INSTRUCTION BASED ON THE VARK LEARNING STYLES OF PRIMARY STUDENTS IN SCIENCE

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Abstract. VARK is a learning style model developed by Neil Fleming in the 1980s. VARK represents the four main learning styles: Visual, Aural, Read/Write, and Kinesthetic. The VARK model provides a deep understanding of different learning preferences, consequently supporting both learners and educators within the teaching-learning process. This contributes to the goal of developing student competencies in the Science subject, as per the 2018 general education curriculum. This research is based on the theoretical analysis of learning styles, and the science curriculum, to propose a science teaching and learning process that addresses the various learning styles of elementary school students, with specific illustrative examples. At the same time, the research conducts pedagogical experiments to initially evaluate the effectiveness and feasibility of the proposed process. The flexible integration of VARK-based learning activities will create a diverse, engaging, and stimulating learning environment in the teaching and learning of the Science subject, which will encourage active student participation and contribute to the enhancement of scientific competencies for primary school students.

Keywords: learning style, VARK, Science, Primary school.

1. Introduction

Since 1987, intending to improve teaching strategies for instructors and help students learn more effectively, Fleming developed the VARK (The VARK Inventory) to explore students' learning preferences [1]. VARK is an acronym for the keywords Visual, Aural, Read/Write, and Kinesthetic. Each keyword corresponds to a respective learning style - the visual, auditory, reading/writing, and tactile/kinesthetic learning styles. In addition to these four distinct learning styles, Fleming also suggested that due to the diverse nature of life experiences, more than 40% to 55-60% of learners possess multiple learning preferences [1, 2]. An individual's preference for one of the learning styles does not mean the other three styles are non-existent for that person.

The VARK model plays a crucial role in the teaching and learning process [1]. VARK helps identify the primary learning styles (Visual, Aural, Read/Write, Kinesthetic) of each learner [3]. Understanding the learning styles of students is an important foundation for teachers to design appropriate learning activities and teaching methods [4]. Based on the VARK model, teachers can apply diverse teaching strategies and methods to cater to the needs of different learning styles. For example: Using images and videos (Visual), providing oral explanations (Aural), having students read materials and take notes (Read/Write), and organizing hands-on activities (Kinesthetic) [4]. The recognition and application of the VARK model in teaching and learning

are essential for creating an effective and engaging learning environment that supports the diverse needs of students. By tailoring instructional approaches to match students' preferred learning styles, teachers can enhance learning outcomes and foster active student engagement.

The education program must provide opportunities for students to choose learning according to their needs and must promote diversity in the curriculum, textbooks, and teaching organization. The goal of the Science subject in the 2018 general education curriculum is to develop the competencies and qualities of primary students, particularly their natural scientific competencies [5]. Teaching science subjects according to the VARK learning style plays an important role in improving the learning effectiveness of students. This method helps identify the best learning style of each student, and then design activities appropriate for each sensory channel. Learning activities designed based on the VARK learning styles of each student not only increase the effectiveness of students' knowledge acquisition, but also personalize the teaching and learning process, contributing to the development of diverse skills such as observation, listening, reading-writing, and practice. Furthermore, VARK learning activities often require active student participation, exchange, and group discussion, thereby enhancing interaction and communication, while also promoting student motivation to learn. Research by Liew et al. (2015) has shown that applying VARK-based teaching and learning can improve learning outcomes [6]. Instruction based on students' VARK learning styles contributes to the development of natural science competencies and general competencies for students in the Science subject. Specifically: 1/Development of natural science competencies: Read/Write activities help students develop a deeper understanding of scientific concepts, principles, and phenomena, thereby enhancing their awareness of natural science; Visual and Auditory activities encourage students to actively explore and discover their surrounding environment, promoting increased exploration of the natural environment; Kinesthetic activities create opportunities for students to apply the scientific knowledge and skills they have learned to real-life situations. Additionally, these activities help students become more proactive, engaged, and self-regulating in their learning, contributing to the development of their autonomy and self-learning competencies; 2/ Development of general competencies: Group activities and discussions stimulate students' communication, sharing, and collaboration abilities, contributing to the development of communication and cooperation competencies; Challenging situations and open-ended activities provide opportunities for students to exercise their creative thinking and problem-solving skills, contributing to the development of problem-solving and creativity competencies.

