

# INTERRELATIONS BETWEEN TEACHER DEVELOPMENT AND CURRICULAR CHANGE: A RESEARCH PROGRAM

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## **Abstract:**

This article presents and describes a research program that has as investigation object experiences, actions and researches that interrelate the professional training/development of the teacher and the problematization/changes of the curricular practices of mathematics education in schools and universities. Such practices include exploratory-investigative activities of mathematics teaching and they take in consideration the students' social and cultural diversity. In this paper, initially, we present the problematization and the theoretical bases that justify and support this program and, later, the research methodology of first and second order. Finally, we present some initial results that were obtained from first-order researches.

## **Inquiring into the relationship between teacher development and curricular changes**

Teacher development and renewal of school curriculum have been, traditionally, treated as independent processes. Generally, the curricular innovations and the processes of teacher education do not take, as a starting and arrival point, the current school culture, the conditions of teaching in schools and the complexity of the pedagogical work. In our opinion, this is the main reason for which curricular reforms have not been able to promote the expected transformations.

The studies developed by our research group (GEPFPM) in the last years about collaborative groups – gathering professionals with different knowledge, in each group - have evidenced that the teachers' collective reflection on their practice have contributed to transform them into professionals: (1) that are more critical-reflective on their work, their knowledge, their students and themselves; (2) that transform their practices autonomously and conscientiously; (3) and that produce knowledge in their professional field (Fiorentini et al., 2004; 2005).

## **Teachers in investigation communities**

The results of these researches lead us to conceive teaching, not only as simple practice, but especially as a praxis in which theory and action are inter-woven, because teachers reflect and theorize all the time, negotiating possibilities between their classrooms and their lives at school and between their daily work with the pupils and the broader movement of change and social equality. We projected, then, a way to be pursued to promote the development of the teaching practices and the teachers' knowledge as well as an increase of their investigation communities. This seems to find an echo in the sayings of Cochran-Smiths & Lytle (1999, p. 292): "constructing local knowledge is understood to be a process of building, interrogating, elaborating, and critiquing conceptual frameworks that link action and problem posing to the immediate context, as well as to larger social, cultural and political issues".

The collaborative alliance among different professionals can help construct teachers' identity and their professional autonomy, in order to become critical users of knowledge elaborated by others (Carr & Kemmis, 1987).

Our trajectory in work and research in Brazil, has consisted of articulating the problems and challenges of teacher education and development of school curriculum. This has brought us a conviction that university researchers, school teachers and future teachers can together learn how to deal with school's diversity and heterogeneity, towards the quality of a possible education for the great contingent of less privileged class pupils. So, the quality of possible education, for each reality, is a collective construction and requires another conception of research, pedagogical work and teacher development.

## **Drafting a program of action and research**

This problematization about the interrelation between teacher education and curricular changes, in the current context, leads us to the following: first, to assume anthropological conceptions towards introducing "an extended vision of the possible contents that must be included, explicitly, in the curricula, beyond the contents considered academically relevant" (Gimeno Sacristán, 1999, p. 174). Second, to assume a political and epistemological stance, which consists of recognizing and investing in the capacity of the teachers' community for promoting professional knowledge, curricular changes and teachers development, in a collaborative and investigative way. This second aspect focus, as a starting point, the problems

and challenges of educational practices in schools. However, this is a complex social process with multiple expressions, with a determined dynamic, that constructs itself along the time and certain conditions.

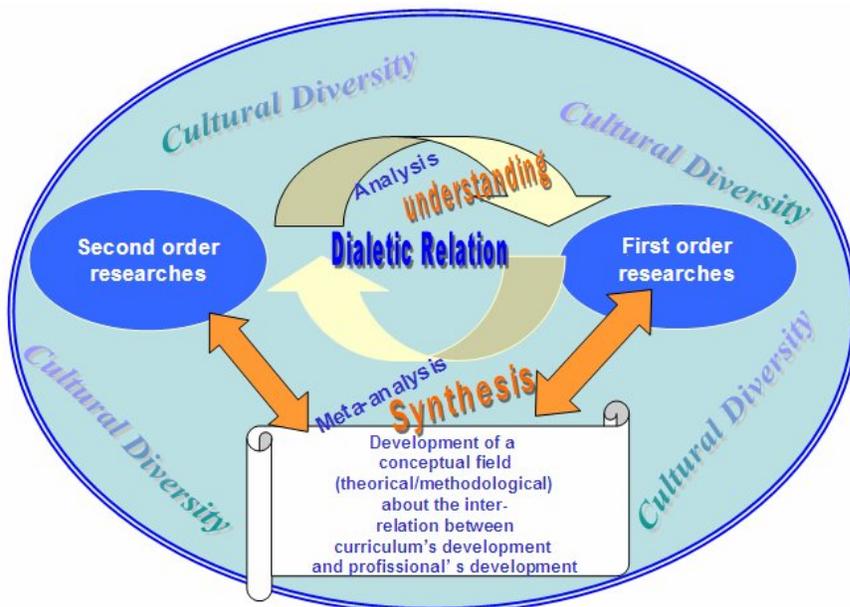
Our main hypothesis of research is, therefore, to conceive school and, specially, teacher's work and school curriculum as cultural phenomena, that is, "as a crossing of cultures that provoke tensions, openings, restrictions and contrasts in the construction of meanings" (Pérez Gómez, 2001, p.12).

