

Future Teachers' Perceptions of their Mathematics Education Program

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Abstract. On the basis of the analysis of classroom lessons, individual interviews were constructed with an intention to probe in detail the complex rationales and background influences that underpin the teaching actions of future secondary level mathematics teachers. This report, part of a global study (Proulx, 2003), underlines the varied perceptions of future teachers regarding their mathematics teacher education program. This variety of perspectives presents a range of issues in regard to the structure, the development, and the possible objectives of mathematics teacher education programs. The problematic of fixed objectives will be discussed in relation to the concept of 'objectives to attain' vs 'objectives to work on'.

1. Introduction to the context of the global research

The global aim of the research was concerned with the complex rationales that underpin the practices of high school mathematics teachers in relation to their mathematical explanations. (Aspects of this research are reported in Proulx, 2003; in press A; in press B.) This research report will focus on one specific aspect of the research, that is, the elaboration of the future teachers' perceptions of their mathematics education program as a background influences that played an important role in their personal construction of teacher knowledge.

2. Some theoretical concepts concerning the impact of teacher education programs

In an extensive review of forty years of research into learning how to teach (not specific to mathematics), Kagan (1992) explains that teacher education programs have little influence or impact on the beliefs and images already developed by future teachers. To that, Bauersfeld (1994) adds that when the new teacher is confronted with conflicting situations, habits and ways of doing that are strongly rooted in his or her personal experiences as a student will emerge¹: he or she will privilege the former methods and, in that privileging, will reproduce the traditional school model. Bednarz, Gattuso, & Mary (1995) summarize Kagan and Bauersfeld's ideas in stating that the stability of those previous representations stay unchanged and follow the teachers into their classroom teaching practices.

However few the effects, Ball (1988) explains that when prospective students have to teach in their practica, they tend to model their approaches after those of their university instructor, whereas others draw and insist on what helped them understand the mathematical concepts in their mathematics education courses. Those differences prompted me to theorise on the concepts of 'didactical copying' and 'didactical re-production' (Proulx, 2003). The former refers to an unmodified re-application of the exact concepts presented in their courses. These teachers cannot explain why they make use of those concepts, except to point out that their university instructor told them it was important and 'good'. In a sense, those teachers reproduce an un-reworked, uncritical

copy of what has been highlighted by the university instructor. ‘Didactical re-production’² refers to an intent to re-use some models, ideas and actions highlighted by the instructors while appropriating and consciously transforming them in his or her own way (they have reasons and they know why they are acting in this certain way). Let’s now turn to some aspects of the methodology.

3. Brief clarification on the methodology

The student teachers in the study were at the end of their 2nd year of the 4-year program, and they had just finished their second internship in the schools the semester before³.

Semi-structured individual interviews were constructed on the basis of previous analyses of videotaped classroom lessons for each future teacher. The interviews consisted of two distinct parts: The first one was specific to their lessons and to aspects or events that occurred in their classrooms; the second one was on a general level and consisted of questions regarding their background influences and their ways of seeing teaching. All those questions were intended to delve into details about their teaching intentions and ideas; and to grasp a sense of the rationales that underpinned their teaching practices. Overall, for each future teacher, the interview was structured around 16-17 questions⁴.

4. Results

The detailed analysis of the interviews shed some light on their personal interpretations or perceptions of their teacher education program. I will highlight, for each of the five future teachers, the principal characteristics of their personal ‘reading’ and interpretation of their education program.

4.1 Albert ‘the technician’: The teacher education program as a “pool of resources”

Albert’s first comments on his teacher education program were very negative⁵. He explained that he did not find his courses to be relevant in the beginning, but that he discovered in his internship that many aspects studied were very useful and could help him to teach effectively. Using many specific elements that were addressed in his teaching education program, including manipulatives, visual materials, different problems and questions aimed at the emergence of some errors and conceptions of the students, and so on, Albert made use of those tools to help him to teach more effectively.

