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Exploration of new post-secondary mathematics teachers' experiences: preliminary results of a narrative inquiry

Sarah Mathieu-Soucy¹, Claudia Corriveau², and Nadia Hardy³

¹Concordia University, Montreal, Canada, sarah.msoucy@gmail.com; ²Laval University, Quebec, Canada; ³Concordia University, Montreal, Canada

This paper reports on a pilot study that has taken place during the winter semester of 2017, in the context of a larger project whose goal is to contribute to studying the transitions from being a university mathematics student to becoming a post-secondary mathematics teacher. With very scarce literature on these transitions at this specific level, this pilot study acts as an exploration into new teachers' significant experiences that may be involved in shaping their relationships with mathematics, and its teaching and learning. We conducted a narrative inquiry with three new post-secondary mathematics teachers who were interviewed on a regular basis during a semester. Those interviews provided an insight into the new teachers' experiences by pointing out themes that are relevant to them. We conclude with a discussion on what remains to be achieved to conduct this research.

Keywords: Teachers' and students' practices at university level, Preparation and training of university mathematics teachers, Narrative Inquiry, Becoming a teacher.

INTRODUCTION

This paper presents a pilot study that took place during the winter semester of 2017. It addresses the transition from being a university mathematics student to becoming/being a post-secondary mathematics teacher. More precisely, the context is set in cegep institutions (general and vocational colleges), the first step in post-secondary education in the province of Quebec, Canada. The focus of this study is on new cegep mathematics teachers who, with an education mainly – sometimes exclusively – in mathematics, negotiate the transition from being a mathematics student (undergraduate or graduate) to teaching at post-secondary level. We start with a brief description of cegep institutions, followed by a discussion on the literature on becoming a teacher at post-secondary level. The theoretical framework and the object of study are then described followed by the methodology and the main results. We conclude with the next steps in the study and our expectations for the results.

A Few Words on the Context of Study

Cegeps are general and vocational colleges. Two-year pre-university programs are offered in sciences, arts or social sciences; three-year technical programs, such as nursing, computer science, building engineering technology, etc., are also offered. All programs include compulsory general courses, such as philosophy, French, English and physical education and multiple programs offer mathematics courses. Some technical programs include mathematics courses that are specific to the field of study. Those courses are offered mostly by mathematics instructors, even if they are not

very familiar with the profession their students are aspiring to do. Pre-university programs in sciences and social sciences offer two calculus courses (differential and integral calculus) and one linear algebra course, slightly different from one program to the other, depending on the institution. Social science students are required to take a quantitative methods course. Some institutions also offer optional mathematics courses for science students, such as multivariable calculus, probability and statistics or discrete mathematics. Therefore, from advanced calculus for science students to quantitative methods for social science students, as well as mathematics applied to computer science, cegep mathematics teachers are required to teach a wide array of courses, to a wide range of programs and students.

To teach in a cegep institution, individuals are (officially) required a 3-year undergraduate degree in mathematics or connected field (Conseil Supérieur de l'Éducation, CSÉ, 2000). However, each institution can add other requirements, such as a master or a doctorate in mathematics. A handful of universities in the province offer a one-year graduate certificate in cegep teaching, unique for all disciplines taught in cegep. Institutions will sometimes see it as an asset when hiring although cegep instructors who have completed one of these certificates qualify them as far from the reality of cegep teaching (CSÉ, 2000).

This context is quite different than that of elementary and secondary institutions. To teach at these institutions individuals are officially required a 4-year degree in education, which sometimes include minimal formal mathematics training. Also, cegep institutions are often a place of transition from secondary to university education; students are introduced to more formal mathematics and some level of autonomy is expected from them (schedule less structured, no mandatory attendance to classes).

Teaching at Post-Secondary Level

Little is known about becoming a mathematics teacher at post-secondary level (e.g. Speer & Hald, 2008). More and more research about post-secondary mathematics education is being conducted, arguing this level is key to the training not only of future teachers but also scientists, engineers and mathematicians (Hodgson, 2001). However, many recognize the need for change in the way the mathematics are taught at this level. Most research emphasizes the mistakes and negative traits of university teaching and claim the inadequacy of the existing training programs on creating change and improving post-secondary teaching, while only few seem to offer concrete solutions (e.g. Beisiegel, 2009; Belnap, 2005; Speer, 2001; Speer, Gutmann & Murphy, 2005). About this, Beisiegel's work (2009) focused on how graduate students "developed a sense of themselves [...] as post-secondary teachers of mathematics" (p. 2) during a teaching assistantship. The author looks closely into the graduate students' lives and their journey into becoming teachers. She concludes that existing training is inadequate and puts forward the need to investigate closely the *experiences* of these students becoming new teachers in order to effectively study

post-secondary teaching and training (2009, p. 25). This recommendation is the starting point for our work with new cegep teachers who were not so long-ago university mathematics students. Our goal is to better understand their experiences in their life as new mathematics teachers and in the transition from being a mathematics student to becoming a post-secondary teacher.

