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Modelling in Mathematics Education in the face of teachers' challenges in the school routine: an interview with Professor Dionísio Burak

Modelagem na Educação Matemática frente aos desafios do professor no cotidiano escolar: uma entrevista com o professor Dionísio Burak

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Dionísio Burak – retired full professor from the Mathematics Department at Universidade Estadual do Centro-Oeste.

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KEYWORDS: Dionísio Burak. Interview. Modelling in Mathematics Education.

PALAVRAS-CHAVE: Dionísio Burak. Entrevista. Modelagem na Educação Matemática.

PRESENTATION

The thematic edition "Constitution of Environments for Teacher Education in Mathematical Modelling" is an initiative of the research group *Modelagem Matemática no Contexto Educacional*. It aims to give visibility to research that investigates different educational designs in which Modelling practices were planned, implemented and/or discussed, based on theoretical-methodological issues.

Considering the relevance of Professor Dionísio Burak as one of the pioneers of Modelling in Mathematics Education in Brazil, as well as his concern for teacher education, we aim to bring a bit of his history with Mathematics Education and Mathematical Modelling to the academic community, given his 54 years of dedication to education. Given the interest in Mathematical Modelling, more specifically in teacher education in Modelling, professors at UTFPR Karina

Alessandra Pessoa da Silva and Emerson Tortola, requested an interview with Professor Dionísio as a way to honor him. The interview was conducted via videoconference on October 28, 2024. Professors Karina and Emerson are part of a research project supported by CNPq, focused on teacher education in Mathematical Modelling. We understand that the interviewee has great relevance to the scientific community, especially in Mathematical Modelling, with a legacy of guidance and practices of Modelling in the classroom across different levels of education.

Professor Dionísio Burak holds a degree in Mathematics from the former *Faculdade Estadual de Filosofia Ciências e Letras de Guarapuava*, obtained in 1973. He completed a specialization course in 1975 with a group of professors from the *Instituto de Matemática, Estatística e Computação Científica* (IMECC) at Unicamp, where he met Professor Rodney Carlos Bassanezi. In 1982 and 1983, he was part of the organization of the commission in Guarapuava for the first specialization course involving Mathematical Modelling in Brazil, along with Professor Rodney and Professor Ubiratan D'Ambrosio. He intensified his research in Mathematical Modelling in Mathematics Education starting in 1984 when he joined the master's program in Mathematics Teaching at *Universidade Estadual Paulista Júlio de Mesquita Filho*, under the guidance of Professor Rodney Bassanezi, completing it in 1987 (Burak, 1987). From 1988 to 1992, he pursued a doctorate in Education at *Universidade Estadual de Campinas*, focusing on Mathematical Modelling (Burak, 1992). In 2010, he completed a postdoctoral internship at *Universidade Federal do Pará*. His research interests are focused on Modelling in Mathematics Education, as well as the teaching and learning of Mathematics. He was the director of the *Sociedade Brasileira de Educação Matemática*, Paraná regional (SBEM-PR), for two terms, totaling four years in charge of this important community of teachers in the state. He is currently a retired full professor from the Mathematics Department at *Universidade Estadual do Centro-Oeste*. Link to the Lattes Curriculum: http://lattes.cnpq.br/3096837034284131.

Out of the 58 papers published since 1994 in journals by Professor Dionísio Burak, 48 are on Mathematical Modelling. In general, there are practices of Mathematical Modelling reported and analyzed at different levels of education, as well as meta-analyses of research based on phenomenology (Klüber & Burak, 2008) and discussions on qualitative research in Mathematical Modelling (Klüber & Burak, 2012). Out of the total works on Modelling, explicitly, five focus on teacher education in Mathematical Modelling (Ferreira & Burak, 2016; Silva & Burak, 2017; Zontini & Burak, 2018; Silva & Burak, 2020; Burak & Zontini, 2020), both in initial education in Mathematics and Pedagogy Licentiate, as well as in continuing education. Besides papers in journals, there are research and experience reports published in regional, national, and international events in the field of Mathematics Education, totaling 98 papers. From 2014 to 2024, Professor Dionísio published 32 articles in events such as *Encontro Paranaense de Modelagem na Educação Matemática* (EPMEM), *Encontro Paranaense de Educação Matemática* (EPREM), *Conferência Nacional sobre Modelagem na Educação Matemática* (CNMEM), and International Conference on Teaching Mathematical Modelling and Applications (ICTMA). Professor Dionísio published a

book (Burak & Aragão, 2012) and organized three others, with three of them having the term Mathematical Modelling in the title. Additionally, he produced 36 book chapters, with 24 discussing Modelling and, specifically, teacher education in Modelling present in four of these chapters. So far, there are 50 dissertations and theses supervised and defended. The thesis of Professor Vantielen da Silva Silva (Silva, 2018) even received a CAPES award for outstanding theses and dissertations.