In a sense, like a technician, Albert went on to pick some tools that would help, in his view, his teaching in the classroom; he saw his teacher education program as an opportunity to acquire some specific tools on mathematics teaching. In brief, in Albert’s case, his teacher education program appeared to serve as a source of resources to help him teach, in his view, more effectively.

4.2 Bertrand ‘the mimic’: The teacher education program as a “didactic authority”

Bertrand had a particular relation to authority – be it the authority invested in a teacher, a textbook, some specific rules, or elsewhere. He never really questioned those authorities and used them as his core arguments. Put differently, he obeyed them. A typical remark was, “I do it like that because my instructor said it was good.” Bertrand seemed to accept without any doubt the remarks or affirmations of his mathematics educators; he applied them without question. He respected the statements of authority figures and considered them as experts in the field.

The interview shows in a clear way that he was not able to explain his teaching actions –his rationales were structured around the fact that some experts have told him so. This was an excellent example of ‘didactical copying’. In fact, I could say that Bertrand did not have any personal rationales for his teaching actions – except for the fact that his teacher educators previously told him that they were important. He did not know why he did what he did, he just did it because someone had told him to do so – and most of all because, as he explained, he *had* to. Any sense of a rationale or reflection on his actions were almost absent in his discourse.

So, his teacher education has an authoritative status in Bertrand’s opinion; the mathematics educators played the role of experts for him. It is a ‘didactic authority’ and a beacon to be followed: it is unquestioned and unquestionable, something to be mimicked.

4.3 Carl ‘the self-assured teacher’: The teacher education program as a “confirmation of his personal and professional identity”

Carl told us in the interview that he was aware and was already implicitly using most of the principles that were introduced in his mathematics teacher education program (he said the $\frac{3}{4}$ of it). In a sense, in the eyes of Carl, his teacher education program had made explicit some elements in which he personally recognized himself as a teacher and, in the same way, allowed him to confirm his personal and professional teacher identity regarding his own personal principles of teaching mathematics⁶.

Put bluntly, Carl is in some ways the complete opposite of Bertrand, because he had a very strong and explicit rationale for his teaching actions. For Carl, it was clear that he knew what he was doing and why: he could explain the purposes of his actions, he was comfortable with his choices and did what he thought was important. Carl had a strong teacher identity, and this identity was guiding his choices and actions as a teacher. He was self-assured and confident regarding the choices he made. However, I want to stress that having a strong teacher identity is not necessary the same thing as being a good teacher, nor that deliberate and intentional actions are the basis of sound pedagogy (Gore and Zeichner, 1991). This is not to say that Carl was not a good teacher; however the fact that he had a strong rationale did not automatically make him a good teacher, since many of his choices and actions in the class could be contested. However, this is a position that I believe is

fundamental for a teacher; a teacher has to know what he or she is doing and why he or she is doing it, and be able to justify it.

Carl's teacher education program had rendered explicit some elements that he had personally recognized himself as a teacher – and at the same time provided confirmation of his personal and professional teacher identity. That is why I describe Carl as self-assured.

4.4 Donna ‘the reflective practitioner’: The teacher education program as a “philosophy of teaching”

Donna's attitude toward her teacher education program is completely different from the others: She operated at a more conceptual level than a pragmatic one⁷. The conceptual principles that Donna derived from her teacher education program included the ideas of construing a meaning to the mathematics and of developing comprehension and reasoning. Donna was not focussed on specific issues or aspects in her teaching (in contrast to Albert, for example); she was on a meta-level, on a level that stresses the importance of creating mathematical meaning and understanding for the students. To do that, she noted that it was important to have students verbalize and explain their solutions, to offer many diverse and flexible interpretations, to create smooth transitions between the notions, to work toward new understandings from already known notions, to adapt teaching, to endeavour to better understand where students were, and so on. She took these underpinnings of her mathematics education program as a kind of a guiding light in her teaching.

