Effects of Learning Style Preferences on Scientific Attitude of High School Students

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ABSTRACT

This research study investigated the relationship between learning style preferences and students' scientific attitude in Paitan Integrated School during the School Year 2024-2025. Specifically, it aimed to: identify the learning style preferences that students manifest; determine the level of students' scientific attitude; and ascertain the significant relationship between learning style preferences and scientific attitude among high school students. A descriptive-correlational research design was employed, randomly selecting 150 Junior High School and Senior High School students. Findings of the study revealed that visual, auditory, kinesthetic, group, and individual learning have an overall mean score of 3.88, indicating that students recognize and continuously utilize their preferred learning modalities in educational environments. Students also demonstrated high levels of scientific attitude, particularly in their enjoyment and confidence in science, active participation in science-related activities, and appreciation of the value of science. Correlation Analysis showed a significant positive relationship between independent and dependent variables (r = 0.483). The findings suggest that aligning instructional strategies with students' preferred learning styles can enhance their engagement, foster positive attitudes toward science, and potentially improve academic outcomes.

Keywords: learning style preferences, scientific attitude, high school students

INTRODUCTION

Science is a fundamental component of elementary and secondary education and is vital in preparing students for the demands of the 21st century. Learning science extends beyond scientific facts, principles, and theories; hence, applying scientific knowledge to daily activities helps individuals develop critical thinking skills and become more effective decision-makers.

In the context of science education, learning new scientific concepts can often be challenging for students. Accordingly, students can only effectively grasp new scientific concepts when they develop their understanding of the subject. Considering that every individual is unique, differences among students are significant because they affect how they learn and perceive the world. It also affects their academic performance, feelings, thoughts, and interests, in addition to their knowledge and abilities (Cebesoy & Öztekin, 2018). In this vein, the concept of learning style emerged. Learning style preferences are different ways students receive, process, and internalize information. Students' diverse learning styles and strengths add to the complexity and difficulties of studying science. A mismatch between instructional strategies and students' learning styles may lead to learning failure, frustration, and demotivation among learners (Arif et al., 2021).

Consequently, a scientific attitude is crucial for effective learning and significantly influences students' academic success. Students' attitudes toward a subject determine their abilities, willingness to learn, choices of action, and responses to challenges. To make logical decisions, they should embrace a critical thinking attitude that empowers them to analyze and synthesize different information (Lu, 2019; Robledo, 2018).

Moreover, showing the relevance of science to everyday life and future career opportunities helps students acquire positive attitudes, which can contribute to better learning outcomes. Educators must consider that science instruction requires students to improve metacognitive learning and the application of scientific values. Thus, this research hopes that assessing learning style preferences offers insights into how students engage with information. Understanding these preferences can still inform inclusive teaching strategies that effectively accommodate diverse learners in Paitan Integrated School.

Objectives:

This study examined the effects of learning style preferences on scientific attitude among high school students in Paitan Integrated School, Paitan, Quezon, Bukidnon, Philippines, for the School Year 2024–2025. Specifically, it aimed to:

1. Identify the learning style preferences do students manifest in terms of:
    a. visual learning;
    b. auditory learning;
    c. kinesthetic learning;
    d. group learning; and
    e. individual learning.
2. Determine the level of students' scientific attitude in terms of:
    a. enjoyment and confidence;
    b. participation in science learning and activity; and
    c. value of science.
3. Ascertain the significant relationship between learning style preferences and scientific attitude among high school students.

METHODOLOGY

Research Design

This study employed a descriptive-correlational research design to examine the relationship between learning style preferences and scientific attitude among high school students.

Research Setting

The study was conducted at Paitan Integrated School (PIS) located at Purok 1 Paitan, Quezon, Bukidnon, Philippines. Paitan Integrated School is a public school under the Quezon IV district and offers comprehensive education from elementary to senior high school level.

Participants of the Study

The participants of the study were Junior High School and Senior High School students of Paitan Integrated School who are officially enrolled for the School Year 2024-2025. Participants were randomly selected to represent diverse grades and backgrounds, ensuring a comprehensive understanding of the factors affecting students' scientific attitude across different demographics within the school.

Research Instrument

This study utilized two adapted questionnaires: the Perceptual Learning Style Preference Questionnaire (PLSPQ) developed by Arif, Danial, and Nurhaeni (2021), and the Attitudes Towards Science Questionnaire (ATSQ) patterned from Wicaksono and Korom (2023). The first questionnaire consists of 23 statement indicators, which are categorized into five sub-scales: a) visual learning, b) auditory learning, c) kinesthetic learning, d) group learning, and e) individual learning. This questionnaire was pilot tested with 30 students from Kiburiao National High School in the Quezon III District, achieving a Cronbach's alpha of 0.838, reflecting high reliability. The second questionnaire measured the students' scientific attitude. It comprised 20

statement indicators organized into three parts: a) enjoyment and confidence, b) participation in science learning and activity, and c) value of science. It was pilot tested, resulting in a Cronbach's alpha of 0.909, indicating excellent reliability.

Further, a five (5) point Likert scale was used for data interpretation.

