Primary teachers' perspectives on mathematics during curriculum reform: A collective case study from Cyprus

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Several recent studies in mathematics education have argued that, for reforms to be implemented effectively, teachers need to have appropriate support through high-quality professional development programs. Most programs, however, typically prepared by policymakers, focus on how to prepare teachers to use the intended curriculum. In this paper, taking a level-oriented approach, I examine in-service primary teachers' perspectives on school mathematics at the macro-level of the state and policies; the meso-level of the school and the wider community, and the micro-level of the classroom. Drawing on data from semi-structured interviews with 22 experienced teachers in Republic of Cyprus schools, I discuss the importance of examining teachers' perspectives on school mathematics before designing and implementing professional development programs that address curricula reforms.

Introduction

The dawn of this millennium has found many educational systems around the world preparing for major large-scale reforms (Fullan, 2009; Tsai & Li, 2017), in attempts to adapt their curricula and classroom pedagogies in ways that promote skills such as effective communication, collaboration and teamwork, creativity, critical thinking, and problem solving (Silva, 2009). With respect to mathematics education, a growing body of literature perceives teachers as the cornerstone of successful reforms (Charalambous & Hill, 2012; Handal & Herrington, 2003; Polly 2017). Teachers are not merely executors of policies but agents of change, and this role stresses how they *act* and *do* (Biesta, Priestley & Robinson, 2015; Priestley, Edwards, Priestley & Miller, 2012). To act as agents, teachers need to make sense of the curriculum in relation to existing teaching practices (Drake & Sherin, 2006) and of their roles in the mathematics classroom (van Steenbrugge & Ryve, 2018). They also need to develop their own content knowledge for teaching (Ball, Thames & Phelps, 2008; Charalambous & Hill, 2012; Clarke, 1997) and align their beliefs about effective mathematics teaching and learning (McDuffie, Choppin, Davis, Magaña & Carson, 2017) with the visions of policymakers.

Reforms that position teachers as technicians implementing prescribed policies fail at times (Kyriakides, 1997; Priestley, 2011). If teachers do not accept and internalise the principles on which a reform is built, they will, in the best case, use new resources or modify their instructional practices superficially (Handal & Herrington, 2003), ultimately lacking the usefulness for learners initially intended by policymakers. A number of studies in mathematics education draw attention to the fact that teachers need guidance and support to appropriately implement new curricula in their teaching (Charalambous & Philippou, 2010; Cohen & Hill, 2000; McDuffy, et al, 2017; McGee, Wang & Polly, 2013). Most of these studies, however, either focus on how practising teachers interact with the new teaching materials in the classroom environment (Drake & Sherin, 2006; Polly, 2017)

or how they shift their beliefs and knowledge, and align them with the new curricula and materials at hand (Kyriakides, 1997; McDuffie et al., 2017; McGee et al., 2013).

Reform implementations are influenced by numerous factors, many of which are related to teachers and teaching. According to Memon (1997), these factors can be clustered under three headings: *curricular* (i.e. the extent to which the innovation is or is not externally imposed; clarity or lack of clarity in what teachers are expected to do; expected changes related or not to curriculum users' needs), *instructional* (i.e. the importance attached to previous practices by teachers; in/adequate knowledge of subject matter; mis/match between curriculum goals and teachers' beliefs; provision or lack of opportunities for professional development), and *organisational* (i.e. provision or lack of supportive mechanisms; provision or lack of classroom materials, facilities, and infrastructure; community participation; communication between teachers; influence of political leaders; influence of bureaucracy).

Similarly, Clarke (1997) identified 12 factors that appear to have an impact on the process of changing teachers' roles in accepting and implementing reforms. These are: (1) the reform movement in general; (2) the principal and school community; (3) internal support personnel; (4) the spirit of collegiality, collaboration, and experimentation; (5) the grade-level team of teachers; (6) innovative curriculum materials; (7) in-service programs for professional development; (8) external support personnel; (9) researchers as audience and critical friends; (10) outcomes valued by teachers; (11) day-to-day conditions under which teachers work; and (12) teacher knowledge.

