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Chapter 14

Learning Styles in Physical Education

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Abstract

The learning styles are cognitive, affective, and physiological traits concerning how students perceive and process information, which is why their knowledge is relevant to enhance the methodologies of classes by teachers and learning strategies by students. Although there are several models that define and evaluate learning styles, a few of them have been used in physical education, highlighting the theories of Alonso, Gallego and Honey, the Kolb model, Herrmann's theory of brain dominance and Model VAK. The few studies carried out in this sample show a preference for reflexive, divergent, dominated B (organized) and D (holistic) styles and for a kinesthetic style. Further studies are required on how students perceive and process information in various areas of education, with the aim of contributing with one more tool to improving the teaching-learning process.

Keywords: learning styles, physical education, reflective, diverging, dominance, kinesthetic

1. Introduction

The term learning style refers to the fact that people use different methods to learn. Although these strategies vary according to what one wants to know, each one develops and enhances cognitive traits, preferences, and tendencies to face a knowledge process, aspects that are defined as a learning style [1]. In 2007, Camargo and Hederich [2] defined the concept of style, explaining that its origin does not correspond to the educational context, but comes from the arts, referring to the characteristics of an esthetic trend identifiable and distinctive. According to Camargo and Hederich, the term style begins to be used in psychology toward the decade of 1950 to talk about certain differentiating or individualizing traits in the characterization of a person.

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According to Camargo and Hederich, a definition of learning styles is described as the cognitive, affective and physiological traits that serve as stable indicators of how students perceive, interact, and respond to their learning environments, that is, they have to do with the way students structure content, form and use concepts, interpret information, solve problems, select means of representation, and so on. The affecting traits are linked to the motivations and expectations that influence learning, while the physiological traits are related to gender and biological rhythms [3].

Another definition states that the expression learning styles have to do with how the mind processes information, learning strategies to work content and how this process is influenced by perceptions [4]. It can also be defined as sets of behaviors and attitudes in relation to the learning context [5]. Some principles about learning styles have been identified, among which the following criteria stand out: (a) styles are preferences in the use of skills, but are not skills in and of themselves; (b) a relationship between styles and skills generates a synergy more important than the simple sum of the parts; (c) people have profiles or patterns of styles, not a single style; (d) styles are variable according to tasks and situations; and (e) people differ in their stylistic flexibility [6].

On the other hand, Woolfolk [7] chooses the concept of preferences, on learning styles, and defines it as the preferred way of studying and learning such as using images instead of text, working alone or in groups, learning in structured or unstructured situations and in other relevant conditions such as an environment with or without music, the type of chair used, and so on. The preference for a particular style may not always guarantee that the use of that style will be effective. Hence in these cases, certain students can benefit by developing new ways of learning. Finally, one of the most widespread definitions in the scientific community is that of Keefe [8] who proposes that learning styles are physiological, cognitive, and emotional modes of how human beings receive and process information.

This chapter addresses the main theories concerning learning styles (CHAEA, Kolb, VAK, Brain Dominations, etc.) with their characteristics. Afterward, we summarize the findings of different scientific works in this area, in Spanish, between 2010 and 2017, made by students of physical education or of related study.

2. Models of learning styles

Since the 1960s of the last century, different models have emerged to explain and classify learning styles, while some focused on the selection of information and others on how to acquire knowledge. The most relevant model in the field of education is given in the following section.

2.1. Divided brain model

Sperry [9] generates a model known as a divided brain, which relates the right hemisphere to spatial reasoning, visualization, creativity, musical aptitudes, and the simultaneous and satisfactory processing of information. This hemisphere is identified with a nonverbal, imaginative, and holistic thinking style. For its part, the left hemisphere is related to sequential and

temporal thinking, with analytical processes such as language comprehension-production, sequential reception of information, sequence numbers, logical analysis and rationality [10].

The existence of these functional differences between the two hemispheres and their independence in regard to perception, apprehension, memories, and feelings, including the argument that the surgical separation of the brain divides the mind into two distinct spheres of knowledge and opens the possibility of dual knowledge in a normal brain [11]. This has led to the idea of the existence of two modes of thought and learning styles, which implies the need for two ways of teaching since a left hemispheric student would have abstract thinking, while a right hemispheric student would be the possessor of a more concrete logical thought [10].

