Revista Românească pentru Educație Multidimensională
ISSN: 2066-7329 | e-ISSN: 2067-9270
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2020, Volume 12, Issue 2, pages: 365-374 | https://doi.org/10.18662/rrem/12.2/283

The Construction of the Didactic Message from the Computer Science Perspective

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Abstract: The main scope of our study is to analyse the sociological and psychological resources of the pedagogical communication employed at the level of didactic message, exploited from the perspective of computer science approached as a model of applied philosophy. The structure of the didactic message is pedagogically fixed at the level of the correlation between student acquired knowledge and his positive formation. From the computer science perspective, it is necessary to analyse the sociological (cultural) and psychological (cognitive and noncognitive) resources of the information. This information included in the school programs, must be related to the competences that include in their structure three categories, defined in terms of knowledge: theoretical, applied, conditional. The transformation of knowledge into special informatic resources, with a positive formative value, requires their transforming within an ascending informatic process. It involves the following actions: a) transformation of data into information; b) assembling information at the database level, by creating and using algorithms and graphs; c) correlation of information integrated into the database at the network level, applicable in open contexts; d) continuous improvement of the results under conditions of external inverse connection (realized by the educator, the teacher) and internal (realized by the educated, the student).

Keywords: *Didactic message; computer science; sociological resources; psychological resources; transformation.*

How to cite: Cristea, G., & Manole, I.-C. (2020). The Construction of the Didactic Message from the Computer Science Perspective. *Revista Romaneasca pentru Educatie Multidimensionala, 12*(2), 365-374. https://doi.org/10.18662/rrem/12.2/283

1. Introduction

The context of the research is represented by the interdisciplinarity between: pedagogy - as a socio-human science specialized in the study of education - and informatics, as "Computer Science", a broad discipline, which has as specific study object "theoretical foundations of information" normatively ordered at database level integrated into networks, perfectible by "practical means of implementation", in conditions of external and internal feedback (Anghel, 2017, p.190). The researched problem is situated in the area of general pedagogy at the level of the existing interdisciplinary relations between basic pedagogical sciences: a) the foundations of pedagogy (general theory of education) - b) theory and methodology of training (general didactics) - c) methodology and theory of curriculum. Thus, the construction of the didactic message involves the reference to: a) the functioning structure of education, based on the permanent correlation between educator (teacher) and educated (student), which must be valorised in the normative plane by observing the principle of pedagogical knowledge (of transforming specialized knowledge into knowledge with positive formative value); b) the teaching action (communication of the didactic message at the class level of students) qualitatively conceived in close connection with the other two actions integrated in the functioning structure of the training activity, the learning (efficient) and evaluation (continuous, formative / self-forming) actions) c) curricular design activity focused on optimizing the connection between information and (positive) training (Cristea & Manole, 2019, pp. 73-81).

From the perspective of computer science, valorised pedagogically in an interdisciplinary context, the construction of the didactic message at the optimal relationship between information and training, requires the use of fundamental concepts (of computer science): data, information, database, algorithms, graphs, networks, reverse connection (feedback).

2. Theoretical foundations

The problem of the didactic message is framed in the area of pedagogical communication, an operational notion defined in the specialized dictionaries at two reference levels that can be harnessed from the computer science perspective.

The first level of reference considers communication as a "pedagogical / didactic design principle". It "requires in the normative plan the conception and the realization of the pedagogical (didactic) message at the level of the necessary common repertoire between educator (teacher)

and educated (student). This "common repertoire must be constructed by the teacher in social (cultural, community) and psychological (cognitive, but also noncognitive / affective and motivational)" (Cristea, 2017, p.23). From a computer science perspective, the common repertoire can be validated by selecting the information that constitutes a database for students, ordered by the teacher in relation to previous knowledge, assimilated and internalized in contexts (networks) (Geven & Van De Werfhorst, 2020, p. 45) that can be permanently improved under external feedback conditions (initiated by the teacher) and internally (achieved by the student), positive (necessary for the consolidation of the knowledge in the network) and negative (necessary for the correction, completion, reordering of the knowledge in the network).

The second reference level considers the pedagogical communication as "teaching action, subordinated to the training activity, next to learning and teaching". As a teaching action, the communication "reflects the functioning structure of the training, based on the correlation between teacher and student", between information and training (Cristea, 2015, p. 502).

The two reference levels, harnessed from the computer science perspective, highlights the sociological and psychological resources of the pedagogical communication employed at the level of didactic message. The perspective of computer science is evoked here not in a technological sense, but in a philosophical model of logical knowledge applied in the area of pedagogy, in general, and of didactics, in particular. We consider the essence of computer science regarded as a model for processing and essentializing information (at the level of basic knowledge) and for their permanent logical ordering in networks (Dulamă, 2010, pp. 83-87).