In this paper, I argue for the need to examine teachers' perspectives on the mathematics curriculum, teaching, and learning, which should inform the design of related professional development programs. I use the term *perspectives* to refer to a blended understanding of *beliefs*, which according to da Ponte (1994, p. 199) are "the incontrovertible personal 'truths' held by everyone, deriving from experience or from fantasy, having a strong affective and evaluative component"; and *narratives*, which are concerned with teachers' professional stories (Kaasila, 2007) and may provide information on their knowledge, thinking, and practice, as well as inform teacher education and professional development (Chapman, 2008). Understanding teachers' perspectives is crucial for designing targeted professional development programs and for evaluating the extent to which a curriculum reform is effectively implemented (Choi & Walker, 2018; Kyriakides, 1997). I propose that teachers' perspectives about different levels be examined: their perspectives on the *macro-level* of a system/ society/ nation/ state, the *meso-level* of a school/ institution/ community, and the *micro-level* of the classroom, in accordance with the work of van den Akker (2004). Taking such a comprehensive approach in mathematics education is important, as "[t]here is potential value in an analysis at all levels (micro, meso, and macro)" (Gerofsky, 2016, p. 82). More specifically, this paper intends to provide answers to the following research question and its sub-questions:

In the Republic of Cyprus, what are primary teachers' perspectives on school mathematics:
(a) at the macro-level of the state and policy,
(b) at the meso-level of the school and the wider community, and
(c) at the micro-level of the classroom?

The case of the Republic of Cyprus is interesting due to the high degree of centralisation of its public school system and the fact that the country is undergoing a curriculum reform in accordance with international trends (see Fullan, 2009; Tsai & Li, 2017) aiming to supposedly promote 21st century skills (see Silva, 2009).

The context of this study

In 1960, after a long period of colonialism and occupation, first by the Ottomans (1571-1878) and then by the British (1878-1959), Cyprus became an independent republic. Since its declaration of independence, the educational system of Cyprus has been highly centralised (Charalambous, Delaney, Hsu & Mesa, 2010). The Republic's Ministry of Education and Culture (MoEC) designs the intended curriculum for all levels of education on the basis of suggestions made by teachers, school inspectors, and appointed academics (Philippou, Kontovourki & Theodorou, 2014; UNESCO, 2005). This curriculum and its accompanied mandated textbooks of mathematics are followed by all state schools (Xenofontos & Papadopoulos, 2015). In fact, an over-reliance on textbooks was reported by both TIMSS 2003 and TIMSS 2007 (Xenofontos, 2014) according to which 97% and 90% of participating Cypriot pupils, respectively, were taught by teachers reporting textbook use[1].

In 1992, the government introduced a reform program which included intended curricula, syllabi, planning guides, and national textbooks (Kyriakides, 1997). However, many teachers felt that the curriculum and national textbooks were overloaded with too much content to be covered. At the same time, they experienced time pressure to cover the content (Kyriakides, 1997), and received little support in professional development. Consequently, the intended curricula were found to be misinterpreted and incorrectly implemented (Charalambous & Philippou, 2010), with teachers tinkering the curriculum to improve pupils' outcomes (Kyriakides, Charalambous, Philippou & Campbell, 2006).

This national curriculum, adopted until 2010, was politicised with strong national(ist) elements (Koutselini-Ioannidou, 1997), due to the historical and cultural connections of the Greek-Cypriot community with Greece (Xenofontos & Papadopoulos, 2015). Since 2010, the educational system of the Republic of Cyprus has been undergoing major curricular reform of all school subjects and levels (from kindergarten to upper secondary education). A key aim of the new curriculum is to create *democratic and humane schools* (MoEC, 2010), intended to be promoted through all school subjects. With few exceptions of papers reporting on programs not specifically designed to support teachers in how to

[1] The Republic of Cyprus did not participate in TIMSS 2011. Also, the TIMSS 2015 report (Mullis, Martin, Foy & Hooper, 2016) does not include information about textbook use.

address current reforms (e.g. Philippou, Papademetri-Kachrimani & Louca, 2015), no published papers were found reporting on professional development programs for primary and/or secondary mathematics teachers in the Republic of Cyprus since the introduction of the new curriculum and textbooks in 2010.

