Intra-disciplinarity or interdisciplinarity in teaching mathematics in primary school?

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Abstract: The new curriculum for primary school has brought from kindergarten not only a new class - the preparatory class, but also a new approach of teaching, learning and assessment of mathematics. Specifically, the study plan provides for pre-school class, the 1st class and the 2nd class a new subject, *Mathematics and explore the environment*, which carries an integrated approach of former subjects *Mathematics and Natural Sciences*. The paper points some elements of monodisciplinary and interdisciplinary approaches and seeks an answer to the question *Intra-disciplinary or interdisciplinary teaching mathematics in primary education?*

Key words: intra-disciplinarity, interdisciplinarity, integrated approach, curriculum

1. Introduction

Intradisciplinarity and interdisciplinarity represent two extremes of scientific knowledge process, between them there is a variety of ways of separating or integrating disciplines. Intradisciplinarity or mono-disciplinarity is focused on independent study subjects on their own merits. Monodisciplinary or intra-disciplinary approach (traditional approach) requires action to tackle a project or solve a problem by limiting the data to a single discipline.

The term “interdisciplinarity” is not a scientific term, that has a unique and universally accepted definition. There are works in the literature, such as Jean Paul Resweber (1981), *La methode interdisciplinare* and D' Hainaut (1981), *Curricula and lifelong education,* which identified the following levels of integration:

- intra-disciplinary integration;
- multidisciplinary integration;
- multidisciplinary integration;
- interdisciplinary integration;
- Integration across disciplines/transdisciplinary integration.

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Educational theory and practice use the term *interdisciplinary integration* at all levels with the exception of intra-disciplinary integration. There are authors who consider that for the last four levels would be more appropriate the term *non-disciplinary perspectives* (D' Hainaut, 1981).

2. Interdisciplinarity

The principle of interdisciplinarity, as it accepted today, has emerged as a result of the projects initiated by UNESCO at the beginning of the seventh decade of the last century in various countries and called *integrated sciences.*

Early 80s had failed to clarify the concept. The article of Italian Giuseppe Gozzer, *Interdisciplinarity: a concept still unclear*, published in 1982, is relevant in this sense. Subsequent studies about the concept put it in various situations, ranging from "a universal pedagogical and epistemological panacea" (Văideanu, G., 1975, p. 4) to a formula likely to encourage superficiality and spiritual disorder which may lead to suppression or mixing disciplines and thus putting into question the teachers traditionally monodisciplinary trained.

However, interdisciplinarity is one of the most important and debated issue regarding knowledge and education. The most known arguments which advocate for interdisciplinarity include:

• Hughes Philip (1985) - the argument advocating interdisciplinarity is not that the subjects would be an erroneous theory of knowledge, but the subjects do not give us the full picture of things seen in isolation. Hughes (1985, pp14) proposed four forms of curriculum integration: integration through correlation of subjects, integration through themes, topics on ideas, integration in practical thinking, integration through the learner's own interested in inquiry.

• J. Moffett - the strongest argument for interdisciplinarity is just that life is not divided into disciplines.

In Romania, the term interdisciplinarity appeared relatively late in everyday language. Thus, we found it for the first time in *The neologisms dictionary* of Marcu and Maneca (1978) and in *Le petit Larousse en couleurs*, (1995), defined as establishing relationships between several sciences or disciplines. There appeared the terms, considered to be synonymous, pluri-disciplinarity and multi-disciplinarity, but the term transdisciplinarity is missing.

Most of Romanian specialists in education have addressed the issue of trying to approach a universally accepted definition of the concept. Here are some of the most cited:

- Interdisciplinarity involves a certain degree of integration between different domains of knowledge and different approaches and use of a common language allowing conceptual and methodological exchanges (Văideanu, G.,1988).
- Interdisciplinarity is a form of cooperation between different disciplines on an issue whose complexity cannot be revealed only by a convergent and caution combination of different points of views (Cucos, C., 1996).

- Interdisciplinarity is the interaction between two or more subjects that can go from a simple communication of ideas to integration the concepts regarding epistemology, terminology, methodology, data and research orientation (Manolescu, M.).

The integrated approach primarily involves curriculum integration. The study plan is organised based on seven curricular areas, which contains disciplines that have in common training objectives. This is an element of curriculum integration, at least for the disciplines from a certain curricular area. Although this isn't an ideal solution, it is a way that leaves the door open to many possibilities for an integrated approach.

