Student`s Learning and Teaching Styles:
Predictors of Academic Performance in Science

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ABSTRACT

It has been found that senior high school students struggled with their academic performance in science. The goal of this study was to use learning styles and teaching styles as predictor factors to estimate students' academic performance in science in Grades 11 and 12. The study was conducted at the Senior High School Department – STEM Strand, Liceo de Cagayan University, Cagayan de Oro City with a sample size of 214 students, selected through proportionate stratified random sampling. The study utilized descriptive-correlational and causal research design. Likewise, mean, standard deviation, Pearson correlation, and multiple regression were the statistics used to analyze the data. Results of the study revealed that all the learning styles studied namely visual, analytical, auditory, reading/writing, and kinesthetic were all preferred by the students. In terms of teaching styles, authority, demonstrator, facilitator, delegator, and hybrid styles were also preferred by the participants, with a very satisfactory level of academic performance in science. The Pearson product-moment correlation data, however, revealed that the only student learning styles with statistically significant association with academic performance in science are reading/writing and analytical. The best predictor of students' academic performance in science is reading/writing learning style with the highest beta coefficient value of 0.026. In terms of relationship, reading/writing and analytical learning styles have a significant positive relationship with students' academic performance in science, and the best predictor variable of the study is reading/writing learning style.

Keywords: *Liceo senior high school, learning styles, teaching styles, science academic performance, multiple regression*

INTRODUCTION

Since the researcher began teaching science at senior high school, she noticed that a large proportion of students in each class do not achieve exceptional (90-100) academic performance. Approximately 51% of students in General Biology 2 classes earned an "outstanding" (90-100) grade, while 40% earned a "very satisfactory" (85-89) grade, and 9% failed (74-below) grade. 36% of students in a different class received an "outstanding" grade (90-100), 33% received a "very satisfactory" grade (85-89), 26% received a "satisfactory" grade (80-84%), and 5% received a "fairly satisfactory" grade (75-79). In

light of these observations, something must be done to improve students' academic performance in science. Students who are at risk of falling from "very satisfactory" to "satisfactory" or "failure" in science subjects require assistance and intervention. In improving their academic performance in science, an issue must be resolved.

Several Filipino students have been lauded for their outstanding academic accomplishments in competitions such as the Robotics Competition, the Physics Olympiad, and the International Science and Engineering Fair, to name a few. In addition, there are cases of learners from rural institutions in remote areas outperforming the international average on the Third/Trends in International Mathematics and Science Study (TIMSS) or attaining mastery levels above 75% on the National Achievement Test (NAT). Nevertheless, according to Education GPS in 2022, the average science performance of 15-year-olds in the Philippines is 357 points, compared to 482 points in Organization for Economic Cooperation and Development (OECD) countries. OECD Countries is an alliance of 37 countries from Europe, North America, and Asia. Boys' performance in science is one of the lowest among the Program for International Student Assessment (PISA)-participating countries and economies with a 355 PISA score, ranked 76/77 in 2018. Also, girls' performance in science is among the lowest, with a 459 PISA score, ranking to boys and a mean of 357. It indicates that the Philippines ranked second-to-last among PISA-participating countries in science performance.

In the Philippines, there is a problem with the process of instruction and learning in the discipline of science, which may have affected student performance in science. According to Majo's (2016) study, a lack of qualified science instructors and limited access to educational resources are the primary causes of low science performance in secondary institutions in Shinyanga Municipality. The study conducted by King'Aru (2014) found that poor methodology in science education, students' negative attitudes toward science classes, and a shortage of materials, such as books and adequately supplied laboratories, all contribute to poor outcomes in Tanzanian secondary schools' science subjects.

According to the research study of Aydeniz and Kaya (2012), learners cited the absence of motivation, the expense of socializing, and inadequate teaching quality as factors affecting their academic performance in science. Even in the public secondary institutions of Nandi County, Kenya, students' recent performance in the fields of chemistry, biology, and physics has been below average (Cheruiyot et al., 2020). Additionally, numerous nations and regions, such as Europe, China, and the United States, are witnessing a decline in student interest in STEM. The reduction may be attributable to poor self-efficacy in science among learners (Hu et al., 2021). These are alarming concerns that must be investigated by science educators

According to Sean Slade (2021), Whole Child Programs Director at ASCD (Association for Supervision and Curriculum Development), education is not merely a system for delivering content; rather, it is a system designed to ensure that all children reach their maximum potential and become productive members of society. UN Secretary-General Ban Ki-moon launched the Sustainable Development Goals (SDG) initiative in 2012, stating that all children have to go to school and that standards for education must improve so that learners can make a difference in society and influence the future. Due to its significance in the lives of learners and its universal applicability in fostering critical thinking and problem-solving skills, the study of science is regarded to be among the most important subjects in educational institutions.

Students are attracted to science because it involves practically applying classroom-learned theories. Public policy decisions that affect every aspect of our lives are informed by scientific information. Moreover, modern children must receive a scientific education to thrive in a world that is becoming increasingly technologically and scientifically advanced. Considering the aforementioned factors, the researcher conducted a study to evaluate instructional and learning methods as predictors of the learners' performance in science.

Theoretical and Conceptual Framework

Narad and Abdullah (2016) defined academic performance as the knowledge acquired and denoted by teacher-assigned grades. Academic performance in terms of education is the educational objective to be achieved by a learner, instructor, or school over a given period. It is measured by examinations or continuous assessments, and the objective may vary between individuals and institutions. Academic performance reflects the degree of how a learner, instructor, or school has achieved their educational goals. Every educational institution's overall effectiveness is determined by the academic performance of its students.

Don Elger from the University of Idaho developed the Theory of Performance (ToP) in 2007 as a basis for assessing the academic performance of students. The Performance Level is influenced by six (6) factors in a holistic manner: context, skills level, knowledge level, identity level, personal factors, and permanent factors.

This research is also grounded in Bruce's (1992) Social Learning Theory. The teaching-learning process, according to this theory, comprises of systems of communication that affect behavior in reaction to the acquisition of novel knowledge and information. This theory also emphasizes observable behavior, clearly defined tasks, and effective student communication. Behavioral models include initiatives that reduce phobias, practicing how to read and compute, and cultivating social and physical abilities.

This theory highlights the significance of instruction as the foundation for students' acquisition of knowledge and skills. Communication as the focal point of instruction indicates that learning is occurring. In addition, all learners can relate what is taught in class to their own experiences. Learning occurs when students respond actively in the classroom, participate, interact, and are willing to complete all assigned tasks and projects.

The Teaching-Learning process also emphasizes socialization among classroom students. This could be accomplished through grouping, pairing, or any other method that reduces or eliminates phobia while tackling challenging lessons or topics. Students will find it challenging to complete a task on their own; as a result, they will experience anxiety and boredom. In contrast, grouping fosters camaraderie among students and helps them master even the most difficult lessons and comprehend essential concepts.

Bruce's educational theory provided insights into the parameters and dimensions of various learning styles. Non-verbal is a teaching methodology that emphasizes action over words. It also implies that the students will be subjected to a great deal of influence in displaying acts of discipline, such as reinforcing the seating plan, making eye contact, and expressing like touch and a smile.

The visual teaching style describes a teacher who makes extensive use of visual aids in the classroom, including, but not limited to, wall displays, posters, flashcards, graphic organizers, and others. Another teaching style is auditory, in which a teacher employs various techniques to capture the learners' attention, such as audio and video recordings, jazz chants storytelling, memorization, drills, and songs. On a regular basis, learners can collaborate in partnerships and small groups with this approach.

The final style of instruction is kinesthetic, in which a teacher employs physical activities, competitions, board games, role plays, and others. Interspersed throughout the lesson are activities that encourage movement and physical activity. A teacher who asks students to complete a table or label a diagram while reading and listening to a lecture is another example of this style.

In addition, teachers must develop their teaching styles and methods based on their individual physical and mental characteristics. The instructor must feel comfortable in the classroom. Teaching style is a matter of choice; what works for one teacher may not work for another. However, it is essential to recognize that there are various learning styles and that learners might not acquire knowledge effectively when a teacher only employs his or her style. In educating everyone most effectively, matching teaching and learning styles is necessary.

After analyzing all of these learning and teaching styles, the researcher concluded that a teacher is free to use any teaching style as long as students learn effectively from it. Students indeed have a variety of learning styles, but they can be motivated to learn if they perceive that their teacher is genuinely invested in their education.

In light of this realization, the researcher felt compelled to determine which specific learning and teaching styles are shared by both parties so that appropriate remediation can improve students' performance and make learning more satisfying and meaningful.

Figure 1 conceptual diagram depicts the relationship between independent and dependent variables. The researcher wishes to collect information on the students' perceptions of their own learning styles and their teacher's teaching style. Teachers' teaching styles include authority, demonstrator, facilitator, delegator, and hybrid, while students' learning styles include auditory, visual, analytical, kinesthetic/tactile, and reading/writing. The academic performance in the science of the G11 and G12 students is the dependent variable of the study.

The researcher found Bruce's studies to be of great assistance in conducting this research, which concentrates on the learning styles of students and teachers' teaching styles through students' perspectives. In the study, Bruce provided the researcher with much information about how students want their teachers to deliver the lessons. Within the framework, this investigation has been conceived.

The study aimed to predict students' academic performance in Grade 11 and Grade 12 Science by examining their learning styles (visual, analytical, auditory, reading/writing, and kinesthetic) and the teachers' teaching styles as perceived by students (formal authority, demonstrator, facilitator, delegator, and hybrid). It also determined the level of students' academic performance, examined the relationship between academic performance, learning styles, and teaching styles, and identified which variables, individually or in combination, best predict students' performance in science.
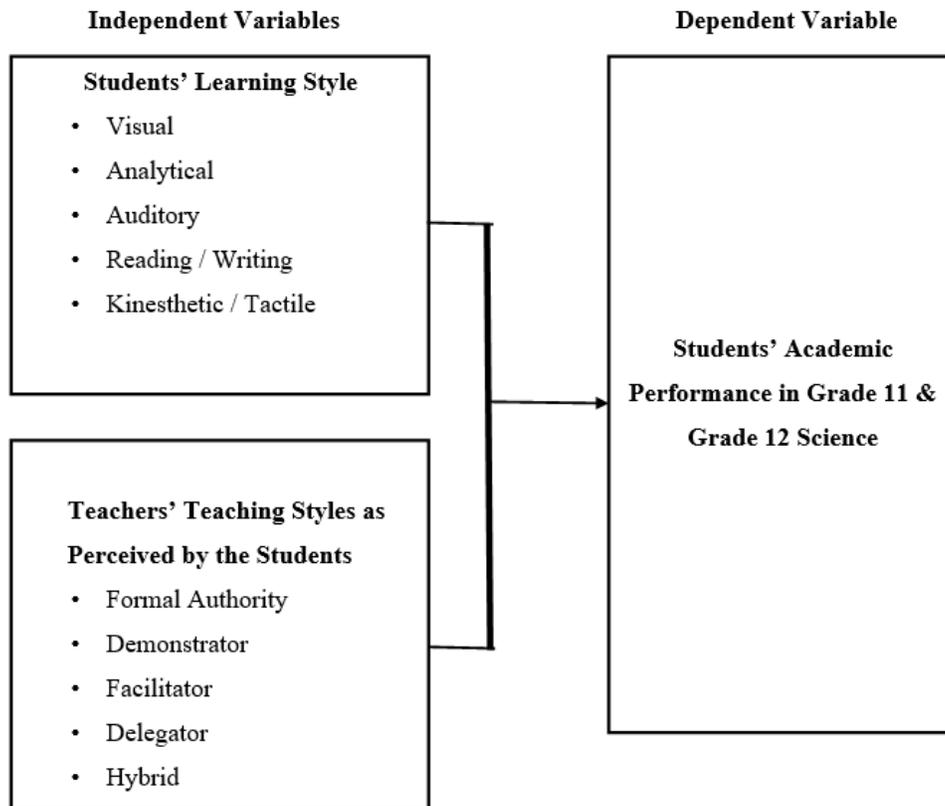
Independent Variables