2.2. Model VAK

The VAK model (Visual, Auditory, and Kinesthetic) was proposed in 1978. The characteristics of these learners are as follows [12]:

a. **Visual style:** Learn more if you do it through the visual channel. He/she likes to get the most visual stimulation possible, prefers reading and studying graphs. Oral lectures, conversations, and instructions without visual support can produce anxiety and confusion. These learners require the visual stimulation of information boards, videos, film, words written on the board, a book or notepad, as they will better remember and understand the information and instructions they receive through the visual channel. If you attend a conference or receive instructions verbally, you should take note.

b. **Auditory style:** This type of student learns better through hearing, for example, with oral explanations. You can better remember and understand the information if you read aloud or if you move your lips while reading especially when it comes to new material. You can benefit by listening to electromagnetic tapes, lectures, class discussions, teaching other peers, or conversing with the teacher.

c. **Kinesthetic style:** This type of student learns best through experience, making more profit by engaging in physical activities in the classroom. Your active participation in the different tasks, trips and role played in the classroom will help you remember the information better. Sitting at a desk for many hours is uncomfortable, needs frequent rest and, above all, physical action in games and dramatic activities.

Currently, there are several instruments for measuring VAK learning styles, one of which has five dimensions: immediate environment, own emotionality, sociological needs, physical needs, and psychological needs, evaluated through Dunn's Learning Styles Inventory (LSI) and Dunn composed of 104 items with three alternative answers each: true, false, and I do not know. This instrument was designed for children between 3 and 12 of the US educational system [13].

2.3. Kolb's model

On the other hand, the Kolb's model defines learning as the process of creating knowledge through experience, that is, learning is generated from subjective experiences and based on it and together with other authors schematized the process in four stages [14]:

a. **Concrete experience:** the world is experienced through the senses such as sight, hearing, touch, smell and taste, and these senses generate learning.

b. **Reflective observation:** reflections on personal experiences are analyzed and sought to understand their meaning.

c. **Abstract conceptualization:** the extent to which the analysis of experiences is integrated and synthesized, inferences are created about why things are as they are.

d. **Active experimentation:** when theories are tested in daily reality, a new knowledge and understanding are generated that can be applied in life.

These four stages work in the same way, becoming a cycle, in which experience is transformed into action, and each cycle perfects and helps to generate understanding. Kolb argues that if a cycle is skipped, learning is incomplete so it will generate a slower, more limited process with little group impact. In the **Figure 1** are observed the different dimensions of this model.

From this, it poses and describes the following learning styles:

a. **Divergents:** capture information through real and concrete experiences and process them reflexively.

b. **Convergents:** perceive abstractly by way of conceptual formulation and actively process this information.

c. **Accommodators:** capture information from concrete experiences and actively process them.

d. **Assimilators:** perceive abstractly and process it reflexively.

Kolb designed an instrument to evaluate learning styles that consist of 12 sets of 4 words (where each represents a style) and the evaluated one must number between 1 and 4 each concept based on which characteristics define him/her better.

