

JUANJO MENA, ANA GARCÍA-VALCÁRCEL,
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SEARCH AND RESEARCH: TEACHER EDUCATION FOR CONTEMPORARY CONTEXTS



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Jottings for the modernization of professional practices in the first stages of the training of mathematics teachers. A screening by nodes of praxeological configuration

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ABSTRACT

The objective of this article is to present some jottings that are required for the modernization of professional practices of the mathematics teacher. Based on the premise that practices are conceived under reflection but become concrete in action; it is a necessity to acknowledge the praxeologies, considering *logos* and *praxis* and its 4 development elements. Following this line of thought, it exposes the need of creating bonds between meaning and sense, fostering the professional identity of the teacher. It deals with the arose problematic concern, of the insufficiency caused by the curricular fragmentation, linear systems and practice communities it is immersed in. As a result, the need of resignifying professional practices which are restricted to the replica of theories and limited to disciplinary borderlines emerges. Thus, the notion of praxeologies with complex views and the notion of attractor for the consolidation of professional practices are considered. This implies to associate akin praxeologies (mathematics, didactics, pedagogy, and contextual among others) as orbits that relate to the attractor “professional practices”; going against the reductionism in which teacher’s professional practices are bemused with instructor practices. Hence, acknowledging the need of rethinking curricular organizers of initial university training programs concerning structural questionings and augmenting the attractor’s percentage value.

KEYWORDS: professional practices, initial training of mathematics teachers, professional identity, praxeologies, attractor.

1. INTRODUCTION

Mathematical education as a contributory *transdisciplinary effort* (Nicolescu, 1999), according to Morin, to a complex commitment, emerges from the systemic that attains all science but overcomes them in quantity and complexity in terms of the relations that emerge; there, a *complex system* is constituted (García, 2006). This system considers that professional practices do not limit to repeating theoretical and methodological constructs. On the contrary, they belong to an ecology that gathers, mutes, adapts and transforms -as well as are transformed- according to geographical, social and intersubjective space in

which they flourish. With this premises in mind, this text presents some elements of consideration and modernization in mathematics teachers' training rescuing the components of the professional practice, particularly professional identity, understanding it as complex systems and not as static linear ones. Attending on the question of PhD research: *How can a complex architecture be for the curricular design of the first stages of the training of mathematics teachers in Colombia that contributes to the social network in which this one is carried out?* Developed by the author, in particular, the related to the professional practices.

2. THEORETICAL FRAMEWORK

The spectrum of professional practice of a mathematics teacher develops and privileges its action to a community of practice -COP- (Wenger, 2001). In general terms, along education history, COP's have centered on professional practices in places like the classroom and the school. Nonetheless, the understanding that one might have of them is not necessarily equivalent. According to the perspective that a COP might bear, to what is considered authentic and the didactic intentions it endows; planning and managing for teacher's training will take the form of an open and complex system or of a linear and enclosed one. In other words, the conception of education that prevails directly affects the training that is offered since this affects professional development in a specific community of practice.

The study of professional practices of the mathematics teacher, according to Bishop (1988) and Skovmose (1994), allows to infer that the COP's in which they have been generated, are circumscribed in linear and enclosed systems. According to Aguerrondo and Vezub (2003), this is clearly seen when teachers are observed in their initial practices (as students or novice teachers); when they consider an excess of theoretical aspects unrelated to the reality they are facing; definitely the estrangement in which training was offered does not reflect the abutment of the reality they face.

The latter recognizes that the whole is greater than the parts, and that teacher training has focused, in excess, on studying the parts, leaving the whole aside since it is assumed as additive. This call is an initial indicative that the comprehension of professional practices corresponds to the study of a complex system, it works according to interacting processes that cannot be abridged nor decomposed. This means that it is superadditive, not additive (García, 2006). This means, we are facing professional practices understood as dialectic construction.

For Díaz (2003) practices are a possible object of study, according to their nature, as ersatz and artificial or as authentic. The former, understood as those "in which a rupture is expressed between the *know what* and the *know how*". (p. 3) and the latter "simply defined as the ordinary cultural practices". (Brown,

Collins y Duguid, 1989, p. 34) cited in Díaz, B. p. 3, 2003). In sum, the first understanding of practices deals with a linear, enclosed system; while the second one is associated with an open, complex one.