Dependent Variable

Students' Learning Style

- Visual
- Analytical
- Auditory
- Reading / Writing
- Kinesthetic / Tactile

Students' Academic Performance in Grade 11 & Grade 12 Science

Teachers' Teaching Styles as Perceived by the Students

- Formal Authority
- Demonstrator
- Facilitator
- Delegator
- Hybrid

Figure 1
Conceptual Diagram Showing the Interplay between Independent and Dependent Variables of the Study

LITERATURE REVIEW

The disparity between the style of teaching and learning preference is a problem with adverse outcomes. Although it is impossible to implement all teaching styles, a teacher should learn to employ various styles to accommodate students' diverse learning preferences. Students must comprehend what the teacher is teaching; thus, multiple strategies are required. The majority of learners in this generation prefer to learn and discover things on their own. They desire to act independently. They appreciate liberty following Abu-Asba et al. To improve student learning outcomes and increase their interest in their studies, science teachers should adapt their teaching strategies to various learning styles, according to a 2014 study. The instructors should adapt activities such as role-playing to students' learning styles and employ a balanced instructional strategy. Providing classroom assignments and activities that enable students to utilize their various learning styles is beneficial. This will encourage the majority, if not all, of students to participate in class and become actively engaged in learning. Thus, it is the teacher's responsibility to facilitate, guide, encourage, and support students in the classroom. Consequently, students learn more efficiently and effectively when their preferred learning styles are reflected in the instructional methods.

A teacher must impart knowledge or lessons in a manner that students can comprehend. It is a responsibility that requires him or her to discover effective ways to become a teacher. Effective teachers must not only master the subject matter they want their students to learn but also know how to convey the lesson and deal with any misconceptions students may bring to class that impede their learning. Even though students and teachers have their desired learning and teaching styles, these differences can be resolved when both parties adapt to the subject matter. These modifications are still under the jurisdiction of the instructor. For the sake of the students' comprehension and learning, the teacher may compromise or modify his teaching style, even if he is not familiar with such a style.

Classroom academic performance will improve if teaching and learning styles are complemented appropriately. In addition to the student's preferred learning style, the teacher can employ numerous strategies that foster camaraderie and cooperation among students, such as the cooperative learning strategy.

The pandemic heralds the "new" normal, wherein digitalization mandates working and learning practices. It forces education to become even more technologically advanced, a trend that is already well-established and driven by commercialism and the dominant market ideology (Pacheco, 2020). The COVID-19 pandemic created unprecedented economic, social, and political challenges on a global scale. In addition to a health crisis, it has also caused an educational crisis. 87 percent of the global learner's population was impacted by lockdowns and quarantines. 1.52 billion learners dropped out of school and did not enroll in alternative educational programs (UNESCO et al., 2020).

Teachers can have a profoundly positive effect on their learners, but they can also be a detriment. Numerous individuals asserted that a teacher who made them feel inadequate was the source of their learning-impairing insecurities. The pandemic has rearranged our requirements, which are now predicated on a different hierarchy. Will this short- or mediumterm occurrence lead to returning to "normal" or propel us into an unforeseeable future? Zizek (2020) argues that there is no restoration to normal; the new 'normal' will have to be built on the ruins of our old lives, or we are going to be plunged into an emerging barbarism whose signs are currently manifest. This is the time of year when teacher-student collaboration is required most.

Student`s Learning Style

The teacher-student relationship is complex and dynamic, so it must be handled with care. Therefore, there is a powerful, intuitive allure to the idea that we all have unique preferences and learning styles. The fact that students vary significantly in the speed and manner in which they acquire new information and ideas, as well as their confidence in their ability to comprehend and apply them, provides further support for the notion that we each have unique learning styles (Huddleston and Unwin, 2013).

If teachers and teacher educators are committed to supporting student learning, they must understand what motivates students to engage in learning. In vocational education, students have their preferences regarding the design characteristics of effective learning environments. Teachers must challenge their students and encourage them to take charge of their education by assuming their perspective.

Adaptive learning assistance is required. Surprisingly, neither students nor teachers favor reflective dialogues (Plackle, 2014).

According to Katsioloudis and Fantz (2012), learning styles are individual traits that govern the way learners deal with their educational environment, peers, and teachers. They disclosed four learning style dimensions, such as sensing learners (concrete, practical, oriented towards facts and procedures) vs. intuitive learners (innovative, conceptual, oriented towards theories and meanings); visual learners (prefer visual aids – pictures, diagrams, flow charts) vs. verbal learners (prefer spoken as well as written explanations); active learners (learn by trying things, working with others) vs. reflective learners (learn by thinking thinly about what they have learned). Additionally, teachers who modify their teaching styles to incorporate both extremities of the given learning style dimensions are more likely to facilitate information comprehension and retention.

In Fleming's VARK learning style paradigm, respondents are surveyed regarding their preferable sensory approaches for learning. This paradigm categorizes learners as visual (V), auditory (A), read-and-write (R), or kinesthetic (K) learners (Prithishkumar et al., 2014). During COVID-19, online learning as a teaching and learning method gained popularity. When classes were suspended, universities shifted from in-person to virtual interaction (Dayagbil et al., 2021).

Learning is viewed as a never-ending process that occasionally culminates in a particular outcome. It has been stated that comprehension cannot be attained when impediments delay the learning process. An effective educational plan will resolve these impediments, resulting in learning that is customized to the learner's needs. The disparity will be exacerbated by the ineffective use of approaches, techniques, and tactics with the learners. Recognizing the learner's preferable mode of learning and learning style enables efficient teaching and student learning. Each learner has a distinct approach to learning and set of inclinations. Some people discover their dominant learning styles, whereas others employ a variety of styles depending on the circumstance (Cabual, 2021).

Student-centered instruction is one method that fosters greater stability between instructor and student during the learning process. While instructors retain authority, they increasingly act as facilitators, coach students, and motivate their learning (Lathan, 2021). For this strategy to be successful, instructors must consider their students' preferred learning styles. If students are aware of their learning styles, they will easily adapt to this method.

The visual learning style prefers to access and comprehend new information using images, diagrams, and graphic organizers. Auditory learners assimilate new material via seminar listening, speaking, and group discussions. Students use mnemonic devices and reverberation as study strategies.

Learners of Read and Write are word-based learners. These students may appear to be diligent note-takers or avid readers, and they can convey abstract ideas in writing. For kinesthetic learners, a tactile visualization of data facilitates comprehension. According to Cherry (2019), these students are active learners who learn best by figuring things out for themselves. This framework determines the learning styles of students and allowing these individuals to access information in their preferred manner will increase

their academic confidence. The teacher is now better able to integrate these learning styles into lesson plans and methods of study.

Teaching and learning approaches each play an essential part in the growth and success of learners. Thus, researchers have placed a great deal of emphasis on identifying the learning styles of learners under the "Next Normal" -- the current system of education.

Visual

Visual learners acquire information through reading and observing images. They acquire and retain knowledge visually. Since they can visualize what they are learning in their minds, they learn best when primarily visual methods are used. They enjoy observing the outcomes of their research. Sakinah (2021) study discovered that learners with a visual learning style could generate mathematical problems, despite their inability to apply mathematical concepts or interpret mathematical problems.

According to a quantitative comparative study by Turner (2022), millennial dental hygiene students in Southern California favored a visual learning approach over Generation Z students. Nesbitt's (2021) study on the film's utilization in a secondary leadership class revealed that participants in leadership training recognized that witnessing films visually affected how they thought about and applied what they had learned in their own lives. Participants viewed using films to convey leadership characteristics as providing cognitive benefits. Even students enrolled in the Modified Foreign Language Program (MFLP) and non-MFLP preferred visual over auditory and tactile/kinesthetic stimuli (Corbitt, 2013).

According to Papoulias (2016), millennial students in online business courses strongly favor visual graphics and text for learning content. Moreover, when devising a completion plan and double-checking, children with visual and kinesthetic learning styles exhibit comparable mathematical connection processes (Baiduri et al., 2021).

Analytical

Traditional learners are analytical thinkers. They focus on the facts and particulars before they can grasp the big picture. Setiawan's (2020) study indicated that learning methods did not affect learners' critical thinking and mathematical skills. Students whose preferred learning style is visual, visually combined with kinesthetic, or a combination of auditory and kinesthetic demonstrate the same level of mathematical critical reasoning. In contrast, Halim's (2021) study demonstrates a beneficial and statistically significant connection between learning patterns and learners' learning outcomes in Physics, as determined by data analysis employing the product-moment correlation method. The study's findings also revealed that analytical and holistic learning styles contributed the most to learning outcomes. The findings of Huincahue's (2021) study demonstrate alongside other results, a favorable relationship between analytical thinking style and mathematical aptitude, as well as a link between grades, self-efficacy, and analytical thinking. In light of the greater emphasis placed on analytic mathematical reasoning in assessment procedures, it is argued that students who prefer analytic methods are favored in the classroom.

In the study conducted by Aggarwal (2022), it was discovered that the presence of cognitively flexible individuals facilitates the task and social processes necessary for effective team information processing, specifically by reducing team process conflict and task conflict and enhancing team social integration. Furthermore, social integration acts as a mediator between cognitive style versatility and team performance. Notably, these effects persist even when team cognitive capacity and additional measures of surface- and deep-level team diversity are considered. The findings contribute to the expanding corpus of knowledge regarding team composition and its effects on cooperation and teamwork.

Rami et al. (2022) conducted a study on developing an innovative method based on artificial neural networks that classify students in real-time according to their cognitive learning patterns. By analyzing additional student data, such as cognitive abilities, their research has improved the detection method for learning styles. The cognitive learning style detection paradigm can enhance students' learning experiences in various online educational activities.

Auditory

Auditory or "aural" learners prefer listening to spoken information. These students prefer to read openly to themselves and perform well in groups that encourage vocal participation. Kusuma (2020) concurred with Van Hiele that there is a correlation between a student's learning approach and their geometric aptitude. During the COVID-19 epidemic, the study revealed that students tended to adopt auditory learning styles. In addition, it is well known that students' ability to think geometrically increases as their geometry proficiency increases. The least proficient at formulating mathematical problems, auditory learners frequently employ elementary mathematical concepts (Sakinah, 2021).

Virtual physics experiments affect students with auditory and kinesthetic learning styles but do not affect students with a visual learning style, according to the findings of Hermansyah's (2021) study. In addition, Karlimah (2017) found that learning environments conducive to the auditory learning style of the student adequately support the students' mathematical connection skills. Therefore, understanding mathematical concepts and their relationships should be a significant component of math instruction for children who prefer auditory learning. The pupils with the highest mathematical connection ability learn best visually, followed by those who learn best visually and kinesthetically. Apipah (2018) found that students who learn best auditorily have the lowest mathematical connection ability.