Research design: Participants, data collection and analysis

The study reported here employs a *collective case-study* methodology (Goddard & Foster, 2002). This approach "involves more than one case, which may or may not be physically collocated with other cases" (Goddard, 2010, p. 164). According to Stake (2005, p. 446), "cases are chosen because it is believed that understanding them will lead to better understanding, perhaps better theorizing about a still larger collection of cases". Furthermore, to indicate the importance of taking individuals' voice into account, participants were encouraged to share personal stories as primary mathematics teachers within the spirit of narrative research, in a similar manner followed in other studies (see, for example, Kaasila, 2007). Narrative research strives to understand the ways in which informants construct stories to make sense of their professional world and intends, among other things, to establish honesty and trust between the researcher and participants (Litchman, 2013), by privileging the voice of individuals.

Twenty-two in-service primary teachers (18 women, 4 men) participated in this project. The teachers were recruited through a snowball sampling approach (Noy, 2008). The selection criteria were (a) willingness to participate, and (b) at least eight years of teaching experience. This second criterion ensured that participants belonged to the generation of Greek-Cypriot teachers considered the "best" high-school achievers and who received their initial teacher education at state-funded programs in Cyprus or Greece. As explained in Xenofontos (2018), having 22 participants was deemed satisfactory for achieving data saturation, since no new issues seemed to emerge after an interview with the eleventh participant. Nevertheless, I decided to conduct twice as many interviews from the point that saturation first appeared, to minimise the possibility of issues gone unnoticed. Table 1 provides biographical information on the participants (pseudonyms, gender, and years of teaching experience).

Each participant was invited to an individual semi-structured interview. The interviews were conducted in Greek, lasted on average for 40-45 minutes, and were held during non-working time and at the places of each participant's choice. The interview protocol, reported in Xenofontos (2018), included questions about three main dimensions: epistemological beliefs about the nature of mathematics, their perspectives on school mathematics, and their perceptions about themselves as mathematics learners and teachers. Table 2 presents examples of the questions that explicitly addressed school mathematics.

Table 1: The participants

Pseudonym	Gender	Teaching experience (years)
Anna	Female	10
Antonis	Male	24
Athina	Female	8
Despina	Female	14
Electra	Female	12
Elena	Female	8
Evangelia	Female	16
Flora	Female	9
Georgia	Female	23
Julia	Female	14
Katerina	Female	23
Lamprini	Female	14
Loukia	Female	11
Maria	Female	16
Marilena	Female	18
Nikolas	Male	12
Pavlos	Male	10
Savina	Female	15
Stella	Female	27
Tasoula	Female	16
Vasia	Female	22
Yiannis	Male	15

Table 2: Sample questions regarding teachers' beliefs about school mathematics

Dimension	Sub-dimensions	Sample questions
School mathematics	The intended curriculum	• Why is mathematics a school subject? • If you could change anything in the mathematics curriculum (add, remove, redesign), what would you change and why? • Is there a personal story you would like to share in relation to the mathematics curriculum?
	Teaching	• What is the teacher's role in the mathematics classroom? • What strategies do you use to help your pupils learn mathematics? • Are there any factors that impede teachers from helping children in mathematics? If yes, what are these? • Is there a personal story you would like to share in relation to mathematics teaching?
	Learning	• In which ways do children best learn mathematics? • What is the role of the pupil in the mathematics classroom? • Is there a personal story you would like to share in relation to mathematics learning?

The thematic analysis process followed can be described as data-driven (Boyatzis, 1998), as it did not make use of any predetermined, specific coding scheme. However, it is

"highly unlikely that researchers distance themselves from theory when performing data-driven analyses. Even at an unconscious level, ideas from the literature review are always present when data are left to, in a way, speak for themselves" (Xenofontos, 2018, p. 52). By following the ideas of coding and categorisation, as addressed by Kvale and Brinkmann (2009) and Miles and Huberman (1994), and with the utilisation of the constant comparison process of Strauss and Corbin (1998), I identified several categories (sub-themes), which were later clustered under more general themes. Sub-themes emerged that provided insightful information about participants' perspectives on school mathematics and curricula at the macro-level of the state and policy, at the meso-level of the school and the wider community, and at the micro-level of the classroom. To increase the trustworthiness of this study, colleagues from Cyprus and the United Kingdom acted as *critical friends* (Baskerville & Goldblatt, 2009), providing both insiders' and outsiders' perspectives during the analysis and the writing-up process.

