Multidisciplinary Strategies in Education

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Abstract

Multidisciplinary method represents the most efficacious way of managing the knowledge allowing the practice and evaluation of students' technical and non-technical skills. Multidisciplinarity should not be seen as a method opposed to specialization but, as summarized by Bohr's phrase "contraria sunt complementa", the two methods can be integrated into a new process of approach to concepts. In addition, multidisciplinarity can be a real social experiment in which students and teachers join into different levels of organization and interaction. In fact, multidisciplinarity consists of three levels: pluridisciplinary, interdisciplinary and transdisciplinary. Each one has its own difficulty degree and represents an approach to the concept under examination, gradually deepening its relations with different disciplines at the level of pluri- and multidisciplinarity, until the concept itself has been overcome – at the level of transdisciplinarity. The last, actually, presents itself not as a method but as a real philosophy, an approach to a dynamic world in which social interactions mix with cultural pluralism. Multidisciplinary approach, through these levels, has been enriched from the pedagogical point of view as studied by J.Piaget and subsequently by B.Nicolescu. Thus, in the article three aforementioned levels of multidisciplinarity are considered and analyzed in detail. From the point of view of a different participation of students and teachers the corresponding behaviors and training paths are proposed.

Keywords: *Multidisciplinary, Interdisciplinarity, Pluridisciplinarity, Transdisciplinarity, Research, Method, Philosophy.*

1. Introduction

The school system, although undergoing modifications by legislations that have radically changed its structure over time, has never had evolutions from the educational point of view, remaining mostly linked to a "convergent thought system" rather than a "critical thinking" realization. Students at school mostly learn the arguments explained by teacher and repeat them during the oral exam. It is a dominant pattern in schools that has little to do with true intellectual formation. In this perspective a teacher is a professional figure that does not produce culture, but transmits it. This situation has caused a slow process of misalignment between the working world demands with the training offer and a widespread "functional illiteracy". Only new educational offers creation remains an important instrument for resolving the profound crisis that the school system is going through. One of the most incentivized solutions to limit the gap between school, university and work is the use of specialization. In this perspective, specialization appears as a natural completion of the training processes in order to create highly qualified work figures, but, paradoxically, they must also be equipped with both an overall and a sectorial vision. In this way specialization has become a strategy in order to limit the knowledge dispersion but its effects have often turned into the creation of a mono-disciplinary knowledge. The creation of such structured competences, however, does not agree with the dynamism of the processes studied and above all favours the sectorial vision over the global one.

In the new three-year training plans (2019-2022) the new concept of multidisciplinarity is often used, but understood as a contrast to specialization. However, multidisciplinarity must not be regarded as a criticism of specialization that has the merit of reflecting the need to create a personal training path, but must overcome the concept of the specificity of a single discipline and a self-sufficient model [1, 2]. This model is not very sensitive to complexity and to the innumerable border situations leading to rethinking of each discipline beyond its disciplinary status. The strength of multidisciplinarity is the convergence on the same theme, through multiple fields of knowledge with a form called "divergent thinking". It is not a mere coincidence that Joy Paul Guilford considered the divergent thinking closely related to the creative act [3]. The well-known motto "Contraria sunt complementa" by physicist Niels Bohr properly identifies the connection between multidisciplinarity and specialization [4, 5]. According to this vision and imagining the concepts as territorial areas, the borders represent the true freedom spaces that allow, even in an unusual way, the creation of interesting and profitable reciprocal relationships. Diversity separates from the rigor of the approaches and requires the use of a plurality

of codes for the search of relations between the constituent elements. Multidisciplinarity becomes strategic and qualifying for specialization. While for the specialization it is easier to identify the appropriate methodologies for a training path creation, what is more difficult, is the creation of multidisciplinary training proposals that can be based both on national cultural resources, which could favour a national identity of the student, and on international resources raising as a foundation of the cultural integration. Assuming that multidisciplinarity is difficult to register within a univocal scheme, it is possible to consider its main components as identified by the psychologist and philosopher Jean Piaget: pluridisciplinarity, interdisciplinarity and transdisciplinarity [6]. These approaches, just like the philosophy underlying the method, are not closed sectors of training, but appear as nuances of multidisciplinarity and can be summarized as:

- pluridisciplinarity: overlapping of various disciplines in a field of teaching or research;
- interdisciplinarity: follows the pluridisciplinarity adding the interaction of several disciplines with the study of an object, a field, an objective;
- transdisciplinarity: extracts from these interactions a common thread, up to reaching a completely new epistemological philosophy with respect to the epistemologies of single disciplines called for collaboration.

