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The aim of this paper is to examine the connections made between real life and school mathematics as politics of mathematics education. The analysis focuses on an elective course, "mathematics applications", offered for middle graders in Turkey. I explore, first, how mathematics education discourses authorize responsibilization, reason and rationality for the administrative needs of a society. Second, my analysis focuses on how the natural lives of humans lie at the center of the political calculations where sovereign decisions are taken. The connection between natural life and life as a citizen offers alternative ways to think about modern sovereignties.

Keywords: Discourse analysis, equity, mathematical applications, politics of education

Introduction

Mathematics is considered as central to young people's preparation for life in contemporary societies (e.g., see, OECD, 2013). The will to teach and learn mathematics for better lives, however, has a political dimension where it conceives mathematics as having a positive role to cultivate the new generations into that knowledge and to the related values (Valero, 2004). In these processes, desire for a "better" life in/through mathematics education discourses constitutes particular subjectivities and differences (e.g., Diaz, 2017). Parallel with the aim of preparing youth for "better" lives, an elective course, "mathematics applications", is offered for middle school students in Turkey to make the school mathematics more real and relevant to life. This course has been the most elected course by students since its initiation (Karagözoğlu, 2015). The course is less about teaching mathematical content (i.e., fractions, triangles or equations); rather, instructional material consists of problems, games and interdisciplinary tasks that include the real life of the child (MNE, 2013). This paper does not treat the "inclusion" of real life in the curricular and instructional materials as natural, but it rather problematizes the processes of associating real life and mathematics as a politicization of natural life. Specifically, I analyze *how* mathematics is associated with "better" life. In doing so, my aim is, first, to explore how connection processes produce administrative tools to govern people at a distance without domination, and second, to examine how these processes make biological life as object of sovereign decisions (i.e., who is allowed to live/die) in today's politics.

Research has already spent some time examining how school mathematics embodies a set of practices that govern students' being and acting as future citizens (see, e.g., Diaz, 2017; Valero, 2004; Yolcu & Popkewtiz, 2018). These studies provide important insights about the way in which particular subjectivities and their differences are made in/through school mathematics to configure (im)proper modes of life as citizens. For example, it is argued that calculations inscribe a bureaucratic mode of thought among students in modern states where mathematics functions as a technology of trust (Kollosche, 2014). Nevertheless, in today's societies, calculations are not merely used for bureaucratic-administrative purposes, but become the politics of life itself (Rose, 2001).

That is, the biological existence of humans becomes the object of politics within narratives of security, health or any kind of crisis. Chronaki (2018), in this vein, uses a fictional environmental crisis to argue how a totalitarian mathematical ban may also function as a form of sovereign power that can penetrate the bodies, locate traces of biological lives and decide who is allowed to live. This provides an insight in how life becomes the object of sovereign decisions. In today's societies, nonetheless, connection between mathematics and life is made without domination, but through an inevitable "need" of mathematics for "better" lives. This vanishing point between sovereignty and productive power relations (i.e., relationship between natural life and life as citizen) necessitates further analysis to grasp the nature of contemporary politics.

Contemporary Political Paradigms and Life

For Agamben (1998), there were two different meanings for the word "life" in the classical world. First one is *zoē*, which is the natural life that is common to all living beings. The other one is *bios*, which is the form of life that is proper to a group (i.e., citizens). The distinction between the two had constituted the "city", consisting of people with a proper form of life, until Foucault (1990) makes visible how natural life is included in political calculations. For Foucault, modern power is exercised through different political rationalities and governmental technologies than the sovereign power –those in monarchies, kingdoms or empires. For instance, contemporary government forms administer lives of self and others in the light of conceptions of what is good, healthy, normal, virtuous, efficient or profitable in order to ensure maximal functioning in civil life and to secure the best possible future for its subjects (Rose & Miller, 1992). In this way, power is exercised through a set of practices that make up citizens as a particular kind of human (Hacking, 2007; Rose, 1999). According to Foucault (1990), this has not always been the case. While "sovereignty took life and let live" in societies ruled by monarchs or religious authorities, he points out the emergence of practices that tend to make lives and let them die (p. 247). In the realm of modernization processes, such practices form human life as the object of politics that authorizes particular action and social participation. He calls them "biopolitics of the population" as they focus on human life as species to maximize its well-being, health and security (Rabinow & Rose, 2006).