Also, it is important to highlight the fact that Donna was unusually reflective in her interview. She never responded without first trying to make sense of what happened. She was able to explain why – both in terms of her background and her intentions – she acted as she did and how she might improve on those teaching actions that needed to be changed. I theorize that for Donna the interview was educative and informative around her teaching and her learning. In a way, she was doing the job of a researcher concerning her own practices: she was analyzing and making conclusions and remarks on her teaching, she was reflecting on her practice⁸, as Griffiths and Tann (1992) explain:

Central to the spirit of reflective practice is reflection on the personal and professional concerns of the individual student teacher. The reflective practitioner reflects on his or her own practice. The theories which are used are taken on wholeheartedly, and criticised open-mindedly. (p. 2)

4.5 Enrico ‘the natural teacher’: The teacher education program as a “teaching model in action”

Enrico might be described as a teacher who reflects *in* the action of his teaching. In other words, his actions and decisions are made on the spot and not planned in advance. I hypothesise that he did not always know the reasons for his actions (Proulx, 2003). Enrico is what I call a ‘natural teacher’ who possesses intuitive instincts for the teaching ‘in action’ and a capacity to analyze,

make decisions and ask questions: an intuitive exemplar teacher in action. Knowing that, it is quite logical that what Enrico got from his teacher education program is better understood in terms of immediate practical action than explicit guiding principles – which I describe in terms of a teaching model in action. By watching and analyzing one university professor in particular, whom he repeatedly named in the interview, Enrico had interiorized a specific teacher model. The actions of this specific mathematics educator were considered important and interesting for him. He tried to put them in place in his teaching. In a sense, his teacher education program provided him with some kind of an exemplar model to follow and adopt.

4.6 A perspective that serves as a guiding light

In addition to the participants' various perspectives regarding their teacher education program, I also found an important coherence in their interpretations of other aspects that played roles in their teaching (e.g., teachers' manual, supervisor, final exams, previous high school teachers, colleagues, personal experiences as teachers or students). So, it seems that there is a sort of a filter through which they interpret and 'read' the many influences and experiences that they encounter and live as learners; this filter would serve as some kind of a guiding light that orients their interpretations of their experiences.

5. Implications

The presence of this guiding light, for which I have coined the expression '*personal conceptual reference framework*' (see Proulx, 2003), played a central role in the professional development of these teachers. Each student teacher appropriated the teacher education program in a different way. In other words, this mathematics education program had a different effect on each of them. This important issue cannot be overlooked by mathematics educators as we construct, plan and teach our mathematics teacher education programs. This implication is that whatever we do in our mathematics teacher education programs, the perceptions, interpretations, uses and outcomes will always be different for each student teacher. This may be something we all already knew, but there is not much evidence that we are acting on this knowledge.

A question arises: With this variety of profiles, how can we structure a teacher education program that works for everybody and that helps each teacher evolve in their professional lives? A teacher with a profile similar to Bertrand's cannot be approached in the same way as a teacher with a profile like Donna's, for example. Educators have to be sensitized to this broad diversity of possible interpretations – of which I highlighted only five possible variations. A possible, and perhaps necessary option would be the administration of diagnostic evaluations at the beginning (of each mathematics education course, for example) to help better understand the diversity of teachers with whom one will work –with the intention of adapting the instruction.

It is also important to have a deep look at Carl's strong personal rationale regarding his teaching. It is my belief that teachers have to know what they are doing in their classrooms and why they are doing it. A teacher should always be able to argue about his or her choices and reflect on them; a teacher should be able to convince someone of his or her choices. It is important that teachers feel comfortable with their teaching so that they feel in control and that their actions are theirs. This is not to say however that what they will do is right or wrong (Gore and Zeichner, 1991), but at least they will know what they are doing and will be able to argue and explain it.

The importance of being able to take and to defend a personal position is something that I believe should be an object of increased focus in the various teacher education programs. Teachers are responsible and autonomous beings that make decisions in the classroom; those decisions to be effective have to be sustained, argued and controlled.