The macro-level: State and policy

Regarding the macro-level of the state and policy, participants' responses revealed two sub-themes: (a) perspectives on who gets to decide about curricula and school mathematics and (b) perspectives on the national textbooks and their content. These are presented in detail below.

Perspectives on who gets to decide

All 22 participants expressed perspectives on who decides about curricula and school mathematics, demonstrating an awareness of the political dimensions of mathematics curricula and "how these political forces connect to the implementation of socially just curricula and pedagogy" (Appelbaum & Davila, 2007, p. 1). All responses were relatively homogeneous, as the participants talked about a top-down approach by the Ministry of Education and Culture. For example, in a typical response, Flora argued that "[f]or the new curricula of mathematics, there is a special team, in which the members are academics, some in-service teachers, and researchers in mathematics and mathematics education". Similarly, Pavlos stated that:

> [t]here's a special team of school inspectors and academics. Together they do research and have meetings, then decide what needs to be included. To be honest, I have no idea about the whole process of how curricula and their content are arranged, but I think there must be some sort of agreement between the Ministry, academics, and teachers. I don't know.

Most teachers were not critical of the team which, according to them, make decisions about curricula, their arrangement and content. In fact, as Evangelia noted, "these people are specialists. They know what to do. (…) It's not up to us to decide". However, four of the teachers did not share the same views as their colleagues, and raised negative points:

> Unfortunately, these academics do not have much experience in schools and the actual day-to-day teaching problems (Maria).

> Decisions are taken by academics who, in my view, don't have much contact with in-service teachers and everyday classroom realities. Even though there are some in-service

> teachers who are asked to be members of the team or offer their perspectives on the new books and their content, our experience shows that in-service teachers' opinions are rarely taken into consideration (Anna).

> To some extent it depends on where these people graduated from. Some studied in the UK, others in the US. Then, they become authoritative figures and impose ideas coming from these countries, as if these work everywhere in the same way (Savina).

> It's a matter of political decisions. So, with every elected government different people are responsible for the curriculum. I don't think everyone in the team knows what they're doing. They basically copy curricula and textbooks from other countries (Vasia).

Perspectives on national textbooks and their content

Since the national mandated textbooks are the main teaching resource in the Republic of Cyprus, it is not surprising that all 22 participants mentioned them in their individual interviews, by making explicit references to the textbooks introduced after 2010. Similar concerns were raised by Greek-Cypriot pre-service teachers (see Xenofontos, 2014), echoing the fact that, in the Republic of Cyprus, mathematics teachers, both in primary and secondary schools, design their instruction around the national textbooks.

Six teachers appeared to be satisfied with the textbooks. Five of six considered that the textbooks and their content did not need any improvements or alterations. In Elena's view, for instance, she said, "it's not my job to decide what needs to be taught to children. We're given the content in the curriculum and the textbooks (…) I'm very pleased with the new textbooks. They're much better than the previous ones. I wouldn't change anything". Loukia was the only teacher among this group of six who claimed that, despite her general content, she would like to see a more challenging chapter in each book: "Maybe we should have moved a bit further from the typical topics of fractions, areas, symmetry, and so on. They could have added a different chapter in each book, a more challenging one. I can't think of something more particular to tell you right now". Here, Loukia sees *challenge* as an issue that could have been included separately in an extra chapter, and not as part of the existing chapters.

The other 16 participants expressed serious concerns about the new textbooks and the arrangement of the content. A major issue raised by these teachers was that the textbooks are content-heavy, and time pressure does not allow practitioners to cover them all. Katerina, for example, stated that:

> [w]e repeat so many things in different grades, and at the same time, we want children to learn different concepts and algorithms. That's why many kids reach sixth grade and have serious gaps. (…) We need to reduce the content and deepen the remaining content (…) Time is a huge constraint in the teaching of mathematics. We feel tremendous pressure.