Nevertheless, according to Agamben (1998), there remain several questions that relate to the original activity of sovereign: If governmental practices are no longer "taking the life" but rather they are "making the life," how can we understand the explosion of numerous and meticulous techniques to control populations at the level of biological/natural life, which are the ones closest to death? If power is exercised at the level of human's biological life, how are its practices and strategies different from domination and repression? To deal with these questions, one should account for the hidden yet converging point between the juridical-institutional and the biopolitical models of power since the inclusion of human's natural life in political strategies points to the original activity of sovereignty:

> Placing biological life at the center of its calculations, the modern State therefore does nothing other than bring to light the secret tie uniting power and bare life, thereby reaffirming the bond between the modern power and the most immemorial of the *arcana imperii*. (Agamben, 1998, p. 6, emphasis original)

In those converging points or in the bonds, the body becomes a vital living system where "real" life become molecularized and organized with the gaze of biological and natural sciences, their institutions, procedures, instruments and spaces of operations (Rose, 2001). Health, for example, provides a transactional zone between political concerns of modern states and personal techniques for the care of the self. It is usually offered as a universal human right to protect persons and as a dignity for their living vital bodies. Here, subjects are rendered responsible for their own biological or natural lives, which previously was the duty of sovereign. This does not mean the disappearance of the sovereign, but refers to modification of practices, operating in the horizon of a natural life.

Within the scope of this paper, I take these changes as a historical continuity rather than a threshold of modernity. Following Agamben's (1998) works and Foucault's (2007) lectures on biopolitics, my aim is to make visible the modifications of how governmental technologies constitute a complex network of practices that blur the distinctions between sovereign, disciplinary and control relations in the field of school mathematics and in the society as well. Affirmation of bare life offers new and more dreadful rationales and foundations for sovereign decisions (i.e., who is allowed to live), not the sovereign himself, because natural life and its needs become politically decisive facts. Mathematics education is part of those rationalities and technologies since one of the concerns in the field is the inclusion of real or natural lives in order to make mathematics relevant for "all". The issue, here, is not merely providing equitable access to mathematics because the discourse of "all" is already proven to produce exclusions (see, e.g., Diaz, 2017; Yolcu & Popkewitz, 2018). A fundamental activity of these processes is the production of bare life through the politicization of natural lives in its calculations so that any decision for those "excluded" can be taken. In this way, sovereign logic is normalized and made permanent with notions of security, health, and biological productivity.

This paper offers alternative ways to think about sovereignty in modern societies. Rather than treating natural life and life-as-citizen as separate entities, the examples presented in the paper make visible the indeterminate relationship between the two as the political paradigm of modern sovereignties. In this way, the politics becomes a set of techniques and strategies that legitimize the connection of natural life and life-as-citizen as paradoxes of inclusion and exclusion such as deciding who is going to live and die. I deal with specific ways and techniques of school mathematics that operate at the level of natural lives, the very biological making of humans. To do this, curricular documents and teacher guidebooks of a "mathematics application" course are analyzed. The reason why the focus is on this elective course is to make visible political rationalities and technologies that are far from domination but similar to sovereignty. I have purposefully selected examples from the textbooks that relate biological processes of life. A numerical analysis of the problems indicates that the examples that relate to natural life constitute approximately twenty percent of the total (n=132) across the middle school grades (5th–8th). The rest of the problems are mental games, strategy development tasks, market relations that are concerned with informed shopping or budgeting, and geometry-measurement problems. Analysis of curricular and instructional texts does not assume that they are the same with teacher practice itself. Nonetheless, discourses are results of practices and, at the same time, they produce further practices

(Popkewitz, 2013). This reciprocal relation shows possibilities of change without assuming a pre-existing subject (e.g., teacher) as an agent of change.

"Adolescent" as an object of school math: Cultivating reason and rationality

The child in the curricular statements of the mathematics application course is configured as a particular kind of human who is "in transition" and needs math to realize their potentials:

> These ages are sensitive transition periods in the life of the students, since the rapid changes are the periods of adolescence. [...] The perceptions of what they get from these ages shape their attitudes towards the course in the coming years and affect their achievements in mathematics [...]. If students challenge the limits of knowledge and skills in mathematics courses in the school, and if they receive the support they need, they will have the best chance of achieving their mathematical potential (MNE, 2013, p. 1, all originally Turkish texts translated by me).

Here, the adolescent is the object of teaching and the target population. Students are configured as "adolescents" who are to learn particular skills to find reasonable and rational solutions to the problems of real life. Adolescent, here, is not merely a label, but a particular kind of human and a fictional construction that comes to being by generating ideas about how one lives or should live (see, e.g., Lesko, 2012). They are to take responsibility in the process so that they would be able to show their agency or "mathematical potentials" in their future lives when they become adults.

