Health, Sports & Rehabilitation Medicine
Vol. 20, no. 4, October-December 2019, 184–188

Teaching strategies with the purpose of abstracting the scientific language, specific to the sports domain

Mariana Ardelean, Nicolae Neagu
"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Romania

Abstract
Abstracting through symbols represents the last stage within the process of cognitive processing of a notion. Taking the form of a *specific language*, graphic representations have the role, on the one hand, to reunite in Venn diagrams the information abstracted via symbols, and on the other hand, to facilitate visualizing the connections between data and revealing some new possibilities to connect and to intertwine them. Dividing into components the entire studied matter/issue (for example, the structural units of sports training, the periodization of sports training, etc.) will lead to a more thorough acquisition of theoretical-practical knowledge, to an understanding of the relationships between two or more teaching concepts, to a comparison and critical analysis of their components, to a reduction of the learning time (emphasis being placed on learning and thorough studying of the links between the studied contents) and, not least, to the development of critical thinking. In this manner, the subjects are determined, within a formal framework, to correctly use in various teaching contexts (in writing/orally) the already known or even new lexical elements, specific to sports training. The cognitive skills formed by using these teaching strategies are the fruit of critical thinking, of cognitive acquisitions obtained through disciplined, self-corrective thinking, whose evaluation criteria are: clarity, accuracy, validity, logic and appropriateness to purpose.
Keywords: graphic symbol method, mathematical operation method, critical thinking.

Introduction

Depending on the experience and the level of previous knowledge, on the motivational system and the psychological mechanisms associated with the knowledge process, teaching contents should be structured, simplified and presented in a manner susceptible to stimulate interest and facilitate understanding. Didactic logic should rely on the logic of the discipline taught, while "knowledge should be grouped around the fundamental logical structure of the science concerned, with emphasis on the most significant theses and principles for the understanding of all the other phenomena" (Nicola, 1994). In this way, decontextualization and loss of the meaning of a knowledge component within that science are avoided.

The literature classifies and details a wide variety of methods, which lead to the achievement of different types of objectives, but the graphic symbol method and the mathematical operation method have been less studied and methodologically grounded, their application spectrum being rather limited.

In essence, the pedagogical quality of a method involves its transformation from a way of knowledge proposed by the teaching staff into a way of learning in order to find the shortest path to the exit, to knowledge, to truth: "However, there is an exit, because there are signs everywhere; their decryption creates alternatives and man must choose", Mircea Eliade showed in his writings (Ruști, 1997).

Abstracting of scientific terminology by using the graphic symbol method

Scientific language is composed of definitions and specific operation terms, which have the role to ensure accuracy, concision and rigor in the logical succession of ideas, allowing elimination of ambiguities and mixing of cognitive information with subject's affectivity. A special category of scientific language is represented by formalized languages, in which the terms and the relationships established between them are replaced by symbols that permit information encoding and processing.

Human culture started by symbols. Regarded during evolution and in a differentiated manner, symbols have mediated the cultural-scientific dimensions of knowledge over time. Human thinking is symbolic in nature, its natural tendency being, as Descartes showed, to "imaginatively express abstract things and to abstractly express concrete things" (Cassirer, 2008). Having its own logic in relation

Received: 2019, June 25; *Accepted for publication:* 2019, July 16
Address for correspondence: "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Gheorghe Marinescu Str. No. 38, PC 540139, Romania
E-mail: mariana.ardelean@umfst.ro
Corresponding author: Mariana Ardelean, mariana.ardelean@umfst.ro
https://doi.org/10.26659/pm3.2019.20.4.184

to individual or collective representations, human actions possess imaginary dimensions, which span a very wide scale, from simpler or more complex hypotheses that can be verified to elements with an occult meaning that are less obvious, abstract or impossible to perceive. Being neutral in relation to truth values, a symbol carries the meaning of memorized and processed notions, because there are no mnesic mechanisms specific to imaging representations (Miclea, 2003).

