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The development of scenario-based learning accompanied by talk moves techniques to enhance science communication skills

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Abstract

This research aimed to examine science communication skills of grade 10 students taught through scenario-based learning (SBL), accompanied by the Talk Moves technique, and to develop their biology learning achievement on the topic of evolution to meet a 70% threshold. The sample consisted of 37 students from Sarakham Pittayakom School during the second semester of the 2025 academic year, selected through cluster random sampling. The data collection instruments included seven SBL–Talk Moves lesson plans, science communication skills assessment rubrics covering speaking and writing dimensions, and a learning achievement test. Data were analyzed using mean, percentage, standard deviation, One-Sample t-test, and repeated measures ANOVA. The findings revealed that students showed statistically significant development in both written and spoken science communication skills across three assessment sessions at the 0.05 level. Furthermore, their post-test learning achievement was significantly above the 70% threshold. These results suggest that integrating SBL with Talk Moves is an effective instructional approach for enhancing secondary school students' science communication competencies.

Keywords: Evolution, Learning achievement, Scenario-based learning, Science communication skills, Science education, Talk moves.

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Contents

Contribution of this paper to the literature
This study proposes a novel integrated instructional approach combining scenario-based learning (SBL) with the talk moves technique to enhance secondary school students' science communication skills through evolution instruction, offering empirical evidence from a classroom intervention and a replicable model for improving speaking and writing skills.

1. Introduction

Communication serves as a fundamental foundation of human life and societal advancement, functioning as a transformative tool that drives progress across multiple sectors, including economics, society, politics, culture, education, and technology through communication. Individuals are able to access information essential to their daily lives and share their knowledge and understanding across various activities (National Economic and Social Development Council, 2018). In particular, science communication, which relies on consistent reasoning and critical reflection, enables both senders and receivers of information to keep pace with global advancements and technological developments, and also allows them to appropriately evaluate the credibility of various information sources. Furthermore, science-based communication has the potential to stimulate imagination and creativity, foster new ideas, and broader perspectives about the world (Hemaseerin, 2009).

Regarding the problems observed in science-learning activities, it was found that students lacked confidence in asking questions, expressing opinions, and presenting in class. Moreover, their ability to provide reasoning aligned with Biology content remained unclear. A science-communication skills assessment tested on Grade 10 students revealed that, although learners possessed knowledge and understanding of Biology content, they were unable to clearly explain the steps and methods used to get their answers. Moreover, adolescent students at the secondary level were often reluctant to express their opinions in class because they did not want to draw attention from their classmates. So, scientific communication is one of the key factors contributing to students' lack of success in Biology.

During the researcher's teaching practicum at a secondary school, where the researcher was assigned to teach Biology to three Grade 10 classrooms totaling 120 students, it was observed that, while most students showed interest and cooperation in learning activities, a portion of them tended to wait for a classmate to take the lead. This was largely due to their inability to express their understanding through writing or speaking. Therefore, it became necessary for teachers to create a learning environment that encourages students to feel comfortable sharing their opinions, fosters confidence in classroom communication, and provides opportunities for discussion and collaborative exchange of ideas.

In response to these challenges, the researcher incorporated Scenario-Based Learning (SBL), an instructional approach that is designed to engage learners in problem-solving and decision-making within realistic simulated contexts, such as bioethical issues, environmental problems, and genetic engineering, through various activities, including group discussion, role-playing, and presentation. This approach supports the development of analytical thinking, problem-solving, and communication skills in both spoken and written forms (Ahmed, 2019). This was combined with the Talk Moves technique, which trains students to use evidence to support propositions, construct arguments constructively, and develop scientific vocabulary. As a result, a classroom discussion culture emerges in which all students actively participate, gain confidence in presenting ideas, and are able to communicate scientific concepts effectively (Michaels & O'Connor, 2012).

Therefore, this study aimed to: 1) improve the learning achievement of Grade 10 students on the topic of Evolution through Scenario-Based Learning integrated with the Talk Moves technique, targeting a passing criterion of 70%; 2) examine the Science Communication Skills of students who learned through Scenario-Based Learning accompanied with the Talk Moves technique.