Thus teaching Science based on students' VARK learning styles plays an important role in enhancing the quality of teaching and learning, helping students develop comprehensively. Therefore, within the framework of this paper, the research focuses on proposing a teaching process based on the learning styles of primary school students in teaching Science, intending to contribute to the development of competencies, particularly natural science competencies.

2. Content

2.1. VARK learning style model

In the 1950s of the 20th century, learning styles were researched by Thelen, and since then, hundreds of different models of learning styles have been applied in teaching. Most researchers recognize that learning strategies are relatively stable outstanding characteristics of individual learners in the process of receiving, processing, storing, searching, and analyzing information in the learning environment [7]. One of the well-known and widely used models in many countries around the world is Neil Fleming's learning styles model [8]. According to Fleming (1992), computer learning methods are divided into 4 main types: VARK (V - Visual, A - Aural/Auditory, R - Read/Write, K - Kinesthetic) (Table 1). To identify learning styles, Fleming (1995) built a

tool to determine learners' outstanding learning styles [9]. VARK question set version 7.1 is published on Fleming's official website (http://vark-learn.com)

Table 1. Preferred learning activities according to VARK learning style
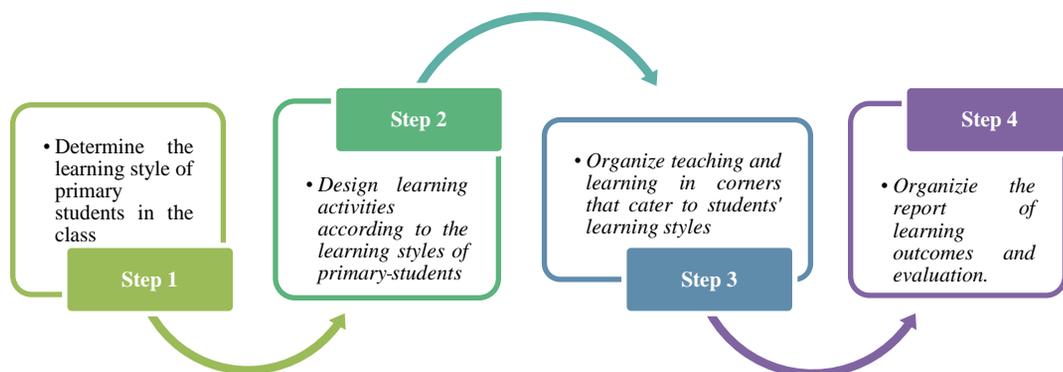
Learning style	Preferred learning activities
Visual	People with a strong visual learning preference learn best when learning activities are presented in visual formats such as Pictures, images, graphs, charts, diagrams, maps, plans, and slide presentations
Aural/ Auditory	Students with a strong aural/auditory learning preference tend to learn best by Listening and talking before reading or writing; They often grasp information well from lectures and presentations and can remember verbal details well. Preferred activities for aural/auditory learners include Presentations, Audio recordings, Discussions, Group discussions, Web-based discussions, Talking things through with others, and Talking aloud to themselves.
Read and Write	Students learn best by reading and taking notes on information. Learners with this preference enjoy instructional materials presented in written text, documents, etc.
Kinesthetic	Students with a kinesthetic learning style learn best through movement, touch, active exploration, science projects, experiments, demonstrations, and simulations. Hands-on experience and practice are important for these learners.

In the practical application of this model for investigating the learning styles of primary students, the results show that not all students have the same dominant learning styles. Each student may have a distinct dominant learning style. Therefore, teachers need to be flexible in using the results of the learning style assessment, so as not to obstruct students' learning. At the same time, teachers should not assume that students will only be suitable for the learning styles that have been studied. Jenifer Fox and Whitney Hofman have emphasized that "not every lesson needs to cater to all learning styles at all times". This means that teachers need to develop an awareness of learning styles and plan using different methods, without expecting learners to precisely fit any particular method [10].