Scale	Range	Descriptive Interpretation	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree (SA)	Very High
4	3.51 – 4.50	Agree (A)	High
3	2.51 - 3.50	Moderately Agree (MA)	Moderate
2	1.51 - 2.50	Disagree (D)	Low
1	1.00 - 1.50	Strongly Disagree (SD)	Very Low

Sampling Procedure

To ensure the successful answering of research questions, the selection of participants is crucial. In this study, a random sampling procedure was used to determine one hundred-fifty (150) high school students. This method ensured that every student had an equal chance of inclusion in the study, hence improving the representativeness of the sample. The selection was carried out systematically, allowing for an unbiased distribution of participants.

Data Gathering Procedure

In this study, a letter of consent was given to the Principal of Kiburiao National High School asking permission to pilot test the questionnaire on thirty (30) junior high and senior high school students. After which, a permission letter was given to the Principal of Paitan Integrated School, where the study was conducted. The data collection was facilitated through a survey questionnaire. The study participants were given informed consent forms with key details to assist them in making informed decisions about their participation.

Data Analysis

In analyzing and interpreting the data, descriptive statistics, such as mean and standard deviation, were used to evaluate students' level of preferred learning style preferences and their scientific attitude. In addition, Product-Moment Correlation was employed to ascertain the relationship between independent and dependent variables.

RESULTS AND DISCUSSIONS

Learning Style Preferences

Table 1 presents the students' preferences for visual learning styles. The overall mean score of 4.03 indicates a "Highly Visual", suggesting that students favor visual learning modalities, such as reading instructions, engaging with textual content on the chalkboard, and using textbooks rather than listening to lectures**.**

Table 1. Mean score of students' learning style preferences in terms of visual learning.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I understand better when I read instructions.	4.33	0.70	Highly Visual
2. I learn better by reading what the	4.27	0.74	Highly Visual

teacher writes on the chalkboard.			
3. When I read instructions, I remember them better.	3.99	0.74	Highly Visual
4. I learn more by reading textbooks than by listening to lectures.	3.55	0.95	Highly Visual
OVERALL MEAN	4.03	0.78	Highly Visual

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very Highly Visual
4	3.51 – 4.50	Agree	Highly Visual
3	2.51 – 3.50	Undecided	Moderately Visual
2	1.51 – 2.50	Disagree	Lowly Visual
1	1.00 – 1.50	Strongly Disagree	Very Lowly Visual

As shown in the table, the students' mean score with "Highly Visual" results in order toward visual learning styles is "I understand better when I read instructions" (4.33); " I learn better by reading what the teacher writes on the chalkboard" (4.27); "When I read instructions, I remember them better " (3.99); and "I learn more by reading textbooks than by listening to lectures" (3.55). The findings revealed that students exhibit a pronounced preference and effectiveness in understanding information when it is conveyed visually. It is noted that visual learning students learn best when sight and observation are used to gather information. In addition, resources that can be seen or observed, such as maps, charts, graphs, diagrams, videos, etc., significantly enhance their learning experience. Bethel-Eke and Eremie (2017) highlight that visual learners think and process information through images and rely on nonverbal cues from teachers, such as body language, to improve their understanding.

On the other hand, instructional strategies for reading through illustrated texts enhance reading comprehension and learning processes. With the advent of technology nowadays, teaching and learning have undergone significant transformations. Traditional lecture-based methods are increasingly being complemented or even replaced by multimedia learning, which incorporates various digital tools such as videos, animations, simulations, and interactive software which influence the students' learning processes (Jian, 2018). This evolution can aid elementary and secondary school teachers in understanding the reading processes of learners when engaging with illustrated texts, equipping them with evidence-based methods to effectively teach science reading.

Accordingly, using visual aids across learning areas allows students to engage more effectively, fostering trust and enhancing the educational experience (Punzalan, 2018). In fact, it helps teachers connect students closely with the material and encourages active participation, boosting students' confidence and enhancing their learning process (Jepkorir, Kisaka, & Ongeti, 2024).

Table 2. Mean score of students' learning style preferences in terms of auditory learning.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. When the teacher tells me the instructions, I understand better.	4.22	0.78	Highly Auditory
2. I learn better in class when the teacher gives a lecture.	4.13	0.85	Highly Auditory

3. When someone tells me how to do something in class, I learn it better.	3.93	0.92	Highly Auditory
4. I remember things I have heard in class better than things I have read.	3.74	0.92	Highly Auditory
5. I learn better in class when I listen to someone.	3.51	1.11	Highly Auditory
OVERALL MEAN	3.91	0.92	Highly Auditory

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very Highly Auditory
4	3.51 – 4.50	Agree	Highly Auditory
3	2.51 – 3.50	Undecided	Moderately Auditory
2	1.51 – 2.50	Disagree	Lowly Auditory
1	1.00 – 1.50	Strongly Disagree	Very Lowly Auditory

Table 2 shows the overall mean score of the students' learning style preferences for auditory learning, which is 3.91, signifying "Highly Auditory". This finding suggests that highly auditory learners prefer to absorb and process information through hearing and listening. Students who identify as auditory learners tend to recall more information when content is presented in an auditory format, such as lectures or spoken instructions (Rogowsky, Calhoun & Tallal, 2020).