The emphasis of the course is not at the end products but the processes of connecting real-life and mathematics in group settings. In this way, students, as future adults, are to learn to find not merely the correct answer but reasonable and rational solutions: "In this course, students need to look for rational and reasonable solutions with their classmates through collaboration rather than finding correct answers" (p. 1). These statements cannot be interpreted as purely domination; rather they are technologies of automation and responsibility that enable the 'proper' life as citizens (Rose, 1999).

Let us take one of the problems, connecting the life as citizen and natural lives of humans. It is related to energy saving through using energy-efficient bulbs. Students are expected to learn about the "importance of energy saving" and "calculating the possible saving" for this particular problem (MNE, 2012, p. 45). Energy saving, here, is neither a personal issue nor about saving money for personal interest. Rather, the mathematical task is contextualized around concerns for human life since energy usage is correlated with CO_2 emission that has a negative impact on earth where we, human beings, live. The image in Figure 1 illustrates how the problem is situated in wider world issues with implications on human's biological lives. Of course, the issue is important and the problem relevant. Nevertheless, the specific questions that are addressed by students through mathematical task assemble with particular processes of making responsible citizens. As stated: "You can also contribute to energy saving. What are your responsibilities for this? In which areas can you save money?" (p. 44).

Figure 1

The mathematical part of the problem is the calculation of the energy saving amount if energy-efficient light bulbs are used or if one avoids unnecessary usage of electricity. In this regard, the emphasis of the questions is on everyday habits of people, not on the mathematics itself. Asking questions such as "How many bulbs do you use at home?", "How many hours are the lights turned on in the living room?" or "How much savings do you get when you turn unused bulbs off?" (p. 44) bring the everyday life into a calculation practice. However, these are not merely prompting questions that push students into the mathematics, but become specific practices that order (im)proper lives in order to socialize 'adolescents' in effective ways. When students denote the correct amount of saving following the calculations, they learn energy-efficient ways of living not just mathematics.

The processes that connect real-life and mathematics do not only regulate human conduct, but also connect with biological lives. The link between the two makes a kind of human who is committed to science, humanity and the world through taking care of nature, life of self and humanity.

> There is a release of 1.5 kilograms of CO_2 into the air for 1 kilowatt of energy production from fossil fuels. Calculate how many kilograms of CO_2 emission you prevented with your energy savings. Show the results you find with tables and graphs. (p. 44)

As the above text shows, energy saving is both a personal and social problem, an issue that the whole society should be "accountable" for. Individual efforts are to take care for the natural life, which is a concern for everyone. In addition to this, the ability to "show the results" is not the domination of mathematics but a specific technology that mathematics education offers for taking ownership in the processes of finding reasonable solution for their own lives. In this way, the truth is not imposed upon student's mind. Individual contribution is valued, but calculations, tables and graphs, simultaneously, create boundaries of rationality in their own solutions and so in their "natural" lives: "All these processes will enable students to take ownership of mathematics and solutions by allowing them to make personal contributions and take responsibility instead of trying to find the "right" solution in the teacher's mind" (MNE, 2013, p. 7).

Students, aged between eleven and fifteen, are regarded as people-in-transition who are to become future citizens. The real-life application of mathematics is the technology to make them part of the society with a sense of belonging so that there would not be any noise, social disorganization or natural disorder in the unknown future. Practices that make the people responsible are embedded in the connection processes in order to ensure the integration would happen in a harmony neither by force nor through domination. In this way, "freedom" is ensured but it is regulated with reason and rationality for their own well-being and natural lives.

Calculations of real life: Irreversible clock time and progressive human nature

Some problems in the mathematics application textbooks are directly contextualized with biological processes of human beings when making the connection between mathematics and real life. See, for instance, how a problem is introduced in a 5th grade teacher guidebook:

> The heart is a marvel of biological engineering with its general structure and function. Even the hearts of people who do not do sports are very strong in terms of durability. Our heart, which has

a high-density vessel structure, has about 2000 capillaries per square millimeter. This allows oxygen to reach the heart muscle continuously and safely at a sufficient level (MNE, 2012, p. 12).

Here, heart as a vital biological character of living human beings, including its health and durability, is the main context that drives the problem. It is described as a "marvel of biological engineering" and a natural mechanism that allows oxygen circulation throughout the body. The mathematical part of the problem is counting and calculation of the frequency of heart rate at a given time, including a minute, an hour, a day, a week, a month and a year. At the end, students present their heart rate frequencies with peers or the whole class and discuss results aiming to learn the relationships between second, minute and hour but also between day, week, month and year (p. 13).