In 2005, we started an articulated program of action and research - involving four research groups of four Brazilian universities (Unicamp, Unesp-RC, UFSCar and USF) – the aim of this program was to develop, coordinate and systemize researches that analyze aspects related to the interrelation between curricular development and teacher's training/development in a socio- cultural perspective that has, as scenery, didactic-pedagogical practices of an exploratory-investigative nature in a context of cultural diversity. This program, therefore, searches to understand this interrelation and to develop a conceptual field that gives a theoretical-methodological framework toward developing projects that articulate teacher's education and curricular development and researches in Mathematical Education.

The investigations that are being developed in the scope of this program contemplate two perspectives: (1) **first-order researches** – field or empiric researches carried out by university professors, post-doctorate students, doctorate students, master students, school teachers and graduating teachers, all participants of collaborative groups; (2) **second-order researches** - theoretical researches or researches of systematization and/or meta-analysis of studies and processes developed in the scope of the program. That is, the material of analysis of this kind of research is constituted mainly by first-order researches and meetings of reflection, analysis and interpretation by teachers and researchers during the realization and evaluation of their first-order research projects.

The development of this research program places face to face with the following challenge: to develop a conceptual and theoretical basis during the process of practice and research. This is the why we understand that second-order researches are necessary and relevant. We believe that this organic and dialectic movement between first-order and second-order researches allows us to develop new directions, new meanings and new issues for experiences

and field researches, which provide new subsidies and results for the second-order research, of which other meanings and issues will result, and thus, ad infinitum (Bakhtin, 2000). Such movement can be understood by looking at Figure 1, which illustrates the dynamics of research and dialectic movement between the two perspectives of research.



**Figure 1:** Representation of the dynamics of the research perspectives of the project

There is a interdependence between the second-order researches and the distinct contexts of research that have been and will be carried out by the participants, considering the specificities of each involved culture, that is, institutional culture, teaching culture, and school culture, among others. This movement does not imply a homogenization of the theoretical-methodological perspective to be used in the understanding of the investigated object. Jus the opposite: it provides another direction, another understanding of the complexity of the processes, in teacher education and in curricular development. We have to underline that these directions can be multiple, but, due to production conditions, they cannot be any direction; because, among different participants, each culture mobilizes an *exceeding vision* (Bakhtin, 2000) that provides new meanings or interpretations.

### **Some initial results of the program**

Let us take by reference five master dissertations concluded in 2007 that were developed by school teachers who participated in collaborative groups, sharing and discussing their researches. Although all the dissertations weave relations between teacher education and

curricular practices, three of them (Andrade, 2007; Cristovão, 2007; Gomes, 2007) had as focus of analysis exploratory-investigative practices developed in the classrooms from the 5<sup>th</sup> to the 8<sup>th</sup> grade of Basic School; and two others (Farias, 2007; Lamonato, 2007) had practices and exploratory-investigative experiences of teacher education in courses of pre-service or in-service education.

Let us consider, initially, the obtained results in the researches of the first set of studies. The first research was done by Cristovão (2007), in the position of in-service math-educator of mathematics teachers at regional education department and as a teacher-researcher participating in a collaborative group at Unicamp. She realized the difficulty of two teachers with cycle, recovery classrooms in mathematics. Then she formed a group with those teachers and other interested partners. This group was characterized as a collaborative group of first-order research-action, which became the object of analysis of Cristovão's research, which was characterized by her as being a *second-order research-action* (Elliot, 2000). It had as an objective to analyze the possibilities and contributions of exploratory-investigative activities for the school inclusion of these pupils. In the first-order research-action, the teachers were able to discuss teaching alternatives, and, jointly, to plan and analyze tasks and activities of exploratory-investigative nature, aiming at the mobilization and appropriation of concepts related to statistics and geometry. The analyses have evidenced that pupils who were considered "weak" in mathematics – by the teachers and by themselves – were able to live rich mathematics experiences. They could perceived themselves as not only being capable of learning school mathematics, but also producing their own ideas, arguments and mathematical relations, increasing their self-confidence in mathematics. And the teachers, themselves, were able to experience and reflect about their practices, developing their autonomy in the production of school curriculum for heterogeneous classrooms and focusing in the practices of "weak" students as well as the possibilities of school inclusion of these students.