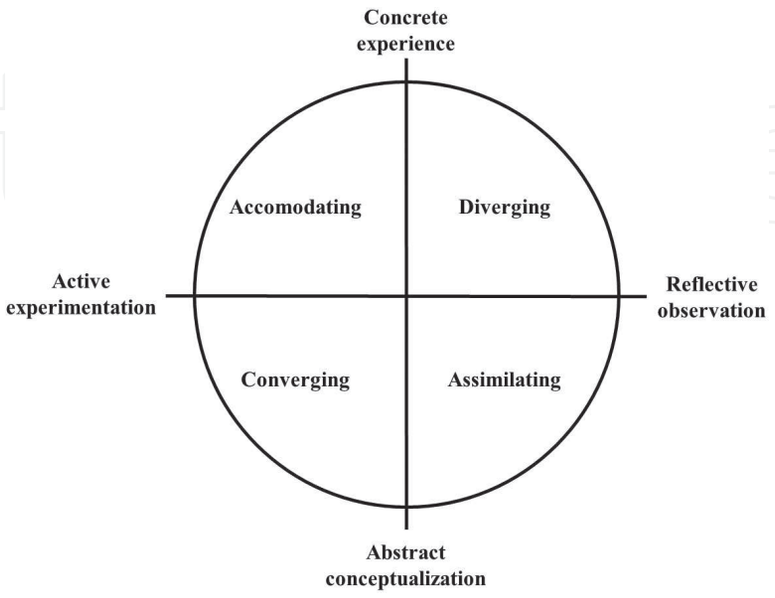

Figure 1. Learning styles Kolb's model [15].

2.4. Model by Ned Hermann

From the split-brain model [9] and the triune brain [16, 17] which posits the existence of three brain layers, each representing an evolutionary state called the reptilian brain that would be responsible for control muscular, respiratory, cardiac, balance, and so on. A second layer that is named as a paleo-mammalian brain or limbic brain that manages the emotions, instincts, ingestion, confrontation, flight, sexual behavior, and the tendency to gregariousness. The third layer is called neo-mammalian brain or neo-cortex brain where the invention and the abstract thought are located. Based on these two theories, Herrmann [18] elaborates a model of the brain constituted by four quadrants that represent different ways of operating, of thinking, of creating, of learning and, in sum, of coexisting with the world. The characteristics of these learning styles are as follows:

a. **Dominance A:** corresponds to the left-cortical hemispheric mixture. They are analytical, logical, quantitative, based on facts, intelligent, distant, ironic, competitive and individualistic. They learn by reasoning and using logic.

b. **Dominance B:** corresponds to the left-limbic hemispheric mixture. They are organized, sequential, retail, and introverted people. They learn from experience through routine and organized structures.

c. **Dominance C:** corresponds to the hemispheric right-limbic mixture. They are original, independent, with a good sense of humor, who like interpersonal relationships and situations involving emotions and feelings.

d. **Dominance D:** corresponds to the right-cortical hemispheric mixture. They are intuitive, holistic, integrative, extroverted, and emotive people. They like to listen and ask, to share, and to evaluate the behavior of others.

The author of this model elaborated the Herrmann Inventory of Brain Dominance that consists of 40 adjectives that describe the types of behaviors organized in 10 columns with four concepts each. The evaluated should weigh the adjectives of each column with values between 1 = less dominant and 4 = more dominant [19]. The results give scores on dominance A (logical), dominance B (organized), dominance C (interpersonal), and dominance D (holistic).

2.5. Model by Alonso and Gallego y Honey

This model was based on the instrument of Honey and Munford, elaborated for professionals of companies of the United Kingdom, which has been adapted and validated by Catalina Alonso. The classification given by this model has the following characteristics [3]:

a. **Assets:** Like new experiences, they are open-minded, nonskeptical, and willing to undertake new tasks. They are people who live in the here and now.

b. **Reflective:** They like to observe the experiences from different perspectives. They gather data to analyze them carefully before reaching any conclusions. They prefer to be cautious and look well before acting.

c. **Theorists:** They tend to be perfectionists. They usually seek to integrate facts into coherent theories. They like to analyze and synthesize. For them, rationality and objectivity are priority issues.

d. **Pragmatics:** Its main feature is related to the practical application of ideas. They are realistic when it comes to making a decision or solving a problem. His philosophy is: if it works, it is good.

The Honey-Alonso Questionnaire on Learning Styles (CHAEA) consists of two parts: one about socio-academic data that consist of 19 questions; the second one consists of 80 items on learning styles, randomly arranged, corresponding 20 questions to each style, and only the positive responses to the sentence are counted.

2.6. Model of Felder-Silverman

The first model proposed by Felder and Silverman [20] had five dimensions: understanding, processing, perception, reception, and organization; later, the latter was eliminated. Each dimension is evaluated by a scale ranging from 11 to −11. The different dimensions of this theory are described in **Table 1**.

