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First-person vicarious experiences as a mechanism for belief change

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Changes of beliefs do not happen arbitrarily; there are underlying mechanisms that enable the shift. This study outlines a problem-solving implementation in which two teachers experienced changes in their beliefs. We describe these belief changes and propose a new mechanism for the shift: first-person vicarious experiences. Our results suggest that, despite their initial uncertainties, teachers who agreed to make a change in their practice underwent a change in belief regarding the efficacy of the practice through first-hand experience of its implementation.

Key words: Beliefs, teacher belief change, first-person vicarious experiences, problem solving.

Introduction

Underlying the heart of this study is the belief in the importance of problem solving in mathematics classrooms. Widely recognized as leading to a deeper understanding of key mathematical principles and content (Pehkonen, Näveri, & Laine, 2013), problem solving has become an integral aspect of curricular reform (Törner, Schoenfeld, & Reiss, 2007). This has led to an emphasis not only on the teaching of problem solving but on the teaching of mathematics through problem solving (Liljedahl, Santos-Trigo, Malaspina, & Bruder, 2016). Yet ours is not a study of problem solving in mathematics. Rather, it is a study of belief changes that occurred *because of* the implementation of problem solving.

When the Chilean government, in response to deepening concerns over the low results of their students in international standardized mathematics assessments, decided to reform the country's mathematics curriculum, it was the belief in the importance of problem solving that provided direction. Problem solving was seen as integral and with that came the mandate that it be implemented in Chilean primary and secondary classrooms where, prior to this, it had been practically non-existent. (Felmer & Perdomo-Díaz, 2017). It was into this context that ARPA (Activando la Resolución de Problemas en las Aulas/Activating Problem Solving in Classrooms) was born. Developed in response to the mathematics curriculum reform, ARPA is a research and development initiative that seeks to implement teacher professional development (PD) strategies that promote problem solving in an integrated classroom setting (Felmer & Perdomo-Díaz, 2017). Organized as a series of workshops held over the course of 10 months and led by trained monitors, ARPA is based on principles of teachers doing and reflecting. As such, its initial focus is the development of the teachers' own mathematical skills through collaborative problem-solving experiences that incorporate non-routine problems and randomized groupings (see Liljedahl, 2016). This leads to opportunities for the teachers to reflect on their own abilities, their mathematical knowledge, the strategies they used, and the emotions they experienced. This gradually moves to the teachers preparing and implementing analogous collaborative problem-solving activities in their classrooms for all their students. In our study we outline how this reform, predicated on the belief of the importance problem solving in mathematics, resulted in a cascading effect that was felt at the

micro level of the classroom. In particular, we focus on the phenomena of belief changes experienced by two teachers as a result of the imposed implementation.

Framing Beliefs

Writing on beliefs requires treading on shifting sands. One of its challenges is the lack of consensus regarding an accepted definition (Skott, Mosvold & Sakonidis, 2018). Noting the difficulty in reaching a definition that is acceptable across all types of studies and disciplines, McLeod and McLeod (2002) suggest, “There is no single definition of the term “belief” that is correct and true, but several types of definitions that are illuminative in different situations” (p. 118). From Leatham (2006) comes a view of beliefs as anything an individual regards to be true. His sensible system framework for understanding beliefs assumes “that what one believes influences what one does” (p. 92). With this framing of beliefs comes the understanding that beliefs cannot be directly observed but must be inferred. Following Leatham (2006), for the purposes of this study, we call beliefs those things we just hold to be true and must be inferred from what we say and do.