Gomes (2007), a teacher-researcher of a collaborative group at USF, has developed an investigation with 5<sup>th</sup> and 6<sup>th</sup> grade classrooms of adult education (EJA), in which she aimed at analyzing the mobilization and the production of mathematical knowledge generated in exploratory-investigative activities and its contributions to the teaching of mathematics in EJA classes. This analysis has evidenced that such activities had allowed the teacher to give voice to the adults, in order to express their ideas and thoughts mathematically, propitiating the

development of an intellectual and critical autonomy and, consequently, their social and educational inclusion. The researcher has evidenced the limits of these tasks, specially, due to the "crowded classrooms, limited time to develop them in class; the culture of silence present in adult classes; the physical and material conditions of the school; and the students' preparation for working with this type of activity" (p. 172). In relation to her professional development, the teacher-researcher underlines that the research of her own practice, starting from opened tasks, has propitiated her to challenge herself in daily practice, mobilization of knowledge(s), sociability, critic sense and creativity, promoting a continuous development of her professional identity.

Andrade (2007), also a teacher-researcher of a collaborative group at USF, has investigated the pedagogical potentialities of virtual stories of the mathematical concept from the perspective of the problems solving from childhood education up to the last year of elementary school. Aiming at analyzing the written mobilization of mathematical concepts of these stories and their: written and oral productions, the study has evidenced that these stories had motivated and mobilized the pupils in all grades to solve the problems of the characters' stories. For solving them, they used pictorial registers on the childhood education and mobilized different strategies in the other grades. Besides allowing the elaboration of new problems and the emergency of investigative tasks/activities, these stories have also opened space for pupils to attribute meanings to the context in which they were inserted. They have also propitiated the emergence of many solving strategies that have transcended the mobilization/production of mathematical concepts, approaching aspects related to their beliefs, values and ideologies.

Regarding the two studies of the second group, let us consider first Lamonato's (2007) - a master student who participated in a collaborative group at UFSCar. She analyzed a process of in-service training of four teachers who teach mathematics in Kindergarten Education. This training process consisted of studies and discussions on teaching of geometry in Kindergarten Education. Its dynamics included experimentation, planning and application of exploratory-investigative activities in geometry with further collective analysis. The author's intention was to investigate the learned facts and the knowledge mobilized by the teachers during the training process. The analysis confirmed that geometry is not a field of mathematics that is present in their teaching practice. Regarding the exploratory-investigative activities, the teachers developed an investigative and argumentative position during the acquirement of new knowledge about

geometric contents. They recognized its importance, when they realized that these contents allow understanding the place and the value of geometry in the Kindergarten Education, as a way of reading and representating space. The actions developed in the classroom by the teachers revealed new ways of understanding the importance of the children's drawings about the games that they played and the changes in their way of teaching.

The study of Farias (2007), a master student who participated in a collaborative group at Unesp, Rio Claro, has investigated the contributions from mathematical representations, evidenced by under-graduate students in mathematics through the use of educative software and the development of explorative-investigative activities. These activities were developed in a Differential and Integral Calculus course, which aimed at didactic-pedagogical education of math-contents of future mathematics teachers. The results have evidenced that in this context the mobility of the mathematical representations significantly promote the interpretation, the visualization and the understanding of the mathematical concepts. They also allow the future teacher to perceive the generation of knowledge that can be used in different ways: images, writing, logical models and laws, that are the basis of these concepts. These shapes and the mathematical language play a fundamental semiotic role in the constitution and understanding of mathematical concepts.

### **Some conclusions**

These first order researches were developed by school teachers that could count on the support and the reflection of collaborative groups involving university math-educators, school teachers and graduating teachers. The results have evidenced that these teacher-researchers presented indications of professional development, such as: (1) changes in the management and organization of school curriculum, recognizing other more effective possibilities of promoting school inclusion of pupils with learning difficulties in mathematics. This is the case of the exploratory-investigative tasks/activities, which breach, thus, with the linear conception of the curriculum and allow changes in the beliefs and conceptions of the pupils in relation to mathematics; (2) learning of new mathematical knowledge, from the experience of this exploratory-investigative environment; (3) change of attitudes in relation to mathematical knowledge and to mathematical activity in the classroom, assuming a more critical and inquisitive stance with the pupils and opening spaces for the production and negotiation of

meanings; (4) a more critical relation with themselves and with the existing practices in the teaching of mathematics at schools and with the processes of teacher training anchored in technical rationality, recognizing the importance of collaborative and investigative practices, in order to face the problems and challenges from school practices.

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