Such practices are not simply mathematical tasks but activities that engage students in a process where they learn the irreversible time that provides qualities of growth, development and progress to human nature. That is to say, the linear time is being made and associated with the accumulated heart rate counts, biological productivity and developmental clock-time. This association generates the "nature" of human life as a linear experience similar to the forms of civilization, evolution, development, acculturation, and modernization (Fabian, 2014). The temporal yet accumulated view of human nature is accompanied with the construction of the child as "adolescent" and, thus, it authorizes proper life as a citizen in companion with the processes of making up their natural lives.

As students count heart rates, they are also encouraged to see and discuss different measurements from different groups. Specifically, students evaluate the different results in terms of "physically active bodies", "other personal characteristics" or "gender" (MNE, 2012, p. 13). Here, numbers become the agents to see and differentiate the modes of life through vital processes of human nature, such as heart rates. However, more is required to secure the best possible future with "healthy" bodies in addition to the comparing different kinds of people in terms of their heart rate measurements. In the 7th grade guidebook, for instance, a similar heart rate context is offered. This time, a caution for possible health problems is presented with algebraic equations for the "recommended maximum heart rate" (i.e., y= 208-(0,7 x age)): "Due to health problems, people have to obey certain limits when doing sports activities. For example, if a certain heart rate is passed while doing sports, this can cause health problems for people" (MNE, 2017, p. 27).

In this way, students are to calculate the recommended hearth rate and how the results change with respect to age. The issue, here, is not simply a matter of comparison. Bodies are calculated with appropriate heart rate at a given age and associated with the kinds of people who do physical activities or who smoke. Techniques of making "normal" bodies also employ rationales to act on those deviate from those normal lines. With numbers revealed from algebraic equations, doing physical activity or quitting smoke become self-authorizations for "adolescents" to "correct" their life, to improve themselves biologically as part of human species and to adapt their bodies in line with the proper modes of life as a citizen. There is no elimination of unhealthy or foreign bodies that are disruptive to progressive human nature; rather, it is a matter of classifying and correcting in the face of death.

Politicization of natural life, life as citizen, and school mathematics

This paper has examined some mathematics education discourses within the scope of contemporary political paradigms. In connecting mathematics and real life, the body is subjugated in a double sense. First, the child is constituted as an object, which is to be made a future citizen, embodying a particular form-of-life through socio-cultural integration. Second, natural life emerges at the center of calculations that make the child a subject who decides for his/her own well-being in that political zone. In other words, biological processes of human life are located at the center of the connections made between mathematics and real life and enabling self-authoritative techniques to maximize health, biological productivity or well-being of their own bodies and also themselves as human species. In these linked ways, people seek for better, healthier or secure options through a continuous "need" for mathematics since the issue becomes natural life and survival, not only framed in economic but also in biological terms.

The specific case of the "mathematics application" course is important to consider since those students taking the course, in fact, are outside of regular mathematics classes. Taking the elective course is considered as extra mathematics support by themselves or their parents (Çoban & Erdoğan, 2013) or as a mean to reduce mathematics anxiety and to develop positive attitudes towards mathematics (MNE, 2013; Keşan, Coşar & Erkuş, 2016). Although those students are excluded, they are still in the system in paradoxical ways, through an "inclusive exclusion" (Agamben, 1998). The student body for this particular course does not actually fit to the regular classes but is simultaneously engaged with additional mathematics through the "need" for mathematics for their well-being and future survival. This generates topological relations of inclusion/exclusion rather than a polarization.

Instead of immobilizing with the unquestionable need of mathematics to make the individual's lives better, healthier or more productive, reading mathematics education discourses through contemporary political philosophy makes visible how the logic of sovereignty circulates along the modern life, which is configured as citizen life. That is, as discourses connect natural/biological life and life as citizen, the sovereign decisions become possible. The analysis, here, allows us to rethink the tactics, tools and governmental technologies of modern sovereignties such as affirmation of real-life in mathematics problems. Rethinking makes visible the possibilities as well. We could reconsider questions that seek to discover whose lives are properly represented because the political issue discussed here is less about authentic representation of real life but it is the representation itself. Each of us has a heart rate and we all are exposed to CO_2 emission.

Political potentialities, which need further explorations, could start with contesting the representational paradigms that seeks to emancipate, live or survive with the mathematics. Or more generally, they could challenge and problematize identity politics that "liberate" people within given and historically polarized populational categories. This is partly because exclusions are being generated through inclusion of real life in mathematical practices. Sovereign logic circulates in these processes where life itself becomes the object of politics that organize its survival and death.

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