1.1. Scenario-Based Learning

Chermack (2002) defines scenarios as multiple alternative future environments that are knowledge-based, plausible, and imaginatively constructed. These serve as a backdrop or context to illustrate how future decisions might be implemented and played out. (Bennett et al., 2016) define scenarios as a set of narratives or descriptions about the future. That have been utilized by decision-makers in business and other sectors for decades as an alternative to traditional predictions, forecasting, and strategic planning processes that rely on a single, fixed vision of the future. Akins and Crichton (2003) explain that Scenario-Based Learning (SBL) is learning within a virtual environment that encourages students to learn through non-linear activities. Learners participate in a variety of tasks and can revisit assignments to achieve authentic learning. These situations range from simple scenarios to those with high requirements or significant complexity. Errington (2011) defines Scenario-Based Learning as an instructional method that intentionally applies real-world events to help learners achieve specific learning outcomes. It allows students to integrate theoretical knowledge with practical skills. Learning through simulated situations makes the classroom experience reflect real life, allowing students to practice communication and teamwork while developing the maturity and professional ethics that are essential for career competency.

Naidu (2010) proposed the following steps for managing scenario-based learning: Errington: 1) Establishing learning goals centered on real-life scenarios or situations to ensure learners can achieve the intended outcomes.2) Defining the operational procedures or the process for confronting the designated scenarios.3) Developing challenging and various scenarios that were rooted in the students' daily lives, with a systematically defined scope of learning.4) Developing assessment tools to test learners' abilities within the context of the assigned scenarios to ensure successful achievement. Errington (2010) proposed a framework for scenario-based learning with the primary objective of encouraging students to learn through near-real-life situations. The instructional design consists of three stages: 1) Facing a Scenario. The instructor defines the objectives and informs the learners. The instructor then evaluates the students' prior knowledge to ensure they are able to solve the problems within the defined scenario. 2) Tackling the Problem. In this stage, learners work collaboratively to solve problems that are presented by the scenario and exchange ideas. 3) Learning Independently Learners are assigned individual tasks to complete based on specific assessment criteria. The Ohio State University (2023) described the instructional steps for Scenario-Based

Learning through the "5 Cs of Scenario-Based Learning," which include: Step 1 Context provides essential background information that frames the situation and guides learners' understanding. Step 2 Challenge refers to the problems or tasks that require learners to apply knowledge and think critically. Step 3: Choices represent the alternative actions or decisions that are available to learners in response to the challenge. Step 4: Consequences are the outcomes of each choice, which may be positive or negative and serve as feedback for reflection and learning. Step 5 Contemplate refers to brief moments that encourage reflection, through instructor feedback or prompts, and may also appear as a broader reflection question covering the overall activity experience. In addition, managing classroom interactions through real-world scenarios promotes collaborative dialogic practices, allowing students to exchange thoughts and co-construct meanings productively (Gillies, 2016). This collaborative setup proves essential in developing student academic competencies during structured activities (Resnick, Asterhan, & Clarke, 2015).

1.2. Talk Moves Techniques

Michaels and O'Connor (2012) defined talk moves as a set of conversational techniques which is used by teachers to promote high-quality classroom discussion talk moves are specific moves or word which is intentionally designed to achieve particular goals in discourse. Tytler and Aranda (2015) described talk moves as teacher actions during interactions with students, which may take the form of follow-up questions, providing feedback, evaluating student responses, or non-verbal communication such as tone of voice, gestures, and facial expressions. Wray, McDonald, Lee, and Pallant (2022) defined talk moves as purposeful verbal techniques that are used by teachers to pose questions or stimulate dialogue with intention, in order to establish classroom communication patterns that encourage students to openly exchange ideas, engage in evidence- and reasoning-based discussion, and collaboratively construct scientific understanding. By structuring classroom talk, these techniques effectively shift communication patterns from traditional lectures toward active student meaning-making processes (Chen, 2022). Such discursive moves also strategically reframe and reposition student contributions within the learning community (O'Connor & Michaels, 2007).

Michaels and O'Connor (2012) identified talk moves as a structured set of instructional techniques designed to support and remain high-quality academic discussion within science classrooms. These techniques consist of nine distinct moves. The first, *Time to Think*, affords students time to spend organizing their cognitive processes before responding to a question. The second, *Say More*, uses purposeful questioning to help students extend their idea's elaboration of their ideas with greater precision and depth. The third, *Clarifying*, requires students to explain the intended meaning of their statements, to clarify and strengthen the context of science communication. The fourth, *Rephrase or Repeat*, cultivates disciplined listening practices by engaging students in the active reformulation of their classmates' contributions. The fifth, *Asking for Evidence or Reasoning*, advances students' capacity for evidence-based scientific inquiry and argumentation. The sixth, *Challenge or Counterexample*, promotes critical and evaluative thinking by exposing students to the boundaries, principles, and exceptions that are inherent in scientific knowledge. The seventh, *Agree, Disagree, and Why*, develops students' ability to construct and defend reasoned positions within scientific discourse. The eighth, *Add On*, facilitates collaborative knowledge construction by encouraging students to extend and build substantively upon one another's contributions. The ninth, *Explain What Someone Else Means*, deepens mutual comprehension by requiring students to interpret and represent the perspectives of their classmates.