Apart from the new textbooks being content-heavy, teachers also reported other serious problems. For Anna, "many of the tasks in the textbooks are presented in uninteresting contexts, and children find them boring. To be honest, I find them boring, too. But if you change the context yourself, give a different communication context, then you watch kids

become stimulated". Despina commented that "the textbooks and tasks are very hard and are not concerned with the average pupil, but refer to pupils above average". Pavlos had a different opinion to that of Despina and argued that "we need to move away from 'supermarket' mathematics" (that is, superficial, and which has implications in basic everyday situations, as for example, paying at the supermarket). Flora shared a similar view to Pavlos, and comments: "if I was given the opportunity to change the content of the textbooks, I would remove some of its content and add thinking skills. We need to push children to think". Maria, however, argued that:

> in their attempt to reduce memorisation, they added many tasks that are beyond pupils' cognitive skills. Even I have to ask my colleagues how to solve some of them! (…) Textbooks do not give pupils many opportunities to practice new concepts and algorithms procedurally. This isn't a good thing. Children also need to develop procedural knowledge and we've taken that away from them.

In general, most participants do not appear satisfied with the new national textbooks for a variety of reasons (some contradict each other). Yet, they seem to agree that textbooks are heavily loaded and much of their content needs to be removed.

The meso-level: The school and the community

Regarding the meso-level of the school and the wider community in which schools are set, teachers' responses revolved around three key areas: (a) perspectives on collaboration between teachers, (b) perspectives on parental involvement, and (c) perspectives on school-based professional development. These are presented below.

Perspectives on collaboration between teachers

All participants talked about the importance of collaboration between teachers for improving school mathematics and successfully implementing the reform. However, not all shared the same views about the current situation of Cyprus' primary schools. Ten teachers appeared happy with the spirit of collaboration between their colleagues, but when asked to provide specific examples or share related personal stories, they all talked about collaboration between teachers who teach the same grade but to a different class, and exchange teaching materials. This was the case for Athina, who said that "[i]n my school, there is good collaboration among teachers. We exchange ideas, worksheets, and share tasks we have used in class and seemed to be helpful to pupils". In a similar vein, Tasoula claimed that "[a]s far as I am concerned, I've always collaborated with colleagues teaching the same grade. We follow the same route, exchange materials and worksheets, or other ideas we might find on the internet or from other resources".

Contrary to their colleagues above, twelve teachers were very critical of the fact that there is no spirit of collaboration among primary teachers in Cyprus' schools. In fact, they expressed negative views about this issue. In Vasia's words, "Cypriot teachers are very competitive and do not want to share their ideas with colleagues, as if others will steal their glory". According to Evangelia, "[t]eachers do not collaborate with each other, and I think this is mostly because they don't feel confident with their own subject knowledge of mathematics. They believe that, if they talk to colleagues, their ignorance will be revealed".

Similarly, Elena pointed out that "[t]here is no collaboration because teachers are scared that, by sharing teaching ideas with others, they might be seen as poor teachers by their colleagues". However, none of the teachers who talked about negative collaboration reported any attempt on her/his behalf to change the situation. This is an important issue that requires further investigation, as extensive research indicates that, when teachers engage in better quality collaboration, pupils' achievement is raised (see for example, Kraft, Marinell & Yee, 2016; Ronfeldt, Farmer, McQueen & Grissom, 2015).

Perspectives on parental involvement

An issue raised by all teachers in this study concerned parents and their role in pupils' learning of mathematics, in accordance with the extensive research in this area (see, for instance, Civil & Bernier, 2006; Fraser & Honeyford, 2000; Sonnenschein, Metzger, Dowling, Gay & Simons, 2016). In fact, an interesting homogeneity was observed in regard to teachers' perspectives, as they all expressed very similar views. Participants argued that parents' involvement in their children's mathematical learning can have positive effects when, according to Flora's response, "parents understand that it's not part of their role to teach, but just to check whether their kids did their homework and do not have any serious gaps. If their child didn't understand something, the parents should report it to the teacher, instead of trying to explain it themselves". Quite often, claimed Antonis, "parents try to explain school mathematics to children at home, and they do it using methods and algorithms that we no longer use in schools! And in the end, all they manage to do is confuse children, so that when they come to school the next day, we have to explain things all over again". Tasoula shared a similar view, and added that "many parents are very strict and force children to do extra worksheets and exercises that they find on the Internet, I don't know? And this puts extra stress on the children". In a similar vein, Georgia talked about her own experiences and said that "I try not to give too much homework, just simple procedural tasks for practice. But then I get so many parents come to me and demand I give more homework to pupils! This is insane".

