



**HAL**  
open science

# The mathematics teacher's quasi-Darwinism: Problematizing mathematics education research

Alex Montecino

► **To cite this version:**

Alex Montecino. The mathematics teacher's quasi-Darwinism: Problematizing mathematics education research. CERME 10, Feb 2017, Dublin, Ireland. hal-01937355

**HAL Id: hal-01937355**

**<https://hal.science/hal-01937355>**

Submitted on 28 Nov 2018

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# The mathematics teacher's quasi-Darwinism: Problematizing mathematics education research

Alex Montecino

Aalborg University, Denmark; [alexm@plan.aau.dk](mailto:alexm@plan.aau.dk)

*This paper discusses the configuration of a quasi-Darwinian view of mathematics teachers, where the survival of the fittest is the cornerstone of a network of practices and discourses. It aims to contribute to the problematization of how mathematics education research and its discourses have effects of power in the fabrication of mathematics teachers' subjectivities, by unpacking naturalized truths of research – truths regarding a productive and successful mathematics teacher. It deploys a Foucault-inspired discourse analysis, and it argues how the research on the mathematics teacher becomes a practice that governs mathematics teacher's subjectivities through the enunciation of the desire subject, a productive, successful and effective teacher.*

*Keywords: The mathematics teacher, effects of power, quasi-Darwinism.*

## Introduction

Providing quality mathematics education has been a concern within the mathematics education community, research on education and international agencies. It is argued that the quality of education and the development of mathematical knowledge is essential for society and social development (Gellert, Hernández, & Chapman, 2013; OECD, 2010b). The idea is circulating that success in school mathematics is a prerequisite for personal and social success. Nowadays, it is considered that mathematics is a powerful mean to understand and control one's social and physical reality (OECD, 2010a), by being a tool and skill that helps people to undertake diverse tasks and problems of everyday life, and of their contexts (OECD, 2014b). However, according to OECD (2014a), modern societies valorize individuals not for what they know, but for what they can do with what they know, in other words, by their *mathematical literacy*:

Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. (OECD, 2010b, p. 4)

Research in the field of mathematics education is seeking to modify reality – in the frame of social changes – through its findings, proposing rationalities, knowledge, and ways of improving education practices – for ensuring the quality of teaching and learning of mathematics. Furthermore, OECD (2014a) stated that “[h]igher educational achievement benefits both individuals and society, not only financially, but in the well-being with which it is also associated, such as better health outcomes and more civically engaged societies” (p. 104). In this fashion, the mathematics teachers become relevant, since they are considered as a central element in the establishment of quality education (Jong & Hodges, 2015; Luschei & Chudgar, 2015; OECD, 2005, 2014b). Several studies have argued on the relation between the quality of the mathematics teacher and the shaping of successful students (cf. Castro-Rodríguez, Pitta-Pantazi, Rico, & Gómez, 2016; da Ponte & Chapman, 2008; Hemmi & Ryve, 2015). Also, it is argued that the teacher is open to policy

influences, whereas factors regarding students and the classroom context are not open to the same policy influences, at least in the short run (OECD, 2005).

All the aforementioned, the circulating discourses around ‘success’ in mathematics, are positioning a way of thinking and understanding mathematics education through the configuration of valid methods of doing research and of arguing about the diverse issues involved in the teaching and learning of the mathematics. For example, “[a]ll research is built around a set of assumptions about the world and how it should be understood and studied” (Jablonka, Wagner, & Walshaw, 2013, p. 41). Thus, this paper problematizes mathematics education research and its effects of power on teachers’ subjectivities and fabrication. A discourse analysis, inspired by Foucault’s ideas, is deployed to unpack the naturalized truths and discursive formations about the effective and competitive mathematics teacher.