Complementing this framework, Wray et al. (2022) delineated four principal components of talk moves through which teachers encourage and enhance students' participation in scientific discourse. The first component, *Say More*, functions as an elaborative prompt, encouraging students to expand and develop their initial ideas. The second, *Revoice or Rephrase*, involves the teacher's strategic repetition or reformulation of student words to consolidate shared understanding across the classroom community. The third, *Ask for Evidence*, serves as an epistemic press, directing students to substantiate their claims with explicit reasoning or empirical support. The fourth, *Crosstalk or Encourage Peer Interaction*, structures opportunities for students to engage in substantive peer dialogue, to collectively advance and refine.

1.3. Science Communication Skills

Kulgemeyer and Schecker (2013) describe science communication as an interactive dialogue process between experts and novices, or between scientists and the general public. Effective communication requires preparing appropriate information by considering the audience's prior knowledge and choosing accessible language or vocabulary in place of specialized scientific terminology. Davies and Pachler (2018) describe science communication as the dissemination of knowledge, scientific findings, and processes to the general public, to enable people to learn and apply information to their everyday decision-making. Pitiporntapin (2014) defines writing for science communication as a form of science communication in which the sender conveys stories, events, methods, or scientific truths to the audience through writing. Bowater and Yeoman (2013) describe approaches to enhancing science communication competency in writing, noting that written science communication must be clear and easy to understand, logically organized in content, and tailored to the writing format the author intends to present, such as report writing, academic research writing, or general article writing. There is an assessment instrument that is developed to measure science communication competency through a systematic review of relevant literature and empirical research. This process yielded a standardized set of criteria encompassing seven evaluative components of science communication writing skills, namely: clarity, content, knowledge organization, writing style, analogical approach, narrative approach, and conversational approach. To communicate scientific concepts effectively, learners must be guided to interpret, evaluate, and construct multimodal representations of knowledge (Tytler, Prain, Hubber, & Waldrip, 2013). Moreover, using explicit dialogue practices trains students to utilize language as a critical tool for collective problem-solving (Mercer & Sams, 2006). Kulgemeyer and Schecker (2013) proposed a conceptual framework for the measurement and evaluation of science communication competency. Their methodology involved assigning learners who are in the role of information senders to select a scientific topic and communicate it through an expert-novice dialogue method. The interactions were documented via audio and video recording, then subsequently analyzed through observational techniques in conjunction with content analysis. This process enabled the identification of key components and the construction of a Science Communication Competency model that comprises four dimensions: (1) Factual Content refers to the scientific knowledge the communicator selects to convey, such as the dispersion of white light into distinct spectral wavelengths; (2) Context refers to the integration of scientific facts within familiar real-world situations for example, using a rainbow to illustrate light dispersion this allows the audience to develop a deeper understanding of scientific principles; (3) Code refers to the linguistic conventions the communicator uses. Which range from domain-specific terminology to everyday language, with scientific vocabulary acquisition regarded as a core objective of science education; and (4) Representation Form refers to the varied modes of presentation the communicator selects to support effective knowledge transmission.

1.3.1. Science Communication Assessment

The scoring criteria were derived from a science communication assessment in the form of a rubric score, based on the component framework of science communication competency established by Kulgemeyer and Schecker (2013), as shown in Table 1.

Table 1. Scoring rubric based on the science communication competency components.

Assessment criteria	3 point	2 point	1 point	0 point
Factual content	Communicates all key content accurately and completely	Communicates key content accurately, but some aspects are missing	Communicates most content inaccurately more than half of the total content is incorrect	No key content is communicated
Context	The examples presented enhance the audience's understanding of scientific content	The examples partially support the audience's understanding of scientific content	The examples do not support the audience's understanding of scientific content	No connection is made between the content and science
Code	Selects technical terms or general vocabulary for communication in an appropriate and comprehensive manner	Selects technical terms or general vocabulary for communication appropriately	Selects technical terms or general vocabulary for communication, but the selection is inappropriate	No consideration is given to whether technical terms or general vocabulary should be used to communicate the content to the audience
Representative form	Selects images, charts, graphs, diagrams, or animations to support communication in a manner that is accurate and fully appropriate to the content	Selects images, charts, graphs, diagrams, or animations to support communication in a manner that is accurate and partially appropriate to the content	Selects images, charts, graphs, diagrams, or animations to support communication, but the selection is not appropriate to the content	Selects images, charts, graphs, diagrams, or animations to support communication, but the selection is not appropriate to the content

2. Methods

2.1. Research Design

This study employed a One-Group Repeated Measures Design without a control group, in which the same group of students was observed across multiple measurement points during the instructional intervention. The design followed the sequence $X_1 \rightarrow T_1 \rightarrow X_2 \rightarrow T_2 \rightarrow X_3 \rightarrow T_3$, which allows developmental progress in science communication skills to be tracked over time. Learning achievement was compared against the 70% criterion using a One-Sample t-test, while science communication skills across three assessment sessions were analyzed by using One-Way Repeated Measures ANOVA.