Some teachers offered ideas on how collaboration between teachers and parents can become more effective. For instance, Athina shared her own practice of:

> … organising a meeting with parents at the beginning of every school year. During that meeting, I explained to parents how my mathematics lessons will be and asked them to trust me because I'm the teacher, it's my job to teach kids, and I know what I have to do. I also tried to make it as clear as possible that they should not try to explain mathematics to their children, as they might be using methods that we don't use in schools nowadays. Their job is to make sure their child has done the homework and leave mathematics teaching to as it's my job, not theirs.

Furthermore, Yiannis commented how "it's nice when parents involve their children in fun mathematical activities at home, like cooking, measuring, counting, and games that involve numbers and other mathematical concepts, rather than try to teach them what I am supposed to do in the classroom". Research evidence from other contexts supports Yiannis' view here (Sonnenschein et al., 2016). In general, participants pointed out that the roles of teachers and parents are, and should be, distinct, for the benefit of children and effective mathematics learning.

Perspectives on school-based professional development

The need for appropriate school-based professional development programs was discussed by ten participants, reflecting a well-documented view in the literature (see Charalambous & Philippou, 2010; Cohen & Hill, 2000; McDuffy et al., 2017; McGee, Wang & Polly, 2013). The teachers who raised this issue emphasised that these programs should be more practical, school-based, and have the form of workshops. Below, Anna summarised the views of her colleagues. She was particularly critical of the in-service seminars presently organised by the MoEC.

> We need professional development programs! But definitely not in the form of these seminars organised by the Ministry. They are ridiculous. They take place once a year, and we go there while someone from the Ministry, a school inspector or something, talks to us about the new textbooks. Teachers are not actively involved in the learning process. We need school-based seminars with practical activities. For example, one teacher could teach a class based on the new curricula and textbooks, while other colleagues could act as 'pupils', so we can see things from a pupil's point of view. It's not just about theory. Practice is important!

Ten teachers talked about the importance of school-based practical seminars and workshops, and four of them offered more specific suggestions about seminars, each commenting on her/his own professional needs as a teacher. For example, Yiannis stated: "I'd like to participate in seminars to do with the development of mathematics education research in general, not just about new textbooks. All we hear about is these textbooks. Enough! We need to learn more about other ideas out there". Antonis and Marilena expressed their lack of confidence in technology (see Pierce & Ball, 2009) and that they would like to participate in seminars on how to incorporate new technologies and software in their mathematics teaching (Callaghan, Long, van Es, Reich & Rutherford, 2018). In Marilena's words, "these new curricula are based on technology. For every few pages in the textbook, there is a relevant applet or software that can be used. I need to learn more about these. And I mean, actually learn practical ideas on how to use technology more effectively". Finally, Julia argued that she would like to develop her subject knowledge (Ball et al., 2008), and not pedagogical content knowledge:

> I'd like to learn more mathematics. And I mean mathematics, not the didactics of mathematics. These new textbooks have concepts that I haven't come across since high school. How am I expected to explain these to children if I don't have the necessary subject knowledge? We need seminars for this.

The micro-level: The mathematics classroom

The third level of analysis was concerned with the micro-level of the mathematics classroom. The teachers' responses were concerned with three sub-themes: (a) perspectives on the roles of the teacher and the pupils, (b) perspectives on the use of materials and tools, and (c) perspectives on collaborative versus individual learning, further analysed here.

Perspectives on the roles of the teacher and the pupils

Considerable homogeneity was reported in relation to teachers' perspectives on their own role and that of their pupils in the mathematics classroom. 20 of 22 teachers talked about the need of pupils to have an active presence in the teaching-learning process (Drew & Mackie, 2011), and not to be passive recipients of what teachers say. For Nikolas, "children need to adopt vibrant roles in the mathematics classroom, be energetic, talk to each other, share ideas, and discover knowledge". As Stella added, "pupils learn better when they experience mathematics themselves, not when they are told to do so by their teacher. They need to touch materials and experiment with them". Along these lines, teachers claimed that the role of the teacher should be that of a coordinator, and not "some kind of authoritative figure who knows everything", as Vasia said. Similarly, Marilena reported:

> a teacher's role is diverse: from mere observer to the one who will give children stimulus for mathematical thinking. Teachers organise the lesson and the order of the activities so that pupils will work and discover knowledge (…) The sad truth is that, from my experience as a practitioner, I've worked with colleagues, especially those of an older generation, who are more traditional. Thankfully, most of them are retired now, so only few traditional teachers are left in education.