Reading /Writing

Students succeed with worksheets, presentations, and other materials containing substantial amounts of text by focusing on the written word, reading, and writing. These students take notes and perform well when referencing written material. The online environment has altered students' learning preferences, with reading and observing images appearing to be the most acceptable methods (Nizam, 2021). Posselt's (2022) study suggests that when instructors are provided with targeted professional development opportunities, meaning-based reading experiences can assist struggling readers in redefining their deficiencies. Also, regarding reading, the auditory type requires the most development, whereas the

visual type requires the least improvement, according to the post hoc analysis of Tadayonifar's (2021) study. In order to increase reading comprehension and enjoyment, the study recommends providing students with reading strategies that correspond to their perceived learning style. In addition, Nurlaela's (2018) research demonstrated that thematic instruction is more effective than traditional instruction and can accommodate a variety of learning preferences and reading levels. Converging learning styles affected how readers evaluated their reading strategies, with individuals with converging learning styles reporting the highest utilization of methods in both groups (Ozkan Gürses, 2016).

Kinesthetic

Kinesthetic learners are physically active and thrive when utilizing their senses throughout their coursework. Due to the experimental component of the course, these students typically perform well in scientific investigations. Neil D. Fleming's VAK model of learning identifies kinesthetic learning as one of the three primary learning approaches. Kinesthetic learners benefit most from active engagement with their physical environment. Undergraduate health, physical education, and sports science students preferred individual, sequential, and physical kinesthetic learning methods (Colvey, 2014).

In addition, students with a kinesthetic learning style had higher levels of mathematical literacy than those with a visual or auditory learning style (Sakinah, 2021). Teachers use kinesthetic learning strategies (KSL) because they know that psychomotor learning can help students learn by eliciting responses that enhance cognitive and emotional domains and positively impact social development (Mosley, 2022). In addition, Kinesthetic (57.1%) and Auditory (37.2%) learning styles were more common among strong and ineffective nursing students, respectively (Kohan, 2021). The kinesthetic learner ranked highest in every category for the ability to represent visuals, symbols, and words. Prospective science teachers who favor kinesthetic over visual or auditory learning have more vital representational skills (Yunus, 2021).

Teacher`s Teaching Style

Middle school teachers devote the most time to teacher collaboration, professional development programs, and individual learning activities, according to Akiba (2012). Moreover, teachers in high-poverty and ethnically diverse districts tend to devote more time to formal learning activities such as professional development programs, teacher collaboration, and mentoring/coaching than their counterparts in affluent and less diverse districts. To increase teachers' participation in shared learning activities, district and school administrators must provide professional development opportunities that meet teachers' requirements for understanding students' knowledge and reasoning.

According to Lagua (2020), the education sector is among the most afflicted by the coronavirus crisis as a result of the lockdowns caused by the virus. Consequently, the online learning platform became the most effective method for pursuing an education. Educators tend to translate or migrate their face-to-face learning techniques to the online environment, as online learning is now mandated. However, this new system will necessitate a mindset of transformation. What typically works in the classroom may apply to something other than distance education. This poses quite a challenge for the first-time online educator.

Teachers must acclimate to the online format with intelligence and sensitivity. The challenge is to create engaging activities that maintain student interest.

Since we are in the "technology generation," there are pedagogical approaches tailored to the preferences of our students. According to the findings of Thepkom (2013), there was a significant difference in students' value of education taught by multimedia teaching style and traditional teaching style according to grade point average (GPA) in the group of students taught by traditional teaching style, indicating that students with higher GPA were more effective on their performance than those with lower GPA. However, students' value of education taught by multimedia and traditional teaching styles was the same.

High school teachers in the suburbs of the southern United States have access to Edmodo, but many prefer more conventional, teacher-centered approaches. Mukenge (2019) conducted a quantitative correlational study investigating the relationship between teachers' technology acceptance and teaching approaches and experiences. The findings suggested that instructors can adopt a more student-centered approach to instruction by emphasizing the usability of technology rather than its potential benefits. A legislative proposal could ensure educators effectively use technology to facilitate student-centered learning. Implementing the suggested policies could result in instructors utilizing instructional technology more effectively, which could affect the learning and motivation of students.

Students are all unique. There are, in fact, students with special needs who can learn alongside other students in the general population. Regardless of the student's disability, education is an essential instrument and a lifelong process that begins in childhood and continues into adulthood. It is meant to have a significant impact on everyone. Students with disabilities face numerous obstacles, including negative stigma, high suspension/expulsion rates, racial inequities, poor academic performance, and low self-esteem. These difficulties have a negative effect on their overall levels of self-esteem, self-concept, and academic achievement. The issue with teaching in this environment is a lack of contemporary or active teaching methods to enhance and sustain motivation and improve students' self-concept, selfesteem, and overall success. Anderson (2023) examined contemporary and active teaching methods, investigated potential connections between these methods and student achievement and self-esteem, and provided recommendations for adapting these methods for unique education settings. According to the findings of Anderson's research, the academic performance and general self-perception of students may be enhanced by employing more contemporary, evidence-based teaching strategies. Recommendations from the study focus on customizing lesson plans and teaching methods to increase positive teacher-student interactions and to better engage students through more contemporary teaching philosophies.

In order to stimulate Higher Order Thinking Skills (HOTS) in students while teaching science, we occasionally introduce debatable topics. Teachers are predominantly responsible for incorporating argumentation into the classroom and play a crucial role in argumentationbased scientific education. De Sa Ibraim and Justi (2022) investigated how teachers' actions during different types of didactic sequences involving argumentation contribute to science instruction and how these actions relate to teachers' knowledge of argumentation and pedagogical content knowledge (PCK). As potential outcomes, they highlighted the need to enhance a hybrid approach to teaching argumentation that combines implicit and explicit instruction and the presentation of behaviors that contribute to argumentative science education. This can aid research into how instructors integrate into argumentation-based science and teacher education.

As educators, we know there is no single ideal teaching method. According to Mandelbaum (2013), pedagogy always needs more prescription precision for all pupils. Teachers with distinct but well-developed problem-solving styles have distinctively different teaching styles, influencing their preferences for particular teaching practices in response to typical classroom activities and interactions. His study found that teachers' high regard for people, novelty, and autonomy in problem-solving predicts their ability to instruct in an individualized, social manner, predicting their use of caring and supportive teaching behaviors. In addition, the ability of teachers to process information internally when making decisions predicts their aptitude for structured and rational teaching styles, which in turn predicts behaviors demonstrating professional competence and communication skill.

The current body of literature must include more scant and inconclusive studies examining more effective biology instruction methods. The primary objective of Gajic's et. al. (2021) study was to examine the relationship between the use of instructional strategies in biology classes and students' academic success, contingent on the instructor's appreciation of each student's unique learning preferences. The results demonstrated a statistically significant correlation between teaching methods, learning preferences, and the academic achievement of biology students. Students simultaneously demonstrated a variety of learning styles and perceptions of the instructional strategies implemented. This led to the conclusion that students performed better academically in biology classes when they were taught using methods that matched their learning styles, which had implications for inquiry-based instruction and the preparation of prospective biology teachers.

Formal Authority

Teachers in formal authority have status among students due to their expertise and role as educators. In this manner, professors provide both positive and constructive feedback. The professor provides students with learning objectives, expectations, and conduct guidelines, providing a framework for their education. Students concentrate on appropriate and standard procedures.

The formal authority and delegator teaching approaches significantly impacted the enjoyment sub-construct of the attitude (Samad, 2019). In examining the relationship between the teaching styles of English instructors and the learning styles of English prep students at the Turkish State University, Dumus et al. (2020) discovered substantial correlations between the avoidant learning style and the formal authority teaching style. Regarding the relationship between classroom management and dominant teaching style among Iranian EFL teachers, Kazemi et al. (2016) found that most Iranian EFL instructors use the formal authority teaching method and adopt interventionist or controlling classroom management strategies in both the behavior and instructional management aspects. The study examined how certain teacher-related factors, such as teacher assessment style, teacher level of awareness of assessment style, and teacher personal characteristics (qualification, years of experience, and teaching styles), affected students' performance in social studies in elementary schools, only two indicators were found to have a statistically significant impact on students' Social Studies success. Social studies teachers frequently employed formal authority and facilitation teaching methods (Adeyemi, 2017).

Examining the premise that formal authority and skilled teaching methods correlate positively with the number of semesters an international faculty member has taught in South Korea, this study investigates whether foreign faculty assimilate into the Confucian legacy classroom culture. However, the results disproved this theory (Ghazarian et al., 2015).

Demonstrator

While the teacher retains considerable authority in the demonstration method, they are more willing to experiment with a student-centered approach. The demonstration encourages students to generate solutions to problems, pose questions, and apply what they have just learned. The demonstrator frequently demonstrates experiments, visuals, and videos in addition to lectures.

In the study conducted by Basheer (2016) on the effectiveness of teachers using demonstrations to improve their student's understanding of and attitudes toward learning the oxidation-reduction concept in junior high school, it was determined that the experimental group's accomplishments and comprehension of the topic were statistically significantly higher than those of the control group which or the students who did not observe the demonstrations.

Andres (2015) sought to determine whether "fit" and "non-fit" between authoritarian vs. demonstrator instruction and visual vs. verbal learning preferences influence Chinese MBA student academic achievement differently in an urban Chinese university setting. The findings supported the meshing hypothesis, which states that compatibility between teaching and learning approaches is significant. Verbal learning outperformed visual learning, while authoritarian instruction outperformed demonstrator instruction. The demonstration teaching method may be more effective than the traditional authoritarian method at accommodating multiple learning modalities (verbal and visual). In addition, Hasan (2020) investigated the relationships between the personality characteristics of dental students at the Faculty of Dentistry at Kuwait University and the students' preferred teaching styles. Several correlations were discovered between specific subgroups and preferred instructional strategies. Students reported that hybrid and demonstrator techniques were the most useful and desired. Moreover, Ahmad's (2012) study aimed to identify the aspects of English language instructors' teaching methodologies that influence their students' performance. According to the study, teachers delivered subject matter using demonstrator and facilitator teaching techniques. In terms of how satisfied students are with their instructors' Englishteaching methods, the Demonstrator and Facilitator Teaching Styles rank higher than the others. However, according to Farooq et al.'s (2022) study on the effect of teaching styles on students' achievement scores at the university level, most professors employ the facilitator teaching style. The expert was the second most prevalent style, followed by the delegator, formal authority, and demonstrator in descending order of frequency.

Facilitator

The facilitator emphasizes how confidential conversations between teachers and students are. The lecturer guides and directs students through queries, discussion of possibilities, and alternative suggestions. The instructor advises students to establish criteria in order to make prudent decisions. The professor

focuses on the ultimate objective of the classroom: to help students develop the capacity for autonomous action, initiative, and responsibility while providing the most assistance and encouragement possible.

Facilitation is predicated on collaboration between the facilitator and the pupil. Only at the level of activity-based facilitation do the study's findings reveal significant differences between course and seminary instructors. Seminary professor assistants employ the non- directive facilitation style during each academic year more often than course instructors, who opt for the activity-based approach (Tiru, 2013).

Examining the relationship between the teaching styles of English teachers and student engagement in secondary classes, Mazloom et al. (2017) found that the overall expert, facilitator, and delegator teaching styles exhibit positive, significant, and robust relationships with all sub-constructs of engagement. On the other hand, Rosalia (2017) also studied the most influential teaching styles on students' interest in English. She discovered that the facilitator teaching style emphasizes teacher-student contact and significantly impacts students' focus. In addition, the results demonstrate that the instructor tried to modify their teaching methods, including humor.

The influence of teachers' epistemological beliefs on their teaching styles has received less attention than research on teachers' cognition and the role of teachers' beliefs in their practices. According to both quantitative and qualitative evaluations, the facilitator style of instruction is the most prevalent method of education. Therefore, language learners should rely on more than just their teachers as a source of information but instead utilize various resources (Soleimani, 2020).