2.2. Participants

The target population consisted of 120 Grade 10 students who studied in three classrooms at Sarakham Pittayakhom School, under the Secondary Educational Service Area Office 26, during the second semester of the 2025 academic year. The sample comprised 37 Grade 10 students from one classroom selected through cluster random sampling, in which the classroom served as the sampling unit.

2.3. Instruments

Three instruments were used to collect data.

2.3.1. Lesson Plans

Seven lesson plans, which integrate scenario-based learning with the talk moves technique, were developed to cover the topic of Evolution over 11 instructional hours. Each plan followed a five-step instructional process: (1) Context, (2) Challenge, (3) Choice, (4) Consequences, and (5) Contemplate, with Talk Moves techniques systematically interpolated at each stage. Content validity was verified by a panel of experts using a five-level Rating Scale, with a mean score of 3.51 or above considered acceptable.

2.3.2. Science Communication Skills Assessment

The science communication skills assessment was developed based on the conceptual framework of Kulgemeyer and Schecker (2013), which covers both speaking and writing skills. An initial pool of 21 items was constructed, from which 12 items were selected for use across 3 assessment sessions conducted after lesson plans 2, 4, and 7. Each assessment session consisted of 2 compulsory writing items and 1 speaking item, randomly which is selected from 2 options. Responses were scored using a rubric (Rubric score) evaluating 4 components: Factual Content, context, language, and representation, with each component scored on a scale of 0 to 3. The quality of the items was verified through the Index of Item-Objective Congruence between the items and the content, and between the items and the components of Science Communication Skills (IOC = 0.80–1.00), as well as the difficulty index, discrimination index, and reliability estimated using the Kuder-Richardson formula. Prior to implementation with the main sample, the instruments were tried out with a group of Grade 10 students from a classroom that were not included in the main sample, in order to examine the reliability and appropriateness of the tools before use with the target group.

2.3.3. Learning Achievement Test

A 30-item multiple-choice achievement test (four options per item) on the topic of Evolution was developed from an initial pool of 40 items. Item selection was based on an acceptable difficulty index (p = 0.41–0.74) and discrimination index (B = 0.38–0.71). Reliability was estimated using the criterion-referenced reliability formula.

2.4. Data Collection Procedure

Data were collected at Sarakham Pittayakhom School, Mueang District, Maha Sarakham Province, during the second semester of the 2025 academic year. The intervention consisted of seven lesson plans that implemented scenario-based learning, accompanied by talk moves over 11 instructional hours. Each lesson presented a realistic scenario that was related to Evolution, followed by a structured discussion facilitated through talk-moves techniques. Science-communication skills were assessed after Lesson Plans 2, 4, and 7, while learning achievement was measured both before and after the completion of all seven lesson plans.

2.5. Limitations

Several limitations of this study should be acknowledged. The study employed a one-group repeated measures design without a formal control group. Although the target population consisted of 120 Grade 10 students across three classrooms, the remaining classrooms were not equivalent in academic profile one classroom followed a sport program curriculum with a distinct schedule and academic background, making direct comparison methodologically inappropriate. Furthermore, the sample size of 37 students from a single classroom limits the generalizability of the findings to broader populations. Therefore, the results should be interpreted with caution, and future studies are encouraged to employ quasi-experimental designs with larger and more diverse samples.

3. Results

In presenting the data analysis results, the researcher organized the findings into 2 sections as follows.

Section 1 presents the analysis of learning achievement on the topic of Evolution through scenario-based learning management, accompanied by the talk-moves technique to promote science-communication skills in Biology among Mathayom 4 students, compared against the 70% criterion. The researcher assessed learning-achievement scores on the topic of Evolution against the 70% criterion using a 30-item learning-achievement test administered after instruction. The analysis of learning achievement on the topic of Evolution through scenario-based learning, accompanied with the talk moves technique, revealed that Grade 10 students achieved a mean learning achievement score of 22.73, which was significantly higher than the 70% criterion at a statistical significance level of .05, as shown in Table 2.