However, every professional practice system, regardless of its affiliation, links obligatorily to what Chevallard (1999) has called *praxeologies*, understood as the professional activities related to the tasks of being a teacher and its professional practice. Two levels are indissolubly adjoined, the first one is the practice level, *praxis*, associated with two basic elements: the tasks and the techniques. These offer sense to the *know how* and the *know what*. The second, the reasoning on the practice, *logos*, in which two other elements circumscribe: technology and theory, as noted by Servín (nd).

Lastly, Vezub in his studies on teachers' training in Latin America, found that the professional development of teachers, therefore, professional practices, present a bountiful number of issues that may be grouped in 4 macro-dimensions. These are: "the institutional organization and the regulation of training, curricular aspects, the models and training approaches and; the trainers, the teachers of teaching training" (Vezub, p. 6, 2007).

Consequently, if the transverse axis of the professional practices in the four aforementioned dimensions is meant to be the teachers' problem solving; a complex, unclosed system that involves dynamic systems is consolidated. Subsequently, these practices are within a system that is not random nor deterministic; it is a chaotic one, in which they behave as an attractor of diverse praxeologies, which revolve around mathematics teachers' training. Therefore, they are considered: "anything in which something stabilizes in time" (Stewart, 1991). Likewise, Lorenz (1995) understands the attractor as "the graphic representation of the phase space" (Alvarez, 2005) which implies to understand it as a collection of points (states) that globally agglomerate and stabilize the system, even when it presents local instabilities.

3. METHODOLOGY.

This investigation assumes a transdisciplinary perspective associated to a socio-critical paradigm; and, develops from an experimental nature. In order to achieve this, it consolidates a mix approach (Creswell & Plano; Clark, 2007; Tashakkori & Creswell, 2007, 2008) in an observational and correlational analysis, from the triangulation of information and theories (Tashakkori & Teddlie, 2003) within the documental revision (F1), carrying out perception surveys on professional practices and its meaning (F2), development of mathematics teacher student's biographies in different levels and education establishments (F3), the development of semi-structured interviews with in

training and in practice teachers (F4), the quantification of the estimation of levels of association among the fields of study (F5), and the construction of a complex curricular proposal (F6).

This paper presents results of the professional practices as a complex system and attractor of praxeological configurations, are stated as partial results of F1 and F3; these components were developed from the second term of 2015 to the first term of 2017, with statistic sample of 75 training teachers of 2 universities.

4. RESULTS.

After revising the documental analysis (F1) and the biographical section (F3) with mathematics teacher students, the following partial results may be acknowledged:

- Related to institutional organization and training regulations:

Being a mathematics teacher in Colombia only achieved a professional status in the 70's (Vezub, 2003, 2007; Guacaneme *et al*, 2011; Albadan, 2017), that means, it is quite young as a complex system and does not completely correspond with this definition. Accordingly, the practices carried out before the mentioned milestone find their meaning and sense linked to ersatz and artificial practices; thus, their role embodies the replication of alienating models that are not consciously adopted by the novice and therefore, they lack of authenticity for those incoming to a COP.

As a consequence, the curricular organization, in general terms, which serves for professional practices during training are constructed with a complex concern but with raw materials that turn to be programmed and linear. These have constituted the tradition in Colombia for more than a century; a contradictory event *per se*. For this reason, it is interesting to observe that 85% of students in their biographies reduce their professional practice to their teaching practice; that is to know and teach mathematics. For example:

“I want to be a mathematics teacher to teach mathematics (E5). To be a mathematics teacher is to know mathematics and to be able to transmit that (E35). The most important seminars -*subjects*- are mathematics’ (E1, E7, E15, E40 and others)”

