, as well as the limited reliance on scientific phenomena to build real learning that is related to the students' reality and that deepens learners’ scientific knowledge (Al-Dhubaiani & Al-Sufiani, 2021). The study of Al-Asmari (2016) who indicated a weakness in Saudi students' ability to engage in and perform scientific argumentation skills. On the other hand, studies of (Al-Dhubayani & Al-Sufayani, 2021; Al-Shayyab, 2019) highlighted the limited ability of science teachers in the Kingdom of Saudi Arabia to engage in scientific argumentation, as well as their inadequate activation of such scientific practices. This deficiency is expected to influence the students' level of engagement in these scientific practices. Therefore, it is necessary to integrate scientific argumentation skills within educational activities that contribute to the development of these skills among learners.

Modern educational trends recommend adopting the standards of science for the next generation as modern standards for developing science teaching and learning.

These standards emphasize that the phenomenon-based learning approach can be adopted as an educational approach that suits the nature of these standards. Studies such as Serbram et al., 2021; Santhalia et al., 2020;Yuliati et al., 2020; Penuel et al., 2019; Yuliati & Parno, 2018) stress the importance of focusing on phenomenon-based learning as a suitable educational approach. This approach connects learners with real contexts that are directly related to their environment and the daily problems they face.

Al-Dhubaiani and Al-Sufiani (2021) indicated the lack of focus in current science curricula on scientific phenomena as a suitable educational entry point for teaching and learning science. The curricula and their contents rely on pre-existing knowledge that students receive and memorize, lacking the ability to familiarize students with scientific phenomena related to their daily lives and engage them actively in these phenomena. To check this, the researcher conducted a pilot study that aimed at analyzing the first unit of the science textbook for the first grade of intermediate school (Science and Interactions of Matter) in light of some standards related to phenomena-based learning. The results of the pilot study revealed a significant weakness in incorporating the content of the unit according to those standards. There are implicit indications rather than explicit ones for some standards related to the current and real-world events and posing questions. The unit ignored linking the content to the student's environment and surrounding problems. The unit did not present phenomenon-based learning as a comprehensive method of teaching and learning. Additionally, learners were deprived of original sources, materials, tools, or methods.

Research Problem

Given the aforementioned, it becomes clear that there is a problem of weakness and deficiency in teaching and learning science in the Kingdom of Saudi Arabia, with little emphasis of science curricula on phenomenon-based learning or students' scientific argumentation skills. To overcome these challenges, the current study tried to keep up with the transformations in science teaching and learning. It intended to develop a proposed program in light of phenomenon-based learning and assess its effectiveness in developing scientific argumentation skills through the science curriculum among first-grade intermediate school female students.

Research Focus

Innovative Instructional Program: This study introduces a new instructional program using real-world phenomena, effectively enhancing scientific argumentation skills among intermediate school students.

Empirical Evidence: Through a quasi-experimental design with 40 students, the research demonstrates that phenomena-based learning significantly improves students' ability to construct strong scientific arguments.

Enhanced Understanding: The findings highlight how learning through phenomena deepens comprehension of environmental concepts, fostering better scientific argumentation skills and the capacity to analyze and predict complex phenomena.

Research Aim and Research Questions

Research Aim: The study aimed to assess the effectiveness of the proposed program in light of phenomenon-based learning in developing scientific argumentation skills through the science curriculum among first-grade intermediate school female students in Saudi Arabia.

Research Question: What is the effect of the proposed program in improving scientific argumentation skills through the science curriculum among female students in the intermediate school stage in the Kingdom of Saudi Arabia?

Research Hypothesis: There was no statistically significant difference at the significance level of (0.05) between the mean scores of the experimental and control groups in the post-administration of the scientific argumentation skills test.