Table 2. Results of the learning achievement analysis on the topic of evolution through scenario-based learning, accompanied by the talk moves technique.

Learning achievement	n	Full Score	$\bar{x}$	S.D	Percentage	t - test	p
Post-test	37	30	22.73	1.43	75.77	7.36	0.000*

Note: *p<.05

Section 2 presents the analysis of science communication skills developed through scenario-based learning management, accompanied by the talk moves technique in Biology at the Mathayom 4 level. The researcher analyzed science communication skills in both speaking and writing developed through Scenario-Based Learning management, accompanied by the Talk Moves technique on the topic of Evolution at the Mathayom 4 level. The assessments were conducted following Lesson Plan 2, Lesson Plan 4, and Lesson Plan 7.

Table 3. Results of science communication skills in writing through scenario-based learning, accompanied by the talk moves technique in biology at the grade 10 level.

Science communication in writing	Score	Df	Score at time			F	P	Different pairs
			1	2	3			
			$\bar{x}$ (S.D)	$\bar{x}$ (S.D)	$\bar{x}$ (S.D)			
1. Context	3	2	1.22 0.54	1.95 0.74	2.35 0.68	34.46	0.00	(1,2)*(1,3)* (2,3)
2. Code	3	2	1.32 0.53	2.11 0.71	2.43 0.50	68.36	0.00	(1,2)*(1,3)* (2,3)*
3. Representative Form	3	2	1.35 0.63	1.95 0.62	2.41 0.60	42.38	0.00	(1,2)*(1,3)* (2,3)*
4. Factual content	3	2	1.22 0.42	2.03 0.55	2.51 0.51	88.82	0.00	(1,2)*(1,3)* (2,3)*
Overall	12	2	5.11 1.47	8.03 1.91	9.70 2.01	104.93	0.00	(1,2)*(1,3)* (2,3)*

Note: *p<0.05.

Analysis of science communication skills in writing outcomes in writing through Scenario-Based Learning, accompanied by the talk moves technique on the topic of Evolution at the Grade 10 level, measured after Lesson Plan 2, Lesson Plan 4, and Lesson Plan 7, with results presented in Table 3.

As shown in Table 3, students who received scenario-based learning management accompanied by the talk moves technique had overall mean scores during the learning management process in the 1st, 2nd, and 3rd assessments of 5.11 (S.D. = 1.47), 8.03 (S.D. = 1.91), and 9.70 (S.D. = 2.01), respectively, with statistically significant differences at the .05 level across all pairwise comparisons. These results can be used to construct bar graphs illustrating the development of science communication skills in writing by dimension in Figure 1 and the overall development in writing in Figure 2.

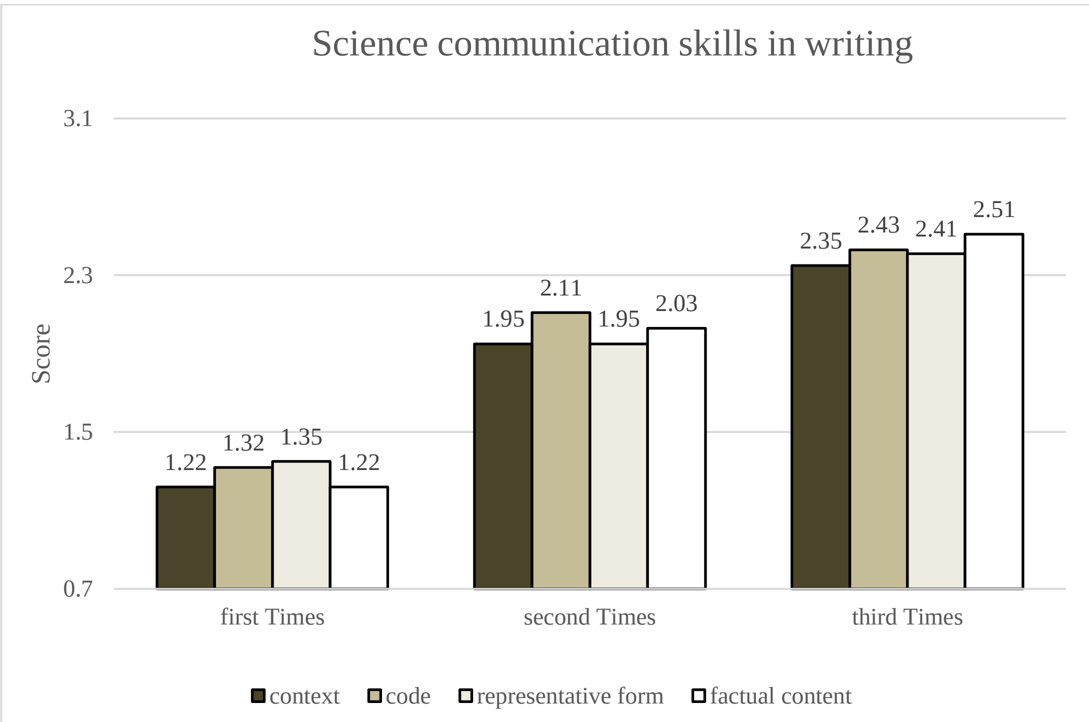

Figure 1. Development of science communication skills in writing.