The challenge – and partially the trigger for our pilot study – is that the literature on post-secondary teaching in general, and in cegep in particular, is very scarce. Looking at research on elementary and high school teachers, we see that it is heavily based on the education they received, namely a degree that aims at training them as *teachers* (e.g. Ambrose, 2004; Ensor, 2001; Franke & al., 1998). However, post-secondary mathematics teachers are mainly, if not solely, trained to become *mathematicians*. Therefore, we cannot transpose or extend the results encountered in the literature about teachers' training for elementary and secondary levels to the group we are interested in. With this lack of background on the transition under study, we chose to conduct a pilot study to inform our main research project.

THEORETICAL FRAMEWORK AND OBJECT OF STUDY

The focus on experience of this study led us to consider Dewey's philosophy (1938) to frame it. For Dewey, one learns through experience and experiences shape how one goes about the world and about new experiences (1938, p. 35). Dewey also sees being faced with challenging experiences as a key aspect of life, growth and change: "growth depends upon the presence of difficulty to be overcome by the exercise of intelligence" (1938, p. 79). Indeed, faced with a familiar context, one can have an idea of how to act, and the consequences of those actions, based on knowledge acquired through past experiences. However, more reflection is needed in an unfamiliar context, where one could have to connect many different, apparently unrelated, experiences in order to know how to act and the related consequences (1938, p. 68). This results in new knowledge that could be applied to one's action per respect to future experiences.

Because of the importance of *new and challenging experiences* in life, growth and change, we chose them to be the focus of our study. In the context of our research, becoming a mathematics teacher at post-secondary level is seen as a trigger for new and possibly challenging experiences. And because a situation may be new and challenging for some but not for others depending on one's past experiences, it is important to put the focus on the experiences lived by the new teachers that are challenging and educational for *them*, and not all experiences that are lived or that might be assumed challenging and educational by others. We call those *significant experiences*.

However, this approach opens the door to a broad and varied spectrum of experiences that may be significant in the transition under study. In our project, we focus on significant experiences that may shape new teachers' *relationships with mathematics and its teaching and learning*. We will use the abbreviation RWMTL for the

remaining of this paper to refer to the relationships under study. These RWMTL entail the visions, opinions, beliefs, attitudes and feelings about mathematics, and its teaching and learning.

In this sense, we hypothesize that new teachers possess a RWMTL, developed through years of doing, learning, being taught, and sometimes teaching mathematics, and that these RWMTL play an important role in their becoming post-secondary mathematics teachers. This hypothesis is supported by the work of Speer (2001) and Beisiegel (2009). Speer's work emphasizes that graduate mathematics students have beliefs about mathematics and mathematics education, and that their RWMTL play a role on how new teachers will act in their new profession, how they will deal with, interpret and react to what happens to them. In particular, she claims that teaching assistants' beliefs, especially about mathematics and undergraduate students, have a significant impact on how they teach and interact with students. These RWMTL are influenced by the education they received in university and by the implicit teacher training they received during their time as students (Beisiegel, 2009, p. 42). It creates a relationship, conscious or not, with education through their experiences as students. Indeed, Beisiegel (2009) claims that graduate mathematics students' life experiences in a mathematics department, shape their "views of the discipline and teaching" (p. 43), as well as how they view what and how they should become. She argues that the experiences those students have can play an important role into how they define their role as mathematics teachers: "it appears that in the lives of mathematics graduate students there exists a complex and intricate interplay between the structures that they encounter, their feelings about mathematics and themselves and their ideas of their future role as mathematics instructors or professors" (p. 43). This last quote reinforces our hypothesis that the RWMTL play an important role in individuals becoming postsecondary mathematics teachers. In general terms, the goal of our main study is to investigate these RWMTL; in particular, our goal is to identify the nature of the significant experiences that shaped new teachers' RWMTL. Incidentally, the goals of the pilot study this paper is reporting on were to come up with a list of themes relevant to, or in relation with, the significant experiences of the new mathematics cegep teachers, in order to support and guide the main study later on.

METHODOLOGY

Our methodology is based on ideas brought forward by *narrative inquiry* ("NI", Clandinin & Connelly, 2000). NI argues that the essence of human experience happens narratively and choosing this method means acknowledging that people make sense and give meaning to their lives narratively – *they lead storied lives* (Clandinin, 2013, p. 13). Furthermore, NI takes into account the wholeness of someone's life while allowing the researcher *and* the subject to collaboratively investigate and distinguish what makes it unique and specific.