Methodology:

General Background

There is a problem of weakness and deficiency in teaching and learning science in the Kingdom of Saudi Arabia, with little focus on science curricula on learning based on phenomena or scientific argumentation skills among students. To overcome these challenges, the current study attempted to keep pace with transformations in science teaching and learning. The current study developed a proposed program in light of phenomena-based learning and evaluated its effectiveness in developing scientific argumentation skills through the science curriculum for first-year middle school female students. The study developed a tool to measure scientific argumentation skills, and the validity and reliability of the tool was examined.

Argumentation skills were also revealed. Scientific studies among female students in the academic year 2021-2022.

Design:

The study used the quasi-experimental approach with a pretest-posttest control group design. The tools for the study were administered in a pre- and post-application manner, as shown in Table (1).

Table 1:
Design of the study

Exp. Grp.	Pre-application: Scientific arg. Skills test	Experimentation (the suggested program)	Post-application: Scientific arg. Skills test
Ctrl. Grp.		The traditional method	

Sample:

The participants consisted of 40 female students from the first-grade intermediate school, in the second semester of the academic year 2021/2022. They were selected using the multi-stage cluster random sampling method.

Instrument and Procedures

A Test in scientific argumentation skills was used as the study tool. The test dimensions were determined through a review of educational literature and relevant previous studies, resulting in three dimensions: assertion skill, evidence skill, and justification skill. The test consisted of 4 multiple-choice questions and 3 textual passages for each dimension.

Test Validity and Reliability:

To validate the test, it was presented in its initial form to a panel of jury members specializing in science education (totaling 23 reviewers). The reliability of the test was assessed through various methods, including the retest method by read ministering the test on a pilot sample of 25 female students after a two-week interval. The total reliability coefficient was calculated using both Kuder-Richardson formula (KR-20) and Cronbach's alpha.

Table 2

Reliability Coefficients of the Scientific Argumentation Skills Test

Sample Size (n)	Correlation (r)	Sum of Products (rx)	(KR-20)	Cronbach's Alpha
12	1.834	4.17	0.921	0.913

Table (2) shows that the overall reliability coefficient of the test using the KR-20 formula is 0.921 and using Cronbach's Alpha is 0.913. This indicates that the test has an appropriate level of reliability and homogeneity.

A Proposed Program in Light of Phenomenon-Based Learning:

The proposed program was developed based on the ADDIE Model for instructional design, including analysis, design, development, implementation, and evaluation stages. It was built according to the phenomena included in the "Global Phenomena" unit from the first-grade intermediate school science textbook, which covers two chapters: environmental balance and climate change. Each chapter includes four lessons. A teacher's guide for implementing the unit was designed and presented to experts in environmental sciences and science education. The content of the proposed program was crafted and delivered according to the stages of phenomenon-based learning, considering the diversity of students, and available resources at each stage.

Data Analysis

To process the data analysis, the current study used the following statistical methods: 1- Arithmetic averages and standard deviations. 2- Ease and Difficulty Coefficient of the test. 3- Discrimination Coefficient of the test. 4- Pearson Correlation Coefficient to calculate the internal consistency of tests. 5- Kuder-Richardson equation 20 (R-20) to calculate the reliability of tests. 6- Cronbach's Alpha coefficient to calculate the reliability of tests. 7- Independent-samples T-test to identify the statistically significant differences between the average scores of female students in the pre- and post-application of the study tools. 8- Modified Black's Gain Ratio equation to identify the effectiveness of the proposed program in light of phenomenon-based learning.

Results:

The hypothesis of the study stated that: There was no statistically significant difference at the significance level of (0.05) between the mean scores of the experimental and control groups in the post-application of the scientific argumentation skills test.

To verify the validity of this hypothesis, an independent sample t-test was used to measure the significance of the differences between the mean scores of the experimental and control groups in the post-application of the scientific argumentation skills test.

Table 3

T-test Significance of Differences between the Mean Scores of the Experimental and Control Groups in the Post-Application of Scientific Argumentation Skills Test

Scientific Argumentation Skills	grp	No.	Mean	Sd.	t-value	Sig.
Overall	Exp.	19	25.11	2.514	14.527	0.000
	Ctrl.	21	11.71	3.227		Sig.