As the focus of the interview is teacher education in Modelling in Mathematics Education, the approach involves discussions on the history of Modelling in Brazil, especially for Professor Dionísio, as well as the path of teacher education in Mathematical Modelling. To this end, the conceptions of Professor Dionísio Burak are highlighted in his words, contextualizing how the characterization of terms and expressions took place.

It is hoped that readers will gain insight into the history of Professor Dionísio and his concern for Mathematics Education, his legacy in Modelling across different levels of education, as well as his concern for the future of student education in Basic Education.

REFERENCES

Burak, D. (1992). *Modelagem Matemática: ações e interações no processo de ensino e aprendizagem*. (Tese de Doutorado em Educação), Universidade Estadual de Campinas, Campinas.

Burak, D. (1987). *Modelagem Matemática: uma metodologia alternativa para o ensino de Matemática na 5ª série*. (Dissertação de Mestrado em Educação Matemática), Universidade Estadual Paulista Júlio de Mesquita Filho, Rio Claro.

Burak, D.; & Aragão, R. M. R. (2012). *A Modelagem Matemática e relações com a aprendizagem significativa*. 1. ed. Curitiba, PR: Editora CRV.

Burak, D.; & Zontini, L. R. S. (2020). Práticas com Modelagem na formação do professor da Educação Básica: a busca por uma nova racionalidade. *Práxis Educativa*, 15, 1-20. https://doi.org/10.5212/praxeduc.v.15.14239.027.

Ferreira, C. R.; & Burak, D. (2016). Formação continuada de professores de matemática da educação básica em Modelagem Matemática: possibilidades da educação a distância online via software moodle. *Educere Et Educare*, 2, 187-202. https://doi.org/10.17648/educare.v11i21.13079.

Klüber, T. E.; & Burak, D. (2008). A Fenomenologia e suas contribuições para a Educação Matemática. *Práxis Educativa*, 3(*1*), 95-99. http://educa.fcc.org.br/scielo.php?pid=S1809-43092008000100010&script=sci_abstract.

Klüber, T. E.; & Burak, D. (2012). Sobre a pesquisa qualitativa na Modelagem Matemática em Educação Matemática. *Bolema. Boletim de Educação*

Matemática, 26, 111-133. https://doi.org/10.1590/S0103-636X2012000300007.

Silva, V. S. (2018). *Modelagem matemática na formação inicial de pedagogos*. (Tese de Doutorado em Educação), Universidade Estadual de Ponta Grossa, Ponta Grossa.

Silva, V. S.; & Burak, D. (2017). A formação matemática no curso de pedagogia: aprendizagens a partir da Modelagem Matemática. *Cadernos de Pesquisa*, 24, 159-175. https://doi.org/10.18764/2178-2229.v24n.especialp159-175.

Silva, V. S.; & Burak, D. (2020). Modelagem Matemática na formação inicial de pedagogos: um caminho para ressignificação do ensino de Matemática. *Práxis Educativa*, 15, 1-14. https://doi.org/10.5212/PraxEduc.v.15.15113.043.

Zontini, L. R. S.; & Burak, D. (2018). Modelagem matemática na pós-modernidade: uma proposta de formação continuada de professores. *Educere Et Educare*, 13, 93-111. https://doi.org/10.17648/educare.v13i29.15360.

INTERVIEW

Emerson: Professor Dionísio, it is an honor to have your collaboration. We are very happy with your acceptance to participate in this interview! You are a reference in Mathematical Modelling and were one of the pioneers in work on teacher education in Mathematical Modelling. Therefore, we are truly delighted to have your collaboration.

The research group *Modelagem Matemática no Contexto Educacional*, aiming to give visibility to research investigating the constitution of environments for teacher education in Mathematical Modelling, invited the scientific community to share the results of research based on theoretical-methodological issues that considered different educational designs in which Modelling practices were planned, implemented, and/or discussed. The shared and approved results were published in the thematic edition titled "Constitution of Environments for Teacher Education in Mathematical Modelling" of the journal **Actio: Teaching in Sciences**, in the third quarter of 2024. With your consent, this interview is being recorded.

Karina: Thank you very much, professor, for honoring us with this moment, and for your availability. We are very happy that you accepted the invitation. For us, it is always an honor to be with you, talking, and engaging in dialogue.

Dionísio Burak: Thank you, I appreciate the opportunity.