### **Movements to examine the mathematics teacher as a discourse formation**

According to Pais and Valero (2012), mathematics education research produces languages and tools that shape what researchers see and say in the world of education and of mathematics education. Mathematics research as a field of inquiry is not an innocent or a neutral activity (Halai, Muzaffar, & Valero, 2016); it has been considered a “social institution which is inseparably linked to power” (Jurdak, Vithal, de Freitas, Gates, & Kollosche, 2016, p. 10). In this fashion, mathematics education, and also its practices, is considered to be political because it operates within governmentality techniques. Hence, by building on these techniques of government, this paper aims to understand how mathematics education research fabricates the mathematics teacher’s subjectivity through regulatory practices embedded within naturalized truths. In other words, it addresses how research sees and talks about the mathematics teacher, by establishing regimes of power/knowledge.

According to Foucault (1972), “[w]e shall call discourse a group of statements in so far as they belong to the same discursive formation” (p. 117). Hence, discourse as a group of statements, provides a particular language and knowledge, assembling regimes of truths. Circulating discourses describe rules and enunciations of a particular body of knowledge from specific spatiotemporal conditions (Arribas-Ayllon & Walkerdine, 2008). This paper deploys a “research on research” (Pais & Valero, 2012) strategy built on Foucault’s discourse analysis. This analytical strategy helps to unpack naturalized truths within research, that seek to generate a productive and successful mathematics teacher, and, at the same time, to trace the power effects on the fabrication of mathematics teachers’ subjectivities. So, by problematizing the discourses, it is possible to understand research as a practice that governs subjectivities through the enunciation of the desired subject.

First, repeated statements about the ‘must be’ of the mathematics teacher are identified. Second, these statements are analyzed to trace their knowledge/power relationships, and their continuities and discontinuities amongst each other. It does this by analyzing published studies about teaching and learning of mathematics. The empirical materials consist of research about mathematics teachers released within the last four years of three journals: *Journal of Mathematics Teacher Education*, *ZDM Mathematics Education*, and *Educational Studies in Mathematics*.

Finally, it problematizes how research and its discourses have effects of power in the fabrication of mathematics teachers’ subjectivities. It does this by portraying how certain rationality is circulating

within research in mathematics education. As will be described, such rationality promotes a quasi-Darwinism, in which the survival of the fittest and the idea of evolution are the cornerstone of a network of practices and discourses.

## **The mathematics teacher research and the survival of the fittest**

In navigating through the discourses that are circulating about the mathematics teacher, amongst the materials analyzed, it is possible to identify some enunciations that are continuously repeated. By following a Foucaultian chain of thought, these particular enunciations constitute statements about how mathematics teachers are supposed to act and be within their practices, their ‘must be’. Such statements respond to concerns raised by research in the field of mathematics education. For example, who is taken as valid for arguing about mathematics teachers, what does a mathematics teacher ought to do, and how to seek for the improvement of the teaching and learning of school mathematics. From the analysis, some discourses about the ‘must be’ of the mathematics teacher are configured as truths. These truths are advertised as desired features that teachers should have if they want to perform successfully, namely: a high knowledge (Fauskanger, 2015), an updated repertoire of techniques (Subramaniam, 2014), and a personality consistent with their practices – personal aspects such as beliefs or attitudes (Jacobson & Izsák, 2015).

These discourses are naturalized under a competition and comparison system of reason. International standardized testing – PISA and TIMSS –, and its reports are examples of how competition and comparison become part of society, by shaping social discussions, decisions, efforts, and initiatives. At the same time, through those tests’ outcomes, diverse countries could monitor themselves to improve the weakest areas, since “[a]ll countries are seeking to improve their schools, and to respond better to higher social and economic expectations” (OECD, 2005). In this fashion, a variety of studies, that seek to improve the teaching of mathematics (see Boston, 2013; Lewis, 2016; Pang, 2016), are aimed to identify how mathematics teachers could achieve a successful practice by analyzing their students’ achievement on national and international tests. But, as discussed elsewhere, what is taken, by research, as a successful practice leads to a system in which teachers compete against others teachers, against what is considered as a desired teacher, and, also, against themselves (Montecino & Valero, 2016). So, research discourse is raising comparison as a mean for knowing the characteristics of competent and effective teacher – the fittest teacher –, effective practices or successful experiences. Within these discourses, it is possible to see statements such as:

By comparing and contrasting the practices of LS [Lesson Study] in mathematics in different countries, it will be possible to explicate the local theories of teaching and learning of mathematics, highlight educational values in each culture, and understand why and how these values support certain teacher development processes that are unique to the culture. (Huang & Shimizu, 2016, p. 394)

In the unpacking of naturalized truths of the analyzed materials, it is possible to see that some statements highlight mathematics teachers’ deficits and flaws. These statements pay attention to what teachers need to improve in their lessons for increasing students’ achievement (Spitzer, Phelps, Beyers, Johnson, & Sieminski, 2011). On one hand, by emphasizing that teachers need to achieve a higher expertise on school mathematical topics (e.g. Karakok, Soto-Johnson, & Dyben,

2015; Magiera, van den Kieboom, & Moyer, 2013). On the other hand, by focusing on the need for developing more effective teacher's practices (see Lee & Kim, 2016). This type of research acknowledges that mathematics teachers have a 'responsibility' for students' performances and, therefore, teachers ought to be highly trained. Alongside the statements about what needs to be improved, other statements exist that pay attention to what teachers lack, in other words, to skills that teachers are required to develop to reach what those studies perceive as 'successful professional development': on the one hand, studies regarding teachers' belief system (e.g. Conner, Edenfield, Gleason, & Ersoz, 2011; Cross Francis, 2015); on the other hand, studies regarding teachers' attitudes (e.g. Hannigan, Gill, & Leavy, 2013; Jong & Hodges, 2015).

According to some research, "[h]ow teachers perceive and adapt their roles will have great impact on overall classroom interactions, such as the teachers' questioning strategies or feedback patterns" (Lee & Kim, 2016, p. 366). This implies that teachers' decisions have an impact on students since it is believed that students' intellectual autonomy could be favored by teachers' practices (Goldsmith, Doerr, & Lewis, 2014). And so, the decisions made by the mathematics teacher have a high impact not only on students but also on their learning (Stocker & Zoest, 2013). This type of research shows that mathematics teachers should be constantly seeking to improve their professional development, practices, knowledge and skills not only for themselves but also for the sake of their students (Afamasaga-Fuata'i & Sooaemalelagi, 2014). Since professional development has been understood as a form of lifelong learning in which mathematics teachers are responsible for their own development and achievements, these types of statements, from a Foucaultian approach, are tracing the ways in which the mathematics teacher should become an effective and competitive teacher, through processes of self-regulation.

According to these studies, teachers should aim at improving, by themselves, diverse personal and technical aspects. Such aspects are supposed to encourage the development of a more effective and competent teacher, by recognizing their own deficits and flaws with the goal of overcoming them. This naturalized truth resonates not only within research but also amongst other discourses on education. For example, OECD (2012) states that effective teachers are a key to close achievement gaps between advantaged and disadvantaged students. And, therefore, the aim should be to (re)train and (re)shape teachers to become the desired effective teacher. In this regard, research is tracing a sort of 'evolutionary line' for mathematics teachers, in which at the end of the line rests the desired mathematic teacher. Teachers should evolve when they achieve the desired levels of knowledge and skills established by society, becoming the productive, successful and effective teacher. However, these desired levels are in constant movement, being redefined by new social interests, concerns, desires and demands as well as new mathematical knowledge that the modern citizen should have. This means that mathematics teachers have to govern themselves into a constant process of change, of (re)training and (re)shaping. As Deleuze (1992) asserts, currently nothing is considered to be finished; all is in a constant becoming.

