

DEVELOPING STATISTICS TEACHERS' IDENTITY: A LOOK AT COMMUNITIES OF PRACTICE

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In this work we studied the development of statistics teachers' identity. The study took place within a teacher education program with weekly meetings. The program promoted the development of statistics teaching materials at the school level and reflection on several tensions that emerged during teachers' practice in the classroom. Statistics teachers together with researchers participated as members of a community of practice that was characterized by their mutual commitment to the group. Data was collected from multiple sources: classroom observations, interactions within the meetings with teachers, autobiographies and interviews. We focused on the episodes that revealed pieces of teachers' identity, those episodes that exposed teachers' experience, background, and life story that helps us to understand how statistics teachers learn.

PROBLEM AND BACKGROUND

In the Colombian national curriculum for compulsory education, statistics is one of the components of mathematics. The inclusion of statistics in the curriculum was official with the publication of the *Mathematics Curriculum Guidelines* (Ministerio de Educación Nacional, 1998) and *Basic Performance Standards* (Ministerio de Educación Nacional, 2003). In our country, the teaching of statistics is assumed by mathematics teachers; consequently, it is common to talk about mathematics teachers and rarely about statistics teachers. Thus, the teachers who are responsible for teaching statistics do not see themselves as statistics teachers but as mathematics teachers. This is problematic if we start from the idea that there are differences between mathematics and statistics (Ben-Zvi, Garfield & Zieffler, 2006, Cobb & Moore, 1997; Scheaffer, 2006).

“Statistics is a mathematical science” (Rossman, Chance, & Medina, 2006, p. 323). Statistics makes extensive use of mathematical tools, it is an independent field and not necessarily a subdivision of mathematics. The development of students' statistical thinking, which is the goal of statistics in the school, has to deal with the presence of *variability*. Variability in data needs to be understood, explained and quantified to solve problems and make decisions in statistics. Variability is the core of statistics and is what makes the distinction between statistics and mathematics (Franklin & Garfield, 2006). The different natures of mathematics and statistics need to be taken into account in teacher education. Different types of reasoning and intellectual skills are involved in teaching mathematics and statistics.

The literature on teacher education is very limited studying the statistics teacher. For example, there are many studies reporting results with mathematics teachers (Horn, 2012; Llinares & Krainer, 2006; Ponte, 2001; Ponte, 2013; Ponte & Chapman, 2006). However, only in recent years, those who teach statistics have been studied in their particular dimensions (Batanero, 2009; Estrada, 2007; Estrada, 2009; Estrada, Batanero, & Fortuny, 2004; Lopes, 2004; Makar & O'Brien, 2013; Pamplona, 2009, Zapata & Rocha, 2011).

In relation to teacher education, the tradition in teacher professional development programs has favored a technical perspective that privileges formal knowledge (disciplinary), one-way communication from teacher educators to teachers (Kumar & Subramaniam, 2012), a gap between theory and practice (Pereira, 2008), contrast between the “expert” (teacher educator) and the “inexpert” (teacher) and between the one who speaks and the one who listens. Thus, the tradition in teacher education has adopted a vision of the teacher as a passive subject and executor of theories and strategies that have been developed by others (Zamudio, 2003).

In this research, we try to account for the constitution of the statistics teacher's identity while attempting to overcome the limited vision of teacher professional development programs. We propose a program inspired by the principles of communities of practice that promotes working together, dialogue, reflection and exchange of experiences but recognizing that teachers' learning is a life time process. We attempt to answer the research question: How does a teacher education program structured as a community of practice disclose indications of the development of statistics

teachers' identity? Identity is understood as "the process by which a person tries to integrate their different status and functions as well as their diverse experiences into a coherent image of themselves" (Epstein, 1978, cited by Day, 2006, p. 69). Studying statistics teachers' identity leads us to discuss how teachers see themselves, how they are seen by others, how they relate to the area of knowledge, how they see "others". Identity is assumed as dynamic, progressive and temporal, but its temporary nature goes beyond a linear notion of time as identity is defined by "the interaction of multiple convergent and divergent trajectories" (Wenger, 2001, p. 193). We understand that teachers' professional development is both a process of personal and professional growth, and a teacher's trajectory helps to constitute his/her identity (Bolívar, 2007). In spite of this, the majority of teachers' professional development programs focus on the content the teachers learn. This emphasis, however, does not take into consideration the knowledge of the processes involved in teachers' learning. Thus, studying teachers' identity is a way to overcome the attention on what teachers learn and focus on how they learn. Identity is a learning trajectory that takes place through participation in specific communities.

An alternative to address teachers' professional development is to create and strengthen opportunities for discussion in which the teachers share their experience and constitute their identity fed from their peers' voices, experiences and reflections. A teachers' program that contributes to the statistics teachers' development and enables the study of their identity could be based on social practice theory (Wenger, 2001). In social practice theory, communities of practice are "groups of people who share a concern, a set of problems, or a passion for a topic, and who deepen their knowledge and expertise in this area by interacting on a regular basis" (Wenger, McDermott, & Snyder, 2002, p. 4). In a community of practice, teachers have the opportunity to participate in joint activities that allow them to learn and share their experience with others, so that identity becomes a process of participation in the community.