Rachman (2021) attempted to identify the various teaching methods English teachers employed during the process of teaching English reading to senior high school students at Madrasah Aliyah Pondok Pesantren Darul Arqam Muhammadiyah Gombara Makassar and to determine how these methods influenced the students' interest in reading. According to the findings, teachers primarily use the authority or lecture style and the facilitator or activity form of instruction. The statistics also indicate that the facilitator or activity manner of the teacher may affect the students' interest in reading.

Delegator

The delegator assists students in developing greater independence. This instructor encourages independent or self-directed teamwork when completing assignments. Upon request, he or she is available as a resource person. Understanding the teaching styles of medical faculty can help modify instructional strategies for more effective instruction in light of the current surge of educational reforms. When the preferred teaching methods of faculty from seven medical schools in the United Arab Emirates, the Netherlands, Saudi Arabia, Malaysia, and Pakistan were compared, the preference for a delegator teacher style, which encourages student collaboration and peer-topeer learning, became evident. The majority of educators understand how to pique students' scientific curiosity. (Dash et al., 2020) These findings may enable medical educators to modify their methods of instruction to enhance student learning.

In a study of teachers' teaching styles and student performance, female students identified formal authority, role modeling, delegation, and facilitation as the most frequently employed instructional strategies. Class level influenced the formal authority, role model, delegator, and facilitator teaching

methods. Role models and facilitator teaching styles have moderately positive correlations with the expert teaching style, while the delegator teaching style has a significant positive correlation with the expert teaching style (Tahir et al., 2021). La'biran (2021) discovered that expert is classified as moderate, formal authority as moderate, personal model as moderate, facilitator as moderate, and delegator as high when describing the teaching styles used by Western English language teachers to teach speaking and the perception of students toward these teaching styles.

The study by Mazloom et al. (2020) compared the teaching methodologies employed by male and female English language teachers in Islamabad secondary schools. Most of their professors opted for the expert style, while male teachers used the personal model style and female instructors used the delegator style.

However, a Malaysian university researched to determine the relationship between lecturers' instructional strategies and students' levels of academic engagement. Most lecturers use the personal model, followed by the expert model, and the delegator model has the lowest mean. In addition, there is a moderately solid but substantial correlation between students' academic engagement and the lecturers' teaching style (Shaari, 2014).

Hybrid

The objective of the hybrid (or blended) instructional strategy is to attain a balance between teacher- and student-centered approaches. Often, hybrid-style instructors contribute their expertise and experience to the classroom. While maintaining a structure for each lecture, they can vary their tempo and select the most engaging exercises to maintain student engagement. Developing an effective teaching style for a topic requires time, effort, a willingness to test various teaching methods, and an evaluation of what works in the teaching (Frunz, 2014).

Educators who employ a hybrid method combine several instructional philosophies. According to Sabaroche (2022), the most crucial conclusion emphasized the need to consider operational initiatives and situational approaches. The sub-findings indicated that leaders must utilize real-world expertise, learner-centered practices, joint operations, solutions for learner diversity and interests, influencing variables, and inclusive and flexible policy operations. Roa (2013) discovered that students who were taught collaboratively performed better than those taught solely through lectures. In addition, preferences for learning methodologies had little effect on academic achievement. The study's findings emphasize the importance of group tasks and a variety of teaching methods, which have significant implications for nursing education.

Academic achievement may be affected by the varied learning styles of each student and each teacher. In order to effectively accommodate and adapt to the demands of the classroom and program requirements, teachers must prepare various teaching strategies, and students must develop and employ their learning strategies. (Ridwan et al., 2019) Teaching and learning styles must be aligned or matched.

It is a concern in special education that there needs to be more contemporary or active teaching methods that enhance children's self-concept (such as the ASC), self-esteem, and overall performance. In

enhancing children's overall self-concept and academic achievement, employing more modern, evidence-based teaching strategies may be beneficial. The findings of Anderson's study (2022) have implications for customizing lesson plans and adapting instruction and delivery methods to nurture positive teacher-student interactions and maintain student engagement more effectively.

Academic Performance

Academic performance reflects the extent to which a student, instructor, or institution has achieved its learning objectives. The academic progress of its students determines any educational institution's success or failure.

In the past two years, all socioeconomic sectors have been affected by the circumstances resulting from the COVID-19 epidemic's atypical scenario. The handling of the situation has increased the tension students feel, and education has not been an exception. Ocaña-Moral et al. (2021) observed society. They concluded that stress is essential for understanding how the pandemic affects people's life satisfaction, specifically, university students who are frequently anxious about their academic performance evaluation. First, for education sciences students at the University of Jaén, perceived stress is detrimental and significantly correlated with life satisfaction but not academic achievement. Second, despite the observation that men and women score higher on life satisfaction and perceived stress measures, respectively, there have been no statistically significant differences between the sexes. Similarly, the findings indicate that students, particularly female students, are already experiencing high levels of stress due to the demand that existed before, during, and after the COVID-19 epidemic.

In terms of the scholastic performance of secondary students, particularly in mathematics and science, many countries achieve "below average" results on the PISA. Courtney et al. The most recent four PISA surveys conducted in 2009, 2012, 2015, and 2018 (2022) examined the relationships between students' use of ICT and their performance in mathematics and science. Almost no association was found between pupil ICT use inside or outside of school, regardless of whether it was related to a specific topic or not, and math or science performance. Stronger student attitudes toward, confidence in, the conviction in the value of, and independent use of ICT were associated with higher math and science performance in the four study years

Attendance was a key performance indicator and proxy for participation in traditional school-based learning. Lu and Cutumisu (2022) examined the impact of in-class attendance in secondary schools' increasingly popular technology-enhanced courses. Due to participation in online learning and performance on formative assessments, the results indicate that lecture attendance does not directly affect academic success. The findings facilitate understanding the relationship between in-class and online learning engagement variables in the context of technologically enhanced courses and the effect of in-class attendance on course academic success. The research suggests utilizing a variety of instructional technologies to provide a variety of academic achievement opportunities. Early in 2020, the COVID-19 pandemic compelled schools to shut down and implement emergency remote instruction (ERI). In addition to dealing with all the other pandemicrelated distractions, students had to adapt to this new educational approach quickly. Mostafa et al. aimed to investigate the effects of the switch to ERI on student performance

and identify the primary variables influencing variations in student performance. al. (2022) combines extensive data from students' institutional records at a notable Historically Black College or University (HBCU) with information from a survey of students regarding the impact of COVID-19 on learning during the Spring 2020 semester. The key findings of our analysis are (a) that students' university experience was positively correlated with performance (continuing students who had spent at least one academic year at the university prior to the outbreak had better performance than first-year students and new transfer students), (b) that students' perception of their performance change following the transition was positively correlated with their actual performance (students who perceived a decline in their performance following the transition performed worse), and (c) that students' perception of their performance change following the transition was positively correlated with their actual.

Gibbs and Simpson (2004) asserted that providing students with feedback on their assignments significantly affected their academic performance. In Ahvaz, Iran, Patra, et. et al. (2022) examined how instructors' written and verbal corrective feedback (CF) during formative assessment (FA) affected English as a foreign language (EFL) learners' academic anxiety (AA), academic Performance (AP), and attitude toward learning (ATL). The data analysis revealed that the instructors' written and verbal CF during FA positively affected the experimental language learners' AP. The results demonstrated that the teachers' CF significantly reduced the EG's level of dread. As a result of the teacher's comments, the students' ATL English findings demonstrated a substantial difference between the pre-test and post-test, indicating that the students' ATL improved considerably.

Cooperation among students is necessary for the development of knowledge and abilities. However, the effectiveness of student collaboration is determined by the extent to which these interactions occur in environments that encourage commitment, trust, and decision-making among those involved. Because information and communication technologies increasingly mediate student relationships, the hygienic condition and the transition to emergency remote instruction have exacerbated collaboration challenges. Pulgar et al. used a sample of secondary students from two institutions in rural and urban regions of southern Chile for their study. (2022) to investigate the effects of diverse physics collaboration partnerships. The study found that working together improved students' grades, notably when collaborating with peers (strong ties). The findings contribute to the corpus of knowledge regarding the effectiveness of cooperation in physics education, considering social interactions and the amount of time necessary for students to develop positive collective processes in the classroom.

In the Philippines, problematic smartphone use among adolescents has become a significant concern for parents and educators. Buctot and Sun-Hee (2021) attempted to determine the variables and antecedents of low, average, and high perceived academic achievement (PAP). The following variables were significant predictors of both NMP and SA: gender, parental educational attainment, ICT (information and communication technology) use, duration and frequency of smartphone use, smartphone experience, and academic achievement. A strong parental foundation and access to high-quality educational resources may aid children's academic performance. The findings indicate that family structure is a significant factor in adolescents' perceptions of their academic performance. Additionally, parents' educational backgrounds were related to students' academic performance, and broken families were found to be substantially related to lower academic achievement (PAP). In addition, it has been demonstrated that the size of the family is

associated with poor academic achievement among children and parents from low-income families who struggle to pay school fees.

Dubuc et al. (2020) investigated whether a person's lifestyle choices can predict changes in cognitive control and academic performance in high school students using a longitudinal design. This study suggests that variations in cognitive control and academic performance in high school students over three years can be predicted by lifestyle choices. High school policymakers and teachers may embrace and utilize politics to promote the importance of leading a healthy lifestyle by developing effective intervention programs. This may result in enhanced academic performance.

Elizondo (2014) sought to identify the factors contributing to the high academic achievement of Hispanic English language learners (ELL) in Texas's Rio Grande Valley high school science classes. Participants were high school seniors enrolled in college-level courses, received commendations on their Texas Assessment of Knowledge and Skills science exam, and ranked near the top of their respective classes. Necessary research revealed that innate abilities accounted for most factors influencing academic success. To internalize self-esteem and self-efficacy and accomplish academic success, Hispanic ELL students must engage in meaningful activities. Self-motivated students have a positive outlook on attaining high academic standards and the ability to delay fewer desirable benefits that may come more rapidly. Students aspire to enhance society by assisting others. This promotes their academic success and enhances their sense of self-worth and self-respect.

Support from parents and instructors is crucial for academic achievement. Low socioeconomic status is not the only cause of low academic achievement. Preparing pupils for college is complex and multifaceted, particularly in STEMrelated courses. Kenz (2021) investigated the relationships between academic and extracurricular high school characteristics and retention in STEM fields, college readiness, and success in introductory science and math courses. College readiness indicators include academic achievement in high school science and mathematics courses, high school GPA, SAT or ACT scores, and participation in high school accelerated college credit programs. A secondary objective was to identify the non-academic characteristic at the secondary school level that most accurately predicts students' chances of success and persistence in college freshman STEM significant courses. According to the findings of this study, SAT scores, AP courses, and high school GPA appeared positively correlated with the majority of outcome factors. Among all academic factors, AP courses as an accelerated college credit scheme were the most significant predictor of college biology success. Furthermore, AP courses as an accelerated college credit scheme were significant predictors of cumulative credits earned toward degree completion. High school GPA was a significant predictor of cumulative GPA attained during the 2018 fall and 2019 spring semesters, accounting for a higher cumulative GPA after the first year. In addition, the HS GPA was the most significant predictor of retention among the three factors (AP credits, HS GPA, and gender) that were significant for most of the dependent variables.