From table (3), it's clear that the mean scores of the experimental group (that studied through the proposed program based on phenomenon-based learning) in the overall scientific argumentation skills in the post-application phase was 25.11, which is higher than the mean scores of the control group (that studied through the traditional method) which was 11.71. This indicates a significant difference between the mean scores of the experimental and control groups in the post-application of scientific argumentation skills test.

To confirm the significance of this difference, the researcher conducted a t-test analysis which showed that the t-value was 14.527, a statistically significant value at a significance level of less than (0.05). This confirms that these differences are statistically significant. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, which states: "There is a statistically significant difference at the significance level of (0.05) between the mean scores of the experimental and control groups in the post-application of the scientific argumentation skills test in favor of the experimental group."

To further confirm the effectiveness of the proposed program based on phenomenon-based learning in developing scientific argumentation skills among first-grade intermediate school female students, the researcher calculated Black’s Gain Ratio equation to determine the effectiveness of the proposed program. The results are presented in Table (4):

Table 4

Results of Black’s Gain Ratio Equation for Overall Scientific Argumentation Skills for the Experimental Group

variable	Pre-Mean	Post- mean	Total	Gain ratio
Overall Sc. Arg. skills	**8.47**	**25.11**	**30**	**1.33**

Inspection of table (4) reveals that the application of the proposed program based on phenomenon-based learning is of a high level of effectiveness in developing overall scientific argumentation skills among first-grade intermediate school female students. The gain ratio between the pre-application and post-application for the experimental group is 1.33, which is higher than the value set by Black's for effectiveness (1.2).

Regarding the sub-skills, they are as follows:

Assertion Skill:

Table 5

Significance of Differences between the Mean Scores of the Experimental and Control Groups in the Post-Application of the Scientific Argumentation Skills Test (Assertion Skill):

Scientific Argumentation Skills	grp	No.	Mean	Sd.	t-value	Sig.
Assertion	Exp.	19	8.74	1.368	8.212	0.000
	Ctrl.	21	4.38	1.910		Sig.

Inspection of table (5) reveals it is evident that the mean scores of the experimental group (that studied through the proposed program based on phenomenon-based learning) in the assertion skill in scientific argumentation skills in the science in the post-application phase was 8.74, which is higher than the mean scores of the control group (that studied through the conventional method) which was 4.38. This indicates a significant difference between the mean scores of the experimental and control groups in the post-application of the assertion skill in scientific argumentation.

To confirm the significance of this difference, the researcher conducted an independent samples t-test for two groups, which showed that the t-value was 8.212, a statistically significant value at a significance level of less than (0.05). This confirms that these differences are statistically significant. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted regarding the assertion skill.

To further confirm the effectiveness of the proposed program based on phenomenon-based learning in developing scientific argumentation skills (the assertion skill) among first-grade intermediate school female students, Black's Gain Ratio equation was used to determine the effectiveness of the proposed program. The results are presented in Table (6):

Table 6

Results of Black's Gain Ratio Equation for the assertion skill for the Experimental Group

variable	Pre-Mean	Post- mean	Total	Gain ratio
Assertion	**2.84**	**8.74**	**10**	**1.41**

Inspection of table (6) reveals that the proposed program based on phenomenon-based learning is effective in developing the scientific assertion skill among first-grade intermediate school female students. The gain ratio between the pre-application and post-application stages for the experimental group is 1.41, which is higher than the value set by Black for effectiveness (1.2).

Evidence Skill:

Table 7

Significance of Differences between the Mean Scores of the Experimental and Control Groups in the Post-Application of the Scientific Argumentation Skills Test (Evidence Skill):

Scientific Argumentation Skills	grp	No.	Mean	Sd.	t-value	Sig.
Evidence	Exp.	19	8.16	1.642	9.742	0.002
	Ctrl.	21	3.52	1.365		Sig.