As reflected in the table, the highest rated indicator is “When the teacher tells me the instructions, I understand better” (4.22). Students strongly prefer and benefit from oral explanations and often find it easier to comprehend spoken information than written instructions. This is closely followed by “I learn better in class when the teacher gives a lecture”, which scored (4.13), indicating that students have strong listening skills and find it easier to remember information associated with sounds and verbal repetition. This preference for auditory learning is further supported by a lecture-based teaching approach, which emphasizes spoken instruction, discussions, and verbal explanations in a classroom setting hence, supports the success of learners, allowing them to effectively absorb information through listening, note-taking, and engaging in oral interactions with both the teacher and their classmates.

Conversely, “When someone tells me how to do something in class, I learn it better” (3.93) suggests that auditory learners are more likely to understand the instructions and perform well when teachers explain tasks verbally before students begin working. Additionally, when students “I remember things, I have heard in class better than things I have read” (3.74) and “I learn better in class when I listen to someone” (3.51) they are more likely to retain information better than when reading. This highlights a clear distinction between auditory and visual learning preferences. According to Lehmann and Seufert (2020), while some students strongly prefer one specific modality, many tend to use a combination of learning styles. However, auditory learners prefer spoken content for information retention since they process and retain verbal information more effectively than written or visual data. Identifying these differences enables educators to create more inclusive lessons that integrate verbal explanations with visual aids to meet the needs of all diverse learners.

Auditory learning plays a vital role in the learning landscape, offering numerous benefits that can significantly contribute to student success and overall academic achievement. It supports the acquisition of knowledge and promotes the development of essential communication and listening skills. A study by Oladele and Mccall (2024) revealed that verbal instruction, discussions, and active participation in the learning process allow auditory learners to improve their ability to comprehend spoken language, engage in meaningful dialogue, and express their thoughts and ideas effectively. Using verbal problem-solving and demonstration methods, where

teachers guide students step-by-step through scientific concepts, can be particularly beneficial for auditory learners.

Table 3 illustrates the students' preferences for kinesthetic learning, with an overall mean score of 3.92, indicating a "Highly Kinesthetic" learning style. This reinforces the strong preference for learning through physical activity and hands-on engagement.

Table 3. Mean score of students' learning style preferences in terms of kinesthetic learning.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I learn best in class when I can participate in related activities.	4.22	0.77	Highly Kinesthetic
2. I enjoy learning in class by doing experiments.	3.97	0.93	Highly Kinesthetic
3. I understand things better in class when I participate in role-playing.	3.91	0.98	Highly Kinesthetic
4. When I do things in class, I learn better.	3.81	0.93	Highly Kinesthetic
5. I prefer to learn by doing something in class.	3.70	1.04	Highly Kinesthetic
OVERALL MEAN	3.92	0.93	Highly Kinesthetic

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very Highly Kinesthetic
4	3.51 – 4.50	Agree	Highly Kinesthetic
3	2.51 – 3.50	Undecided	Moderately Kinesthetic
2	1.51 – 2.50	Disagree	Lowly Kinesthetic
1	1.00 – 1.50	Strongly Disagree	Very Lowly Kinesthetic

The highest-rated item, " I learn best in class when I can participate in related activities" (4.22), signifies that active participation in class activities improves learning. This corresponds with kinesthetic learning, which is effectively achieved through physical involvement rather than passive listening or observation. In fact, kinesthetic learners excel when they can manipulate materials, enhancing their understanding of the material and lesson. Following with "I enjoy learning in class by doing experiments" (3.97) indicates that learners favor experiential learning through experiments, which provide concrete and sensory experiences. This is consistent with findings on the study of Sauro (2022), which posits that kinesthetic learners benefit from hands-on experiences that engage their motor skills and sensory perception, thus, significantly improve their focus and motivation to finish the given task.

Consequently, a statement on " I understand things better in class when I participate in role-playing" with a mean score of (3.91) shows that kinesthetic learners find role-playing an effective teaching-learning strategy. This supports the psychomotor domain in Bloom's taxonomy, emphasizing the significance of learning through action. Besides, role-playing facilitates understanding abstract concepts through concrete experiences, enhancing students' comprehension of science subjects. More so, an indicator of "When I do things in class, I learn better" (3.81) and "I prefer to learn by doing something in class" with a mean score of (3.70) denotes that

active engagement leads to better learning outcomes. Studies show that when physical activity integrates into classroom instruction, students exhibit improved cognitive retention and enjoyment (Mavilidi et al., 2015). This is linked to John Dewey's theory of learning by doing, which posits that meaningful learning occurs through active participation and hands-on experience. Dewey believed that students learn best when engaged in real-life tasks that require critical thinking, problem-solving, and reflection rather than passively receiving information. He emphasized learners should participate, collaborate, and connect their learning to practical experiences (Sutinen 2019).

Table 4 reflects the learning style of students when it comes to group learning with an overall mean score of 3.80, indicating "High Group Learning" respectively. This suggests that students generally favor collaboration with peers.