2.2. Instruction process based on the VARK learning styles of primary students in science

The Science subject in primary school helps students develop a love for people and nature, scientific imagination, an interest in exploring the natural world, an awareness of self-health protection, family, and community, a sense of responsibility for saving and protecting natural resources, and a sense of responsibility towards the living environment. The subject helps students develop their autonomy and self-learning competencies, communication and collaboration competencies, and problem-solving and creativity competencies. Especially, the subject helps students develop natural science competencies, providing them with an initial understanding of the natural world, competencies for exploring the surrounding natural environment, and the competencies to apply knowledge to explain natural phenomena and relationships, solve simple problems in life, and behave appropriately to protect their health, that of others, and to protect natural resources and the surrounding environment.

Based on the research of NH Chuyen (2014) [11] and PV Quynh & NV Hien (2018) [12] on the theory and practice of teaching based on student's learning styles, we propose the following instructional process for teaching aligned with students' learning styles:

• Determine the learning style of primary students in the class **Step 1**	**Step 2** • Design learning activities according to the learning styles of primary-students	• Organize teaching and learning in corners that cater to students' learning styles **Step 3**	**Step 4** • Organizie the report of learning outcomes and evaluation.

- Step 1: Determine the learning style of primary students in the class

Based on the questionnaire to investigate VARK's anti-inflammatory drugs according to the link: https://vark-learn.com/wp-content/uploads/2022/04/The_VARK_Questionnaire_Vietnamese.pdf.

Then, determine the learning style of primary students in the class.

- Step 2: Design learning activities according to the learning styles of primary students

When designing learning activities according to learning styles, primary students are divided into 4 groups corresponding to different learning styles: V, A, R/W, and K. Based on Fleming's research on the preferred learning activities of each learning style type [1], teachers design learning activities with specific tasks and teaching aids that are appropriate for the learning style strengths of the learners, as shown in Table 1. At the same time, teachers need to based on the required learning objectives design learning activities that not only meet the learning styles of students but also achieve the goals of developing general competencies and natural science competencies in teaching science in primary schools.

To teach according to the learning styles of students, teachers can use teaching in learning corners combined with other methods such as observation, cooperative learning, problem-solving, etc.: Then, the teacher identifies and designs learning tasks and activities for each corner that is appropriate for the specific learning styles of the students: 1/ Visual Corner: Suitable for Visual learning style. Teachers can use images, diagrams, charts, and videos to illustrate scientific concepts, laws, and processes. 2/ Auditory Corner: Suitable for Auditory learning style. Teachers can organize group discussions, and oral presentations to give students opportunities to listen and exchange ideas. 3/ Read/Write Corner: Suitable for Read/Write learning style. Teachers can ask students to read materials, take notes, write reports, and summarize content. 4/ Kinesthetic Corner: Suitable for Kinesthetic learning style. Teachers can design practical activities, simulations, and model-building so that students can directly participate and experience.

Flexibly combining learning activities based on VARK helps create a diverse, attractive, and engaging learning environment that encourages active student participation in the learning process.

- Step 3: Organize teaching and learning in corners that cater to students' learning styles

To organize teaching and learning in corners that are suitable for students' learning styles, the teacher first needs to prepare and arrange the classroom space to accommodate the different learning styles of students.

+ Introduction to the lesson, learning corners, and tasks in the corners: The teacher poses the problem, introduces the lesson to stimulate students' interest, curiosity, and exploration, and states the learning objectives that students need to achieve after the lesson. Then, the teacher introduces the corners, the tasks in each corner, the time allotted, and the expected outcomes. It is important