During our professional trajectories, we belong to different social configurations that, although not always considered communities of practice, have important contributions to the constitution of our identity. To belong to those different configurations we use mechanisms called by Wenger (2001) *modes of belonging* that are defined by: *engagement, imagination and alignment*.

Through *engagement* we get actively involved in the negotiation of meanings and identities by doing things, working alone or together, using or producing artifacts. Engagement gives us direct experience with regimes of competence. The *imagination* influences our experience of identity and it is a type of auto establishment in social practices. We construct images of the world, the past, the future and from ourselves that help us to understand how we belong or not. Through *alignment* we feel part of projects, associations or movements in which we share their goals. But that does not mean that we are engaged. Alignment does not mean passive acquiescence, rather it is a process of coordinating perspectives, interpretations, actions and contexts. In this report, we focus on those *modes of belonging* released in teachers' stories that help us to understand the constitution of their identity.

METHODOLOGY

Participants were in-service teachers of the compulsory education cycle from public schools in a large city in Colombia who voluntarily joined the statistics teachers' professional development program. In their schools, these teachers were responsible for the teaching of statistics, with the exception of one teacher who only taught mathematics and never had the opportunity to teach statistics. All of them held a professional degree in mathematics education and some were working towards a master's degree in science.

The professional development program was conducted in three-hour weekly meetings during one semester. In the meetings, we dealt with issues related to the teaching of statistics. We carried out different activities like planning a statistics class about to be taught in the classroom, restructuring the planned class according to the reflections originated in the group discussions, observing and discussing episodes from participants' statistics classes, and designing and testing statistics activities. The meetings were settings in which non-hierarchical relationships were built and all voices were accepted. All the participants shared their experiences and learned from others.

There were multiple sources of data (all in Spanish) such as: autobiographies, ideograms, semi-structured interviews, journals, writings related to participation, and life stories, video recordings from statistics classes and video recordings of the meetings in the professional development program. In spite of the large amount of information, for this particular report we only took into account the teachers' statements (verbal or written) related to the constitution of their identity as statistics teachers. Other pieces of data were used exclusively to confirm and contrast our findings.

ANALYSIS AND RESULTS

We try to describe possible paths in the constitution of teachers' identity in the process of becoming a statistics teacher. To fulfill that goal, we considered teachers' training trajectories released through statements used in verbal or written discourse. We argue that teachers' identity is constituted from multiple sources in a constant dialogue between the individual and the culture, a process in which it is relevant how, when and with whom they have become teachers. We present four cases with different levels of training and experience Daniel, Zaida, Cristina and Germán (names are pseudonyms to protect participants) that illustrate different forms of identity. We think that these cases are particularly relevant in supporting our arguments.

Daniel is a high school teacher with nine years of statistics teaching experience. He received training in statistics in high school. He pointed out that he felt strong admiration for his statistics teacher in high school: "I remember that her classes were very enjoyable. [...] She knew what she was doing. [...] high school awakened my academic interest because before I was a very bad student" (interview, August 6, 2013). In addition, Daniel took a statistics course in his undergraduate program and had planned to take an extra course in his graduate program: "now in the master program I will take a statistics course". In Daniel's conversations, his interest in statistics is clear. He joined the development program "because the subject was statistics". During the professional development program, he shared some concerns related to certain statistical concepts, activities conducted in the classroom, as well as his satisfaction for teaching statistics: "I love to teach statistics". In terms of how he sees himself as a statistics teacher, he said "I feel fine as a teacher, as a statistics teacher much better". We identified that Daniel felt *aligned* with statistics and had an interest in further education in the area. Daniel's initial training certainly has been an important element to constitute his identity as a statistics teacher. He sees himself as a statistics teacher and his experience has strengthened his identity. This agrees with theoretical positions that suggest that identity emerges not only as a result of a professional degree but continues during the practitioner's life (Vaillant, 2007). In addition, Daniel's participation in other social configurations (multi affiliation), such as a high school setting, has showed him certain models of statistics teaching that he admires and tries to imitate. In accordance with Wenger (2001), this is related to *imagination*. Each experience leads us to an image of the past and relates us to an image of the future.

Zaida has taught statistics for thirteen years and she believes that teaching statistics has been a learning experience: "teaching statistics has opened a range of possibilities for new activities, ways to build, do, and assess" (meeting, May 15, 2013). Zaida's statistical training during her school years was absent: "I learned nothing in statistics in primary, middle or high school [...] everything was at the level of other [mathematical] branches" (interview, August 12, 2013). In her undergraduate program, she took a statistics course but the experience was not positive because she was expecting a baby. "I was pregnant and I felt sleepy all the time [...] it was hard for me". She recognized that her first experiences teaching were not easy: "for me it was very difficult to teach statistics because I had not had the preparation in high or elementary school, nobody had motivated me". Zaida's image of herself as a statistics teacher, started to change as she had her first experiences teaching: "when I started working I saw the importance of statistics [...] I had to start looking at textbooks, libraries, wherever possible to prepare my classes". Zaida's challenges at work have taken her to learn statistics as an autodidact, taking advantage from different sources.