2.1 Pluridisciplinarity

Pluridisciplinarity alone is a sterile process, as it does not bring any cultural enrichment but is necessary for the organization of knowledge. In fact, it only identifies information related to several disciplines that converge on a single theme. Therefore, from the point of view of pluridisciplinarity, each subject collaborates for its own part to analyze a theme by determining a common field of different areas without defining the constitutional laws among the elements. Or turning into mathematical terms, for the elements of non-disjoint sets according to the known nomenclature A∩B in which the sets A and B represent different disciplines (Fig.1).

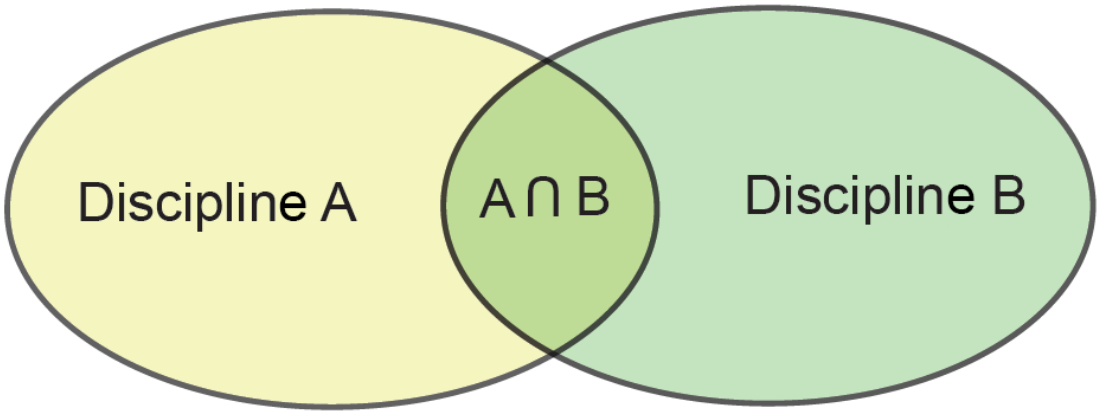

Fig. 1. Pluridisciplinarity scheme.

A pluridisciplinarity's fundamental assumption is its' similarity to a labile system and therefore the lack of being exactly determinable. That is to say, it is impossible to create an approach that includes all the disciplines that can be intersected with regard to a main theme. For this reason, the task of creating these intersections can be left freely to the students in such a way that they realize the different dimensions a concept is composed of, being these dimensions multiple. The concept map expressed, again due to the presence of the degree of lability, is not rigorous, but possesses the fundamental features of neural networks being thus their representation. So it is made up of nodes and links in which information is connected by logical laws and above all the resulting map is an adaptive system that modifies its interconnections based on external and internal information flowing through the network [7].

2.2 Interdisciplinarity

In turn, interdisciplinarity, as more specific, adds to the simple superimposition of disciplines the subjective interaction functions, generating, thus, the true phenomenon of information exchange. Returning to the example of a neural network, interdisciplinarity, as the rule under which nuclei exchange information within the network, has the role of the function f(x) which defines the constitutive law among the elements x of the various disciplines. Interdisciplinarity, with respect to pluridisciplinarity, is more complex due to its' foundation on the assumption of the operational logical structures existence that allow us to create a theoretical construct exceeding the phenomenal datum, as proposed by the philosopher Immanuel Kant [8]. J.Piaget himself defines interdisciplinarity as "the search for deeper structures of phenomena, destined to explain them". This is the research that defines the degree of detail and therefore the difficulty of dealing with a concept with the relative level of approach to different disciplines [9]. The major problem of interdisciplinarity is that every interaction is affected by subjectivity, so the weight of a discipline in explaining a concept depends in part on personal choices. From organizational point of view, having an interdisciplinary approach, the task of defining the tools of investigation and the theories of each discipline necessarily requires the simultaneous presence of teachers and students.