According to the *Syllabus* approved by Order no. 3418 / 19.03.2013, discipline *Mathematics and explore the environment* has a novelty in relation to the disciplines studied before in the first two classes of primary education. In the study plan, the discipline *Mathematics and explore the environment* is part of the curriculum area *Mathematics and Natural Sciences*, realizing an integrated approach of concepts specific to Mathematics and Natural Sciences domains, which are allocated to the preparatory class and first class 4 hours per week and to the second grade, 5 hours per week. The main reasons that had led to an integrated approach to mathematics and natural science elements within the same programs are:

- A holistic learning at this age is more likely to be interesting for the students, being closer to their universe of knowledge.
- To contextualize learning by reference to the surrounding reality increases the depth of understanding concepts and procedures that are used
- Interactions between two areas: mathematics and science enables more efficient use of teaching time and increases flexibility of interactions.

Another element of curriculum integration is the integration of contents in integrated cognitive fields (Vlăsceanu, L., 1988) that transcend the boundaries between disciplines. In 1991, R. Case proposed four forms of content integration:

- integrating content by linking elements of different disciplines or within them;
- integrating skills or processes;
- school integration and self-integration through relationships between the student's school life and the outside world;
- global integration, ensuring close links between all student learning experiences, both planned and unplanned.

According to the syllabus for Mathematics and explore the environment, in the preparatory class, Ist class and II nd class, the learning contents consist of inventory purchases necessary to student for literacy with basic elements of the two integrated "disciplines". Thus, they are grouped in the following areas:

- Numbers;
- Figures and geometric bodies;
- Measurements;
- Dates;
- Life sciences;
- Earth Sciences;
    - Physical Sciences.

The integrated approach of contents must be accompanied by a new approach to teaching, learning and assessment. The new National Curriculum, by passing the preparatory class at primary school, brought not only an extra year of study, but also operating with *themes*, *thematic topics*, issues underlying the design of teaching and represents an essential element of continuity between kindergarten and primary education. The themes chosen must provide an integrating opening vision, identifying in reality. In these situations, students could choose or propose some topics of study. For example, the *life theme* (Syllabus for Mathematics and environmental exploration -example integrated approach to IInd grade) can be used for training specific skills included in general competencies:

1. *Use numbers in elementary computations*: calculations with numbers representing data on the mass of animals, the distances covered during migration, the number of species that can be found in certain living environments.

2. *Highlighting the geometrical properties of objects located in environment*: pair elements of life seen environments with lighting and geometric shapes, identifying the axis / axes of symmetry schematic representations of plants and animals by geometric figures, realization and completion of tables data about subjects living environments, respecting the instructions that use the words "row" and "column ".

3. *Identification of phenomena/relationships/regular/structures in the immediate environment*: composition of problems from favourite living environments, recognition of living environments in the drawings/pictures/layouts/documentaries/presentations, performing experiments in order to highlight the presence of air, performing experiments that highlight simple air movement.

4. *Generating simple explanations by using logic elements*: the staging of stories from real/imaginary from living environment studied using logical operators such "and", “or", "not", recognition the adaptations to the environment of plants and animals in discussions on the theme: *"What would happen if I move animals/plants from aquatic environment X to terrestrial environment Z?*, identifying changes/events in the life of plants, animals and humans due to day-night cycle.

5. *Solving problems from sorting and representation of data*: classification of the bodies, from a living environment, in the living and non-living and recording findings in a Venn diagram, grouping a variety of plants and animals based on

affiliation to a living environment and recording the results in a graphic organizer, the association of solving a problem with a graphic/drawing, solving problems using representatives' images of a living environment.

6. *The use of conventional standards for measurements and estimates*: identification of animals of a particular living environment based on characteristics regarding the length/weight ("higher", "shortest", "easier", "harder"), involving children in experiences in which they have to decide for themselves if they can/cannot buy an object with the amount of money they have.

3. Intra-disciplinarity

Intradisciplinarity was one of the principles that formed the basis of traditional curricula. Such an approach crosses the teacher's work on the discipline he teaches, on the vertical transfer of content inside the discipline and less on the priority of education – the pupil.

According to the *Dictionnaire actuelle de l'education*, (Guerin 1993), intra-disciplinary integration is the operation which combines two or more interrelated contents in the same field of study, in order to solve a problem, studying a theme or developing the skills development. For example, integration of historical data of several countries to understand the dynamics of a whole epoch.