to note that the teacher needs to guide students in choosing the starting corner (and may need to adjust if too many students choose the same corner).
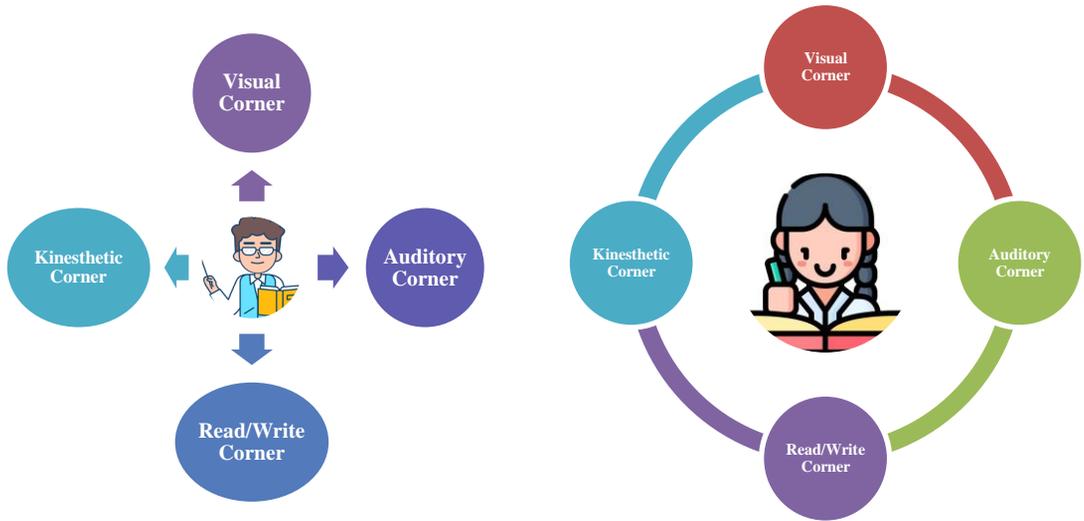

Figure 1. Peer learning corners

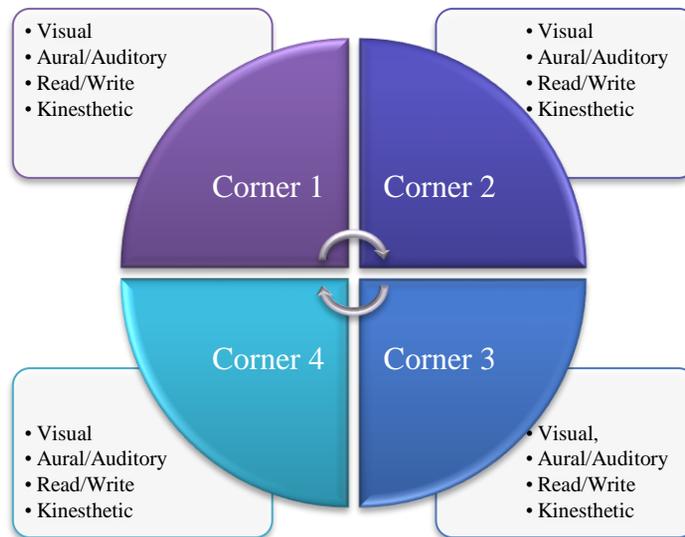*Figure 2. Continuing learning corners*

Figure 3. Combined learning corner

+ Organizing students' learning in the corners: The teacher guides students to work individually or in groups in each corner to complete the assigned tasks. If the learning corners are parallel, meaning the learning activities are designed to achieve the same learning objectives and content, the teacher will organize students to implement according to the diagram in Figure 1, where students will choose the learning corners that suit their learning styles. If the learning corners are sequential in Figure 2, meaning the learning activities are designed with different learning objectives and content, the teacher will have students rotate through the learning corners, allowing them to choose the corner they prefer to start with. This ensures that students can experience a variety of learning styles. The teacher organizes the learning process by combining the consecutive learning corner and the peer learning corner, which is the combination of Figure 1 and Figure 2. By combining these two diagrams, there are 4 learning corners, each of which is designed with learning activities suitable for different learning styles. The content and objectives

in the 4 corners are different, as shown in Figure 3. In this case, students will move through the learning corners in sequence until the end of the lesson, and at each corner, students will choose their preferred learning tasks according to their individual learning styles. Thus, in organizing the teaching and learning process according to student learning styles, the teacher can choose to organize it according to Figure 1, and Figure 2, or combine the two according to Figure 3, depending on the learning objectives and content.

The teacher needs to observe the class, monitor, and identify students' difficulties to provide timely guidance and support. The teacher can group students based on the learning content and learning styles, guide students to rotate through the corners in a circular pattern, or allow students to freely choose and exchange corners between groups, as appropriate, to ensure the effectiveness of learning.

- Step 4: Organize the report of learning outcomes and evaluation.