NI was developed specifically to understand and inquire into experiences, in relation to the people who have them and the physical and social context where they are

(Clandinin, 2013). This is to emphasize how past experiences and social and individual matters influence how someone lives an experience. In our case and for the research project, we use NI to determine what significant experiences shape new teachers' RWMTL. In the context of the pilot study we are reporting on, we use NI to shed a first light into these significant experiences; collaboratively working with the subjects in thematising them, their nature and their shaping role.

With this in mind, we built open and semi-structured interviews with broad questions, so teachers would account for what is actually relevant or important in their journey of becoming teachers. This gives a chance for the unexpected to arise.

The Process of Investigation

Weekly meetings were planned with three cegep teachers during a whole semester (January to May 2017), but we ended up meeting with each of them 15, 10 and 4 times respectively over the whole semester. The meetings, which lasted between 30 minutes and 90 minutes, were audio-recorded. The first teacher was starting his third year as a teacher, had completed a master in mathematics and a one-year certificate in pedagogy. The second participant was starting his second year of teaching, had completed a master in mathematics and had also completed a one-year certificate in pedagogy. The third participant was teaching his second course while pursuing their second year of Ph.D. in mathematics. They were asked to share stories of events they lived in the week prior to the meeting, which they identified as significant for their RWMTL, and of reflections they made about these events. After each meeting, an account was written in the form of a story of the meeting, using as much as possible the words of the teacher, with only slight changes for clarity purposes. Those accounts constitute the data that was analyzed.

RESULTS

Emerging themes

The pilot study served as a way for us to learn about significant experiences of new teachers in relation with mathematics, teaching and learning. Our goal was to circumscribe areas, contexts or topics, we call them *themes* to be concise, which seemed to play an important part into their lives, thoughts and reflections. We wanted to find themes that seemed to foster experiences that were significant for them. This list is not meant as “a list of understandings” but rather as a list of words to help us think to understand the stories (Clandinin, 2013, p. 39). Of course, those ideas will not be final as we do want to stay open to what will come up as we meet new people next year, for the main study, and learn about their experiences.

First, as we considered the teachers' relationship with **teaching**, two categories arose: “being a teacher” (1) and “teaching to students” (2). The former (1) addresses the very personal aspects of the journey into becoming a teacher. It includes themes such as the *new teachers' expectations of the profession of teaching mathematics in a*

cegep institution. This unfolds in reflections in relation to whether or not they attended cegep as students, the lifestyle they expect to have while holding such a position and the expectations arising from their memories of their own teachers. Another theme that came up is about *being part of an institution and being part of a community of teaching*, who respectively involves reflection on the role of cegeps in the society, and integrating in a team of established teachers. Finally, *the ability to teach*, which includes their reflections in relation to their own and others' abilities, and the *initial training* they should have or want to have, were topics that played a role in their everyday life and reflections.

The latter subdivision (2) of the themes in relation with teaching that we found addresses themselves as teachers in relation with their students. This includes the *role they (should, can) have in their classroom*, whether it is to pass on knowledge, make it interesting or getting them prepared for a job or university. They also reflected on the *assessment of the level of difficulty* of concepts or problems as very central in their daily life, whether it comes from their own judgment or from a formal source such as ministerial specifications. In the same line of thought, reflections on the *assessments* were playing a huge role in their experiences with questions such as how many, when, weight of each, and also how to prepare the students for them and how to assess exactly what needs to be assessed. Finally, their *teaching method*, using technology for example, and the *ability to adjust to the students*, to their ways of thinking and being, were present in the reflections expressed.

As we considered the teachers' relationship with **learning**, the following themes emerged. First, the *expectations of the level of the students*, as far as what they should know from high school or from previous cegep courses, and the *expectations in relation to the students fulfilling their role in the classroom*, such as participating in class and doing their homework, were central topics for the teachers. On another note, the teachers found challenging to manage the *students' expectations in regard of their teacher*, as far as the act of teaching and the level of the material they were expecting. Finally, the teachers mentioned choosing the *attitude towards the students* as being a challenge, especially when it comes to differences between countries and provinces, since many teachers are not from Quebec, where the relationship between a teacher and its students might be different according to different cultural norms.