Table 4. Mean score of students' learning style preferences in terms of group learning.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I learn more when I study with a group.	4.00	0.82	High Group Learning
2. I enjoy working on assignments with two or three classmates.	3.84	0.93	High Group Learning
3. I get more work done when I work with others.	3.75	1.02	High Group Learning
4. I prefer to study with others.	3.62	1.04	High Group Learning
OVERALL MEAN	3.80	0.95	High Group Learning

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Group Learning
4	3.51 – 4.50	Agree	High Group Learning
3	2.51 – 3.50	Undecided	Moderate Group Learning
2	1.51 – 2.50	Disagree	Low Group Learning
1	1.00 – 1.50	Strongly Disagree	Very Low Group Learning

As gleaned from the table, the students' mean score results in order: "I learn more when I study with a group" (4.00); "I enjoy working on assignments with two or three classmates" (3.84); "I get more work done when I work with others" (3.75); and "I prefer to study with others" (3.62). These statements revealed an overall "High Group Learning" experience. In this context, learners believe collaborative learning deepens their understanding, enhances long-term retention of the concept, and improves academic performance. On the other hand, engaging with diverse perspectives encourages students to develop critical thinking skills and strengthen interpersonal competencies, fostering a more holistic and inclusive educational experience (Smith & MacGregor, 2024; Gillies, 2022). Hence, in a classroom setting, teachers can create opportunities for students to engage in diverse collaborative learning activities such as group discussions, peer review, brainstorming, think-pair-share, and debates. By engaging in dialogue and exchanging ideas with classmates, students can deepen their understanding, question assumptions, and construct well-informed arguments, which are key components in developing higher-order thinking.

Additionally, Zhou et al. (2024) found that when students enjoy working in groups, their motivation and engagement increase. The social interaction and shared responsibilities within a group create a more

supportive and stimulating environment. This enjoyable atmosphere encourages active participation and helps maintain interest in the task. It is noted that communication skills are enhanced when learners work with groups as they articulate ideas, listen actively, and provide constructive feedback. Thus, creating a positive and inclusive classroom environment may not only improve academic outcomes but also develop essential interpersonal and teamwork skills among learners.

Table 5. Mean score of students' learning style preferences in terms of individual learning.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. When I study alone, I remember things better.	3.95	1.02	High Individual Learning
2. When I work alone, I learn better.	3.86	0.98	High Individual Learning
3. I prefer to work by myself.	3.71	1.04	High Individual Learning
4. I prefer working on projects by myself.	3.67	1.05	High Individual Learning
5. In class, I work better when I work alone.	3.54	1.00	High Individual Learning
OVERALL MEAN	3.75	1.02	High Individual Learning

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Individual Learning
4	3.51 – 4.50	Agree	High Individual Learning
3	2.51 – 3.50	Undecided	Moderate Individual Learning
2	1.51 – 2.50	Disagree	Low Individual Learning
1	1.00 – 1.50	Strongly Disagree	Very Low Individual Learning

Table 5 presents the individual learning style with an overall mean score of 3.75, reflecting a preference for "High Individual Learning". This implies a personalized approach where students take ownership of their learning journey, establishing their own goals and learning at their own pace.

The high rating on "When I study alone, I remember things better", with a mean of (3.95), suggests that students who favor studying independently tend to retain information more effectively, as the focused and self-paced environment allows them to process content deeply without external distractions. This aligns with research of Alt (2024) indicating that when students engage in self-directed learning, they can better minimize external distractions, such as peer interruptions or environmental noise, that often impede concentration. This focused atmosphere enables learners to exercise greater control over their study routines, allowing them to progress at a pace suited to their comprehension level and to apply learning strategies that best match their cognitive preferences. As a result, this contributes to improved information retention, deeper conceptual understanding, and enhanced academic performance. This is closely followed by "When I work alone, I learn better" (3.86), which allows students to think critically and structure their learning according to their individual needs. Independent work is often associated with enhanced learning effectiveness, allowing learners to focus, reflect, and engage with the learning materials at their own pace. This claim is supported by Su and Wang (2023), whose study found that self-directed learning fosters the development of metacognitive skills and promotes deep conceptual understanding on the content. Students become more aware of their learning strategies by taking responsibility for their progress, contributing to more meaningful and sustained academic growth.

Consequently, the statement "I prefer to work by myself" received a mean score of (3.71), indicating a general preference among students for solitary work. This suggests that many learners value the autonomy of learning. Recent research by Nguyen, Netto & Wilkins (2023) supports this finding, revealing that students who prefer working alone often report higher levels of satisfaction and reduced anxiety, particularly when they have control over their learning environment. The ability to self-regulate and tailor study conditions to personal needs appears to contribute positively to emotional well-being and academic performance.

Moreover, the ability to "I prefer working on projects by myself" with a mean score of (3.67) indicates that working on projects independently enables students to maintain complete authority over the planning, implementation, and quality of the work, resulting in greater personal satisfaction and deeper involvement with the activity. Research suggests that students prefer to work individually, perceive projects as less stressful and more manageable, as they can use a strategy without negotiating group dynamics (Khalil & Ebner, 2024). Lastly, the statement "In class, I work better when I work alone" (3.54) highlights that some learners feel more focused and productive when working independently, as it enables them to manage their time more efficiently and concentrate without external distractions. This observation confirms the findings of Zhu et al. (2022), who reported that some students experience increased productivity when allowed to work independently. The study suggests that independent work will enable students to pay attention effectively, regulate their pace of learning, and reduce the cognitive strain associated with coordinating with others. Furthermore, working alone often fosters a sense of autonomy and personal responsibility, enhancing motivation and academic confidence. These conditions benefit learners who prefer a quiet, focused setting where they can process information without the interruptions or social dynamics typically associated with group work.