The teacher organizes each group of students to report the results at the corner, while the remaining groups listen, provide feedback, and make additions, based on the evaluation rubric to assess. The teacher uses an evaluation toolkit to check the knowledge and skills that students have achieved after the lesson, summarize the knowledge, and provide opportunities for students to apply it. Afterward, the teacher guides students on how to store the results and products they have collected and achieved

2.3. Example illustration

Teaching based on students' learning styles in activity-based teaching: Exploring the main parts and sound production of some musical instruments - Lesson 11. Sound in everyday life (*Science Textbook Grade 4* - Canh Dieu series - Page 41)

- Step 1: Determine the learning style of primary students in the class

According to the survey results of 48 students in class 4H at Nguyen Trai primary school, Thanh Xuan District, Hanoi, based on Neil Fleming's model, there are 4 types of learning styles: (18.75%) 9 students have a visual (V) learning style; (33.33%) 16 students have an auditory (A) learning style; (27.08%) 13 students have a read/write (R/W) learning style; (20.84%) 10 students have a kinesthetic (K) learning style. The survey results show that the 4th-grade primary students surveyed have diverse learning styles, with the number of students with an A-type learning style being higher than the other learning styles.

- Step 2: Design learning activities according to the learning styles of primary students

Requirements to be achieved: 1/Natural Science Competency: (i) Understanding of Natural Science: Identify the names of some musical instruments and their main components; (ii) Exploring the Natural Environment: Compare how different musical instruments produce sound (String instruments create vibrations in the strings to produce sound; Percussion instruments create vibrations in the struck surface to produce sound; Wind instruments create vibrations in the air inside the instrument to produce sound); (iii) Applying Acquired Knowledge and Skills: Apply the principles of sound production in musical instruments to make simple musical instruments using readily available materials; 2/General Competency: Problem solving and Creativity: Construct a musical instrument from glass bottles and water to create different sounds; 3/Learner Qualities: Diligence in completing academic tasks.

Visual Corner		Read/Write Corner
- Learning materials: images of some musical instruments ((Source: Science Textbook Grade 4 - Connecting Knowledge with Life)		*- Learning materials*: Reading handout about musical instruments + The drum is an important instrument in the percussion section and it determines a lot about the rhythm, making the music more lively as well as keeping the beat.

Name of musical instrument	Main divisions	How to make sound

+ Compare the main parts and how they produce sound for those musical instruments.

+ Construct a musical instrument as shown in the image below (Source: Science Textbook Grade 4 - Connecting Knowledge with Life), and comment on the sounds produced when we tap on the bottles or gently blow into the mouth of the bottles.
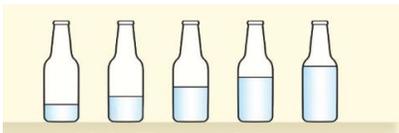
Auditory Corner

- *Learning materials:* Computer, video introducing some musical instruments and how they produce sound

- *Task***:** Watch the video using the following link

+ https://www.youtube.com/watch?v=YZeip8stA58

+ https://www.youtube.com/watch?v=pEdPPNN-zoE

+ After watching the video, please complete the information table about the main parts and how they produce sound for those musical instruments.

Name of musical instrument	Main divisions	How to make sound

+ Compare the main parts and how they produce sound for those musical instruments.

+ Construct musical instruments using water glasses or glass bottles according to the instructions in the video. Then, comment on the sound produced when we tap on the bottles or gently blow into the mouth of the bottles.

Kinesthetic Corner

- *Learning materials:* Some musical instruments such as drums, guitars, flute

- *Task:* + Please use the musical instruments (drums, guitar, flute) and make them produce sound. Which parts of each of these instruments produce sound?

+ Compare the main parts and how they produce sound for those musical instruments.

+ Using the prepared materials, construct musical instruments from water glasses or glass bottles. Then, comment on the sound produced when we tap on the bottles or gently blow into the mouth of the bottles.

Many musical pieces only need the drums to create the melody. Drums are usually large and round, proportional, and are divided into three main parts: the drum head, the drum shell, and the drum base.

+ The bamboo flute is a traditional musical instrument made of bamboo or reed tubes, with holes drilled into the body to produce sound and notes when blown. The type of flute commonly learned is the transverse flute, which is differentiated from the end-blown flute. The bamboo flute belongs to the wind instrument category.