In 1992, Soloman developed the Inventory of Learning Styles using the dimensions of the Felder-Silverman model. The instrument has 28 items [22]. Subsequently, Felder and Soloman [23] created the Index of Learning Styles (ILS) consisting of 44 items with two possibilities of

Dimension.	Characteristics
(1) Preference to process: this is divided into active and reflective.	Active students learn by working with the material, applying it and testing things. They like to work in groups to discuss what has been learned, tend to retain and understand information through activities.
	Reflective students prefer to work alone and they like to think about the material used to learn.
	They also prefer to think carefully about information rather than discussing, applying, or explaining it.
(2) Preference to perceive: this is divided into sensory and intuitive.	Sensory students like to learn facts, use sensory experiences as a source of information, are careful and detailed, realistic and practical.
	Intuitive students like theoretical rather than fact, are creative, innovative, like to relate things, abstractions and mathematical formulas.
(3) Preference to receive: this is divided into verbal and visual	Verbal students prefer words, written or oral explanations.
	The visual students remember better what they have seen (drawings, graphs, figures, etc.), the pleasure of reading the slate, books or manuals.
(4) Preference to understand: this is divided into sequential and global	Sequential students have a linear progress of their learning, since they learn with accumulation of information, are logical and retail.
	Global students learn great leaps, absorbing information from many things at once, with difficulty in understanding connections between them and with interest in extensive knowledge spanning many areas.

Table 1. Dimensions of Felder and Silverman's theory [20, 21].

response (a or b). Each dimension is represented with 11 questions, whose score is calculated by subtracting the answers b from the answers a.

2.7. The Grasha's model

Another model of learning styles that has drawn particular attention in recent years is the one proposed by Grasha. This theory is based on the observation of patterns of behavior related to students' preferences when it comes to interacting with their classmates and their teachers in the classroom. The author [24] postulated six styles of learning based on three dimensions of bipolar character: (a) student's attitudes toward learning (participatory vs. elusive); (b) perspectives on peers and teachers (competitive vs. collaborative); (c) reactions to classroom teaching procedures (dependent vs. independent). According to Grasha, although these styles in each dimension are bipolar, it does not mean that they cannot be complemented since they only represent extremes, among which different types of profiles can be formed. The characteristics of the proposed styles are described as follows:

a. **Participatory:** They are good elements in classes, enjoy the session, and try to be outstanding most of the time. They have a lot of readiness for school work.

b. **Elusive:** They do not show enthusiasm in class. They do not participate and remain isolated. They are apathetic and disinterested in school activities. They do not like to be in the classroom for long.

c. **Competitive:** They study to demonstrate their supremacy in terms of the use or qualification of others. They like to be the center of attention and receive recognition for their achievements.

d. **Collaborative:** They like to learn by sharing ideas and talents. They like to work with their classmates and teachers.

e. **Dependent:** They show little intellectual curiosity and only learn what they have to learn. They visualize teachers and their peers as guiding figures and/or authority to carry out their activities.

f. **Independent:** They like to think about themselves. They are autonomous and confident in their learning. They decide what is important and what is not, and enjoy working alone. They avoid teamwork.

The Grasha-Riechmann Learning Styles Scale [25] consists of 60 items, with five response scores ranging from 1 = Strongly Disagree, to 5 = Strongly Agree. To know the predominant style of learning the scores corresponding to each style are added and divided by 10, to find the average of the items assigned to each style.

3. Research on learning styles in physical education

A review of the works published between the years 2010 and 2017 shows few studies on the learning styles in students or professionals of the Physical Education, a situation that happens in many of the careers of education, being the areas of health and engineering that present

more inquiries about this subject. We used Dialnet, Redalyc and Scielo databases, in addition to the scientific collaboration network Researchgate. The search yielded a total of 2220 articles on learning styles (Dialnet = 911; Redalyc = 86; Scielo = 203; Researchgate = 1020), 13 of them met the following criteria: (a) Published since January 1, 2000 until July 31, 2017; (b) Spanish language; (c) research articles; (d) university population; (e) career in physical education or related.