The curricular design of the didactic message is realized according to the general and specific objectives defined in the school syllabus in terms of competences. The didactic message must include information processed and specially correlated to constitute the database that can be "received, assimilated and internalized by the students" (Webb & Cox, 2004, p. 235). The database, acquired and gradually used, proves the competence achieved by the students, at different levels, developed within a "pedagogical-logical-psychological" system, promoted by Bloom within the taxonomy of cognitive psychological objectives. The information integrated in the database can thus be capitalized in a positive training sense depending on the stage reached by students in training, psychologically tested through the level of acquired competence (De Landsheere & De Landsheere, 1979, pp. 62-67):

a) knowledge - simple, of data, terms, particular facts, classifications, criteria, methods, means, notions, principles, laws, theories);

b) understanding - "at the most elementary level" of internalized knowledge through transposition, interpretation, extrapolation, "without necessarily establishing a connection between one material and another";

c) application - "the use of abstract representations in particular and concrete cases", of rules of proceeding, of methods that allow solving problems, of different degrees, from simple to complex;

d) analysis - of the constituent parts of the problem solved, possible by "searching for elements, searching for relationships, searching for organizational principles";

e) synthesis - "the combination of elements or parts - of the problem solved and analysed - in order to form a whole" structured by "producing a personal work, elaborating an action plan, deriving from a set of abstract relations";

f) critical evaluation - "formulating judgments on the value" of the products of the activity, the problems solved, analysed and synthesized by exploiting the resources of critical thinking.

Reporting to competences stimulates the activity of processing information at the database level. This direction of action is proven at the level of the pedagogical and informational functioning structure of any competence that includes a set of: a) declarative, theoretical - conceptual, factual (facts, essential events) symbolic (formulas, etc.), normative (laws, principles), scholars, experts, professionals; b) procedural, applicative knowledge - skills, procedures, operations, methods, strategies, skills (necessary in the problem solving process); c) attitudinal knowledge - valuable attitudes towards the theoretical and applied knowledge that condition their assimilation, internalization and efficient use (Dulamă, 2010, pp. 18-22).

3. The main theoretical argument

The main theoretical argument aims at the pedagogical validation of the construction of the didactic message (built at the optimal correlation between information - positive-training) by capitalizing on the fundamental concepts of computer science that define:

1. The specific study object (the essentialized information, qualitatively processed, permanently): a) the data - "the elements of a set"; information - meaningful data obtained and "seen in context"; b) algorithms - "a finite sequence of steps necessary to solve a logical problem"; c) graphs -

"a data structure consisting of zero or more nodes (peaks of a problem) and zero or more edges connecting pairs of nodes"; d) database - data set, structured by abstracting and generalizing operations (by indexing, deleting / adding, modifying, combining, recombining) with the purpose of transforming meaningful data into essential information that can be integrated into networks, perfect able through feedback; e) networks - "group of (informational) devices connected through communication facilities" (specific to each reference area - see, in the case of the didactic message, pedagogical communication) which have a dual purpose: coordinating the transmission of information and establishing connections between the processed information (essentialized) and permanently refined at the database level; f) feedback - the inverse connection that guides and modifies the communication actions in relation to the obtained results, positive (which determines positive feedback) or negative (which determines negative feedback).

2. The specific normativity, involved in the ordering of the specific study object (essentialized information, qualitatively processed, permanently) through: a) axioms of informatics: transforming data into meaningful information; fixing the information in the network integrated database, perfectible through feedback (in an open context); b) laws of computer science: the law of the reverse connection (Wiener, 1961, p. 75); the law of required variety; the law of negative entropy (applied in pedagogy, at the level of the evaluation strategy of continuous evaluation); c) principles of informatics: integrity of the domain; the integrity of the fundamental entities; referential integrity.

3. Research methodology specific to informatics - capitalizes on cybernetic models used in information processing, at abstract, analytical, topological, hierarchical level.

4. Methodological arguments

These arguments are necessary in the context of applying the theoretical argument in the analysis of any teaching message. Such an analysis requires the restructuring of the didactic message that maintains dysfunctions generated by: a) informational over-dimensioning of school programs and textbooks, but also of some school aids; b) the deficient conduct of the teacher who asks for priority (sometimes exclusively), the mechanical memory and the external motivation of the students (Jarvela & Jarvenoja, 2019, p. 426). Possible solutions through computer analysis aim:

1) The use of algorithms for search, sorting and "lossless compression" of information with a positive pedagogical meaning that generates the formation-priority development of thinking and motivation in any activity (lesson, etc.).

2) Focusing on information with a positive pedagogical meaning (Paulsen & McCormick, 2020, p. 23) that constitutes the database of the respective school subject, its "disciplinary matrix" which includes fundamental: theoretical knowledge (concepts, laws, etc.) and practical knowledge (skills and abilities). Which must be internalized by the students, in time, in order to be used in open, multiple, for medium- and long-term contexts (Cristea & Manole, 2019, p.75).

3) Correlation of information with a positive pedagogical sense, integrated in the database in networks adapted to the specific of the domain (the respective school subject) by the calling of graphs constructed by zero or more nodes with zero or more edges, which can be used in the construction of some ideal-models (of education, of the curriculum (Cristea & Manole, 2019), of training, (Cristea, 2008, p.106).