Anything can be or can become a symbol, under conditions of which in addition to the *signifier* (the visible part), the image, the sign, the abbreviation, etc., there is also a *signified* (the invisible part). Despite the polemic generated by semiology studies regarding the relationships established between the terms *sign-signified-signifier/ symbol-symbolized-symbolizer*, in the majority of the specialized studies, a synonymy between the terms *sign* and *symbol* is found when defining or explaining them (Apostol, 2013). Thus, a *sign* is a symbol, an emblem, an image, etc. which indirectly represents (conventionally or by virtue of an analogical correspondence) a notion, an idea, a quality, an indicator, all that expresses, indicates or symbolizes something different from itself. If a *sign* represents the unity between the meaning and a graphic indication, a *symbol* represents an image, a conventional sign, a group of conventional signs or a conventional abbreviation used in science and technique to note certain concepts, operations, dimensions, and representing quantities, operations, processes, formulas, etc. (Cirlot, 2002; Eliade, 2013; Adkinson, 2018; Jacobi, 2018).

According to the idea that a *sign* denominates and a *symbol* expresses, the latter maintains an optimal balance between content and expression, between intellect and affectivity – with the mention that *signs* stand for ideas, but the ideas represented by *symbols* are their own direct significance (Butiurcă, 2007; Evseev, 2007). Thus, the abstracting process of the essential and non-essential characteristics of an object, process/class of objects or class of processes confers the symbol/sign a particular structure: in a single image the subject consciously links (associates) the image (sign, symbol) with the corresponding concepts. The symbol thus becomes the sensory support of the concepts (carrier of the concepts) and is reproduced during the process of their application (Kendel & Squire, 2000; Li & James, 2006).

Being full of content and having a great force of suggestion, today symbols are accepted mainly for practical reasons, becoming carriers of the meaning of memorized and processed notions.

Theoretical conceptualizations regarding the efficacy of using mathematical operations in the teaching process

In the process of teaching contents specific to sports training, subjects frequently do not really and timely perceive the correlations between newly taught and previously acquired notions. Not being able to easily establish quantitative content relationships between the data of a problem situation, they predominantly focus their attention on the direct concrete final answer – mistaken or not (Chiriacescu, 2012; Fotescu, 2014; Pera, 2017). By means of the graphic symbol and the mathematical operation methods, subjects can be placed in a new learning situation, to discover truth and to associate the information obtained with practical aspects.

Venn diagrams have the role of organizing information logically, helping to eliminate terminological ambiguities and mental discomfort created by the too high or the too complex influx of information, leading to a logical organization of information. This cognitive organizer, graphically represented by the intersection of two or more circles, evidences the similarities that occur in overlapping spaces and the differences between non-overlapping sections, respectively, highlighting in this way the particular and common characteristics of the classes of objects, processes or concepts specific to sports training (Dan & Chiosa, 2008).

Using Venn diagrams will allow operating with properties of mathematical groups at all teaching stages. The criterion chosen to form a group must not generate any doubt regarding the fact that a certain element belongs or does not belong to the group. For example, if A is the *group* of students at a Faculty of Physical Education and Sport and B is the group of 1st year students, it can be said that B is a *part* or a *subgroup* of A or that group B is *strictly included* in group A; this will be written as $B \subset A$. Using *Venn diagrams,* the relationship of inclusion will be represented (Figure 1).

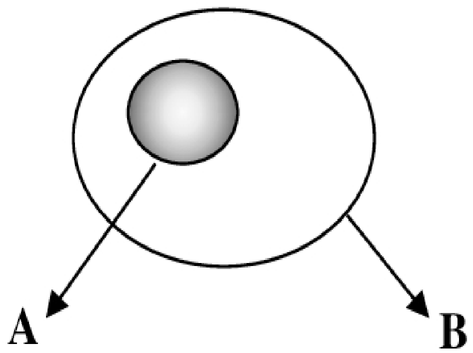

Figure 1 – Relationship of inclusion between two groups.