Figure 1 illustrates the developmental score trends in science communication skills in writing, which show a continuous upward trajectory. When considered by dimension, the mean scores for the Context dimension in the 1st, 2nd, and 3rd assessments were 1.22 (S.D. = 0.54), 1.95 (S.D. = 0.74), and 2.35 (S.D. = 0.68), respectively. The code dimension yielded mean scores of 1.32 (S.D. = 0.53), 2.11 (S.D. = 0.71), and 2.43 (S.D. = 0.50), respectively. The representative form dimension showed mean scores of 1.35 (S.D. = 0.63), 1.95 (S.D. = 0.62), and 2.41 (S.D. = 0.60), respectively. The Content dimension recorded mean scores of 1.22 (S.D. = 0.42), 2.03 (S.D. = 0.55), and 2.51 (S.D. = 0.51), respectively.

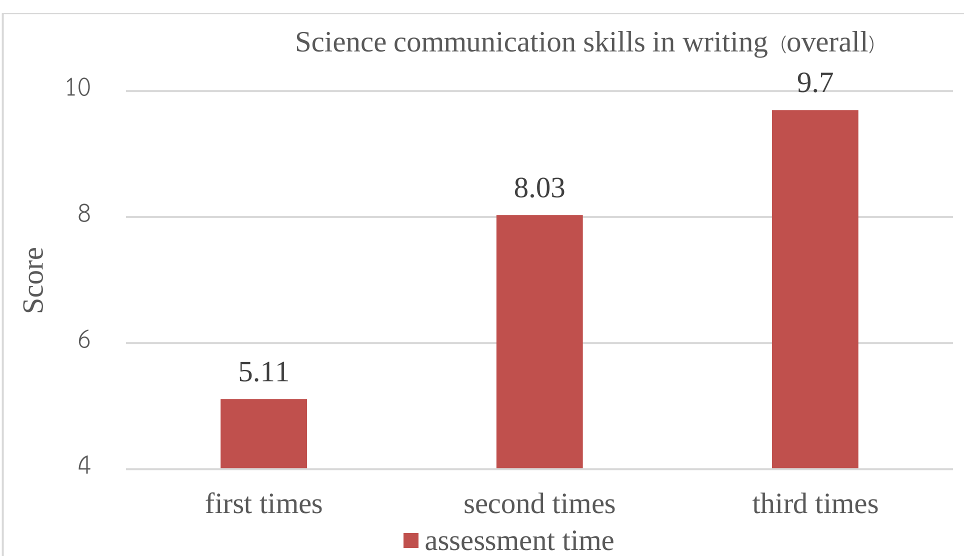

Figure 2. Development science communication skills in writing (overall).

Figure 2 illustrates the upward trend in the overall development of students' written science communication skills. The mean scores for the first, second, and third assessments were 5.11 (S.D. = 1.47), 8.03 (S.D. = 1.91), and 9.7 (S.D. = 2.01), respectively. The increase between each assessment session was statistically significant at the .05 level.

Analysis of science communication skills in speaking outcomes in writing through scenario-based learning management accompanied by the talk moves technique on the topic of Evolution at the Grade 10 level, measured after Lesson Plan 2, Lesson Plan 4, and Lesson Plan 7, with results presented in Table 4.

Table 4. Results of science communication skills in speaking through scenario-based learning management, accompanied by the talk moves technique in biology at the grade 10 level.

Science communication in speaking	Score	Df	Score at time			F	P	Different pairs
			1	2	3			
			$\bar{x}$ (S.D)	$\bar{x}$ (S.D)	$\bar{x}$ (S.D)			
1. Context	3	2	1.14 0.67	1.43 0.55	2.30 0.62	44.76	0.00	(1,2) (1,3)* (2,3)*
2. Code	3	2	1.19 0.66	1.78 0.71	2.38 0.59	44.49	0.00	(1,2)*(1,3)* (2,3)*
3. Representative Form	3	2	0.89 0.77	1.13 0.63	2.30 0.66	41.45	0.00	(1,2)*(1,3)* (2,3)*
4. Factual Content	3	2	1.46 0.61	1.86 0.71	2.32 0.63	19.08	0.00	(1,2)*(1,3)* (2,3)*
Overall	12	2	4.68 1.93	6.20 1.78	9.30 1.88	102.77	0.00	(1,2)*(1,3)* (2,3)*

Note: *p<0.05.