Inspection of table (7) reveals, it is evident that the average scores of the experimental group (that studied through the proposed program based on phenomenon-based learning) in the evidence skill in the post-application phase was 8.16, which is higher than the average scores of the control group (that studied through the conventional method) which was 3.52. This indicates a significant difference between the mean scores of the experimental and control groups in the post-application of the evidence skill in scientific argumentation.

To confirm the significance of this difference, the researcher conducted an independent samples t-test for two groups, which showed that the t-value was 9.742, a statistically significant value at a significance level of less than (0.05). This confirms that these differences are statistically significant. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted regarding the evidence skill.

To further confirm the effectiveness of the proposed program based on phenomenon-based learning in developing scientific argumentation skills (evidence skill) among first-grade intermediate school female students, Black's Gain Ratio equation was used to determine the effectiveness of the proposed program. The results are presented in Table (8):

Table 8

Results of Black's Gain Ratio Equation for the evidence skill for the Experimental Group

variable	Pre-Mean	Post- mean	Total	Gain ratio
Evidence	2.47	8.16	10	1.32

Inspection of table (8) reveals that the proposed program based on phenomenon-based learning is effective in developing the scientific evidence skill among first-grade intermediate school female students. The gain ratio between the pre-application and post-application stages for the experimental group is 1.32, which is higher than the value set by Black for effectiveness (1.2).

Justification Skill:

Table 9

Significance of Differences between the Mean Scores of the Experimental and Control Groups in the Post-Application of the Scientific Argumentation Skills Test (Justification Skill):

Scientific Argumentation Skills	grp	No.	Mean	Sd.	t-value	Sig.
Justification	**Exp.**	**19**	**8.21**	**1.475**	**10.678**	**0.000**
	Ctrl.	**21**	**3.81**	**1.123**		**Sig.**

Inspection of table (9) reveals, it is evident that the average scores of the experimental group (that studied through the proposed program based on phenomenon-based learning) in the justification skill in the post-application phase was 8.21, which is higher than the average scores of the control group (that studied through the conventional method) which was 3.81. This indicates a significant difference between the mean scores of the experimental and control groups in the post-application of the justification skill in scientific argumentation.

To confirm the significance of this difference, the researcher conducted an independent samples t-test for two groups, which showed that the t-value was 10.678, a statistically significant value at a significance level of less than (0.05). This confirms that these differences are statistically significant. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted regarding the justification skill.

To further confirm the effectiveness of the proposed program based on phenomenon-based learning in developing scientific argumentation skills (justification skill) among first-grade intermediate school female students, Black's Gain Ratio equation was used to determine the effectiveness of the proposed program. The results are presented in Table (10):

Table 10

Results of Black's Gain Ratio Equation for the justification skill for the Experimental Group

variable	Pre-Mean	Post- mean	Total	Gain ratio
Evidence	**3.16**	**8.21**	**10**	**1.24**

Inspection of table (10) reveals that the proposed program based on phenomenon-based learning is effective in developing the scientific justification skill among first-grade intermediate school female students. The gain ratio between the pre-application and post-application stages for the experimental group is 1.24, which is higher than the value set by Black for effectiveness (1.2).

Based on the above results, the null hypothesis is rejected for all the sub skills of scientific argumentation, and the alternative hypothesis is accepted.

Discussion:

While there is no direct relationship between the independent variable (phenomenon-based learning) and the first dependent variable in the current study, i.e. scientific argumentation, previous studies have examined the effectiveness and impact of phenomenon-based learning in developing closely related dependent variables. These variables intersect with various forms of scientific thinking skills, which involve making claims, hypotheses to solve problems, interpreting phenomena or scientific positions, collecting information, and providing scientific evidence to support these claims. Thus, the skills intersect with various forms of scientific thinking skills, including assertion, evidence, and justification skills.

Studies such as (Islakhiyah, 2017) explored the impact of phenomenon-based learning on developing scientific interpretation skills, including assertion, evidence, and justification, showing a positive impact. Other studies like (Putri et al., 2018) aimed to develop problem-solving skills, that include some scientific argumentation skills, through phenomenon-based learning. Similarly, (Santhalia et al., 2020) found that phenomenon-based learning effectively developed problem-solving skills relying on experimental learning. Also, (Yuliati et al., 2020) showed that students acquired concepts of projectile motion through phenomenon-based experimental learning, all of which rely on scientific thinking and argumentation skills to reach scientific generalizations and explanations.