The idea of the 'evolutionary line' helps to tell the narrative of the becoming of the mathematics teacher as the survival of the fittest, since research in the field highlights the features of the 'fittest subject'. This portrays that the survival of the fittest – the desired mathematics teacher – involves practices of self-regulation, but also of competition against other teachers, practices that could lead to the exclusion of certain teachers labeled as 'inferior subject', unproductive, unsuccessful, and

inefficient. For example, Lee and Kim (2016) have argued that mathematics teacher training programs “should include more specific investment in the effective use of classroom dialogue for learning” (p. 378), a ‘fittest subject’ should evolve in an effective classroom communicator whereas the ‘inferior subject’ will not evolve as a classroom communicator, and, will therefore be taken as ineffective. Consequently, the survival of the fittest governs the self and conducts mathematics teachers’ practices towards the desire to evolve, (re)shaping the research about mathematics teachers within a system of reason rooted in a quasi-Darwinism, since it traces the paths for teachers to increase their abilities to survive, compete and evolve.

### **Quasi-Darwinism of mathematics education research and its effects of power**

The analysis deployed has pointed to the existence of statements on the desired mathematics teacher, a self-regulated and evolved subject. These statements have been (re)producing certain truths about who the effective teacher is. For example, mathematics teachers should perceive themselves as responsible for others – i.e., their students’ performances –, as promoters of social change – i.e., by closing achievement gaps –, and also, as responsible for themselves – i.e., tracing their professional development and learning the best possible way. These statements are building a quasi-Darwinian view of mathematics teachers; an ‘evolutionary line’ that is embedded within the above discourses and shapes the fabrication of the fittest subject.

The quasi-Darwinism (re)shapes mathematics teachers’ ways of being and acting at a particular time and place, through discourses that are produced and reproduced under certain *regimes of power/knowledge* (Foucault, 1982). The naturalized truths are constituted, on the one hand, within a particular regime of knowledge, which delineates who is the one to discuss about the mathematics teacher and how, and in what way the knowledge regarding the teacher should be generated. On the other hand, within a regime of power which defines what understanding is meaningful to be studied – what discourses are taken valid regarding certain issues or aspect of the mathematics teacher – and which practices, knowledge and techniques should be targeted. Therefore, a quasi-Darwinian view (re)produces what the mathematics teacher should be – the becoming – towards the development of the ‘human capital’ (OECD, 2001). Human capital voices the value that subjects have in correlation with their knowledge, skills, education and preparation for the future, which translates into personal, social and economic well-being. Alongside, a quasi-Darwinian view (re)shapes a discourse aimed at optimizing the becoming of the teacher. Moreover, the research on mathematics teachers seeks to minimize all aspects that could lead to an ‘inferior subject’. In order to be the fittest, teachers should engage in practices that turn them into accountable and measurable agents.

In this regard, it is possible to state that research in the field of mathematics education becomes a technology of the self (Foucault, 1997) that regulates mathematics teachers’ conducts towards the shaping of the desired mathematics teacher. By promoting ‘cultural thesis’ (Popkewitz, 2008) about the desired mathematics teacher, the analyzed research has effects of power on teachers subjectivities, meaning how mathematics teachers understand themselves and their becoming. Only the ‘fittest subject’ is the one able to develop the skills and knowledge that society demands and requires, is the only one who can evolve in a ‘superior subject’; subjects able to adapt themselves to the new social and professional demands. In other words, teachers are to evolve in subjects that

have the tools, skills, and knowledge to survive to all social changes and challenges; becoming a successful, effective, competent and fittest subject.

Thus, within the circulating discourses is configured a narrative in which if the mathematics teacher does not adapt or evolve, he/she is excluded or labeled as deficient. The teacher who survives through social changes and challenges is neither the knowledgeable teacher, nor the successful teacher, nor the most intelligent teacher; rather he/she is the most adaptable to change.

### Acknowledgements

I would like to thank Melissa Andrade Melina and Lisa Björklund Boistrup for their comments to previous versions of this paper.