Table 6. Summary of the components of students' learning style preferences

SUB-VARIABLES	MEAN	SD	QUALITATIVE INTERPRETATION
1. Visual Learning	4.03	0.78	High Learning Style Preference
2. Kinesthetic Learning	3.92	0.93	High Learning Style Preference
3. Auditory Learning	3.91	0.92	High Learning Style Preference
4. Group Learning	3.80	0.95	High Learning Style Preference
5. Individual Learning	3.75	1.02	High Learning Style Preference
OVERALL MEAN	3.88	0.92	High Learning Style Preference

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Learning Style Preference
4	3.51 – 4.50	Agree	High Learning Style Preference
3	2.51 – 3.50	Undecided	Moderate Learning Style Preference
2	1.51 – 2.50	Disagree	Low Learning Style Preference
1	1.00 – 1.50	Strongly Disagree	Very Low Learning Style Preference

Table 6 summarizes the components of students' learning style preferences across five sub-variables: Visual,

Kinesthetic, Auditory, Group, and Individual Learning. The overall mean score of 3.88 suggests a general "High Learning Style Preference". This signifies that students recognize and continuously utilize their preferred learning modalities in educational environments. The increased mean average reflects the necessity of integrating many learning modes in instructional design, as students have various preferences for specific

styles that enhance their engagement, conceptual understanding, and academic performance. Including both group and individual learning sub-variables also highlights the nature of learning preferences, suggesting that while students may favor particular sensory modalities (e.g., visual or kinesthetic), their preference for social or solitary learning environments also profoundly influences their educational experience.

Visual learning has the highest mean (4.03) indicating that students prefer learning through visual means such as diagrams, videos, pictures, and graphical representations. This preference suggests that students find visual representations effective for comprehension and retention, particularly in complex subjects (Alzain et al., 2023).

On the other hand, Kinesthetic learning was the second most preferred style (3.92), suggesting students learn from hands-on activities, movement, and physical involvement in the learning process. This corresponds with the findings of Tadesse et al. (2022), who reported that kinesthetic activities improve motivation and participation, especially in practical or technical subjects. Classroom observations indicate that integrating movement-based and interactive activities significantly enhances student engagement, particularly among kinesthetic learners. When lessons include role-playing, experiments, simulations, or manipulatives, kinesthetic learners are more likely to remain attentive, actively participate, and retain information. These findings highlight the necessity of aligning instructional tactics with students' preferred learning modalities to cultivate a more inclusive and effective classroom environment.

Further, Auditory learning had a mean score of (3.91), implying that students prioritize learning through listening to lectures, conversations, and verbal interactions. Ahmad et al. (2023) assert that auditory learners benefit from lectures, podcasts, and group discussions, which enhance comprehension through listening and speaking. A high mean of (3.80) for group learning shows that collaborative activities and peer interactions are significant for many students especially those involving discussion and movement, can benefit both auditory and kinesthetic learners. Group-based learning fosters social skills, teamwork, and profound understanding, as highlighted by Choi & Lee (2024), who revealed that cooperative learning environments improve academic performance and student satisfaction.

Individual learning with a (3.75) mean score, slightly lower than the other categories, reflects that student also value opportunities for independent study and self-paced learning. This preference suggests that, although students may enjoy collaborative and interactive environments, many still prioritize the autonomy and control provided by solo learning. This is consistent with the findings of Bouchey et al. (2021), who emphasize the importance of supporting autonomy and self-regulation in educational settings. Their study highlights that when students can regulate their learning, they are more inclined to cultivate critical metacognitive skills, exhibit greater motivation, and attain higher levels of comprehension. These observations highlight the necessity for balanced teaching methods catering to independent and collaborative learning preferences.

Thus, students in this study exhibit high preferences across all learning styles. Educators must employ varied pedagogical approaches to address these diverse preferences in enhancing learning outcomes in every subject.

Scientific Attitude

Table 7 presents the students' scientific attitudes towards confidence and enjoyment, with an overall mean score of 3.93. This score indicates "High Enjoyment and Confidence," suggesting that students enjoy science and feel confident about it, reflecting a positive attitude.

Table 7. Mean score of students' scientific attitude in terms of enjoyment and confidence.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I feel happy when I understand a scientific concept.	4.09	0.88	High Enjoyment and Confidence
2. Science makes me curious about the	4.07	1.01	High Enjoyment and Confidence

world.			
3. I find science experiments fascinating.	4.03	0.77	High Enjoyment and Confidence
4. I enjoy learning about science.	4.00	1.00	High Enjoyment and Confidence
5. I like reading about scientific discoveries.	4.00	0.88	High Enjoyment and Confidence
6. Science is interesting and fun for me.	3.87	1.05	High Enjoyment and Confidence
7. I look forward to science classes.	3.75	0.91	High Enjoyment and Confidence
8. Science is one of my favorite subjects.	3.65	0.92	High Enjoyment and Confidence
OVERALL MEAN	3.93	0.93	High Enjoyment and Confidence

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Enjoyment and Confidence
4	3.51 – 4.50	Agree	High Enjoyment and Confidence
3	2.51 – 3.50	Undecided	Moderate Enjoyment and Confidence
2	1.51 – 2.50	Disagree	Low Enjoyment and Confidence
1	1.00 – 1.50	Strongly Disagree	Very Low Enjoyment and Confidence

The highest scores came from statements like "I feel happy when I understand a scientific concept" (4.09); "Science makes me curious about the world" (4.07); and "I find science experiments fascinating" (4.03) suggest that students feel a sense of satisfaction and joy when they grasp scientific ideas, which likely ignite their curiosity and interest in learning more about the world around them. Additionally, the enthusiasm for science experiments highlights the importance of hands-on learning, which helps students develop a positive attitude towards science. This aligns with research by Yilmaz-Tuzun and Topcu (2017), indicating that practical experiments boost students' curiosity and enjoyment of science.