The second area where writing on beliefs requires careful attention is the realm of stability of beliefs. As Liljedahl, Oesterle, and Bernèche (2012) argue, “The field of mathematics education has assumed for too long that stability is an inherent and definable characteristic of beliefs” (p. 101). Their meta-study of beliefs in mathematics education found that stability has many meanings, “from difficult to change, to slow to change, to resistant to change” (p. 112). Further impacting our understanding of the stability of beliefs is Green’s (1971) stress on distinguishing what we believe and how we believe it. He suggests that beliefs that are held evidentially are less resistant to change than are beliefs held nonevidentially. By this he is referring to the basis on which the belief is held—with or without regards to evidence. For Green (1971), beliefs held on the basis of evidence or reason “can be rationally criticized and therefore can be modified in the light of further evidence or better reasons” (p. 48). For example, a teacher may hold an evidentiary belief that group work is untenable because she tried it unsuccessfully once. There is potential to change her belief by providing her with a positive experience with group work. Following Liljedahl et al. (2012) and Green (1971), we propose a further understanding of beliefs as changeable truths that must be inferred from what one both says and does.

Models of Change in Belief and Change in Practice

Early models proposed that changes in beliefs would lead to change in practice (see Figure 1). Accordingly, teacher PD models focused on occasioning belief changes as a change in belief was seen as a necessary precursor to change in practice (see Philipou & Christou, 2002). However, this does not capture what happened in our phenomenon. As we shall detail later, what we suggest happened for our participants is that changes in practice led to changes in beliefs (see Figure 2).



Figure 1



Figure 2

To better understand this phenomenon, we turn to Guskey (1986) who, noting the abysmal success of PD programs, proposed an alternative model. Arguing that the previous models failed to take into account the process by which change in teachers typically occurs, he proposed a model in which the elements were reordered around student outcomes (see Figure 3).

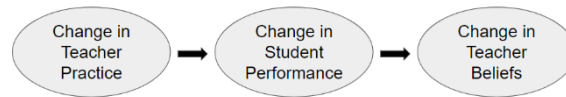


Figure 3

His model suggests that significant change in teachers' beliefs occurs primarily after they gain evidence of improvement in student learning, which for Guskey can include not only cognitive achievement but also elements such as behaviour or attendance. These improvements typically result from changes teachers have made in their classroom practices—a new instructional approach, the use of new resources, or simply a modification in teaching procedures. It is important to note that, for Guskey, it is not the PD per se, but the experience of successful implementation that changes teachers' beliefs. They believe it works because they have seen it work in their students, and that experience shapes their beliefs. Equally important is Guskey's view of change as gradual and difficult—new practices require incremental implementation.

Liljedahl (2016) also talks about this phenomenon of a change of practice leading to change of belief. He differs from Guskey (1986) in that the participants are asked to implement a practice for which they have no personal certainty will work. In doing so, this method bypasses the classroom norms that frequently act as an impediment to change in practice (Liljedahl, 2016). Liljedahl came to call this a first-person vicarious experience:

They are first person because they are living the lesson and observing the results created by their own hands. But the methods are not their own. There has been no time to assimilate them into their own repertoire of practice or into the schema of how they construct meaningful practice. They simply experienced the methods as learners and then were asked to immediately implement them as teachers. As such, they experienced a different way in which their classroom could look and how their students could behave. (p. 384)

For example, in order to promote the practice of student collaboration, Liljedahl had to first bypass the classroom norm that the doing of mathematics was an individual pursuit. To that end, he had teachers work on problem-solving tasks in visibly random groups during a 90-minute PD session. At its conclusion, the participants were required to introduce visibly random grouping in their classrooms. The result was a significant uptake in the practice that Liljedahl attributes to two factors: (1) the ease of modelling it in a PD setting and (2) the teachers having personally experienced the impact on their own learning when visibly randomly grouped.

Similarly to Liljedahl (2016), the ARPA problem-solving initiative also incorporates Guskey's (1986) notion of changing practice to change beliefs—the teachers in our study were required to implement changes in practice which resulted in changes of beliefs. We were curious about the mechanism behind that change and this curiosity led to our research question: Can we understand their belief changes through the lenses of Guskey (1986) and Liljedahl (2016)?