Similar inclusion relationships can be established for various teaching contents specific to the discipline *Theory and methodology of sports training*, such as those involving the structural elements of sports training, the periodization of sports training, sports selection, the stages of training, the components of sports training, etc.

For example, by noting the training macrocycle with H, it can be found that the five types of mesocycles: A – adjustment mesocycle, B – basic mesocycle, C – preparation and control mesocycle, D – pre-competition mesocycle, E – competition and recovery mesocycle are *subgroups* of H; so $A \subset H$, $B \subset H$, $C \subset H$, $D \subset H$, $E \subset H$ (Figure 2).

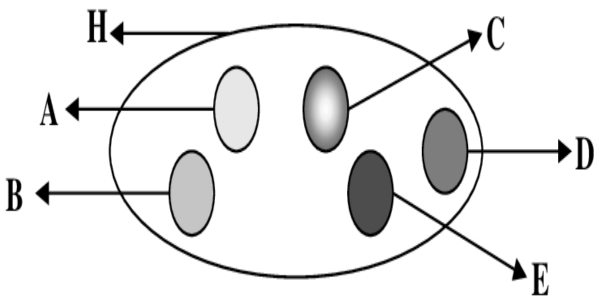

Figure 2 – Relationship of inclusion between the training mesocycles and macrocycle.

Establishing graphic symbols for the type of exercise characteristic of each training microcycle (Dragnea, 2006): □ low exercise (restoration and recovery), □ moderate exercise (without high-intensity exercise), □ moderate exercise (one lesson with high-intensity exercise), □ submaximal exercise (4 lessons with high-intensity exercise), □ exhaustive exercise (5 lessons with maximal exercise) based on *mathematical group operations*: *union* (AUB), *intersection (*A∩B) and *difference* (A\B and B\A) allows analyzing the typology of microcycles in terms of characteristics of the exercise composing the adjustment mesocycle – group A, and the basic mesocycle – group B (Figure 3).

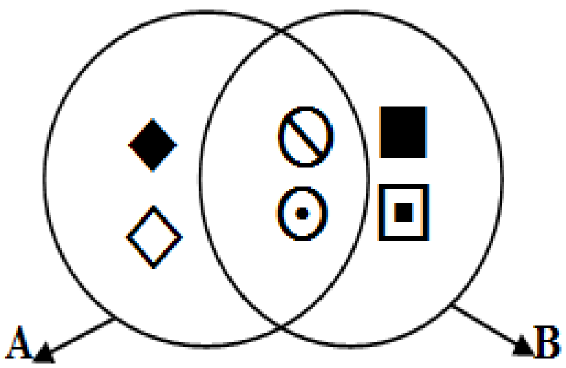

Figure 3 – Relationships between the adjustment mesocycle and the basic mesocycle.

A *union* of groups A and B, noted with A□B, is the group of all elements belonging to at least one of them. This will be written A□B = {x | x∈A or x∈B} or {□,□,□,□}□{□, □,□,□} = {□,□,□,□, □, □}. It follows that the structure of the two types of mesocycles includes the types of exercise associated with the symbols.

An *intersection* of groups A and B, noted with A∩B, is represented by the elements common to the two subgroups. This will be written A∩B = {x | x∈A and x ∈B} or {□,□}. This means that in the two training mesocycles subjected to analysis, two microcycles have the same exercise values: a microcycle is characterized by low exercise (restoration and recovery), while the other is characterized by submaximal exercise (3 lessons with high-intensity exercise).

The *difference* between groups A and B, noted with A\B, will contain only those elements that are included in group A and are not found in group B. This will be written A\B ={x | x∈A and x∉B} or {□,□} and B\A ={x | x∈B and x∉A} or {□,□}. From the analysis of the elements (symbols) that differentiate the two groups, it results that group A or the adjustment mesocycle is differentiated from group B or the basic mesocycle by the design and the presence of two types of microcycles: one characterized by moderate exercise (without high-intensity exercise), and the other characterized by the same type of exercise, but which includes a lesson with high-intensity exercise. Regarding the elements that differentiate group B from group A, these refer to the presence in the basic mesocycle of a submaximal exercise microcycle (4 lessons with high-intensity exercise), as well as an exhaustive exercise microcycle, in which 5 lessons with high-intensity exercise are scheduled.