### References

- Afamasaga-Fuata'i, K., & Sooaemalelagi, L. (2014). Student teachers' mathematics attitudes, authentic investigations and use of metacognitive tools. *Journal of Mathematics Teacher Education*, 17(4), 331–368.
- Arribas-Ayllon, M., & Walkerdine, V. (2008). Foucauldian discourse analysis. In C. Willig & W. Stainton-Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 91–108). London: SAGE.
- Boston, M. (2013). Connecting changes in secondary mathematics teachers' knowledge to their experiences in a professional development workshop. *Journal of Mathematics Teacher Education*, 16(1), 7–31.
- Castro-Rodríguez, E., Pitta-Pantazi, D., Rico, L., & Gómez, P. (2016). Prospective teachers' understanding of the multiplicative part-whole relationship of fraction. *Educational Studies in Mathematics*, 92(1), 129–146.
- Conner, A., Edenfield, K. W., Gleason, B. W., & Ersoz, F. A. (2011). Impact of a content and methods course sequence on prospective secondary mathematics teachers' beliefs. *Journal of Mathematics Teacher Education*, 14(6), 483–504.
- Cross Francis, D. I. (2015). Dispelling the notion of inconsistencies in teachers' mathematics beliefs and practices: A 3-year case study. *Journal of Mathematics Teacher Education*, 18(2), 173–201.
- da Ponte, J. P., & Chapman, O. (2008). Preservice mathematics teachers' knowledge and development. In L. D. English (Ed.), *Handbook of international research in mathematics education* (pp. 223–261). New York: Routledge.
- Deleuze, G. (1992). Postscript on the societies of control. *October*, 59, 3–7. doi:10.2307/778828
- Fauskanger, J. (2015). Challenges in measuring teachers' knowledge. *Educational Studies in Mathematics*, 90(1), 57–73.
- Foucault, M. (1972). *Archaeology of knowledge*. London: Routledge.
- Foucault, M. (1982). The subject and power. *Critical Inquiry*, 8(4), 777–795.
- Foucault, M. (1997). Technologies of the self. In M. Foucault & P. Rabinow (Eds.), *Ethics: Subjectivity and truth* (pp. 223–251). New York: The New Press.

- Gellert, U., Hernández, R., & Chapman, O. (2013). Research methods in mathematics teacher education. In M. A. Clements, A. J. Bishop, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Third international handbook of mathematics education* (pp. 327–360). New York: Springer.
- Goldsmith, L., Doerr, H., & Lewis, C. (2014). Mathematics teachers' learning: A conceptual framework and synthesis of research. *Journal of Mathematics Teacher Education*, *17*(1), 5–36.
- Halai, A., Muzaffar, I., & Valero, P. (2016). Research rationalities and the construction of the deficient multilingual mathematics learner. In R. Barwell, P. Clarkson, A. Halai, M. Kazima, J. Moschkovich, N. Planas, M. Setati-Phakeng, P. Valero, & M. Villavicencio Ubillús (Eds.), *Mathematics education and language diversity: The 21st ICMI study* (pp. 279–295). Cham: Springer.
- Hannigan, A., Gill, O., & Leavy, A. (2013). An investigation of prospective secondary mathematics teachers' conceptual knowledge of and attitudes towards statistics. *Journal of Mathematics Teacher Education*, *16*(6), 427–449.
- Hemmi, K., & Ryve, A. (2015). Effective mathematics teaching in Finnish and Swedish teacher education discourses. *Journal of Mathematics Teacher Education*, *18*(6), 501–521.
- Huang, R., & Shimizu, Y. (2016). Improving teaching, developing teachers and teacher educators, and linking theory and practice through lesson study in mathematics: An international perspective. *ZDM Mathematics Education*, *48*(4), 393–409.
- Jablonka, E., Wagner, D., & Walshaw, M. (2013). Theories for studying social, political and cultural dimensions of mathematics education. In M. A. Clements, A. J. Bishop, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Third international handbook of mathematics education* (pp. 41–67). New York: Springer.
- Jacobson, E., & Izsák, A. (2015). Knowledge and motivation as mediators in mathematics teaching practice: The case of drawn models for fraction arithmetic. *Journal of Mathematics Teacher Education*, *18*(5), 467–488.
- Jong, C., & Hodges, T. (2015). Assessing attitudes toward mathematics across teacher education contexts. *Journal of Mathematics Teacher Education*, *18*(5), 407–425.
- Jurdak, M., Vithal, R., de Freitas, E., Gates, P., & Kolloche, D. (2016). *Social and political dimensions of mathematics education: Current thinking*. Cham: Springer.
- Karakok, G., Soto-Johnson, H., & Dyben, S. (2015). Secondary teachers' conception of various forms of complex numbers. *Journal of Mathematics Teacher Education*, *18*(4), 327–351.
- Lee, J.-E., & Kim, K.-T. (2016). Pre-service teachers' conceptions of effective teacher talk: Their critical reflections on a sample teacher-student dialogue. *Educational Studies in Mathematics*, *93*(3), 363–381.
- Lewis, C. (2016). How does lesson study improve mathematics instruction? *ZDM Mathematics Education*, *48*(4), 571–580.
- Luschei, T., & Chudgar, A. (2015). *Evolution of policies on teacher deployment to disadvantaged areas*. UNESCO.
- Magiera, M. T., van den Kieboom, L. A., & Moyer, J. C. (2013). An exploratory study of pre-service middle school teachers' knowledge of algebraic thinking. *Educational Studies in Mathematics*, *84*(1), 93–113.