6. Conclusion

This research should prompt discussion of the structure, the development, and the possible objectives of mathematics teacher education programs. It also sheds some important light on the possible effects of teacher education programs and moves us away –perhaps very far away– from a cause-effect mentality, or a 'training' mindset, in the project of educating 'good teachers'. With the sorts of interpretive perspectives presented herein, it is clear that the outcomes cannot be 'controlled' and are much more diverse and unpredictable than we might expect.

Mathematics teacher education programs should focus especially on the professional development and evolution of each teacher –that is, to participate in the continuous unfolding of their teacher identity.

This idea of ever-evolving professional teacher identity does not mean, however, that the final goal has to be that each teacher ends up at the same spot and becomes the 'good teacher'. Teacher education programs should focus on the evolution and improvement of each teacher in a broad sense. This means that the main objective is not that each teacher attains a certain specific pre-determined level, but does mean that each teacher improves (and not in comparison to a fixed and assumed 'good teacher' entity).

This is not to say that we do not need goals in our teacher education programs, or that we do not need a curriculum. However, it is in the approach to the curriculum that the difference is located. The curriculum is understood here as something to work with, as a starting point on which we expand. A curriculum is not something to attain in the end; it is something to work on and with, it is the grounding point. This is easily explained by the difference between having 'objectives to attain' and 'objective to work on'. Instead of fixing a goal or an objective at the end and focussing exclusively on it by narrowing our actions in long-term planning, the objectives and goals would be

used as starting points, and from there, borrowing from Davis (2004), *expanding the space of the possible*.

Learning should be about ‘opening doors’ and not about closing some. When we learn, we are not settling all the riddles of the universe one by one, we are creating new opportunities for learning, we are ‘opening doors’ to new possibilities. As a matter of fact, I feel the urge to end this with two quotes taken from Davis (2004):

This [...] prompts a redescription of lessons plans as ‘thought experiments’ rather than ‘itineraries’ or ‘trajectories’ –as exercises in anticipation, not prespecification. So framed, a lesson plan is distinct from a lesson structure, the latter of which can only be realized in the event of teaching. (p. 182)

Oriented by complexivist and ecological discourses, teaching and learning seem to be more about expanding the space of the possible, about creating the conditions for the emergent of the as-yet unimagined rather than about perpetuating entrenched habits of interpretation. Teaching and learning are not about convergence onto a pre-existent truth, but about divergence –about broadening what is knowable, doable, and beable. The emphasis is not on what *is*, but on what might be brought forth. Learning thus comes to be understood as a recursively elaborative process of opening up new spaces of possibility by exploring current spaces. (p. 184; emphasis in the original)

Notes

- ¹ Bauersfeld (1994) uses the sociological concept of *habitus* developed by Pierre Bourdieu to describe those old habits.
- ² Désautels (2000) stress an important difference between ‘reproduction’ and ‘re-production’. ‘Re-production’ is not referring to a mechanical process where the agents of a situation are seen as determined puppets, ‘re-production’ is highlighting the fact that cognitive notions are re-produced by agents while also being transformed by them. In fact, the concept of ‘didactical copying’ would mostly refer to ‘reproduction’ (in one word).
- ³ Except for one of them, Donna, who was in her 3rd year and did not followed the ‘traditional’ path.
- ⁴ However, one of them, Enrico, had 21 questions in his interview.
- ⁵ Detailed analysis of Albert is found in Proulx (in press A).
- ⁶ In fact, it is interesting to note that it is not really obvious that Carl felt that his teacher education program brought him something, since he already knew most of the principles. The outcomes of the teacher education program for Carl are mostly at the level of the validation and the deepening of his *own* personal teaching principles.
- ⁷ Detailed analysis of Donna is found in Proulx (in press B).
- ⁸ However, quite in the same way that it was said for Carl, the fact that she reflected on her practices does not imply that her teaching actions were better or more acceptable (see Gore and Zeichner, 1991).

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