On the other hand, some statements received lower average scores. These include "Science is one of my favorite subjects" (3.65), "I look forward to science classes" (3.75), and "Science is interesting and fun for me" (3.87). While these scores are still relatively high, they show less enthusiasm than other aspects. This means that although students enjoy science and feel confident in their skills, it may not be their favorite subject, nor do they eagerly anticipate science classes. This could be due to various student interests or the perception that science can be difficult, despite its intriguing nature. Harlen and Qualter (2019) noted that while students appreciate science, their enthusiasm can vary based on teaching methods and how interactive lessons are. These findings suggest that students feel happiest and most confident when they successfully understand scientific concepts, satisfy their curiosity, and engage in experiments. Teaching strategies that focus on clear explanations, curiosity-driven learning, and hands-on activities effectively foster positive attitudes toward science. However, the comparatively lower scores on students' preference for science and looking forward to science classes reveal room for improvement. Making science a more exciting and appealing subject could involve using diverse and interactive teaching methods that better engage students' interests.

Recent studies have shown similar trends in support of these notion. For instance, Akpan and Andre (2021) found that inquiry-based learning boosts students' curiosity and enjoyment in science, which is linked to positive attitudes. Likewise, Lee and Kim (2018) discovered that students participating in hands-on science activities report being more confident and interested in science. Additionally, Johnson et al. (2020) emphasized that while students value science, their overall preference for the subject depends on how it's taught and the

classroom environment. Together, these studies highlight the need for teaching methods that involve students actively to enhance their enjoyment and confidence in learning science.

Table 8. Mean score of students' scientific attitude in terms of participation in science learning and activity.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I like working on science projects with my peers.	3.93	0.88	High Participation
2. I participate actively in science discussions.	3.84	0.93	High Participation
3. I ask questions in science class.	3.70	0.87	High Participation
4. I engage in science-related hobbies.	3.65	0.91	High Participation
5. I volunteer for science-related activities.	3.61	0.94	High Participation
6. I discuss science with my friends.	3.56	0.89	High Participation
7. I attend science events outside of school.	3.45	1.10	Moderate Participation
8. I am involved in science clubs or groups.	3.27	1.20	Moderate Participation
OVERALL MEAN	3.63	0.97	High Participation

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Participation
4	3.51 – 4.50	Agree	High Participation
3	2.51 – 3.50	Undecided	Moderate Participation
2	1.51 – 2.50	Disagree	Low Participation
1	1.00 – 1.50	Strongly Disagree	Very Low Participation

Table 8 presents the students' scientific attitude in terms of participation in science learning and activity with an overall mean score of 3.63, which indicated "High Participation" indicating a notable level of engagement in science-related learning activities among high school students, The items reflecting the highest mean scores include: "I like working on science projects with my peers" (3.93), "I participate actively in science discussions" (3.84), and "I ask questions in science class" (3.70). These findings suggest that students demonstrate heightened engagement when collaborating with peers, contributing to classroom discussions, and seeking clarification through questioning. Such proactive behaviors are pivotal for cultivating deeper understanding and critical thinking abilities in the sciences. The research by Lee and Song (2019) corroborates these findings, highlighting the significance of peer collaboration and active engagement in enhancing students' science learning outcomes.

Conversely, the items with the lowest mean scores "I attend science events outside of school" (3.45), "I am involved in science clubs or groups" (3.27), and "I discuss science with my friends" (3.56) indicate moderate to low levels of engagement in extracurricular science activities. This disengagement outside the formal learning environment points to a potential gap; while classroom participation is robust, students appear less involved in science-related extracurricular events or groups. Factors influencing this trend may include limited access to

opportunities, time constraints, or a lack of awareness regarding available activities. Further, Martin and Yin (2017) found that although students appreciate the value of science education during school hours, their involvement in extracurricular science activities is typically diminished, often resulting from external factors such as availability and parental support.

Students' participation in the scientific process is notably more robust within the structured classroom context, particularly through collaborative and discussion-oriented frameworks. These modalities are essential for fostering scientific inquiry and building student confidence. Nonetheless, the comparatively lower engagement in extracurricular and informal science dialogues indicates a pressing need for educational institutions to enhance and promote opportunities for student involvement in science beyond the confines of the classroom. Encouraging participation in science clubs, community-based science initiatives, and informal peer discourse is crucial for bolstering students' scientific attitudes and intrinsic motivation. Recent studies further affirm the critical nature of active participation and peer interaction in science learning. For instance, Akcay and Yager (2020) illustrated that students who collaborate on science projects and engage in classroom discussions exhibit heightened interest and achievement within the sciences.

Additionally, Thompson et al. (2018) highlighted a positive correlation between participation in science clubs and extracurricular activities with long-term student engagement and career aspirations in STEM fields. However, such participation remains relatively infrequent. These studies underscore the imperative of fostering both in-class and out-of-class science participation to nurture a well-rounded scientific ethos among students.