Perspectives on collaborative vs individual learning

The majority of the participants (19 out of 22) shared experiences of how they organise pupils to work in mathematics classrooms. Sixteen argued that they prefer a mixed approach, switching from individual to group work and vice versa. Such a view is in contrast with the beliefs of Greek-Cypriot pre-service teachers in a previous study, who claimed that collaborative learning does not seem to work in the context of Cyprus (Xenofontos, 2014). As Electra claimed here:

> I do use both approaches. Sometimes, I have children work individually, while in other cases I ask them to work together in small groups. Each approach serves different purposes. When children work on a challenging task or are expected to discover new knowledge, I'd rather they work in groups because, you know, they can listen to their peers and share ideas. They learn better when they work together. In other cases, let's say when I want them to practise something, like a new algorithm, or to assess whether they understood something, I'd rather they work individually.

Despite their agreement about the importance of using both approaches, three of the teachers argued that when they say group work and collaboration, they mean pupils work in pairs. As Katerina explained, "[w]orking in pairs is useful because they discuss new ideas and share views with a peer. But I don't ask children to work in bigger groups because then it's chaos".

Three of the teachers expressed different views than those of their colleagues above. Vasia stated that "[i]n my classroom, children always work individually. Mathematics is not a subject for children to work together. We do this with other subjects that require discussion, like language and history. But during mathematics children should work individually". Julia, on the other hand, linked the two approaches to children's age groups:

> When I teach younger children, you know, grades 1 to 3, I'd rather they work individually or in pairs because young children don't really know how to collaborate and exchange ideas. But when I teach older pupils, grade 4 to 6, I prefer to put them in groups, in which they can discuss and share ideas with their peers.

Finally, Loukia was the only teacher who argued that decisions about the use of each approach depends on who she has to teach each time. In her own words, "it's not black or white. I cannot say I prefer one approach to another. Every year it depends on who I have in front of me. For some children, collaborative learning works better. For others, working individually is much more beneficial".

Perspectives on the use of materials and tools

An interesting homogeneity was observed concerning teachers' perspectives on the use of materials and tools in the mathematics classroom (Moyer, 2001; Swan & Marshall, 2010). In particular, 20 out of 22 teachers talked about the importance of using tangible materials in their instruction so that children can visualise mathematical concepts and algorithms. As Marilena argued, "it's very important to use materials in the mathematics classroom, concrete materials that children can touch and use to represent mathematical ideas. We have many materials of this kind, like the Dienes cubes, fraction circles and bars, 3-D shapes and nets, and so on". Marilena's comment summarises the views of other teachers as well.

Savina was the only teacher who argued that weaker pupils need more support by using more concrete materials. In her own words, "materials are helpful to all pupils. However, I think the use of materials is particularly beneficial for weaker kids. You need to use more materials with them in order to help them understand. Stronger children can think more abstractly without materials". Similarly, Stella believes that "the older the children, the less materials they should use. As they grow up, they must be able to think in a more abstract way. So, I'd say I use more concrete materials with younger pupils".

Six teachers made particular references to the use of technology, software, and applets. In fact, they all pointed out that children enjoy learning mathematics via technology more. As Pavlos said, "every time I use technology to show something or have kids work on computers with applets, they seem to enjoy mathematics more". This, according to Despina, "is not something we shouldn't expect. These kids are surrounded by technology in all aspects of their lives, in and outside school. Learning by using technological tools seems natural to them". Yet, even though they agreed on the benefits of the use of technology, Lamprini and Georgia were critical of the fact that schools are not equipped with necessary technological equipment. As Georgia said,

> the new curriculum encourages the use of technological tools, and I personally agree with this. But how can we do this since not all schools have the appropriate infrastructure? My school has no computer lab. In my classroom, I only have one computer. How are children supposed to work in groups and experiment with software and applets?