Methodological Considerations

While the difficulty in ascertaining beliefs is generally acknowledged (Skott, Mosvold, & Sakonidis, 2018), it is argued that qualitative studies have much to offer in the study of beliefs in that they offer a deep understanding of the ways in which people develop and change their beliefs (Olafson, Grandy, & Owens, 2015). For the purposes of our study, talking with the participants and

allowing them to tell their stories provided a rich description of the phenomenon and allowed us to respond to our research question regarding the nature of their changes. Note, ours is a small-scale study meant to document the occurrence of a phenomenon rather than its prevalence.

The source of our data was interviews with two participants: Luisa, a primary education teacher who was teaching in a Chilean public school at the time of the study and Josefa, a special education teacher who was assigned to a student in Luisa's fifth-grade classroom. These interviews were originally conducted as part of a larger project that studied the problem-solving experiences of a child with special needs. During their separate interviews, her teachers were also asked a series of questions intended to elicit their perceptions of changes experienced as a result of the problem-solving implementation. Ranging from 40 to 60 minutes in length, the interviews were audio recorded and transcribed in their entirety in Spanish. As this study is an international collaboration conducted by researchers from Canada and Chile, the transcripts were subsequently translated from Spanish to English by a researcher at the University of Chile and later reviewed by another researcher at the University. When first analyzing the interviews, we realized that not only was there a change in the student, but also in her teachers. So, guided by Guskey (1986) and Liljedahl (2016), we reanalyzed the transcripts for evidence of changes in practice. For example, one teacher detailed the change in how she offered a student support in terms of 'before and after'. In keeping with our understanding of beliefs as inferable truths, we attended to those before and after descriptions to establish the teachers' beliefs prior to the change in practice and the resultant new belief.

Findings

In the following we present two situations, which best exemplify instances in which we noted that an imposed change in practice led to change in beliefs. Each analysis begins with a summation of the original belief and the circumstances surrounding its change.

Change in teachers' beliefs regarding integration in mathematics classrooms

Prior to participating in ARPA, Luisa and Josefa's students with special education needs were usually taught mathematics using individual materials prepared by Josefa, the special education teacher, in a resource room isolated from the classroom. While both supported integration in theory, they were uncertain whether it could be successful in their classroom. This is common among mathematics teachers with 80% ($n = 228$) holding positive beliefs regarding integration yet less than one-third believing they possessed useful philosophies or strategies to implement its practice (DeSimone & Parmer, 2006). For Josefa and Luisa, this changed when, as part of their commitment to the ARPA program, they prepared and delivered a multi-level problem-solving lesson. Their success at meeting the needs of students with varying levels of ability in this lesson changed their beliefs regarding their own ability to successfully integrate their students. Their theoretical belief in the importance of integration was now reflected in their practice where they moved to a full inclusion model.

One of the expectations of teachers participating in ARPA is preparing lessons incorporating the strategies they have been introduced to in ARPA. At the urging of their ARPA monitor, Luisa and Josefa decided to prepare a public problem-solving lesson. Unique to this lesson was that it was designed to be multi-grade and open to observation by the community. Teachers are sometimes

hesitant to prepare materials for multi-level students as they believe the wide range of needs and abilities may be an obstacle to success (Kiely, Brownell, Lauterbach, & Benedict, 2015). Luisa and Josefa were no exception to this belief as we see in this excerpt from Josefa: *“We were worried about the reactions of the girls to working with younger girls”*. Luisa was worried in particular about the students with special education needs and felt unsure whether they would be able to contribute effectively in this type of group dynamic. She was especially concerned for one girl saying, *“Maybe she won’t be able to talk, because all the other girls do not know her, because they are from second and eighth grade”*. It was concerns such as these that had prevented both teachers from implementing the integration practices that they valued. It is not that the teachers opposed integration, rather they struggled to believe it could be effectively implemented, as Josefa states,

There is this integration and diversity discourse, theoretical stuff, but how do we face it? There is a lot of talk about how everybody is different, that we must work with our diversity, but what I used to do was to bring the girls [with special education needs] to the resources classroom. I’d take them out of the classroom and give them their individual material, that I created and used.