If mathematical group operations allow evidencing the common elements and the particular characteristics of different sports-related classes of objects or processes, mathematical operations with brackets have the role of facilitating the deep understanding of a process, provided that this is approached in its integrality. For example, in the language specific to sports, it can be said that achievement of operational objectives will lead to fulfillment of current objectives, and these will ensure meeting of intermediate objectives, and subsequently, of final objectives. The same statement, in mathematical language, will translate as: {[(x + x + ... x) + y + y + ... y] + z + z + ... z}= t; the first language, specific to the field of sports, involves great generalization, determined by multiple human and methodological variables; the second, mathematical, language, from which ambiguity is absent, is dominated by explainability.

A transdisciplinary teaching approach, open to mathematical logic, which aims to reconcile the contradictions between affectivity and reason, will lead to a more objective evaluation of the plausibility and relevance of the connections between the studied processes and to a deeper understanding of the problem subjected to analysis.

Development of critical thinking by using the graphic symbol and the mathematical operation methods in the teaching process

The most important contribution of critical thinking is that it gives rise to action (any understanding is followed by action). Thinking critically means to continuously evaluate the plausibility and relevance of available data, to ask questions, to look for answers, to find alternatives to already established attitudes, to logically analyze the arguments of the others, etc. Being an efficient learning tool, it helps the subjects to choose among the available alternatives and to understand the mechanisms of their own thinking; this type of thinking "is a higher-order cognitive ability which involves intellectual autonomy, flexibility and a certain degree of constructive skepticism" (Nicu, 2007).

Because critical thinking allows the learning subjects to keep control of information, their stimulation is required for the development of their critical reflection and self-reflection ability regarding their learning experiences (Bieltz, 2012). The development of the level of critical thinking is aimed at orienting the learning and assessment actions towards higher-order cognitive and affective behaviors leading to the understanding of one's own thinking mechanisms.

Adjusting the teaching strategies to the personality and interest of each subject will lead to the elimination or reduction of the conflicting nature of the relationships with the disciplines of motricity which, in terms of terminology and contents to be acquired, are not always harmonious (Santi, 2018). Certainly, these relationships should not be irreconcilable, because the contradicting terms are found in the learning subject, but the contradiction is also solved within the subject. The irrefutable proof is that each subject succeeds in acquiring, better or worse, in a longer or shorter time period, the contents requested by the evaluator. This aspect guarantees an intelligence that must be systematically exploited in the teaching process whenever the contents of the discipline, through the nature of the problems addressed, offers this opportunity. It is important to intelligently design acting strategies, to create teaching situations able to cognitively challenge, incite the subjects, so that their intelligence as well as that of the teaching staff manifests not only by advancing their own hypotheses at a given moment, but also by considering the arguments opposing them.

It is important that the teacher should possess careful listening techniques, that he or she should try to think with the subject, i.e. to temporarily adopt the subject's conceptual scheme, and even provide additional arguments for possible hypotheses. The teacher should receive the subject's "reply" not to discourage it, but to bring it to discussion. If the logic requires it, he or she must admit the validity of the arguments, instead of vainly persisting in defending an idea whose inconsistence or exaggeration has been proved. Only in this way is his or her own point of view reformulated, either more comprehensively or more restrictively, and the subject has the chance to develop and use flexible logical thinking, the ability to synthesize, argue and interpret the teaching contents objectively. In fact, this is also feedback, the effort to reach an agreement (be it partial) through mutual position clarifications, through an attempt to reduce divergences, through the common construction of a possible convergence or a differentiation without incompatibility, but without renouncing one's own point of view and without urging the other to do so. This is why teaching strategies should be attractive, efficient and capable of significant cognitive transformations (Crețu, 2019).