Karina: Professor, you already have an extensive history with Mathematical Modelling, being one of the pioneers in our country, especially in Paraná. You mentioned that in 1984 you started your master's degree, but before that, you had already worked on specialization in Modelling, and it was there that you got to know Mathematical Modelling. Now, we would like to know what motivated you to work with Mathematical Modelling, to delve more deeply into this methodological approach.

Dionísio Burak: Well, my concern has always been Basic Education, Karina and Emerson, because I was a Basic Education teacher. I started in 1970, in what we now call Basic Education. The school was always my foundation. When I had the opportunity, after finishing my licentiate and starting my teaching at the University in 1974, my goal was always to improve teacher education. As a Basic Education teacher, at that time—although it didn't have that name back then, it was equivalent to what we now call middle school, high school, and so on—my concern was always with teaching and learning. Why do our students have so much difficulty learning Mathematics? What happens to our students? We saw that children are always very active, so why did they have difficulties in school? This was my great concern from the beginning.

Emerson: Professor, we see all this work that you talk about with great enthusiasm, right? And the teacher is always motivated to think about improving teaching. So, thinking in this context, how did working with Mathematical Modelling reflect on your professional practice as a teacher?

Dionísio Burak: Well, in my professional practice, this work also ended up having a different reflection because initially, it was like this, as soon as we finished university or college, we were already working in elementary and high school. At that time, we saw Mathematics as something ready and finished, that left no room for doubt, with textbooks already prepared with answers. Any doubt you had seemed to be a doubt in yourself, not in the book. You used the book, you had to go from start to finish, you had to complete the entire program. This view changed completely from my point of view as I began to see other forms. But look, I initially saw Modelling from a perspective that still did not please me for elementary and high school because all the students' difficulties in the way I was doing it still did not fully satisfy me. And this was causing me distress because I thought: there's no point in repeating what's there! My advisor was Professor Rodney, you know him, and he is a professor of Applied Mathematics, an excellent professor, wonderful! However, that adopted conception, for Basic Education, I felt deep inside that it was not working. And then, over time, during the master's degree, which I completed in 1987, working with teachers, my idea was still to reach the classroom, even though I took an indirect path: I first worked with teachers in 1984, 1985, and 1986, doing my dissertation work. And over time, I saw how many changes were being made, I was already thinking and doing things differently. Initially, I chose the theme because while doing the master's degree, you have a dissertation to complete, a focus you cannot deviate much from. My theme was the construction of a Popular House. And then I worked on this theme with the teachers for what? So that the teachers would get to know a new form. I still did not know a new form; I was making this journey while walking. It was over time, as I walked, that I saw what was adequate, what was not, what I could improve, what I had to do. I felt that the paradigm on which I based all my type of teaching did not satisfy me. When I finished the master's degree, although discontent, I continued with that vision and with many questions, much more than when I started. I sought to know and build new references for the intended change. It was in the doctorate that I began to have other disciplines, not only Mathematics, but Psychology, History, Epistemology, and Mathematics Education, among others that opened my mind. I knew a change had to be made. But that change was still under construction. When close to completing the doctorate in 1992, I submitted my thesis in 91/92, I had come across a study, what we called Mathematics Education, its Nature, and its Methodology. Then I had access to this text, and when I read it, things in my mind became clear: now I found something that, let's say, strengthened my conviction, I felt there was a possibility of teaching differently. My formation during the master's and doctorate, I consider it a time of reflection, to fulfill the stages of the master's and doctorate. However, my greatest reflection started after the doctorate when I really felt that a change had to happen. And you know that a change is not easy! When you decide there is a need