Students' performance in secondary school Earth science courses is essential to their long-term scientific literacy and job readiness in geoscience disciplines. In academic environments before college, performance frequently depends on access to high-quality materials and instruction. Schlendorf (2022) used a non-experimental correlational research method to investigate the relationships between teacher and school characteristics and students' engagement and academic achievement in Earth science. According to

the findings, the prevalence of Earth science engagement in the school strongly predicts Earth science achievement. In addition, it acted as a partial mediator between school-level poverty, schoollevel underrepresentation of ethnic minorities in science, and school-level English language proficiency. This indicates that increasing Earth science enrollments may have a long-term effect on geoscience knowledge, performance, and engagement, particularly for underrepresented students. These findings have significance for policymakers who desire to modify precollege Earth science curricula and teacher preparation programs to promote fairness in various educational contexts.

Discovering second-to-last among PISA-participating nations in 2018 is disheartening. According to a report by Mateo (2019) in The Philippine Star, "Education Secretary Leonor Briones claims that student performance in math and science has improved since the implementation of the senior high school program." Former president Rodrigo Duterte added, "The Department of Science and Technology reported a considerable improvement in performance on tests in science and mathematics, and it is due to the senior high school program." These words from the former president inspired the researcher to conduct this study to aid in advancing Filipino students' science academic performance.

Relationship of Academic Performance in Science, Student`s Learning, and Teacher`s Teaching Styles

Science has provided the world with numerous modern conveniences, particularly those that have simplified people's lives. Due to its importance to society and the government, science has been designated a key metric for gauging a nation's growth. The study by Bondoc (2016) on the possible factors that could predict the academic performance of students in Science at UP High School Cebu revealed that science anxiety and teacher effectiveness are the only significant prospective predictors of academic achievement in science. In addition, it is recommended that the teacher utilize strategies and procedures that are suited to the needs of the students in order to enhance student performance in the physics class discussion, laboratory, and achievement test (Center, 2016).

It is difficult for science instructors to use strategic intervention materials (SIM) to improve their students' academic performance. Sinco (2020) investigated the effect of these intervention tools on teaching the three highlighted science subjects that were least learned: the circulatory, nervous, and respiratory systems. The results revealed a significant difference between the pre-test and post-test Performance of the students. Using SIMs was an effective intervention that improved students' post-test performance.

According to Magulod's (2018) study, Filipino university students enrolled in applied science courses prioritized visual, kinesthetic, and social learning preferences over tactile, auditory, and solitary ones. In addition, it was discovered that students have moderate study habits and techniques, as well as time management, concentration, note-taking, reading comprehension, test preparation and test-taking, reading speed, writing ability, and test anxiety management. The preponderance of students achieve high levels of academic success. The findings of this study can assist instructors in designing and implementing effective instructional interventions (teaching styles) to improve academic performance.

Even though the Collaborative learning style was the most prevalent among Turkish physiotherapy students, the Participant learning style was significantly more successful academically. The academic performance of Turkish physiotherapy students may be enhanced by teaching methods that encourage greater student participation. Future research should investigate the relationship between the teaching methods employed by physiotherapy instructors and their students' academic Performance and learning preferences. (Ilcin 2018). Cecilia's (2019) study discovered that students had diverse learning preferences. Each learning method is required to enhance students' academic performance. The audio-visual learning modalities are the most effective combination. Students' academic performance may be enhanced if they know and can utilize their preferred learning styles. No doubt, learning approaches influence student academic performance. It has also been suggested that teachers modify their instructional methods and approaches to permit students to utilize a variety of learning styles. Academic achievement and learning approach are closely related. There was no correlation between academic achievement and comprehensive critical thinking ability, but there was a strong correlation between academic achievement and deductive ability alone (Aziz et al., 2022). In addition, he stated that effective, collaborative, and interactive teaching strategies (teaching approaches) can enhance academic achievement and learning.

There is no significant difference between the relationship between a student's learning style and academic achievement. According to H Awang et al. (2017), students' academic success was highly correlated with their individual learning preferences.

Consequently, each learning approach has its advantages and disadvantages. According to Jahanbakhsh (2012), students who majored in math science exhibit significant correlations between their sensing-intuitive learning methods and academic performance. Students majoring in speculative science demonstrate a strong correlation between active-reflective learning strategies and academic achievement. Academic achievement is strongly related to both the input (visual-verbal) and understanding (sequential-global) dimensions of learning among students of empirical science. Although teachers may not always provide information and learning experiences corresponding to their student's learning preferences, individuals acquire knowledge through various learning methods. Dewi (2019) concluded that incompatible learning and teaching methods may lead to student dissatisfaction and performance issues. Students' academic success is influenced by the methods of instruction used by their instructors. Dewi (2019) concludes that teaching methods significantly impact students' academic performance and learning preferences.

The cited literature and studies helped strengthen this study's main hypotheses. These will serve as a solid foundation for further analysis and interpretation of the study. The evidence and data presented by foreign and local researchers enrich the study's theoretical framework, research design, methodology, and discussion. Studies demonstrate that teaching styles influence students' learning styles, which in turn affects students' academic performance. Facilitation techniques employed by instructors contribute to students' interest in learning. When students become engaged in learning, they experience a tremendous sense of accomplishment beyond the classroom.

METHODS

Research Setting

Liceo de Cagayan University is a non-sectarian university in Cagayan de Oro City, Philippines, comprising twelve colleges and five departments. It is the second-largest university in the city and received its University/Level III status from the Commission on Higher Education in 1998. Dr. Rafaelita Pelaez once served as the university's president. The University holds the highest number of accreditations from PACU-COA in Region X. Initially, the university focused on tertiary-level education, offering courses in law, commerce, engineering, and liberal arts. In 1981, the Basic Education Department was established, providing primary and secondary levels of education. In 1998, the university became the first in the country to offer a graduate program, the Diploma/Master of Local Governance Scholarship Program.

The researcher chose to conduct the study at this university because she is currently a senior high school teacher, teaching Grade 11 and Grade 12 Science. This allowed her full access to the participants during the data collection phase, especially in the STEM Strand. In this way, STEM students had the opportunity to engage in projects that have practical applications that can benefit their future academic and professional endeavors. Conducting research in the STEM Strand allows the researcher to gain a deeper understanding of the subject matter they teach. By exploring the latest advancements, methodologies, and best practices, the researcher can improve their knowledge and pedagogical approaches. This, in turn, can lead to more effective teaching strategies and better student outcomes.

Research Design

This study utilized descriptive-correlational and causal research design. The descriptive-correlational research design was used to determine the relationship between the two variables, dependent and independent variables. On the other hand, according to Reyes (2022), causal design is a type of research that assesses the impact of a specific change on existing norms and assumptions. Causality studies aim to explain a phenomenon through conditional statements like "If X, then Y." In this context, causal effect, from a nomothetic perspective, occurs when changes in an independent variable result in variations in another phenomenon, the dependent variable.

The objective of this study was to investigate whether there is a correlation between teachers' perceived teaching styles by students and students' learning styles and how these factors influence academic performance in science. The teachers' teaching styles were formal authority, demonstrator, facilitator, delegator, and hybrid. In contrast, the student's learning styles were visual, analytical, auditory, reading/writing, and kinesthetic/tactile. The research involved data collection, tabulation, and computation, the analysis and interpretation of the results, and drawing implications from the findings.

Participants and Sampling Procedure

The study consisted of Grade 11 and Grade 12 STEM students for the school year 2022-2023. A total of 460 STEM students were officially enrolled during this academic year. To determine the sample size, the researcher utilized Slovin's Formula. Additionally, proportionate stratified random sampling was employed to select the research participants.

Research Instrument

The research utilized a questionnaire as the instrument, which was developed based on Louis Rubin's Teaching Style Model (2000) and Evelyn Davis et al.'s Learning Style Model (2003). The questionnaire was modified to align with the characteristics and needs of the respondents. Two survey questionnaires were distributed to the students. The first part of the questionnaire focused on the student's learning styles, including visual, analytical, auditory, reading/writing, and kinesthetic/tactile styles. Each sub-variable consisted of eight questions, resulting in forty questions.

The responses were rated on a 5- point Likert scale, where five represented "Strongly Agree," four represented "Agree," three represented "Neutral," two represented "Disagree," and one represented "Strongly Disagree." On the other hand, the second part of the questionnaire aimed to gather information about the students' perceptions of the teaching style, specifically regarding formal authority, demonstrator, facilitator, delegator, and hybrid styles. Each sub-variable consisted of five questions, resulting in twenty-five questions. The responses were also rated on a 5-point Likert scale, following the same scoring system as the first part. The questionnaires were designed to assess the student's learning styles and their perceptions of the teachers' teaching styles using a Likert scale.

Data Gathering Procedure

The study was conducted during the first semester of the Academic School Year 2022-2023. Prior to commencing the research, the researcher obtained approval from both the dean of the School of Teacher Education and the principal of the Senior High School Department at Liceo de Cagayan University, specifically the RNP Campus. Once approval was granted, the researcher obtained clearance from the Research Ethics and Board (REB) of Liceo de Cagayan University. To ensure the survey questionnaire's validity and reliability, pilot testing was conducted among the participants. Considering the ongoing COVID-19 pandemic, the researcher used a Google Form link for data collection. The link was shared with the Science and Mathematics Department Chairperson and the teachers responsible for teaching science subjects.

Validity and Reliability of Instruments

The researcher sought input from three experts who reviewed the questionnaire to ensure content validity. Their suggestions and recommendations were incorporated into the final version of the questionnaires. In addition, the instruments used in the study underwent a pilot test with a sample of fifteen

Grade 11 and fifteen Grade 12 science students. These pilot participants had similar characteristics to the respondents but were not included in the main study.

The purpose of the pilot test was to gather accurate and reliable data and to receive feedback and suggestions for improving the questionnaire. To assess the reliability of the instruments, the researcher employed Cronbach's Alpha reliability coefficient. The results were tabulated and analyzed to determine if all items demonstrated sufficient reliability. A Cronbach's Alpha value of 0.700 or higher was considered acceptable for ensuring reliability.

Ethical Considerations

The researchers ensured that the study adhered to ethical standards in qualitative research by observing several key principles. To protect anonymity, participants' real names were replaced with aliases in all transcripts and reports, allowing them to share experiences freely (Orb, Eisenhaur, & Wynaden, 2001). Informed consent was obtained after explaining the study's purpose and emphasizing voluntary participation, with participants signing forms indicating their willingness to take part (Cohen, Manion, & Morrison, 2018).

The accuracy and credibility of data were ensured through triangulation, comparing interview responses with field notes to strengthen trustworthiness (Patton, 2002). Proper in-text citations and complete references were used throughout to maintain academic integrity (Creswell, 2014). Audio recordings of interviews were conducted only with participants' consent, used solely for transcription and verification, and deleted afterward (Orb et al., 2001).

Additionally, an audit trail was maintained, including consent forms, interview guides, field notes, and transcripts, ensuring transparency and accountability (Lincoln & Guba, 1985). By following these ethical procedures, the researchers upheld respect, honesty, and professionalism, ensuring that participants' rights and well-being were protected throughout the study.

Statistical Techniques

The data collected in this study were subjected to specific statistical treatments. The data were coded, tallied, and tabulated for better presentation and interpretation of results. The statistical methods used are the following: Mean and standard deviation were employed to determine the levels of teaching styles, students' learning styles, and academic performance in science.

Meanwhile, Pearson product-moment correlation coefficient was used to measure the relationship between academic performance, teachers' teaching styles, and students' learning styles. Furthermore, Multiple Regression Analysis was used to determine the single or combination variables best predict academic performance in science.