The studies found included samples of students from Spain (2 studies); Spain-Venezuela (1 study); Costa Rica (1 study); and Chile (9 studies). Honey-Alonso questionnaire (CHAEA) was used in eight studies; Kolb's inventory in two studies; Brain Dominance Inventory in one study; and the visual–auditory-kinesthetic (VAK) research in two papers.

A research carried out at the University of Castilla-La Mancha in Spain, where the CHAEA was applied to evaluate learning styles for 315 students of physical education, shows that the predominant style is the Reflexive (44.01%), then Active (23.44%), theoretical (19.01%) and finally the Pragmatic (13.54%). When comparing between males and females, the former presented higher scores in the Reflexive and Pragmatic styles [26]. Another study using the same instrument was carried out at the University of Concepción in Chile, evaluating 65 students of physical education, revealing that the Reflexive style has the highest score with 15.1 of 20 possible. It follows the Pragmatic style with 13.1 points, Theoretical style with 12.7 and the Active with 11.9. When comparing between women and men, the latter have higher scores in the four styles [27].

In another study using the CHAEA, 227 students of Physical Education of the University of Granada and Alicante in Spain were evaluated, obtaining an average of 15.37 points in the Reflective style, 14.29 in Theoretical style, 13.08 in the Pragmatic style and 11.73 in the Active style [28]. An investigation at the Universidad de Los Andes-Táchira in Venezuela and the University of Valladolid in Spain evaluated 124 and 107 students of physical education, respectively, showing in the Venezuelan institution scores of 14.78 points in the Reflexive style, 12.89 points in Theoretical style, 12.79 in the Pragmatic style and 11.86 in the Active style. The Spanish students presented scores of 14.24 in the Reflective style, 12.77 in the Active style, 12.44 in Theoretical style and 12.42 in the Pragmatic style. Both groups do not present differences in learning style scores by academic institution [29].

A study of 2014 in Costa Rica [30] tested 204 high school students in the Teaching of Physical Education of Sport and Recreation, of Bachelor in Promotion of Physical Health and of the Degree in Sports Performance of the National University. In all three races, students scored higher in the Reflective style (14.40; 14.34 and 14.48, respectively), then in the theoretical (13.45, 13.50 and 13.37, respectively), in the Pragmatic style (13.26, 13.85 and 12.42, respectively) and finally the lowest scores correspond to the Active style (12.35, 12.83 and 11.90, respectively).

An investigation of 2014 in Santiago, Chile, evaluated 151 students of physical education of the SEK University, showing that the preferred style is the Reflective with 14.33 points, followed by the Active with 13.64, then the Theoretic with 13.63 and finally, the Pragmatic with 13.53 points [31].

A study using the CHAEA-36 questionnaire in 102 students of physical education from a private university in Santiago de Chile shows that the reflective and theoretical style are those that present

Instrument.	Authors	Year	Predominant style
Honey-Alonso Learning Styles Questionnaire (CHAEA)	Gil et al. [26]	2007	Reflexive
	Madrid et al. [27]	2009	Reflexive
	Belasco et al. [28]	2011	Reflexive
	Gutiérrez et al. [29]	2012	Reflexive
	Salas-Cabrera [30]	2014	Reflexive
	Maureira et al. [31]	2014	Reflexive
	Maureira et al. [32]	2016	Reflexive
	Serra-Olivares et al. [33]	2017	Combined and active
Kolb's Learning Styles Inventory	Maureira et al. [34]	2013	Divergent
	Maureira et al. [35]	2015	Convergent
Ned Herrmann's Inventory	Maureira et al. [36]	2016	Dominances B y D
VAK Inventory	Maureira et al. [37]	2012	Kinaesthetic
	Flores et al. [38]	2015	Kinaesthetic

Table 2. Sample on some research on learning styles in students of physical education.

a higher score, with averages of 6.98 and 6.38 points, respectively [32]. Another study using CHAEA-36 evaluated 122 physical education students at the Universidad Católica de Temuco in Chile, showing predominance in two combined styles with 56% and Active with a 21% [33].