However, despite their uncertainty, they prepared a task in which students from grades 2, 5, and 8 all worked in visibly random groups within their grade levels on the same problem. Both teachers expressed satisfaction with the outcome of the public lesson with Josefa noting, *“And, you know what? Surprisingly, it turned out very well”*. They had observed the students successfully working and learning together regardless of age or ability. Their general fears for the success of the students were eased by observing the students respond to each other as Josefa explains, *“For example, when the fifth-grade girls were in front of the class explaining their solutions, the eighth-grade girls would listen and say: “Hey, I didn’t think about that””*. Their particular fears for their special education students were negated as they watched them be included in the groups and share their contributions. Although initially reluctant to implement this public lesson, its success impacted their beliefs about their own classroom practice with Josefa remarking, *“If we can prepare a lesson for three different [grade] levels, shouldn’t we be able to do that inside the classroom? I mean, it was empirically demonstrated that we can—when you talk about diversity in the classroom—it is obvious that we can do it”*.

Concerning the initial inconsistency between the professed beliefs of the teachers in our study and their actual practice, Leatham (2006) notes that we must look deeper, “for we must have either misunderstood the implications of that belief, or some other belief took precedence in that particular situation” (p. 95). In our study, we found the latter—while both teachers believed that integration of students with special education needs was important, they also held a stronger belief that it only works in theory, which possibly prevented them from enacting their belief in practice. Their involvement with ARPA and its expectation that they integrate all students in lessons offered a first-person vicarious experience that changed their belief regarding the difficulties of integration. This allowed for a match between their professed belief and their actual classroom practice.

Change in teachers’ beliefs about low-performing mathematics students

We view the teachers’ beliefs regarding integration as being contained within a cluster of beliefs that also comprised beliefs regarding low-performing students’ ability to work successfully in

collaboration on non-routine problems. Most simply put, they did not believe it was possible. They believed that low-performing and/or students with special needs would be unable to cope with the vagaries of group dynamics and have little to offer in the way of solutions for non-routine problems. Despite these beliefs, and with the encouragement of their ARPA monitor, they changed their mathematics practice to include all students in visibly random groupings that worked collaboratively on non-routine problems. The results surprised them. The students were not only accepted within their groups, they were viewed as contributing members. Observing the success of their students led both Josefa and Luisa to change their beliefs regarding their students' capabilities.

Luisa recalls that when the ARPA monitor suggested, *"Those children who have more difficulties are the first to solve the problems"*, both her and Josefa's initial response was a disbelieving, *"Yeah, hopefully"*. Similarly, they held low expectations for successful collaboration, particularly for Cristina, a student with special education needs. As Luisa explains, *"Well, I thought her [Cristina's] participation and the acceptance of her classmates would be minimal"*. However, with little expectation of success, they implemented the non-routine problems and visibly random grouping recommended by their ARPA monitor. The teachers were pleased with the results. In particular, Josefa shares that Cristina, the student with special needs, *"has improved a lot. She can solve a problematic situation and face it, read it and look for solutions. She doesn't sit still, she tries to solve it"*. Additionally, Cristina's peers valued her contributions and were willing to work with her in groups too. As Josefa notes, *"Working in groups is like a second-nature to her and she can work in any group"*. Likewise, Luisa recalls the other students saying *"Look, she [Cristina] did it"*. She goes on to add that *"although Cristina wouldn't say "Girls, let's do it this way", she was making small contributions that were useful for what they were doing as a group"*. Similarly, the teachers observed the success of other low-performing students, like Daniela, who solved a difficult problem. As Josefa explains,

She [Daniela] was present the class when we were teaching the problem of Theresa's floor tiles. Nobody in the class could find the solution. And it is a class where all the girls think they are very good at math. They are very competitive and this girl, Daniela, raises her hand and answers the problem. Luisa and I look at each other surprised.