Table 9. Mean score of students' scientific attitude in terms of value of science.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. Science helps us understand the world better.	4.26	0.91	High Value of Science
2. Science improves our daily lives.	4.15	0.96	High Value of Science
3. Science is important for solving real-world problems.	4.12	1.00	High Value of Science
4. Science is crucial for future technological advancements.	4.10	0.99	High Value of Science
OVERALL MEAN	4.16	0.96	High Value of Science

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Value of Science
4	3.51 – 4.50	Agree	High Value of Science
3	2.51 – 3.50	Undecided	Moderate Value of Science
2	1.51 – 2.50	Disagree	Low Value of Science
1	1.00 – 1.50	Strongly Disagree	Very Low Value of Science

Table 9 reflects the students' attitudes toward the value of science. The overall mean score of 4.16 indicates a "High Value of Science." These findings suggest that high school students have a strong positive disposition toward the intrinsic value of science. Among the specific indicators, students strongly agree with the statement, "Science helps us understand the world better" (4.26), underscoring their acknowledgment of science as an essential framework for interpreting natural phenomena and everyday experiences. This is closely mirrored by their perceptions that "Science improves our daily lives" (4.15), "Science is important for solving real-world problems" (4.12), and "Science is crucial for future technological advancements" (4.10). These responses

reveal that students recognize science for its explanatory capabilities and practical implications in addressing societal challenges and driving innovation.

As noted, profound appreciation for science indicates that students possess a keen awareness of the relevance and impact of scientific knowledge across both personal and broader societal contexts. It highlights an advanced understanding that science transcends mere academic inquiry and represents a vital discipline influencing health, environmental sustainability, technology, and economic progress. Such perceptions are crucial in fostering sustained interest and motivation in scientific learning, as students who grasp the significance of science are more likely to engage deeply and pursue further education or careers in scientific fields.

These findings align with the work of Osborne and Dillon (2017), who posited that students' recognition of the utility and importance of science is strongly correlated with positive attitudes and high levels of engagement in science education. Further, contemporary research reinforces that valuing science is pivotal in shaping students' scientific attitudes. Chen and Lin (2019) identified that students who recognize science as integral to resolving real-world challenges tend to demonstrate elevated motivation and persistence in science courses. Similarly, Garcia et al. (2021) found that students who appreciate the role of science in technological advancement are more inclined toward aspirations in STEM careers. These studies underscore the necessity of educational strategies that highlight science's societal and practical implications to cultivate students' appreciation for the discipline. In conclusion, the data elucidate that high school students value science significantly for its capacity to enhance understanding, improve daily living, and resolve pressing problems.

Table 10. Summary of students' scientific attitude.

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. Enjoyment and Confidence	3.93	0.93	High Scientific Attitude
2. Participation in Science Learning and Activity	3.63	0.97	High Scientific Attitude
3. Value of Science	4.16	0.96	High Scientific Attitude
OVERALL MEAN	3.91	0.95	High Scientific Attitude

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly Agree	Very High Scientific Attitude
4	3.51 – 4.50	Agree	High Scientific Attitude
3	2.51 – 3.50	Undecided	Moderate Scientific Attitude
2	1.51 – 2.50	Disagree	Low Scientific Attitude
1	1.00 – 1.50	Strongly Disagree	Very Low Scientific Attitude

The analysis of students' scientific attitudes presented in Table 10 indicates an overall scientific attitude, with a mean score of 3.91. This reveals that students express notably high levels of enjoyment and confidence in science. This finding underscores their positive emotional connection to scientific concepts and strong self-efficacy when engaging with scientific activities. Such emotional investment is crucial for fostering sustained interest and academic achievement within the discipline. Further, the dimension measuring participation in science learning manifests a commendable mean score of (3.63), suggesting that student is actively involved in a variety of science-related projects, discussions, and extracurricular activities, albeit at a slightly lower intensity compared to their reported enjoyment and confidence levels. The highest mean score is evident in the value of the science dimension (4.16), indicating a strong recognition among students of science's significance

in comprehending the world, enhancing everyday life, addressing real-world challenges, and propelling technological innovations.

This pattern reflects high school students' multifaceted and positive scientific attitude, encompassing affective, behavioral, and cognitive components. The heightened enjoyment and confidence levels denote emotional engagement and an enhanced perception of competency in scientific domains, which can motivate continued exploration and learning. The observed behavioral engagement through active participation is essential for deepening conceptual understanding and applying scientific knowledge.

Furthermore, a strong appreciation of science shows a cognitive recognition of its importance to society, which could foster a lifelong commitment to scientific education and STEM-related jobs. These findings are consistent with recent literature elucidating the complex nature of scientific attitudes. For example, Tuan, Chin, and Shieh (2019) established that positive emotional responses and self-confidence in science are significant predictors of students' engagement and sustained interest in scientific pursuits. Similarly, Wang and Liu (2020) reported that students with a high valuation for science tend to engage more vigorously and excel academically in related subjects. Additionally, research by Kim and Song (2018) corroborates the dynamic interplay between enjoyment, participation, and value as integral to developing robust scientific attitudes that contribute to academic success and intrinsic motivation.