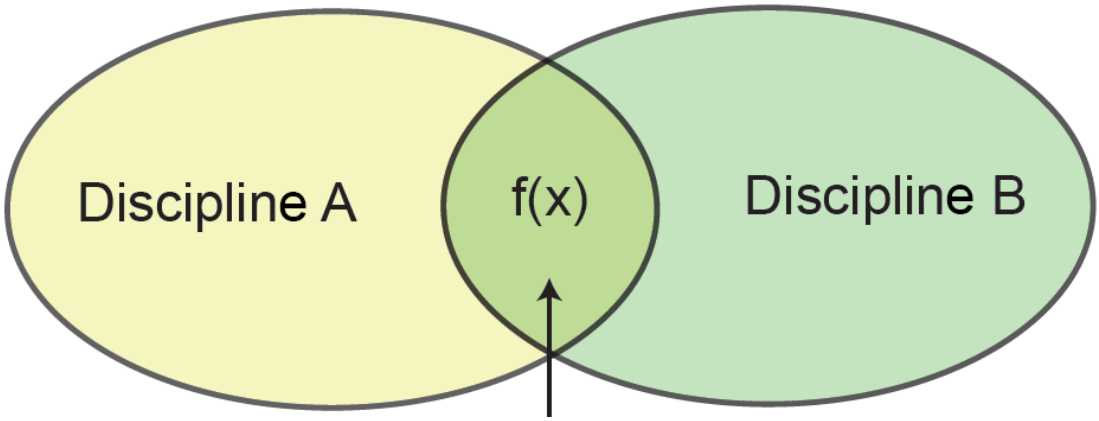

Fig. 2. Interdisciplinary scheme with the function indicated.

2.3 Transdisciplinarity

Transdisciplinarity, being more complex, embraces the themes that cannot be treated by single disciplines in veiw of their multidisciplinary nature, and differs from both multidisciplinarity and interdisciplinarity since it is located at a different level of communication. From the transdisciplinarity point of view the disciplinary intersections emerge and above all a new way of thinking and knowledge organizing to face the complexity of the world have to be considered. Therefore, rather than a method, it is a philosophy that treats the world from a different perspective when compared, for example, to the Greek classicism of Aristotle or the scientific approach suggested by Descartes. Transdisciplinarity must not be based on a simple knowledge, but must act on "learning to know" as defined by Basarab Nicolescu in 1985 - an evolved concept of Jean Piaget nominated in 1970 [9, 10]. Nicolescu in fact replaces the word transdiciplinarity with "beyond the discipline". This turns transdisciplinarity into an intellectual approach that aims to know the world complexity. This philosophical system, when a theme is chosen, collapses in a pattern represented by pluridisciplinary and the circle of formation closes through divergent thinking [11].

Therefore, a new training proposal must not have a simple coexistence of the three approaches, but must possess a true multidisciplinary study shared before a didactic activity. The end result must be the establishment of a structural system without stable borders between disciplines.

3. Conclusion

The structured mono-disciplinary competences that still remain dominant today don't match the dynamism and rhythm the modern society exposed to. Becoming outdated quite fast, these strictly sectorial approaches cannot guarantee neither employment nor demanded expertise to a graduate student, given the continuous displacement of human workforce by AI expert systems.

In this context, such instruments and pluri-, inter-, and transdisciplinarity, being conceptually more difficult and closer to the innate parallel information processing capacity of biological neural networks [12], represent the approaches, the cultivation of which would permit to keep the lead of a human in terms of innovation, synthesis, divergent thinking and creativity.

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