+ Guitar: It is a type of musical instrument with frets and strings, with wide applications in various musical genres, able to accompany singing, ensemble playing, or solo performance. The guitar is a stringed instrument that, traditionally, is made of wood and uses animal gut, nylon, or steel strings and is distinguished from other stringed instruments by its construction and tuning.

- *Task:* Read the information about the introduction of the musical instruments above or find more information in books and newspapers.

+ Complete the information about the main parts and how they produce sound for those musical instruments.

Name of musical instrument	Main divisions	How to make sound

+ Compare the main parts and how they produce sound for those musical instruments.

+ Read the instructions on how to make musical instruments as follows: Prepare glass bottles with caps (e.g., mineral water bottles). Then, put different amounts of water into the bottles. After that, tap on the bottles or gently blow into the mouth of the bottles.

What observations can you make about the sounds produced?

- Step 3: Organize teaching and learning in corners that cater to students' learning styles

The teacher introduces the students to four learning corners and the tasks at each learning corner. Subsequently, the teacher actively divides the students into four groups according to the learning styles investigated in the first step (group 1 - Visual corner, group 2 - Auditory corner, group 3 - Read/Write corner, Group 4 - Kinesthetic corner). Since there are quite a few students with learning styles of type A and type R, group 2 and group 3 may be divided into 2 smaller groups (2A1 and 2A2; 3R1 and 3R2) to facilitate the students' participation in learning at the corners. At the same time, the teacher needs to prepare the space and learning resources to ensure sufficient quantity for the corners with a large number of students, such as the Auditory Corner and the Read/Write Corner. Alternatively, students can be allowed to choose their preferred learning corner, but in this case, the teacher must anticipate the possibility of one corner becoming overcrowded and thus must prepare sufficient space and teaching resources to ensure the students' optimal learning experience while completing the learning tasks. Subsequently, the teacher organizes the students to carry out learning activities according to the diagram in Figure 1, where the four groups corresponding to the VARK learning styles will each choose a learning corner to complete the tasks at that corner. In teaching, the teacher needs to monitor the class, observe, and identify the students' difficulties to provide timely guidance and support. At the same time, the teacher should announce the schedule for students to complete the tasks, and the learning worksheets, and prepare to report the results.

- Step 4: Organize the report of learning outcomes and evaluation.

The teacher organizes for students to report their results, and the class listens, provides feedback, and makes additional contributions to evaluate the outcomes. The teacher uses an assessment toolkit to check the knowledge and skills that students have acquired after the activity, summarizes the key knowledge, and creates opportunities for students to apply it in their lives. The teacher organizes a guessing game where students have to identify the musical instruments and how they produce sound. The teacher lets the students listen to the sounds made by various musical instruments one by one.

* Pedagogical experimentation

The research also experimented with the actual teaching-learning process at Nguyen Trai Primary School, Thanh Xuan District, Hanoi. The subjects of the experiment were two classes: Class 4A as the experimental class with 50 students, and Class 4H as the control class with 48 students. The students in the two classes had equivalent academic levels based on their performance in the first semester (2023-2024). The pedagogical experiment was carried out over 10 weeks (from 02/01/2024 to 24/03/2024).

Table 2. Criteria for achieving natural science competence (in learning activities about the main parts and sound production of some musical instruments)

Level	Criteria for achieving natural science competence (in learning activities about the main parts and sound production of some musical instruments)
Level 1 (not yet completed): < 5 points	Understanding of Natural Science: Unable to name at least 3 musical instruments correctly and unable to accurately identify their main components.
Level 2 (completed): from 5 points to 6 points	Understanding of Natural Science: Able to name at least 3 musical instruments and correctly identify their main components.
Level 3 (Well Completed) from 7 points to 8 points	Exploring the Natural Environment: Compare how different musical instruments produce sound (String instruments create vibrations in the strings to produce sound; Percussion instruments create vibrations in the struck surface to produce sound; Wind instruments create vibrations in the air inside the instrument to produce sound

Level 4 (Excellently Completed): from 9 points to 10 points	Applying Acquired Knowledge and Skills: Applying the principles of sound production in musical instruments to make a simple musical instrument using easily available materials; problem-solving and creativity competence: Making musical instruments from glass bottles and water to create different sounds

To assess the level of student competence, an evaluation form with a 10-point scale and 4 proficiency levels was utilized: Level 1 (Not Completed): Score < 5; Level 2 (Completed): Score ranging from 5 to 6; Level 3 (Well Completed): Score ranging from 7 to 8; Level 4 (Excellently Completed): Score ranging from 9 to 10. The details of this assessment framework are presented in Table 2. Before and after the experiment, a test was administered to evaluate the students in both the experimental and control classes through a task sheet.