- Related to models and trainers

Even today, universities dedicated to give instruction on professional practices of mathematics teachers are in the struggle between instructing vs. coaching; as can be seen in the revision of scope and sequences. This implies that it hasn't

been understood a model in which training is embedded in the *relation knowledge-transformation* (Gil, 2015). This is portrayed when going over seminars that belong to knowledge branches (mathematics, didactics, pedagogy and practices); however, comprehensions and requirements of the relations implied are non-existent nor of the explicit pretensions. Besides, a percentage unbalance is kept among the aforementioned dimensions, León backs this when studying 25 curricular organizations in Colombia, finding that in average “39.07% of subjects related to curricular proposals correspond to mathematical training, 21.47% to professional knowledge, 11.66% to training on didactics, 10.97% to pedagogical training, 5.48% to practice, and 5.40% to research training”. (León *et al*, p.64. 2013)

The latter, reveals the existent rupture between the praxeologies conveyed in the professional practices. Accordingly, the model is restraint to the *logos*, and has left as homework, to the student, the *praxis*. And, what we call *praxis* circumscribes to the mathematician’s technique and task; rather than to the mathematics educator’s practice leaving aside the principle of professional identity, based on the trainer’s beliefs. Such insufficiencies indicate that professional practices have not been able to evolve into a didactic system that acknowledges, as mentioned by Díaz (2003), actions of *cultural relevance* and outturns *social activity* that the former promote during training (Derry, Levin y Schauble, 1995). In short, we have not made possible the shift to complex systems and to its configuration of praxeological nodes.

5. IMPLICATIONS/DISCUSSION.

The discussion, deep inside, emerges when professional practices are understood as non-linear systems, because this would imply to initiate a study of multiple relations and infinite consequences when posing a problem and its solutions are kept within the attractor “professional practices”. On the same token, considering it and the orbits that surround it (the mathematical, didactic, and pedagogic praxeologies) goes along with the impossibility of controlling all the variables that may come up, confirming that professional identity is only possible form the subject’s mutation and evolution. Thus, the debate that arises is: How may universities configure a professional practice system, in teachers training programs, that considers global stability but is also willing to assume the local instabilities in a finite space of time? An early answer would imply a change of curricular organizers.

6. CONCLUSIONS

Professional practices of mathematics teachers must be configured as didactic organization, hence, they should overcome *empiric and spontaneous praxeologies of the teacher* (Bosch y Gascón, 2001) and understand the *didactic codetermination* (Chevallard, 2001 y 2002), becoming an attractor of praxeologies. Accordingly, they must be designated from punctual, local, global, disciplinary and didactic levels of action which have as a methodological constructor problem solving. The latter, serves, as well, as a transversal axis to the 4 macro-dimensions in which professional practices may be configured. In like manner, it is necessary to carry out actions that invite to bring down the confusion between mathematics teacher professional practice = mathematical instructing practices. *Professional identity*, (Gysling, 1992; Catonnar, 2001; Lasky, 2005; Sloan, 2006; Vezub, 2007) as a autobiographic, constitutive, mutable, and dynamic process is the one that allows *defining themselves and the others* (Lasky, 2005). In other words, professional practices require understanding that their action does not fall, in an exclusive manner, on official institutions of traditional direct encounter. This is how, universities must incorporate designs in which professional practices may and must be directed towards other spaces, rarely pondered under schools' traditional view; among others in prisons, publishing houses, research groups, and hospitals just to name a few. Foreseeing how professional practices may look like in settings different from traditional classrooms; configurations that as an attractor node assume mathematical, didactic, methodological, pedagogical, and social praxeologies are required. A curricular reorganization is needed, in terms of dimensions (orbits - praxeologies-) and professional practices (attractor) which connect empirical, spontaneous praxeologies of the teacher with the construction of the professional identity as a dual process. Moving from the restrained and programmatic seminar to the reflexive professionalizing action that recognizes the role of mathematics as a social construction. Consequently, questionings that may serve as curricular organizers are: What mathematics does a mathematics teacher require to know? What sceneries must the teacher have in mind? What is the difference between instructor practices and professional practices? Which are the instances for contentment of a mathematics teacher? Which curricular organizers are required in professional practices? What do we require, as trainers, to get into professional practices modernization? In the end, it is imperative that initial training programs augment the percentage of the professional practices attractor along the program of studies, in pursuance of reducing the existent fracture.

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