As far as the teacher's relationship with **mathematics**, we did not come up with a list of themes as we found that our data did not allow us to do so. Indeed, as we met the participants over and over, we realized that it was not spontaneous for the new teachers to talk about mathematics when asked about their daily lives. They favoured talking about teaching and their students. We conjecture that they have a number of things to think about other than the mathematics, such as the themes mentioned above, which seem to take much more work to be mastered or managed than to master the mathematics they are teaching. In other words, it made us realize that for (these) new teachers, it is difficult to talk about mathematics spontaneously when questioned about their experiences as new teachers; considerations in relation to

teaching and learning seem to take all their time. Among the three participants, only one would address mathematics when discussing their everyday activities; the individual still in the midst of completing their Ph.D. in mathematics. This made us think that the new teachers that were full-time, not actively conducting research in mathematics nor taking mathematics courses, seemed to have in the front of their mind matters that were farther from mathematics and closer to teaching and (their students') learning. The two other participants, when asked directly, struggled to talk about mathematics for more than a few moments.

Finally, we found multiple themes that were present **across mathematics, teaching and learning**. Indeed, it seemed that some institutional aspects specific to cegep were having an impact on the teachers' experience at multiple levels. First, as mentioned in the introduction of this paper, cegep institutions offer science, social science and technical programs. The teachers expressed multiple times that there were challenges on multiple levels to teaching to different audiences. For example, in a differential calculus class for science, a teacher has to teach to future engineers and future doctors, two groups who do not have the same interests and goals. Also, this same teacher may teach in the same semester differential calculus for social science students (the course covers almost the same material), who have again very different interests, goals and aspirations, to study psychology or economics for example, in relation with mathematics and, for some of our participants, very different ways of thinking. Finally, that same teacher may have to teach mathematics to technical programs, where the goal is for the students to learn the mathematics they would need to apply in their field. Therefore, the teachers we met expressed how difficult it was to navigate teaching to those different audiences: how to teach them according to their expectations and aspirations, how they learn best, and to determine what kind of mathematics, and what in the mathematics, they really needed.

Another key aspect across mathematics, teaching and learning is the fact that cegeps offer courses during the day and courses at night as part of continuing education. Indeed, teaching in continuous education meant that the teacher was not assigned an office space, and was not active in the department (they were not necessarily invited to department meetings). This also meant that they were often left on their own to discover the ways of the institution, would rarely come across other instructors and seemed to lack opportunities for asking advice. It is also important to mention that new cegep teachers often have to teach at multiple institutions during the first few years, sometimes even during a semester, before they can be guaranteed work at one place. This isolation and constant change seemed to be heavy for teachers who enjoy working with others, reflect through discussions on teaching, get advice from more experienced colleagues or just be active in their workplace. The students are also different, as most day-students are young adults who go to school full-time and, night-students are older and work full-time during the day. And again, to try to adapt to all those aspects turned out to foster a number of significant experiences for our participants.

CONCLUSION: WHAT'S NEXT

This pilot study helped us understand and circumscribe themes that were at the heart of becoming a teacher in cegep institutions.

However, through the 29 interviews we conducted, very few experiences were complete enough to be talked about in terms of how they played a role in the new teachers' lives, mainly because the reflection in relation to an experience was often missing or incomplete. Indeed, from our data, we found that the reflective experience can take a long time, longer than the academic term in which the experience happened. This made us realize that our goal of understanding changes in the RWMTL could not be tracked over this short period of time. Indeed, our pilot left us believing that reflection on recent experiences is often not mature enough for teachers to be comfortable verbalizing it and sharing it with us. Also, we were unable to know if the recent experiences would play a significant role in the transition under study on a longer term. Therefore, to be able to hear about *significant experiences*, we need to go another route. Our conjecture is that by introducing a theme first and asking participants to share past experiences in relation to this theme, we could be able to grasp some of these significant experiences and the role they play in shaping new teachers' RWMTL.

Indeed, by asking the participants to talk about experiences that have shaped their RWMTL in relation to a specific area, context or topic, we hope to hear about the experience *and* the reflection associated to it. As Dewey (1938) would say, the quality of an experience comes mostly from what it opens to, i.e. the resulting tools and how they help understanding and acting towards new experiences (p. 27). This takes time, since we think about our past experiences differently with time, reflection and probably other experiences. We therefore want to understand how the new teachers evolved in this transition, how their way of living and acting towards new experiences evolved with time and new experiences. As Clandinin (2013) said, we, the participants and the researchers, "are always interpreting [our] pasts from [our] present vantage points" (p. 46).

The pilot interviews also revealed that the participants had a hard time focusing on experiences specifically related to mathematics and often tended to discuss experiences related to class management, institutional constraints, etc. This lead us to design new protocols with the hope of instilling the norm that the goal is to talk about experiences with *mathematics*, and its teaching and learning.

To conclude, the pilot study helped us in creating protocols for the main study that would guide our endeavour to understanding some of the experiences that shape new cegep teachers' RWMTL, and more precisely, what kinds of experiences are significant as they transition from being mathematics students to cegep teachers, all while staying open to the new lives we will meet as the main data collection unfolds.

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