RESULTS AND DISCUSSION

Table 1. *Level of the students' learning styles in terms of visual*

Indicators	Mean	SD	Description	Interpretation
1. I prefer to see information written on the board and supplemented by visual aids and assigned readings.	.50	.791	Strongly Agree	Highly Preferred
2. I like to write things down or take notes for visual review.	4.31	.924	Agree	Preferred
3. I am skillful with and enjoy developing and making graphs and charts.	3.50	.928	Agree	Preferred
4. I can easily understand and follow directions on a map.	3.88	.861	Agree	Preferred
5. I can understand a news article better by reading about it in the newspaper or online rather than by listening to a report about it on the radio or the internet.	3.78	.893	Agree	Preferred
6. I think the best way to remember something is to picture it in my mind.	3.58	.959	Agree	Preferred
7. I am good at working and solving jigsaw puzzles and mazes.	4.24	.754	Agree	Preferred
Continuation…				
Over-all Mean	3.97	0.87	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 1 illustrates the level of students' learning styles related explicitly to visual learning. The table shows that the highest mean score of 4.50 was obtained for item number 1, which states, "I prefer to see information written on the board and supplemented by visual aids and assigned readings." On the other hand, the lowest mean score of 3.50 was obtained for item number 3, which states, "I am skillful with and enjoy making graphs and charts." The overall mean score of 3.97 indicates a preference for visual learning. This finding aligns with the research by Sahabuddin et al. (2018), which emphasizes the significance of visual learning style and its influence on students' success in studying entrepreneurship. It was also discovered that most (40%) of students in the Nursing Colleges at the Universities of Mosul and Kirkuk were visual learners (Ibrahim, 2016). Similarly, a study by Ariastuti et al. (2022) found that a large portion (49%) of undergraduate students majoring in English Education preferred a visual learning style. Another research by Rogowsky et al. (2020) revealed that individuals with a visual learning style, including fifth

graders and adults, had better comprehension than those with an auditory learning style. Furthermore, Jazuli et al. (2019) found that student groups with a preference for visual learning styles exhibited higher learning outcomes when implementing the Brain-Based Learning strategy than the Project Based Learning group.

Table 2.
Level of the students' learning styles in terms of analytical

Indicators	Mean	SD	Description	Interpretation
1. I approach a topic in a careful, graded, "step-by-step" manner.	3.81	.860	Agree	Preferred
2. I make an in-depth study of an item that reflects a more general problem.	3.92	.753	Agree	Preferred
3. I give focus on contrasts and differences.	4.21	.719	Agree	Preferred
4. I consider facts and give objective judgments.	4.06	.766	Agree	Preferred
5. I examine logical cause/effect relationships.	4.19	.819	Agree	Preferred
6. I try to recall my personal experiences to stimulate my reactions.	3.89	.832	Agree	Preferred
Overall Mean	4.01	0.79	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 2 displays the level of students' learning styles in relation to analytical learning. The table indicates that the highest mean score of 4.21 was obtained for item number 3, which states, "I give focus on contrasts and differences." On the other hand, the lowest mean score of 3.81 was obtained for item number 1, which states, "I approach a topic in a careful, graded, step-by-step manner." The overall mean score of 4.01 suggests a preference for the analytical learning style. The research conducted by Balasubramanian (2018) primarily focused on developing a reinforcement model for an adaptable learning environment based on learners' cognitive skills. The model identifies the learner's Learning Style (LS), maps Learning Objectives (LO) based on Bloom's Taxonomy, and incorporates a reinforcement model that tracks and provides feedback on developing knowledge competency levels. Additionally, Aggarwal's study (2022) found that the presence of cognitively flexible individuals facilitates effective team information processing by reducing conflicts and enhancing team social integration.

The research conducted by Lwande et al. (2021) suggests the possibility of estimating a learner's cognitive characteristics and learning preferences within a learning management system. Furthermore, Halim's study (2021) demonstrated that analytical and holistic learning styles significantly contributed to learning outcomes. However, Setiawan's study (2020) indicated that learning methods had minimal impact on students' mathematical critical thinking abilities.

Table 3.
Level of the students' learning styles in terms of auditory

Indicators	Mean	SD	Description	Interpretation
1. I can remember best by listening to a lecture that includes information, explanations, and discussions.	4.20	.858	Agree	Preferred
2. I require explanations of diagrams, graphs, or visual directions.	4.02	.816	Agree	Preferred
3. I can tell if sounds match when presented with pairs of sounds.	3.82	.993	Agree	Preferred
4. I do best in academic subjects by listening to lectures and tapes.	3.90	1.08	Agree	Preferred
5. I learn to spell better by repeating words out loud than by writing the words on paper.	4.06	.981	Agree	Preferred
6. I would rather listen to a good lecture or speech than read about the same material.	3.63	1.07	Agree	Preferred
7. I prefer listening to the news on the radio or online rather than reading about it in a newspaper or on the *Continuation…* internet.	3.58	.947	Agree	Preferred
Over-all Mean	3.89	0.96	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 3 illustrates the level of students' learning styles concerning the auditory modality. The table shows that students obtained the highest mean score of 4.20 for item number 1, which states, "I can remember best by listening to a lecture that includes information, explanations, and discussions." On the other hand, the lowest mean score of 3.58 was obtained for item number 7, which states, "I prefer listening

to the news on the radio or online rather than reading about it in a newspaper or on the internet." The overall mean score of 3.89 suggests a preference for the auditory learning style.

According to interviews conducted with the students, their abilities, attitudes, and inclinations toward an auditory learning style significantly influence successful learning (Kayalar & Kayalar, 2017). In undergraduate nursing, females showed a greater preference for the auditory learning style (30.3%) compared to males (27.3%), while males favored the kinesthetic learning method (32.3%) slightly more than females (29.8%) (Ibrahim et al., 2016). Additionally, studies have indicated that women are more inclined toward visual and auditory learning modalities (Rahman et al., 2017). Remarkably, high academic achievers were found to have a predominance of auditory learning style (Malacapay, 2019). However, Rogowsky et al. (2020) found no significant correlation between a preference for auditory or visual learning approaches and understanding.

Table 4.
Level of the students' learning styles in terms of reading and writing

Indicators	Mean	SD	Description	Interpretation
1. I re-write my notes after the class.	3.65	1.19	Agree	Preferred
2. I write notes to myself in the margins.	3.63	.991	Agree	Preferred
3. I use colored pens and highlighters to focus in on key ideas.	3.70	1.32	Agree	Preferred
4. I compose short explanations for diagrams, charts, and graphs.	3.74	.984	Agree	Preferred
5. I write out instructions for each step of a procedure.	3.83	.978	Agree	Preferred
6. I compare notes with someone else's.	3.38	1.27	Neutral	Moderately Preferred
7. I print out notes for later review	3.75	1.09	Agree	Preferred
Over-all Mean	3.67	1.11	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 4 displays the level of students' learning styles concerning reading and writing. The table demonstrates that students obtained the highest mean score of 3.75 for item number 7, which states, "I print out notes for later review." Conversely, the lowest mean score of 3.38 was obtained for item number 6,

which states, "I compare notes with someone else's." The overall mean score of 3.67 suggests a preference for the reading and writing learning styles.

The online learning environment has influenced students' learning styles, with reading or viewing images being the most widely accepted learning method (Nizam, 2021). In the field of healthcare sciences, students showed a preference for reading (26%) and visual learning (32%) (Kamal et al., 2021). Shahrki et al. (2016) found that the Read/Write Style was the most popular learning method among medical students. Additionally, the research conducted by Graham et al. (2017) demonstrated that reading interventions can enhance students' writing skills. Moreover, the post hoc analysis in the study by Tadayonifar (2021) revealed that the auditory learners had the most room for improvement in reading skills, while the visual type had the least need for improvement in reading skills.

Table 5.
Level of the students' learning styles in terms of kinesthetic and tactile

Indicators	Mean	SD	Description	Interpretation
1. I prefer to use posters, models, or actual practice and other activities in class.	3.90	.895	Agree	Preferred
2. I enjoy working with my hands or making things.	4.17	.794	Agree	Preferred
3. I can remember best by writing things down several times.	4.15	.851	Agree	Preferred
4. I play with coins or keys in my pocket.	2.58	1.50	Neutral	Moderately Preferred
5. I don't chew gum, smoke, or snack while studying.	3.16	1.15	Neutral	Moderately Preferred
6. I learn the spelling of words by "finger spelling" them.	3.60	1.25	Agree	Preferred
Over-all Mean	3.59	1.07	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 5 illustrates the level of students' learning styles concerning kinesthetic and tactile preferences. The table reveals that students obtained the highest mean score of 4.17 for item number 2, which states, "I enjoy working with my hands or making things." Conversely, the lowest mean score of 2.58 was obtained for item number 4, which states, "I play with coins or keys in my pocket." The overall mean score of 3.59 indicates a preference for kinesthetic and tactile learning styles.

When examining the multiple intelligences of secondary students, it was found that they displayed various learning preferences, but tactile and auditory learners were the most predominant. The highest marks were obtained for the three types of intelligence—naturalistic, visual, and kinesthetic (Sener et al., 2018). Furthermore, in a study conducted among third-semester English Language Education Program students at Universitas Brawijaya, both men and women tended to exhibit a kinesthetic learning style (Tyas

et al., 2017). In the learning styles of undergraduate healthcare professional students, the primary learning preferences identified at the end of the educational course were kinesthetic, tactile, and visual (Koohestani et al., 2020). Additionally, nursing students from Marawi City were found to utilize all four learning styles simultaneously as their primary modes of learning, with a majority expressing a preference for the kinesthetic learning style (Bangcola, 2016). However, according to the study by Jamulia (2018), visual perception was the students' preferred primary perceptual learning style, while kinesthetic, individual, tactile, auditory, and group perception were their preferred minor perceptual learning styles.

Table 6.
Level of the teachers' teaching styles as perceived by the students in terms of formal authority

Indicators	Mean	SD	Description	Interpretation
1. My science teacher prefers to give lessons while standing in front of the class or discussing through virtual classes.	4.23	.916	Agree	Preferred
2. My science teacher often do talking and writes information on the board/virtual board.	3.99	.941	Agree	Preferred
3. My science teacher expects students to listen and take notes during class.	4.54	.617	Strongly Agree	Highly Preferred
4. My science teacher considers students as objects of influence.	4.03	.817	Agree	Preferred
5. My science teacher separates himself/herself both from the educational team and from each student individually.	4.23	.916	Agree	Preferred
Over-all Mean	4.20	0.84	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 6 displays the level of teachers' teaching styles as perceived by students, specifically focusing on demonstrators. The table reveals that students obtained the highest mean score of 4.54 for item number 3, which states, "My science teacher expects students to listen and take notes during class." On the other hand, the lowest mean score of 3.99 was obtained for item number 2, which states, "My science teacher often talks and writes information on the board/virtual board." The overall mean score of 4.20 suggests a preference for teachers with a formal authority teaching style.

Chetty's study (2019) indicates that instructors' instructional methods impact students' academic progress. It was discovered that Iranian EFL instructors primarily utilize the formal authority teaching

method and employ interventionist or controlling classroom management strategies in both behavior and instructional management aspects (Kazemi et al., 2016). Additionally, lecturers performed well in the expert category of instructional methods (Shead, 2018). However, students taught biology using student-centered teaching methods demonstrated better academic performance and higher levels of interest than those taught using teacher-centered (formal authority) teaching methods (Audu, 2018).