Zaida in her extended trajectory highlights the value of her teaching experience. She stated that the teaching of statistics "has been an important experience in my life" (autobiography, March 3, 2013). She recognized herself as a teacher of the subject: "as a statistics teacher, I look at myself

differently, I have learned many things” (interview, August 12, 2013). She has also become a support benchmark for her colleagues. It is interesting to note that the establishment of Zaida’s identity as a statistics teacher took a particular path. She has become a statistics teacher as the result of her professional practice. Her training in relation to the statistical knowledge was not strong but her career has demanded her to take certain actions to strengthen her disciplinary training and act accordingly. The statistics teacher that Zaida is today is the result of personal experience rather than professional training. This contrasts with Vaillant (2010), who suggests that the constitution of the identity is a product of personal experience and the role recognized by society. In addition, Zaida’s job demands put her in a position of *engagement* that compels her to develop an identity of participation with her practice while she becomes an *image* for her peers.

Cristina is a high school teacher with a bachelor’s degree in mathematics education and some studies of environmental engineering. She does not have any experience in teaching statistics. She had statistical training when she was a high school student in eleventh grade but she does not hold very good memories from that experience. She described that once when coming into her high school statistics classroom, “the teacher already had half blackboard written and I could not do anything else but write-down [from the board], but I stayed the same [did not learn]” (interview, August, 2013). During her engineering studies, Cristina took a statistics course focused on software use, and in her training as a teacher, she took a basic course. However, she mentioned that:

I never saw the usefulness or taste [to statistics], for that reason, truthfully, I forget it so easy. [...] In the early years, I did not have the opportunity to have good foundations. [...] I got to college and I found things that I say wow [...] I had never seen in my life. (Interview, August, 2013)

Although Cristina had had training in statistics in various scenarios, she did not have to teach it. Her responsibility has always been teaching mathematics. In the school she works for, statistics is an independent subject and that fact has represented some relief for her because somebody else has to teach it. However, she stated that if she had to teach statistics, she would have to study a lot to be able to give a practical approach to her classes. Even though Cristina had statistical training at school and college level, her *images* from the past are not very positive, besides, she has never been a statistics teacher. She feels that if she had to teach statistics that would be a huge challenge. Cristina, with training in statistics but without teaching experience (*no engagement*), does not see herself as a statistics teacher. This case illustrates the strong influence of experience in the constitution of the statistics teacher’s identity in which the *images* from the past are essential in the construction of present *images*. Simultaneously, this description illustrates a scenario of inconvenient *engagement*. Cristina did not feel competent in the subject and according to Wenger (2001), we close the possibilities of negotiation with what is different or confronts us.

Germán is an elementary school teacher with one year of statistics teaching experience. From his school years he said, “I do not remember anything that has to do with statistics” (autobiography, March 3, 2013). He took a statistics course in his undergraduate program and what he remembers is that “for every situation there always was a formula” (interview, July 21, 2013). Besides Germán’s undergraduate training, he took two teachers’ professional development programs focused on teaching statistics but his *image* of statistics did not change much: “[statistics is] a bunch of equations and formulas to apply at the test”. He, however, did not see himself as a statistics teacher and said, “I do not see myself as a statistics teacher [...], my contact and knowledge of statistics is rather poor”.

It is remarkable to contrast that Germán’s and Zaida’s statistical training is similar. None of them studied statistics at the school level, both had a basic statistics course offered in mathematics education at college and both had completed two teachers’ professional development programs in teaching statistics. Despite their similar training, their teaching experience is different and how they see themselves as statistics teachers is also different. Where does this difference come from? According to Wenger (2001) this comes from *imagination*. Two people can learn different things from the same activity. Furthermore, it seems plausible that statistics teaching experience (*engagement*) is a key factor when it comes to establishing the identity as a statistics teacher. Those daily lessons that provide the early experiences constitute important elements for future learning

based on cumulative experience. The role as a statistics teacher is assumed when the teacher is in contact with the discipline, students, and colleagues in real and concrete scenarios.

CONCLUSION

While statistics training is an essential aspect in the constitution of a statistics teacher's identity, it seems that experience is a much more decisive factor. Daniel and Zaida with extensive experience in statistics teaching, and with much less statistics training than Cristina, see themselves as statistics teachers. In our study, many teachers had similar basic training in statistics; however, the fact of having the same courses in their background does not guarantee that teachers would construct similar *images* of themselves as statistics teachers. That is, the constitution of the statistics teacher's identity does not end with the initial training. It is necessary to build it and this is done to the extent that the teachers get some statistics teaching experience (*engagement*) and construct *images* of themselves as statistics teachers in *alignment* with their teaching practice.

Surely a statistics teacher's identity is constituted from multiple factors since it is an individual and collective, complex and dynamic process. The preliminary results of this study show that statistical teaching experience is a decisive factor, but it is necessary to continue this search in more depth and detail.

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