The teachers came to realize that low-performing students did not need simpler problems, nor special resources, but that they could solve challenging problems. As Josefa notes,

And many times, we had simplifications, we'd plan a simple problem, or with more concrete support, or we'd plan problems with smaller numbers. And we realized it wasn't necessary. Do you get it? That helped us to realize that the students were more capable than we thought. So, you have a different disposition. And according to that, you start giving different support too, things that maybe you didn't even plan, but you go with the flow and you realize that they can do it.

We suggest that it was the change in the teachers' beliefs regarding their students' ability to work on non-routine problems in visibly random groupings that allowed the change in the belief regarding integration to occur. The teachers believed in integration, but until now did not believe they could successfully implement it. To enact their beliefs, the teachers needed the necessary pedagogical knowledge of how to implement practices that support integration (Buehl & Beck,

2015). In speaking of the difference that visibly random grouping and non-routine problems made in the classroom, Josefa explains that “*Those things* [visibly random groups and non-routine problems] *make the things you want to happen, happen*”. We can infer from this that, within their belief cluster, the successful implementation of integration practices is positioned as an overarching belief—it is the ‘thing’ they want to make happen. And it happened because ARPA’s requirement that the teachers implement specific practices allowed them to observe positive results in their students. This changed their beliefs regarding students’ abilities, which in turn allowed them to change their belief of their own ability to integrate. And as Josefa explains, “*That was a process we had to go through. But it was very good for us*”.

Discussion and Conclusion

Although not all imposed changes in practice result in changes in beliefs, our participants implemented imposed practices that did change their beliefs. As our data was collected post-hoc, we did not directly observe the changes nor were we able to conduct pre-interviews. However, we were able to infer that, after being asked to prepare and teach a public problem-solving lesson, the teachers changed their beliefs regarding their ability to effectively integrate children with special education needs and their belief regarding the ability of low-performing students. Fitting with Guskey (1986), a partial answer to our research question then, is that their beliefs changed after noting evidence of improvement in student learning. They believed it works because they saw it work and that experience shaped their beliefs. Not fitting with Guskey (1986), however is how the belief change occurred. Guskey (1986) views change as gradual and difficult with new practices requiring slow implementation. Our participants experienced something quite different. There was no gradual assimilation—they were required to change their practice even if they were uncertain about its effectiveness. They were given personal assurances that it would work from their ARPA monitors, but they were not given time to assimilate the methods into their own schemas. They had simply experienced the changes themselves as learners in the ARPA sessions where they were exposed to collaborative problem-solving and then been required to implement the new practice. They had undergone a first-person vicarious experience (Liljedahl, 2016).

Leatham (2006) reminds us that “The challenge for teacher education is not merely to influence what teachers believe—it is to influence how they believe it” (p. 100). To further answer our research question, the findings suggest that first-person vicarious experiences influence the how—the teachers now believe it experientially, which we argue, motivated the belief change. Additionally, the PD aspect is vital as our participants needed to feel or see the changes themselves before their beliefs changed. They still had no certainty it would work in a different context, but they had experienced first-hand that it could. Our findings also suggest that first-person vicarious experiences are effective at altering evidential beliefs—those beliefs that are based on evidence or reason (Green, 1971). For example, the teachers believed that integration only worked in theory because of their previous unsuccessful attempts, which only served to reinforce the belief. Buehl and Beck (2015) would point out quite rightly that the teachers were lacking the pedagogical tools to enact their belief in integration. However, if this was all that was missing, teacher practice would be easy to change. We suggest that they were also lacking a first-person vicarious experience that provided the necessary evidence to change the belief. For our teachers, the success of their public

lesson gave them new evidence that they could effectively integrate students and resulted in a change of beliefs.

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