The data reflect a high scientific attitude among students characterized by substantial enjoyment and confidence, active participation, and a deep appreciation for the value of science. These interconnected components collectively form a supportive framework for effective science education, suggesting that educators should prioritize nurturing all three dimensions to sustain and enhance students' scientific engagement and overall academic achievement.

Correlation of Independent and Dependent Variables

Table 11. Relationship between independent variable and scientific attitude.

INDEPENDENT VARIABLES	R-value	PROBABILITY
Learning Style Preferences	.483	<.001**
a) Visual Learning	.663	<.001**
b) Auditory Learning	.720	<.001**
c) Kinesthetic Learning	.691	<.001**
d) Group Learning	.678	<.001**
e) Individual Learning	.652	<.001**

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

The data presented in Table 11 reveal a significant positive correlation between students' learning style preferences and their scientific attitudes, evidenced by an overall R-value of 0.483 ($p < 0.001$), indicating a moderate relationship. This finding suggests that students' preferred modalities for learning substantially influence their attitudes toward science. When dissecting the specific learning styles, each demonstrates strong positive correlations with scientific attitude: auditory learning ($r = 0.720$), kinesthetic learning ($r = 0.691$), group learning ($r = 0.678$), visual learning ($r = 0.663$), and individual learning ($r = 0.652$), all yielding p-values below 0.001, thereby affirming the highly significant nature of these relationships. This indicates that students with pronounced preferences for particular learning styles are likelier to exhibit favorable scientific attitudes, underscoring the critical need to align instructional strategies with these preferences to bolster student engagement and confidence in scientific endeavors.

Notably, the strongest correlations were observed within auditory learning modalities. This suggests that students who thrive in multisensory learning environments—involving hands-on activities and auditory input—tend to foster the most positive attitudes towards science. This observation aligns with educational theories advocating those multisensory experiences enhance cognitive understanding and intrinsic motivation. Kinesthetic and group learning also displayed high correlation coefficients, reinforcing the efficacy of movement-based learning and collaborative contexts in nurturing positive scientific attitudes. Although visual and individual learning styles exhibited slightly lower correlations, they still reflect substantial positive relationships, indicating that students who engage through observation or independent study also experience benefits in their scientific outlook.

These findings highlighting the significant role of learning styles in shaping science-related attitudes and achievements. Alghamdi and Alzahrani (2020) found that congruence between teaching methodologies and students' learning preferences improved engagement and attitudes toward science. Likewise, Rahman et al. (2018) identified a strong association between tactile and kinesthetic learning activities, such as experiments and hands-on projects, and heightened scientific motivation and confidence.

Furthermore, Smith and Jones (2017) emphasized that auditory and group learning strategies enhance communication and collaborative competencies, positively influencing students' perceptions of science education. The data highlights educators' need to recognize and integrate varied learning style preferences in science pedagogy to cultivate affirmative scientific attitudes. Educators can significantly enhance student engagement, motivation, and overall disposition toward science by customizing instructional methods to accommodate auditory, kinesthetic, visual, group, and individual learning preferences.

CONCLUSIONS

Based on the results of the data analysis, the researcher came up with the following conclusion:

The students exhibit "High Learning Style Preferences" for visual, auditory, kinesthetic, group, and individual learning styles, with high mean scores in each domain. Visual learning was notably preferred, with learners demonstrating a marked preference for reading instructions, engaging with visual content, and utilizing visual aids. Auditory and Kinesthetic modalities were also highly rated, suggesting that students benefit from listening, hands-on activities, and physical engagement. Group learning emphasizes the positive effect of collaborative learning, noting that group study fosters conceptual understanding and retention of the learning materials. Individual learning style reveals students' value of autonomy, concentration, and personalized learning pace.

As to the students' scientific attitude measured in terms of enjoyment and confidence, participation in science activities, and valuing science are positively influenced when instructional approaches align with their preferred learning styles. The data suggest that a mismatch between teaching strategies and student learning preferences may impede engagement and the cultivation of a scientific mindset.

A significant correlation exists between independent and dependent variables, thus rejecting the stated null hypothesis. Students' preferred modalities for learning substantially influence their attitudes toward science.

Thus, this study presents the importance of acknowledging individual learning differences in the science classroom. By identifying and accommodating varied learning styles, educators may cultivate a more inclusive, engaging, and successful teaching and learning environment that encourages favorable scientific attitudes and supports academic achievement.

RECOMMENDATIONS

Based on the findings and conclusions drawn from this study, the following recommendations are given:

Since students exhibit high learning style preferences, teachers should design lessons that incorporate a variety of instructional methods (visual aids, auditory materials, kinesthetic activities, collaboration, and independent learning) to address their diverse learning preferences.

The students' learning behavior about attitudes displayed favorably toward the three constructs. Science educators may consider other variables to provide emotional engagement and involvement in science class.

School administrators may organize training and workshops for teachers on differentiated instruction and inclusive teaching strategies. They should also encourage teachers to share best practices and resources that effectively address various learning styles in science education.

The overall findings on learning style preference significantly affect learners' specific attitudes. Further research should incorporate mixed-methods approaches, including qualitative data collection, to provide richer insights into students' experiences and perspectives. Expanding the research to include multiple schools or diverse educational settings, strengthening the findings' generalizability. There is also a need to explore the relationship between learning styles and other factors such as motivation, self-efficacy, and science achievement across different contexts.

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