Forming the bridge that links the contents taught with the new contents to be acquired, these methods create the binder between the teacher's communication needs, spanning a very wide scale, and the relatively reduced expression means available to the subject (at least during the first stages of learning). Facilitating learning and representing a useful tool for both the teaching-learning process and evaluation, these methods will lead to intellectual autonomy, to the formation of an ability to critically analyze the teaching contents and to transfer solutions to similar situations.

Conclusions

1. Using the graphic symbol and the mathematical operation methods at all teaching stages is not a panacea for all the theoretical and methodological contents of sports training. However, these can be successfully used whenever aiming to assess the plausibility and relevance of concepts, data, classes of objects and processes specific to sports training.
2. Practice and repeated examination by various well-organized tests, with a broad spectrum of items and different complexities, in order to stimulate curiosity and motivation create the premises for the development of subjects' cognitive abilities.
3. Using the graphic symbol and the mathematical operation methods should be considered as an alternative or a complement to the teaching methods grounded in the literature, on the one hand, and, on the other hand, as an opportunity for teachers to improve, regulate and self-regulate their didactic approach.

Conflicts of interest
There are no conflicts of interest in this study.

References

Adkinson R. Simboluri sacre, popoare, religii și mistere. Ed. ART. București, 2018.
Apostol MS. Introducere în semiotică. Suport de studiu pentru seminar. Ed. Pro Universitaria. București, 2013.
Bieltz P. Bazele gândirii critice. Ed. Acad Ro. București, 2012.
Butiurcă D. Metamorphoses of the transparency of significant. In: Annals of „1 Decembrie 1918" University of Alba Iulia - Philology 2007;I(1):220-227.
Cassirer E. Filosofia formelor simbolice. Vol. I. Ed. Paralela 45. Pitești,2008,130.
Cirlot JE. A dictionary of symbols. Translated from the Spanish by J. Sage. 2nd ed. New York: Dover, 2002.
Chiriacescu R. Dicționar mitologic. Ed. Univ 2012. DOI: 1 0.5 682 I97 860 6 59 Il
Crețu DM. Predarea și învățarea în învățământul superior. Ed. Univ. București, 2019.
Dan CT, Chiosa ST. Didactica matematicii. Ed. Universitaria. Craiova, 2008.
Dragnea A. (coord.) Educație fizică și sport – Teorie și didactică. București: Ed FEST, 2006, 79-80.
Eliade M. Imagini și simboluri. Ed. Humanitas. București, 2013.
Evseev I. Dicţionar de simboluri. Ed. Vox. București, 2007.
Fotescu V. Psihopedagogia creativității. Ed. Presa Pro Univ. București, 2014.
Kendel ER, Squire LR. Neuroscience: Breaking Down Scientific Barriers to the Study of Brain and Mind. Sci. 2000;290(5494):1113-1120. DOI:10.1126/science.290.5494.1113.
Jacobi J. Complex, arhetip, simbol în psihologia lui CG Jung. Ed. Trei. București, 2018.

Li JX, James H. Handwriting generates variable visual output to facilitate symbol learning. J Exper Psych: Gen. 2016;145(3):298-313. http://dx.doi.org/10.1037/xge0000134.

Miclea M. Psihologie cognitivă. Modele teoretico-experimentale. Ediția a II-a revăzută. Iași: Polirom, 2003.

Nicola I. Pedagogie. Ed. Did Ped. București, 1994, 300.

Nicu A. Strategii de formare a gândirii critice. București: Ed. Did Ped, 2007.

Pera A. Psihologia structurilor cognitive ale imaginarului arhaic. Ed. Univ. București, 2017. DOI:10.5682/9786062806170.

Ruști D. Dicționar de simboluri din opera lui Mircea Eliade. Ed. Coresi. București, 1997, 157.

Santi EA. Psihologia educației - repere teoretice și practice. Ed. Univ. București, 2018. DOI:10.5682/9786062807429.