A significant positive correlation exists between instructors' emotional intelligence and their instructional approaches across all subscales, including formal authority, expert, personal model, facilitator, and delegator (Oznacar et al., 2017). However, in the case of students studying business courses, it was discovered that the formal authority and delegator teaching approaches significantly impacted the sub-construct of enjoyment in terms of attitude (Samad, 2019).

Table 7.
Level of the teachers' teaching styles as perceived by the students in terms of demonstrator

Indicators	Mean	SD	Description	Interpretation
1. My science teacher prefers to show students what he/she is talking.	4.45	.778	Agree	Preferred
2. My science teacher often use visual aids in presenting a lesson.	4.57	.672	Strongly Agree	Highly Preferred
3. My science teacher usually demonstrates the subject lesson for full student understanding.	4.42	.757	Agree	Preferred
4. My science teacher does not run out of time to have student interaction during class.	1.52	.690	Agree	Preferred
Over-all Mean	3.74	0.72	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 7 illustrates the level of teachers' teaching styles as perceived by students, specifically focusing on demonstrators. The table indicates that students obtained the highest mean score of 4.57 for item number 2, which states, "My science teacher often uses visual aids in presenting lessons." On the other hand, the lowest mean score of 1.52 was obtained for item number 4, which states, "My science teacher does not run out of time to have student interaction during class." The overall mean score of 3.74 suggests a preference for teachers who employ a demonstration teaching style.

Conventional demonstration outperformed the video-assisted training program when comparing posttest skills, even though both methods were equally effective in enhancing students' nursing abilities

(Devi et al., 2019). Medical students preferred skill demonstration regarding knowledge retention, readiness, and ease of completion, but they favored videos regarding convenience, accessibility, efficiency, and review (Pilieci, 2018). Furthermore, irrespective of the Teacher Effect, the demonstration technique significantly improved academic success among engineering students (Giridharan et al., 2017).

Based on the interview results, teachers favored the "Demonstration" and "Question and Answer" strategies because they were straightforward to implement (Unal, 2017). Utilizing the demonstration approach as an alternative teaching strategy in classroom writing assignments is highly recommended, as it consistently enhances students' writing skills (Bagus et al., 2020).

Table 8.
Level of the teachers' teaching styles as perceived by the students in terms of facilitator

Indicators	Mean	SD	Description	Interpretation
1. My science teacher asks students to participate while providing guiding questions.	4.41	.657	Agree	Preferred
2. My science teacher helps students to find answers and information through exploration.	4.15	.733	Agree	Preferred
3. My science teacher encourages students to write a concept map in their notes.	3.53	.942	Agree	Preferred
4. My science teacher motivates students to take notes to use for studying outside of class.	4.27	.801	Agree	Preferred
5. My science teacher facilitates the student learning process by creating a good learning environment.	4.32	.695	Agree	Preferred
Over-all Mean	4.14	0.76	Agree	Preferred

Continuation…

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 8 displays the level of teachers' teaching styles as perceived by students, specifically focusing on facilitators. The table indicates that students obtained the highest mean score of 4.41 for item number 1, which states, "My science teacher asks students to participate while providing guiding questions." Conversely, the lowest mean score of 3.53 was obtained for item number 3, which states, "My

science teacher encourages students to write a concept map in their notes." The overall mean score of 4.14 suggests a preference for teachers with a facilitating teaching style.

In enhancing the learning process, educators need to model an active, student-centered learning environment where students take responsibility for their active engagement and self-directed learning. In contrast, the teacher takes on a facilitator role (Sharoff, 2019). The facilitator's teaching style was a significant predictor variable, while other styles did not impact the model. The facilitation model was more influential than the delegator, expert, authority, and personal models (Dilekli, 2016). Additionally, teacher creativity positively predicted the facilitator and delegator styles while negatively predicting the authority and expert styles (Ghanizadeh et al., 2016).

In order to effectively employ facilitation methods in online teaching, educational institutions need to create an integrative learning environment that fosters a sense of community, social presence, and connectedness, along with resources that facilitate individual and group interactions between faculty and students (Obizoba, 2019). Furthermore, facilitation techniques were found to impact the depth of reflection among student teachers during group dialogic reflection (Foong et al., 2017).

Table 9.
Level of the teachers' teaching styles as perceived by the students in terms of delegators

Indicators	Mean	SD	Description	Interpretation
1. My science teacher encourages student-to-student discussion.	3.67	.864	Agree	Preferred
2. My science teacher often uses group work activities.	3.91	.848	Agree	Preferred
3. My science teacher takes the role as an observer.	4.40	.730	Agree	Preferred
Over-all Mean	3.99	0.81	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 9 displays the level of teachers' teaching styles as perceived by students, specifically focusing on delegators. The table indicates that students obtained the highest mean score of 4.40 for item number 3, which states, "My science teacher takes the role of an observer." Conversely, the lowest mean score of 3.67 was obtained for item number 1, which states, "My science teacher encourages student-to-student discussion." The overall mean score of 3.99 suggests a preference for teachers who adopt a delegator teaching style.

While delegating is considered a modern instructional approach, it has faced criticism for potentially undermining teacher authority. The teacher assumes a less traditional authoritative role as a

delegator and functions more as a consultant (Prabhu, 2018). A study on primary school teacher candidates at Cagayan State University revealed that their instructional approaches, such as personal modeling, facilitation, and delegating, reflected their orientation as subject matter experts and strategists. This study emphasizes equipping prospective primary teachers with the necessary pedagogical knowledge and skills to succeed in their roles (Magulod, 2017). Additionally, inadequate or absent delegation can negatively affect patient safety and care, highlighting the need for educational and organizational support to develop safe and effective delegation skills among newly trained nurses (Magnusson et al., 2017).

When self-efficacy was included in the model, it was found that the delegator teaching style had no effect. However, the facilitator and delegator teaching methods impacted the model (Dilekli, 2016). Furthermore, a study by Kundu (2018) suggests that educators who embrace facilitator and delegator roles are more likely to incorporate technology in the classroom.

Table 10.
Level of the teachers' teaching styles as perceived by the students in terms of Hybrid

Indicators	Mean	SD	Description	Interpretation
1. My science teacher tries to address all the students' learning styles.	4.17	.820	Agree	Preferred
2. My science teacher combines traditional classroom techniques with computer-mediated learning activities.	4.31	.756	Agree	Preferred
3. My science teacher integrates technologies as part of the learning approach.	4.23	.767	Agree	Preferred
4. My science teacher integrates blended learning in the *Continuation…*	4.45	.688	Agree	Preferred
classroom discussion.				
Over-all Mean	4.29	0.758	Agree	Preferred

Legend:	Scale	Range	Description	Interpretation
	5	4.50-5.00	Strongly Agree	Highly Preferred
	4	3.50-4.49	Agree	Preferred
	3	2.50-3.49	Neutral	Moderately Preferred
	2	1.50-2.49	Disagree	Rarely Preferred
	1	1.00-1.49	Strongly Disagree	Not Preferred

Table 10 displays the level of teachers' teaching styles as perceived by students, specifically focusing on hybrid approaches. The table indicates that students obtained the highest mean score of 4.45 for item number 4, which states, "My science teacher integrates blended learning in the classroom discussion." Conversely, the lowest mean score of 4.17 was obtained for item number 1, which states, "My science teacher tries to address all the student's learning styles." The overall mean score of 4.29 suggests a preference for teachers who adopt a hybrid teaching style.

Significant findings indicate that students achieved higher programming success when their teachers demonstrated flexibility in class design, responsiveness to student needs, expertise in technical topics, and a commitment to fostering independent thinking (Strawhacker et al., 2018). Integrating various teaching styles under the guidance of educators who have received specialized training is an effective method for providing positive learning experiences and promoting physical literacy among primary school students (Invernizzi et al., 2019). The study conducted by Shamsuddin et al. (2020) concludes that educators should tailor their coursework to align with students' preferred learning styles, such as assigning more practical tasks for Convergent groups, which are believed to enhance students' achievements.

Moreover, compared to traditional physical education lessons using a direct instruction model, preliminary evidence suggests that teachers utilizing a hybrid teaching approach can encourage student responsibility and independent decision-making, leading to greater enjoyment and perceived competence (Gil-Arias et al., 2020). Even in piano instruction, the results of Zhukov et al.'s (2016) study demonstrate that students who followed a hybrid curriculum significantly improved their sight-reading abilities across all assessed categories, surpassing the gains observed in separate programs.

Table 11.
Level of students' academic performance in G11 and G12 Science

Range	Interpretation	F	Mean	SD	Interpretation
90-100	Outstanding	122			
85-89	Very Satisfactory	38			
80-84	Satisfactory	45			
75-79	Fairly Satisfactory	23			
Below 75	Did not meet Expectations	6			
	Total	214	86.57	6.07	Very Satisfactory

Table 11 displays the academic performance of students in Grade 11 and Grade 12 Science. The table indicates that the mean score of the 214 participants is 86.57, with a standard deviation of 6.07. Based on the mean score, it can be inferred that the students have a highly satisfactory academic performance in Science.

According to a study by Libao et al. (2016), there is a connection between extrinsic motivation and academic success in learning science. Another meta-analysis explores the relationship between student academic performance and emotional quotient (EI). The findings suggest that ability EI is a stronger predictor of achievement in the humanities compared to Science. Additionally, self-rated EI is a better indicator of academic performance than scores on standardized tests (MacCann et al., 2020). An analysis of the research findings highlights how specific norms and values related to performance metrics become embedded in knowledge production practices. This is particularly evident when examining the role of performance metrics in the life sciences and the interaction between institutional and disciplinary cultures in evaluating research within these fields (Muller et al., 2017). The results of a study conducted by Manzano et al. (2016) demonstrate that Audience Response Systems (ARS) positively affect test scores, especially outside of a university setting. However, the effectiveness of ARS interventions for improving academic marks seems to vary depending on the university disciplines. It appears more beneficial in Pure Soft

Sciences or Applied Hard Sciences disciplines. On the other hand, students pursuing science subjects tend to experience higher stress levels than those in other disciplines. This stress can adversely affect their mental, physical, and emotional well-being, ultimately impacting their academic performance (Maajida et al., 2018).

Table 12.
Relationship between the students' academic performance, teachers' teaching styles, and students' learning styles

Variables	N	R	P-Value	Interpretation
Formal Authority	214	.032	.641	Not Significant
Demonstrator	.050	.050	.471	Not Significant
Facilitator	.104	.104	.130	Not Significant
Delegator	.099	.099	.151	Not Significant
Hybrid	.022	.022	.746	Not Significant
Visual	.058	.058	.401	Not Significant
Analytical	.145(*)	.145	.034	Significant
Auditory	.116	.116	.091	Not Significant
Reading & Writing	.166(*)	.166	.015	Significant
Kinesthetic	.095	.095	.166	Not Significant

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

Table 12 displays the correlation between students' academic performance, teachers' teaching styles, and students' learning styles. The table reveals that the variables formal authority, demonstrator, facilitator, Hybrid, visual, auditory, and kinesthetic have probability (p) values greater than the alpha level 0.05, indicating that these variables do not have a statistically significant relationship with students' academic performance in science. On the other hand, analytical and reading & writing learning styles have p-values lower than the alpha level of 0.05, suggesting a positive and significant relationship between these two variables and students' academic performance in science. Therefore, if students utilize analytical and reading & writing learning styles, their academic performance in science will improve.