4) Organizing the networks by: a) filtering, sorting, combining input data (basic concepts); b) fixing the output data within the type and variant of the lesson aimed at consolidating the skills, using the abilities in solving problems and problem situations, analysing the synthesis of the basic knowledge (theoretical, applied, etc.).

5) Validation of the network database at the level of teaching-learning-evaluation relationship supported normatively by the feedback principle (continuous formative evaluation, with the function of regulation-self-regulation of the training activity).

6) Improvement of the database at normative level, by appealing to:

a) the principle of integrity of the fundamental entities of the activity (proven within the interdependence between objectives - contents - didactic methodology; teaching - learning - evaluation);

b) the law of the inverse connection, which fixes the links between the input data and the output data with the purpose of regulating the self-regulation of the activity (education, training, curricular design of the education and training activity) in an open context (education system, education process, lesson, etc.).

5. Elimination of counterarguments

It is necessary in the conditions in which the pedagogical slogan of the competence centering induces the opinion of diminishing the role of the

contents in the training activity. Analogously, the thesis of promoting a formative education induces the opinion of diminishing the importance of the information in any didactic message. The analysis of the didactic message from the perspective of computer science - using the fundamental concepts of computer science - allows to highlight the interdependence, objectively, between: a) the competences pursued in any training activity (according to its psychological objectives) and the basic contents necessary for their acquisition, over time, in the medium and long term; b) the informational dimension of the didactic message and its formative dimension, respectively between the information selected by the designer and the training effects (positive - negative) recorded at the student's personality level.

The formula of competence, promoted at the level of education policy, records not the exclusion of knowledge, (Al-Samarraie et. al., 2018, p. 2005), but implies a set of knowledge - skills - attitudes and values (Manole & Petac, 2016, p.82). In pedagogical terms (Paris, 2012, p. 96), all the three components of competence have a common basis, fixed in terms of knowledge, expressed in UNESCO documents under three main formulas: to know (theoretical knowledge) - to know to do (applied knowledge) - to know to be (knowledge supported by attitudes and values appropriate to those who learn effectively and responsibly (Delors, 2000, pp. 69-78).

In terms of cognitive psychology, "the components of a competence are: a) "specific declarative knowledge (ideational resources)" (basic concepts, laws, principles, etc.)

b)"specific procedural knowledge (procedural resources) "(cognitive skills and strategies) involved in problem solving)

c) "specific attitudinal knowledge" (the attitudes, values and behaviours of the student that condition the sustainable learning and the efficient use of declarative and procedural knowledge).

The formation of competences requires the acquisition, internalization of the basic knowledge (theoretical, applied, attitudinal), selected and integrated in the structure of the didactic message by capitalizing on the models of informative analysis of informatics, its fundamental concepts (information, algorithms, graphs, databases, networks, external and internal, positive and negative feedback.

In the same context, the achievement of a formative education (which positively forms) requires the optimal selection and correlation of the essential information (basic concepts, basic skills and abilities, basic cognitive strategies, basic attitudinal knowledge, specific to each school subject), validated from the perspective of computer science, by using its theoretical, normative and methodological superior resources. Thus, in the

construction of any teaching message, the optimal relationship between the proposed information and the positive training effects, determined immediately and in time, must be considered. Positive formative effects are generated by the information received, assimilated and internalized by the student, prioritized by the higher psychological resources of internal thinking and motivation.

6. Conclusions

Theoretical research considers the possible interdisciplinary relationships between pedagogy and computer science. They can be used in constructing and validating the didactic message.

The problematic of the didactic message is grounded on two levels of reference with aperture to the informatics area, which aims at communication as a principle of curricular design and as an effective teaching action. The curricular design of the didactic message implies the optimization of the relations between informing (the information integrated informatically in the database of the curricula, of the lesson project etc.) and the positive training of the students at different levels of competence (knowledge - understanding - application - analysis - synthesis - evaluation / critical thinking).

The main theoretical argument aims at the pedagogical validation of the construction of the didactic message at the level of the optimal correlation between informing - training, basic knowledge (theoretical, procedural, conditional) - skills (general and specific). This main theoretical argument is supported by the call to the fundamental concepts of computer science (which define the specific study object, the specific normativity and the specific research methodology - of informatics).

The methodological arguments are proposed on the background of observing some dysfunctions existing in the construction of the oversized didactic message, including the deficient conduct of teachers. They can be overcome by capitalizing on computer science resources that allow the use of algorithms for searching, sorting, compressing information in a positive pedagogical sense, of graphs that support the construction of the database, of networks developed by combining input (fundamental concepts) and output (the results of the activity), perfectible in conditions of external and internal, positive and negative feedback, treated also as a level of the principle of informatisation, together with the principle of integrity (the fundamental entities of the training activity, tested within the

interdependence between objectives - contents - didactic methodology; teaching - learning - evaluation).

On this background can be eliminated the counterarguments brought or induced by the slogan of focusing the didactic message only on the competences, without explicit reference to the knowledge needed to acquire them. The competences are the product of the most significant pedagogical knowledge (theoretical, procedural and attitudinal), informatically validated at the database level, fixed in the structure of any didactic message, integrated in the network, which contributes with priority to the development of internal thinking and motivation.

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