In mathematics, more than in other disciplines, intra-disciplinary approach (traditional, we will not dwell on that now) does not rule out the perspective of an integrated approach. Mathematics is an "interdisciplinary discipline". Even in primary education, mathematics treats interdisciplinary, at least, elements of arithmetic and geometry, two "disciplines" that led to the formation of a new discipline - mathematics.

We do not like the point of view of those who say that the monodisciplinary approach leads to the drain of scientific creation, reduced to mere technical research, monotonous and strictly specialized in a limited field.

4. Inter-disciplinarity versus intra-disciplinarity

D' Hainaut (1981) presents a series of advantages and disadvantages for both intra-disciplinary approach and for the interdisciplinary approach. The answer to the following question *Interdisciplinarity or intra-disciplinarity* is not simple and should take into account a variety of factors, some of them listed below.

The internal consistency of discipline obviously increases in intra-disciplinary approach and decreases in the case of interdisciplinary approach. In mathematics, perhaps more than in other disciplines, interdisciplinary approach increases the risk of superficiality, of giving up the rigor and depth, essentials elements of mathematics.

The horizontal transfer of knowledge. Monodisciplinarity fails to provide the knowledge transfer from a discipline to another discipline. Thus, the student won't have an overview of the studied processes and phenomena in other disciplines. *To develop the capacity to communicate using mathematical language* and *developing the interest and*

motivation for the study and application of mathematics in various contexts, framework objectives in the curriculum for primary education remained, for most, as a wishes and hints. How many math teachers were not faced with the question: *What's the use?*

Specialized encyclopaedic paradox is one of the arguments used by some specialists for interdisciplinary approach. Simplifying, if knowledge is restricted, the level of knowledge of pupils increases. Forcing the language (mathematics) by passing to the limit, when knowledge tends to zero level, the knowledge about that area tends to infinity or translated to "non mathematicians", by excessive specialization is reached *by knowing all about ... nothing!*

But how much can go with interdisciplinarity? The logic of the previous example, if knowledge is extended, then the learning content decreases. In other words, when knowledge tends to infinity, the level of knowledge tends to zero, get *to know ... nothing about ... everything!*

Human relationships between actors of the educational process. Intra-disciplinary approach creates a rift between teachers of different subjects. Every teacher in his devotion to the subject they teach and ignorance of other subjects, get to disregard other disciplines. It also loses sight of the main objective of education - student, to the detriment transmission of knowledge.

Teacher training. In our country, most of the teachers are the result of a monodisciplinary initial training which make difficult the integrated approach in teaching of disciplines. The exceptions are few, this may include teachers for primary and pre-primary education. Unclear legislative framework, frequent changes correlated with immobility and lack of new continuing professional trainings, make difficult the integrated approaches. Add to this, the lack of pedagogical tradition and specific literature and researches influence the integrated approach.

The teachers' attitude towards integrative tendencies. The experience of curricular changes in preschool education demonstrated that after a period of latent or active opposition to the integrated approach, teachers have accepted and even supported this endeavour. The situation was the same with the preparatory class, before the implementation of it.

5. Conclusions

The intra-disciplinary and interdisciplinary approaches are not incompatible, not mutually exclusive. Interdisciplinarity, even by its „definitions", assumes the existence of disciplines and the absolute necessity of disciplines in some situations. "The interdisciplinary performed at groups of related disciplines or designed as a more radical notion of discipline does not imply abandonment of the term discipline. Conversely, subjects, with their own methods and epistemology -because of the very specificity - must be considered necessary for both a systematic intellectual formation as well as a good understanding of the world " (UNESCO, 1975).

Answer to *Intra-disciplinary or interdisciplinary?* question seems to be intra-disciplinarity and interdisciplinarity. The most effective solution consists of a balance between extremes. Based on the principle of unity of science and taking into account the characteristics of children's learning process, the National Curriculum requires the teaching-learning and evaluation process to be characterized by a shift as devoid of discontinuities, from full integration in preschool education and the first three grades of primary education, the separation more pronounced for the latter part of high school. In mathematics, this decision brought continuity between preschool and primary education - switching from the integrated approach from preschool level to the integrated approach at Mathematics in primary education - but unfortunately not solve the problem but only moved it between classes II and III of solving its remaining primary school teacher's account.

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