Research indicates that professors' teaching methods substantially impact students' academic success and classroom satisfaction (Odom, 2019). Students' prior learning skills, abilities, and cultural assumptions may also influence their academic performance (Arredondo, 2018). It is recommended that teachers employ various teaching styles to cater to the diverse learning needs of their students (Buella et al., 2019). The District of General Emilio Aguinaldo has a significant association between instructional planning, teaching styles, and student reading performance (Doria, 2019). Various teaching styles employed by teachers can inspire students to achieve better grades in subjects like English (Samson, 2019). The matching between instructors' teaching styles and students' learning style also significantly impacts student achievement (Karatas et al., 2021). Responsive Teaching Strategies can help narrow the academic performance gap between different groups of students (Primus-Scott, 2019). However, the overall impact of teaching styles on students' numeracy achievement may be insignificant (Nasamu, 2021). Similarly, the study by Parham (2022) found no statistically significant association between learning style and academic achievement among online postsecondary adult learners.

Implementing modern, evidence-based teaching methods can enhance students' academic performance and self-concept. Anderson's study (2023) suggests that customizing lesson plans and teaching methods engage students through contemporary teaching styles and foster positive teacher-student interactions. Teacher competencies, teaching styles, and student participation are strong predictors of academic achievement among business education students in colleges of education (Salami, 2021).

Table 13
Variables singly or in combination best predict students' academic performance in G11 and G12 Science

Variables	Unstandardized Coefficient		Standardized Coefficients			
	B	Std. error	Beta	t	Sig.	Interpretation
(Constant)	81.47	4.453		18.29	.000	
Formal Authority	-.861	.958	-.080	-.899	.370	Not Significant
Demonstrator	.467	1.049	.041	.445	.657	Not Significant
Facilitator	1.20	1.214	.106	.993	.322	Not Significant
Delegator	.521	.898	.054	.580	.562	Not Significant
Hybrid	-1.35	1.015	-.132	-1.33	.182	Not Significant
Visual	-1.47	1.186	-.116	-1.24	.214	Not Significant
Analytical	1.51	.951	.143	1.59	.011	Significant
Auditory	.308	.839	.032	.368	.714	Not Significant
Reading & Writing	1.23	.660	.164	1.87	.026	Significant
Kinesthetic	-.179	.784	-.020	-.228	.820	Not Significant
R=.237 R^2=.056	F=1.20	P=.028				

Table 13 presents the results of multiple regression analysis to determine whether the variable/s singly or in combination best predicts students' academic performance in G12 Science. The R-value of .237 implied a weak relationship between the student's academic performance and the independent variables. Meanwhile, the R^2 value of .056 implied that the independent variables only explained 5.6% of the variability of the student's academic performance in science. In contrast, the probability value of .028 indicates a statistically significant relationship between the dependent and independent variables. On the other hand, formal authority (p-.37>.05), demonstrator (p-.657>.05), facilitator (p-.322>.05), delegator (p-.562>.05), Hybrid (p-.182>.05), visual (p-.214>.05), auditory (p-.714>.05), kinesthetic (p-.820>.05) have probability values of greater than the alpha level of 0.05. This implied that these said variables were not significant predictors, whereas analytical (p-.011<.05) and reading & writing learning styles (p-.026<.05) have probability values lower than the alpha level of 0.05, which implied that these two variables are significant predictors of student's academic performance in Grade 11 & 12 Science. Based on the standardized coefficients beta value, the best predictor is reading & writing style with a beta value of .164, followed by analytical learning style with a beta value of .143. Furthermore, the regression equation is $Y=B_0 + B_1X_1 + B_2X_2$, or $Y=81.47 + 1.51 (X_1) + 1.23 (X_2)$.

Where Y is the students' academic performance in grade 11 and grade12 Science

B_0 is the unstandardized coefficient B constant

B_1 is the Unstandardized Coefficient (B) 1,

B_2 is the Unstandardized Coefficient (B) 2,

X_1 is the analytical learning style, and

X_2 is the writing and reading learning style.

The regression equation indicates that for every one-point increase in students' analytical learning style, their academic performance in science is predicted to increase by 1.51. In contrast, a one-point increase in writing and reading learning style is associated with a predicted increase of 1.23 in academic performance, assuming all other variables remain constant at a score of 81.47.

The relationship between GPA and openness is influenced by synthesis-analysis and elaborative processing, which are reflective learning modes. These findings suggest that students' academic performance can be enhanced by carefully and methodically analyzing materials while exhibiting intellectual curiosity (Koseoglu, 2016). Similarly, Halim et al. (2021) found that analytical and holistic learning styles significantly impacted learning outcomes. Ibarrientos (2021) also discovered a strong correlation between students' learning preferences and their performance in school, specifically in the analytical, physical, and physiological aspects of learning. Additionally, cognitive style and gender significantly influence secondary school students' self-confidence and academic achievement (Hooda et al., 2018). However, Shirazi et al. (2019) found no connection between critical thinking and academic success, suggesting that early success in nursing school is not primarily attributed to critical thinking ability (Leahy, 2021).

According to Shahrakipour et al. (2017), the read/write learning style was the most preferred method among medical students. Many university professors believe that a mismatch between students' and teachers' teaching and learning styles is the underlying cause of students' academic failure. However, both male and female dentistry students at Taibah University in Saudi Arabia showed the least preference for reading and writing learning styles (Hashem, 2022). The mean final test results did not significantly differ between Babol University Dental students who preferred the reading/writing learning style and those who did not (Nasiri et al., 2016). Additionally, the read/write learning style showed an inverse association with education level, suggesting that the tendency to employ this learning style also increased as education level increased (Tonkaboni et al., 2022).

Summary

The previously specified research objectives served as the direction for this investigation. The study's major goal is to predict how well students would perform academically in science classes in Grades 11 and 12. Specifically, it gathered the students' learning styles and the teacher's teaching style as perceived by the students. It also gathered data to know if a significant relationship exists between the students' academic performance and (a) students' learning styles and (b) teachers' teaching styles. This study tried to determine which among the variables is/are predictors of academic performance in science.

This study, done at Liceo de Cagayan University's Senior High School, STEM Strand, with a sample group of 214 students, used Descriptive - Correlational and Causal Research Designs. A 5-point

Likert Scale Perception Survey Questionnaire that has been adopted and tailored to the study's needs was used to collect the data. After being pilot tested, the Cronbach's alpha coefficients for the questionnaires were 0.905 (Part I. Students' Learning Styles) and .880 (Part II. Teachers' Teaching Style as Perceived by the Students), which made them satisfactory and reliable. The researcher used a grading scale with associated descriptions linked to DO no. 8, s. 2015, to assess the academic performance of the students. In order to analyze and understand the data, several statistical methods were used, including descriptive statistics for problems 1, 2, and 3, Pearson correlation coefficient (r) for problem 4, and multiple regression analysis for problem 5.

The findings of the study revealed that visual, analytical, auditory, reading and writing, and kinesthetic were all preferred learning styles of the students, with an overall mean of 3.97, 4.01, 3.89, 3.67, and 3.59, respectively. On the level of the teaching style as perceived by the students, formal authority, demonstrator, facilitator, delegator, and Hybrid were all preferred by the students, with an overall mean of 4.20, 3.74, 4.14, 3.99, and 4.29, respectively. As to the students' academic performance level in G11 and G12 Science, the mean score is 86.57 with a standard deviation of 6.07, which revealed that students have very satisfactory performance.

All the teaching styles (formal authority, demonstrator, facilitator, delegator, and Hybrid), as perceived by the students, revealed that they are insignificant to their relationship with the students' academic performance in science since all their probability values were greater than the alpha level of 0.05. However, among the students' learning styles, only Analytical (p- .034<.05) and Reading and Writing (p- .015<.05) have probability values lower than the alpha level of 0.05, which revealed that there is a significant positive relationship between these two variables and the student's academic performance in science.

Multiple Regression Analysis was used to determine which among the variable/s singly or in combination best predicts students' academic performance in science. The R-value of .237 implied a weak relationship between the students' academic performance and the independent variables. Meanwhile, the R^2 value of .056 implied that the independent variables only explained 5.6% of the variability of the student's academic performance in science. In contrast, the probability value of .028 indicates a statistically significant relationship between the dependent and independent variables. On the other hand, formal authority, demonstrator, facilitator, delegator, Hybrid, visual, auditory, and kinesthetic have probability values greater than the Alpha Level of 0.05. This implied that these said variables were not significant predictors, whereas analytical (p-.011<.05) and reading & writing learning style(p-.026<.05) have probability values lower than the alpha level of 0.05, which implied that these two variables are significant predictors, of students' academic performance in grade 11 and 12 Science. Based on the standardized coefficients beta value, the best predictor is reading & writing style with a beta value of .164, followed by analytical learning style with a beta value of .143. Using the regression equation, it can be interpreted that for every one-point increase in students' analytical learning style, the students' academic performance in science will increase by 1.51. In contrast, with one point increase in writing and reading learning style, the students' academic performance in science will increase by 1.23, assuming all other variables are held constant to a score of 81.47.

CONCLUSIONS

Although the students preferred the different learning styles to achieve very satisfactory academic performance in science, they have specific actions or standards preferred under each learning style. For the visual learning style, students highly prefer when they see information written on the board and supplemented by visual aids and readings. Analytical students get interested in contrasts and differences. Auditory learners can remember best by listening to a lecture with information, explanations, and discussions. Students who love reading and writing fondly print notes for future review purposes. Kinesthetic and tactile learners learn best when their hands make things.

In learning science, students who prefer a formal authority teaching style appreciates a science teacher who expects their students to listen and take down notes in class. Students want their demonstrator teacher to use visual aids in presenting lessons. Students prefer a facilitator teacher to provide questions that trigger their participation. Students sometimes want their science teacher to take the role of an observer so they can, instead, delegate the tasks and learn on their own. Students also prefer a teacher who shifts from one teaching style to another based on the need of the lesson and the learners.

Among all the variables, Analytical, Reading, and Writing Learning Styles have a significant positive relationship with the academic performance of students in science. This implies that if students use analytical, reading, and writing learning styles more frequently, students' academic performance in science is higher. As to the predictability between the two predictors, namely analytical learning style and reading and writing learning styles, the best predictor is reading and writing style. This implies that for every one-point increase in students' analytical learning style, the students' academic performance in science increases to 1.51, while the increase in writing and reading learning style is 1.23.

RECOMMENDATIONS

1. Since the students preferred all the different learning and teaching styles, it is recommended that students practice varied learning styles and teachers use varied teaching styles matching the type of lesson to learn and lesson to teach, respectively.

2. Since this study revealed that Reading and Writing and Analytical Learning Styles have a significant relationship to academic performance in science, it is advisable for students trying to excel more academically in science to use these learning styles. Students struggling in science are also recommended to use these learning styles to improve academic performance.

3. Reading and writing in science are not just tools for interacting with people; they are also learning skills that help students to organize their thoughts, conclude, and explain their thinking. Science teachers should develop in their students the skill of reading because Science is based on theories and laws that can be used as the basis for any additional knowledge. Writing is also critical because Science is full of proven facts that students must note. Since Science is observing and recording, the skill of writing is essential for students to learn and perform best academically.

4. Students may engage in a metacognitive activity (Analytical) when they write because they have to choose the right words to convey what they are thinking while also reflecting and clarifying.

5. Students may develop their reading and writing, and analytical learning styles because these are predictors of academic performance in science. Thus, the more they master reading, writing, and analytical learning styles, the more their academic performance in science improves.

6. Science teachers may recommend reading, writing, and analytical learning styles to their students to achieve outstanding academic performance in science.

7. The school principal may conduct a series of seminars and workshops on learning styles and teaching styles appropriate for teaching and learning in the new normal setting.

8. Future researchers may conduct a similar study exploring other learning styles and teaching styles not covered in the study to another group of participants.

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