In relation to studies using the model of learning styles of Kolb was found a research carried out in 2013 in the Metropolitan University of Education Sciences (UMCE) and the University SEK (USEK) both in Santiago de Chile. At the UMCE, first-year students of physical education are preferably Divergent with 48% of cases, then Assimilator with 22%, Resident with 17% and Convergent with 13%. In the same institution in the fourth year students are Divergent in 62% of the respondents, then Assimilator in 18%, Accommodation in 12% and Convergents in 8%. Meanwhile, in the USEK 1st year students are Acclimatizers in 32% of cases, Divergent in 27%, Assimilators in 26% and Convergents in 15%. In the fourth year, 59% of students are Divergent, 18% Assimilator, 16% Resident and 7% Convergent [34]. Another study carried out with 192 students of physical education at SEK University in 2015 shows that 42.2% of them have a Convergent learning style, 27.6% are Assimilator, 21.9% are Accommodator and the 8.3% is Divergent [35].

Using the model of Ned Herrmann, 102 physical education students from a private university in Santiago de Chile were evaluated, showing higher scores in the (organized) and D (holistic) brain dominance, while the dominance A (logical) and C (Interpersonal) have less development [36].

In relation to learning styles based on the Visual, Auditory or Kinaesthetic (VAK) model, 227 students from the SEK University of Chile were evaluated, the kinesthetic style being the predominant in all career years, followed by the visual style and finally the auditory [37]. Another study from 2015 that evaluated 127 students of the 1st and 4th year of physical education at a

private university in Santiago de Chile shows that the preferred style is kinesthetic, followed by the visual and after these the auditory, a situation that occurs in both the levels [38].

In summary, it is possible to notice that in 7 out of 8 studies using the CHAEA questionnaire, students showed a preference for reflective style, in samples of students from Spain, Costa Rica and Chile (**Table 2**). These students like to analyze the information, they are cautious and look out the experiences from many points of view.

Kolb, Cerebral dominance, and VAK models have been tested in samples with students of physical education of Chile, so will be interesting to carry out measurements in other countries, to test these models with similar samples but with different social and cultural realities.

4. Conclusions

In addition to the theory of learning styles, there are different cognitive factors that influence this process, such as intelligence, creativity, personality, motivation, among others [39], so it would be utopian to ask teachers to control all these variables, since each subject is different, but it is possible to try to measure them, obtaining a more objective description of the group of students, to know where to start, not only in knowledge but rather a diagnosis of who we are going to educate and how these people prefer to learn.

Knowing the theory of learning styles is imperative for the educator, in addition to using the most appropriate strategies according to the characteristics of each individual [40]. For example, Dunn and Dunn indicate that children should be educated using methods that fit their perceptual preferences [41].

On the other hand, it is not only necessary to know the learning styles of the students by the teachers, but also it is the task of the educator to adapt the style of teaching to the way of learning of its students, where the teaching process and learning will be significantly improved [42]. This does not mean that the teacher needs to plan four or five different strategies to face the challenge but to incorporate in the teaching strategy didactic elements that cope with the diversity of participants and find the way to explain the main key and core concepts or ideas from more than one point of view, perspective, *and/or* example, ranging from several intellectual and practical approaches.

Another important point is to separate the academic success from the qualifications because there are several investigations of learning styles measuring and correlating these variables [43–47], some with some degree of correlation and most with negative results. Researchers reached the conclusion that the student not knowing his style of learning does not know how to use it to study. Therefore, it is not only necessary to measure learning styles but also to teach them how to use them appropriately.

Finally, and insisting on the relevance of using learning styles as a tool that will facilitate the teacher and the learner in the learning process, it is surprising to see that in a review with the main theories of learning styles (CHAEA, Kolb Inventory, Brain Dominance, VAK, etc.) in

university students of physical education between 2000 and 2017, only 13 articles, similar situation that occurs when all the studies on learning styles are reviewed in educating students in their diverse disciplines [48]. Therefore, this situation leaves us with a very important task to develop in the coming years as experts in physical education, to proposing and structuring appropriate methodologies for each style of learning, enhancing the self-knowledge and learning of these students.

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