Discussion and implications

This study is based on a set of premises. Firstly, it acknowledges the significant role of teachers in the successful application of any educational reform. No reform can be effective if teachers do not fully embrace its underlying principles (Handal & Herrington, 2003), so that they can act as agents of change (Biesta et al., 2015; Priestley et al., 2012). Secondly, as indicated in the beginning of this paper, successful reform implementations require appropriate teacher professional development. Through carefully designed programs, teachers should be provided with opportunities to challenge their existing beliefs and practices and to align them with the visions of the reform (Charalambous & Philippou, 2010; Cohen & Hill, 1999; Drake & Sherin, 2006; McDuffy et al., 2017; McGee et al., 2013; Polly, 2017). Thirdly, the preparation and design of professional development programs need to take teachers' existing beliefs and practices into consideration, understand them and build on them, and not approach teachers as if they were technicians who need to be trained on how to apply a reform, its accompanied curricula and other instructional materials and methods. In the context of Cyprus, studies regarding the previous reform initiated in 1992 (Kyriakides, 1997; Kyriakides, et al., 2006; Charalambous & Philippou, 2010) concluded that when teachers' beliefs and professional needs are not explicitly addressed by professional development programs, teachers do not fully align their beliefs and practices in ways that meet the standards of the visionaries of a reform, which, subsequently, is set for failure.

The three-level analysis followed here provides useful insight into Gerofsky's (2016) statement about the potential value of such an approach. The teachers in the present study mostly expressed high agreement and positive perspectives on school mathematics and curricula at the micro-level of the classroom. In particular, teachers' perspectives on (a) the importance of both individual and collaborative learning, (b) the use of various teaching materials and representations, (c) the recognition that pupils have an active role in the discovery of knowledge, and (d) their own role as supportive role models, are in line with the spirit of the reform (see MoEC, 2010) and the calls of the international research community for the development of 21st century skills (Silva, 2009). However, participants' perspectives regarding the macro (state and policy) and meso (school and community) levels reveals a number of factors that may prohibit the successful implementation of the reform, unless further action is taken. More specifically, this study brings to the surface many concerns associated with the prohibiting factors pointed out by Memon (1997) and Clarke (1997). Many of the participants (a) expressed their dissatisfaction regarding who gets to decide on the content of the mathematics curriculum, (b) believed that the new textbooks do not meet their own professional needs or their pupils' learning needs, (c) argued for the necessity of more school-based professional development opportunities, (d) comment on the lack of collaborative culture and mentality in the Cypriot schools, and (e) were concerned with how parental involvement in mathematics could be more effective, and not another obstacle to pupils' learning.

The findings of this study have practical implications within and beyond the educational system of the Republic of Cyprus. Individual research initiatives in examining teachers'

perspectives on school mathematics and curricula in the light of the current large-scale educational reform, could be utilised by the Republic's Ministry of Education and Culture (MoEC). In a highly centralised educational system, teachers' professional development programs are more likely to be effective if applied at large and initiated by the MoEC. Also, as indicated by the participants of this study, school-based programs would be more beneficial to teachers, instead of the scattered large-scale seminars the MoEC organises every academic year. With regards to this study's cross-national implications, it would be unfortunate and naïve to claim that the sub-themes (teachers' perspectives) identified under each level (macro, meso, micro) are prone to generalisability and transferability to other contexts. However, colleagues in other countries might find the adoption of the level-oriented approach useful, while keeping in mind that when such an approach is applied to a different context, it is expected that different perspectives of teachers will emerge. Those perspectives, as with these indicated by the Greek-Cypriot teachers in this study, will be framed by the particularities of the sociocultural context in which they exist, and the educational system being examined. Furthermore, future researchers could examine possible interconnections and overlaps between teachers' perspectives through the three levels, as this approach was not pursued in this paper.

To conclude, the level-oriented approach (macro, meso, micro) to analysing teachers' perspectives on school mathematics has the potential to inform the designing of professional development programs, by indicating the level(s) at which teachers' perspectives are more misaligned with the visions of a reform. In the Cypriot context as presented in this study, teachers' perspectives on mathematics teaching and learning in their own classroom environments (micro level) match the visions of the new reform fairly clearly. However, misalignments are observed when it comes to their perspectives on the school environment (meso level) and the official policies (macro level). It is, therefore, crucial for policymakers to address teachers' perspectives on all levels, listen to the teacher's concerns, and try to address them in more effective ways.

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