- Montecino, A., & Valero, P. (2016). Mathematics teachers as products and agents: To be and not to be. That's the point! In H. Straehler-Pohl, N. Bohlmann, & A. Pais (Eds.), *The disorder of mathematics education: Challenging the sociopolitical dimensions of research* (pp. 135–152). Cham: Springer.
- OECD. (2001). *The well-being of nations: The role of human and social capital*. Paris: OECD.
- OECD. (2005). *Teachers matter: Attracting, developing and retaining effective teachers*. Paris: OECD.
- OECD. (2010a). *Mathematics teaching and learning strategies in PISA*. Paris: OECD.
- OECD. (2010b). *PISA 2012 mathematics framework*. Paris: OECD.
- OECD. (2012). *Equity and quality in Education: Supporting disadvantaged students and schools*. Paris: OECD.
- OECD. (2014a). *Education at a glance 2014: OECD indicators*. Paris: OECD.
- OECD. (2014b). *PISA 2012 results: What students know and can do. Student performance in mathematics, reading and science*. Paris: OECD.
- Pais, A., & Valero, P. (2012). Researching research: mathematics education in the political. *Educational Studies in Mathematics*, 80(1), 9–24.
- Pang, J. (2016). Improving mathematics instruction and supporting teacher learning in Korea through lesson study using five practices. *ZDM Mathematics Education*, 48(4), 471–483.
- Popkewitz, T. S. (2008). *Cosmopolitanism and the age of school reform: Science, education, and making society by making the child*. New York: Routledge.
- Spitzer, S. M., Phelps, C. M., Beyers, J. E. R., Johnson, D. Y., & Sieminski, E. M. (2011). Developing prospective elementary teachers' abilities to identify evidence of student mathematical achievement. *Journal of Mathematics Teacher Education*, 14(1), 67–87.
- Stockero, S. L., & Zoest, L. R. (2013). Characterizing pivotal teaching moments in beginning mathematics teachers' practice. *Journal of Mathematics Teacher Education*, 16(2), 125–147.
- Subramaniam, K. (2014). Prospective secondary mathematics teachers' pedagogical knowledge for teaching the estimation of length measurements. *Journal of Mathematics Teacher Education*, 17(2), 177–198.