As shown in Table 4, students who received scenario-based learning management accompanied by the talk moves technique had overall mean scores during the learning management process in the 1st, 2nd, and 3rd assessments of 4.68 (S.D. = 1.93), 6.20 (S.D. = 1.78), and 9.30 (S.D. = 1.88), respectively. The post-hoc pairwise comparisons revealed statistically significant differences at the .05 level across all pairs for the code, representative form, factual content, and Overall dimensions. However, for the context dimension, significant differences were observed only between the 1st and 3rd assessments (1,3)*, and between the 2nd and 3rd assessments (2,3)*, whereas the progress between the 1st and 2nd assessments (1,2) was not statistically significant. These results can be used to construct a bar graph illustrating the development of science communication skills in speaking by dimension, as shown in Figure 3, and the overall development of Science Communication Skills in speaking, as shown in Figure 4.

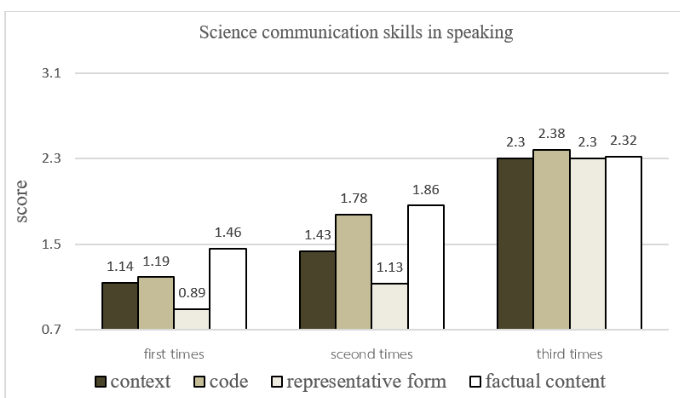

Figure 3. Development of science communication skills in speaking.

Figure 3 illustrates the developmental score trends in science communication skills in speaking, which show an upward trajectory. When considered by dimension, the mean scores for the context dimension in the 1st, 2nd, and 3rd assessments were 1.14 (S.D. = 0.67), 1.43 (S.D. = 0.55), and 2.30 (S.D. = 0.62), respectively. The code dimension yielded mean scores of 1.19 (S.D. = 0.66), 1.78 (S.D. = 0.71), and 2.38 (S.D. = 0.59), respectively. The representative form dimension showed mean scores of 0.89 (S.D. = 0.77), 1.13 (S.D. = 0.63), and 2.30 (S.D. = 0.66), respectively. The factual content dimension recorded mean scores of 1.46 (S.D. = 0.61), 1.86 (S.D. = 0.71), and 2.32 (S.D. = 0.63), respectively. The mean scores across the code, representative form, and factual content dimensions increased progressively, with the differences being statistically significant at the .05 level for all pairwise comparisons. However, for the context dimension, the upward progress was statistically significant only when comparing the 3rd assessment to the 1st and 2nd assessments.