Table 3. Pedagogical survey results of the experimental class (EC) and the control class (CC)

Level			Level 1	Level 2		Level 3		Level 4			
Point			*<5*	*5*	*6*	*7*	*8*	*9*	*10*	*Mean*	*Sig*
Before the pedagogical experiment	**EC (N=50)**	N/%	0 (0%)	7 (14%)	9 (18%)	11 (22%)	12 (24%)	7 (14%)	4 (8%)	7.30	0.722
		Level	*0 (0%)*	*16 (32%)*		*23 (46%)*		*11 (22%)*			
	CC (N=48)	SL/%	0 (0%)	6 (125%)	7 (14.6%)	11 (22.9%)	13 (27.1%)	8 (16.7%)	7 (4%)	7.40	
		Level	*0 (0%)*	*13 (27.1%)*		*24 (50%)*		*15 (20.7%)*			
After the pedagogical experiment	**EC (N=50)**	N/%	0 (0%)	0 (0%)	5 (10%)	2 (4%)	7 (14%)	20 (40%)	16 (32%)	8.80	0.028
		Level	*0 (0%)*	*5 (10%)*		*9 (18%)*		*36 (72%)*			
	CC (N=48)	N/%	0 (0%)	3 (63%)	6 (12.4%)	14 (29.2%)	7 (14.6%)	10 (20.8%)	8 (16.7%)	7.81	
		Level	*0 (0%)*	*9 (18.7%)*		*21 (43.8%)*		*18 (36.5%)*			

Before the pedagogical experiment, the experimental and control classes exhibited comparable levels of student competence. This is evidenced by the similar mean scores of the experimental class (7.30) and the control class (7.40), as well as the associated variance of sig = 0.722 > 0.05. Therefore, the difference in mean scores between the experimental and control classes was not statistically significant. Additionally, the distributions of proficiency levels attained by the students in the experimental and control classes were nearly identical. These findings indicate that the students in the two classes possessed equivalent levels of competence prior to the experiment.

After the pedagogical experiment, the experimental class exhibited a higher mean score (8.80) compared to the control class (7.81). Additionally, the results of the independent samples T-test conducted in SPSS yielded a significance value of Sig = 0.028 < 0.05. Therefore, the difference in mean scores between the experimental and control classes was statistically significant. Furthermore, the percentage of students in the experimental class who attained the highest proficiency level (Level 4) was 72%, which was notably higher than the 36.5% observed in the control class. These findings suggest that the competence level of students in the experimental class was higher than that of the control class following the experiment.

The results presented in Table 3 suggest the efficacy of implementing VARK-based learning styles in the teaching of 4th grade Science. Preliminary findings indicate that students in the experimental class achieved notably higher outcomes compared to their counterparts in the control class. This, to some extent, demonstrates the effectiveness of applying the VARK-based teaching and learning process in the Science subject, which has contributed to enhancing the competence of students, particularly in the domain of natural science.

3. Conclusions

Applying the VARK (Visual, Auditory, Read/Write, Kinesthetic) learning style approach in teaching Science at the primary school is an effective way to cater to the diverse learning needs and preferences of students. Teachers need to diversify the forms, methods, and tools of teaching to help students actively engage and achieve better learning outcomes. Based on an analysis of the VARK learning style model, the research has proposed a teaching process that aligns with the learning styles of primary students in science teaching and provided specific illustrative examples. Additionally, the research has presented concrete examples of applying this process in teaching and conducted preliminary testing to demonstrate the effectiveness of the proposed process. The strategic integration of learning activities based on the VARK learning style is expected to foster a diverse, engaging, and stimulating learning environment for science education at the primary school level. This approach may contribute to enhancing the competence of primary school students, particularly in the competence of natural science teaching and learning science at the primary school.

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