The results of the current study align with the findings of some studies related to the dependent variable. For instance, the study of (Al-Haddad, 2020) demonstrated the effectiveness of a proposed program in science based on the theory of TRIZ, an innovative problem-solving theory, in developing scientific argumentation skills (assertion, evidence, and justification) among intermediate school students in Kuwait. Also, the study of (Emrah and Muhammed, 2021) showed the positive impact of Argument-Based Teaching (ABT) on enhancing argumentation tendencies among fourth-grade students.

The results are consistent with the findings of (Pratiwi et al., 2021), that confirmed the effectiveness of phenomenon-based learning through an electronic unit on thermal chemistry in developing critical thinking skills. This study addressed skills such as assertion, evidence, and justification in explaining the phenomenon, investigating its occurrence, and providing explanations. The results also resonated with (Purwat et al., 2019), which highlighted the effectiveness of Problem-Based Learning (PBL) units, an aspect of phenomenon-based learning, in improving scientific argumentation skills.

Conclusions and Implications:

The results of the current study can be attributed to the following reasons:

1. The proposed program based on phenomenon-based learning supports the development of scientific argumentation skills. Phenomenon-based learning involves developing and analyzing claims, examining

ideas, presenting evidence, and constructing logical arguments in certain conditions about whether the proposed explanation for a given topic aligns with observations.

2. The proposed program contributed to enhancing the assertion skill as it is rooted in constructivist learning principles, which actively engage learners in constructing knowledge autonomously. This process enhances students' ability to clarify their viewpoints, persuade others, and continue the research process, discovery, and knowledge exploration while verifying claims.
3. The program's design fosters the development of evidence skills. The program followed scientific steps, beginning with selecting a scientific phenomenon in the learner's environment, activating scientific argumentation by making claims related to the phenomenon, and collecting evidence to support these claims. This process encourages students to justify and explain scientific phenomena by gathering data, statistics, reports, and quotations that strengthen the evidence's ability to support the claims. This achieves greater engagement from the student when studying the scientific phenomenon through the skills of scientific debate. This enhanced the enjoyment of learning and made learning meaningful and beneficial for the learners.
4. The proposed program, within the context of phenomenon-based learning, contributed to the development of scientific justification skills. The program encouraged students to construct learning in a

collaborative social context. Through participation, students engaged in scientific debate by discussing with peers, presenting their arguments and evidence gathered to reinforce their claims. They critiqued these arguments and evidence, expressed their opinions, and respect each other's perspectives. This process aimed to achieve the goal of scientific debate, enhance their skills more effectively. Students strived to convince their peers by establishing a strong connection between claims and evidence, explaining this relationship to support the validity of their claims.

5. The proposed program is based on active inquiry-based learning and problem-solving, creating an internal drive that motivates students to put in more effort in the research process and exploration to reach solutions, prove claims, and explain scientific phenomena.
6. The proposed program allowed students to experience the phenomenon and link higher-order thinking skills with their real-life experiences. This is reflected on their ongoing learning experiences, turning scientific argumentation into a routine practice for students to use critical thinking and creative problem-solving skills. This approach shifted them away from memorization and rote learning and made them focus on the effective practice of scientific argumentation skills in the future.

Recommendations:

Based on the results of the study, Science education stakeholders are advised to:

1. Utilize the proposed program based on phenomenon-based learning in teaching science to first-grade intermediate school students in Saudi Arabia and expand its use across different educational stages.

2. Incorporate phenomenon-based learning as a component of professional development programs for science teachers at all educational levels.
3. Train science teachers to develop scientific argumentation skills.
4. Utilize the current study's tools (Scientific Argumentation Skills Test) to measure these variables among first-grade intermediate school students.

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