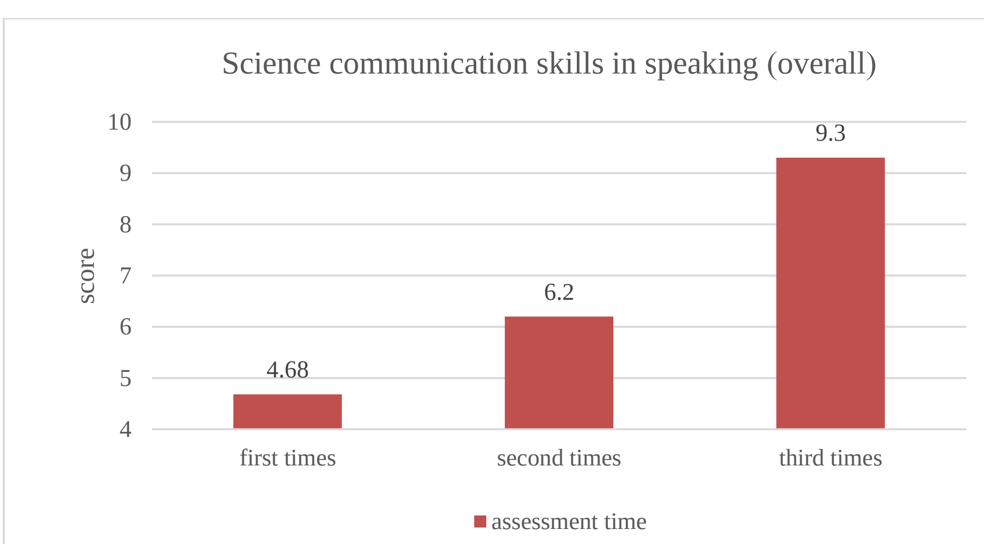

Figure 4. Development of science communication skills in speaking (overall).

As shown in Table 4, students who received scenario-based learning management accompanied by the talk moves technique had overall mean scores during the learning management process in the 1st, 2nd, and 3rd assessments of 4.68 (S.D. = 1.93), 6.20 (S.D. = 1.78), and 9.30 (S.D. = 1.88), respectively. The results for the overall dimension revealed statistically significant differences at the .05 level across all pairwise comparisons, indicating that the cumulative science communication skills in speaking improved progressively and significantly at each assessment point throughout the instructional process.

4. Discussion

Based on the research findings on the development of scenario-based learning management accompanied by the talk moves technique to promote science communication skills in Biology among Mathayom 4 students, the researcher discusses the results as follows. Students who learned through scenario-based learning management accompanied by the talk moves technique showed continuous and statistically significant improvement in their science communication skills in both writing and speaking across the 1st, 2nd, and 3rd assessments at the .05 level of significance. This can be attributed to the nature of scenario-based learning, which emphasizes active learner participation in problem-solving and decision-making within realistic simulated contexts. The learning process through scenarios stimulates students to analyze information, evaluate evidence, and propose solutions through a variety of activities, such as group discussions, role-playing, and presentations. These factors directly contribute to the development of science communication skills in both speaking and writing, particularly in terms of practicing the explanation of scientific and biological concepts to others and engaging in reasoned exchanges of ideas within each designated scenario. This is consistent with Ahmed (2019), who stated that this type of learning management enables learners to develop the ability to communicate scientific information effectively through realistic simulated situations that require higher-order thinking processes. The findings are also consistent with Liu, Liao, Huang, Lee, and Lai (2025), who found that scenario-based learning significantly improves students' communication skills, as it provides opportunities for learners to practice communication in realistic contexts. Science communication skills are considered a component of academic communication, which requires explanation, reasoning, and systematic presentation of information. Therefore, scenario-based Learning may contribute to the development of students' science communication skills. Furthermore, the talk moves technique played a significant role in enhancing learners' science communication skills. It served as a scaffolding tool that trained students to use evidence and reasoning to support their propositions, encouraged constructive argumentation, and developed the ability to listen to others' opinions with a focus on ideas and evidence rather than on individuals. The talk employed strategies that included wait time, clarifying, and asking for evidence or reasoning, which helped create a supportive classroom atmosphere that increased students' confidence and willingness to express their opinions. This is consistent with Michaels and O'Connor (2012). Regarding learning achievement, students who learned through scenario-based learning management accompanied by the talk moves technique achieved learning outcomes that exceeded the 70% criterion at a statistically significant level of .05. This was due to a learning process that placed students in realistic simulated situations, stimulating decision-making, knowledge exchange, and collaborative problem-solving. Additionally, students received systematic feedback following each lesson plan, allowing them to recognize their own weaknesses and continuously improve their understanding. This is consistent with Errington (2010), who noted that scenario-based learning management enables learners to integrate knowledge with real-world practice and develop rational thinking. It is also consistent with the research of Kaseamsuk, Mahavijit, and Fukushima (2024), which found that scenario-based learning management effectively enabled learners to achieve learning outcomes above the designated criteria.

5. Conclusion

The researcher summarized the research findings according to the objectives as follows. Students who learned through scenario-based learning management accompanied by the talk moves technique showed continuous and statistically significant improvement in their science communication skills in writing and science communication skills in speaking across the 1st, 2nd, and 3rd assessments, at the .05 level of significance. Furthermore, students who learned through scenario-based learning management accompanied by the talk moves technique achieved learning outcomes above the 70% criterion, with statistical significance at the 0.05 level.

6. Recommendation

Teachers should clearly define timeframes for each instructional stage and monitor student behavior throughout activities. Scenario presentations should include clear guiding questions and supporting diagrams. For future research, scenario-based instruction should be further developed in combination with storyline and talk Moves techniques to continuously and effectively enhance students' science communication skills.

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