to change, even when most continue to do it the same way, wanting to change things and doing them differently becomes complicated. Well, you are in that dilemma and thinking I will be alone! However, I preferred to take this new direction! Doing things differently from the usual way, breaking with the prevailing paradigm! And the decision taken was sustaining me, strengthening me more and more. It was when I managed to have clarity that the paradigm I was working with would not bring the results I was aiming for. This was always my pursuit, from the beginning, trying to change the teaching of Mathematics, making teaching more meaningful for students. I knew that I also had to break with my conjectures built during the licentiate. Ways that initially we follow because when we graduate, in a more traditional model, you know very well, the way of teaching is to present the contents, do some exercises, then a list of exercises, and so on. That had to be broken. But I also had to start breaking with that. Decided, I subjected myself to it! Then, I started seeking other areas of knowledge to build greater understandings in Philosophy, Psychology, Mathematics Education, Epistemology, Aristotle's Philosophy, Sociology, and so on, to fully understand the foundations needed for this change. I knew I had to prepare for this change because I would be walking alone for some time. Thus, as I decided to take that path, I would be walking alone! And it was so… and my conception of Modelling was changing over time. In these four decades of Mathematical Modelling, there has not been a single year in which I did not think, rethink, redo, review, better base certain aspects and activities, right? Although perhaps the Modelling in the conception of Mathematics Education is different from other conceptions of Modelling, I felt it was based in a way that pleased me deeply. And it was so, then, that what I call Modelling in Mathematics Education was built, Mathematics Education. But what Mathematics Education? Over these times, the expression Mathematics Education came with various biases. If you look at Skovsmose, you will see what Mathematics Education is for him: it is classical Mathematics, classical formalist Mathematics. But he comes from the bias of the Critical Mathematics conception of Freudenthal. In the perspective of French Didactics, they called Mathematics Didactics Mathematics Education. In the Modern Mathematics Movement, even Professor Ubiratan considered that Mathematics Education was the new mathematics, the new Mathematics, from the United States. In the search for understanding, I came across another vision of Mathematics Education by Higginson (1980), which fully satisfied me because it was a more multidisciplinary vision. It involved not only Mathematics but also Psychology, Sociology, Philosophy, besides Technology, Language, and Anthropology. I consider this conception has everything to do with what I wanted because my priority was teaching Mathematics in Basic Education. What I wanted was to improve Mathematics teaching, the teaching and learning process of Mathematics. I did not think of investing more heavily in another level of education until then, because I wanted to focus on this part of Basic Education and the initial and continuing education of teachers. Over all these years, I was improving, changing, and reflecting on Modelling, with my advisees, who are also part of this change. Although the conception of Modelling in Mathematics Education is an individual conception, it is not individualistic! Because it was complemented, enriched, and improved by my advisees, people from Pedagogy, teachers from the teaching networks I worked with, from Mathematics, with other

areas of knowledge. To make them more adequate, I re-signified some nomenclatures because, according to the conception I work with, some types of language made no sense, had no meaning at that moment. So, over all this time, Modelling, as I call it, was also the great challenge, my great love, wasn't it? Apart from my family, it is my great love, and we continue together and firm. And I think that if I still have to change something throughout the rest of my existence, I will change, without any doubt. That was my trajectory! So, this made me, over time, consider everything that was important from these other areas to constitute the framework of Modelling, like Higginson, besides the dimensions involved in teaching Mathematics. This was important to me.

Karina: We know about your relationship with Mathematical Modelling, it is enduring. It is a relationship that has no divorce, right? There is no separation. It is impossible to separate Modelling from Professor Dionísio or Professor Dionísio from Modelling when we study or read the texts you publish or share with us. You always speak very fondly of Basic Education. We hear and feel this in your words and in the practices with Modelling you have already developed, especially in Basic Education. We also know that you have guided the work of other people working with Modelling. Among these practices with Modelling, is there one that marked you in a special way?

Dionísio Burak: Look, I think each practice is a practice; it is different. It is different; it is singular because it is not an application, you know, Karina? Even if it is the same theme, the groups are different, the research, even if on the same theme, has different points, the problems are different, considerations can be different. You see, we usually call it an activity, right? But I also make this distinction, because of a very special person, and I think her practice also helped me a lot in understanding the difference between calling practices and activities in Modelling. This happened during the elaboration of Ventielen's thesis. She is a pedagogue and was also concerned with Mathematics in the education of the pedagogue. In her thesis, she did a whole work together with our research group GPEEM. So, her work, Tiago's work, Laynara's work, well, I could not mention just one or two because all of them had significant contributions, right? It is like that… that thing of always trying to do the best in each practice, trying to extract what could be better, but not just in Mathematics because Modelling has much more than just Mathematics. It has a lot to do with being, the student's psychology. It is the formation of the being, the being that can have its own opinion, that can develop its autonomy. To have autonomy, one needs freedom, and Modelling was being constructed in a way that our student was not passive but the protagonist of the actions from the beginning to the end of the Modelling process. So, the idea of Modelling transcends Mathematics in itself for me, but it is also the formation of the human being that the world needs today. Much more than sometimes being an expert mathematician, but above all, it needs to be a better human being. And when you work in a practice, not just the mathematical aspects, teaching and learning, but you work on ethics, morality, purpose, the philosophical values

involved in Modelling, you start to see that people can be a little better, they can see something beyond, that serves them for life, not just for a semester, for a year, for a school period. I remember well an article from 2010 when I seem to have said, what a pity that people cannot understand Mathematics Education the way I understand it, because as they understand it, they will see that if it is for teaching Mathematics in Basic Education, we need new visions, new approaches, focal points, anyway, it was always my concern, to say this: all practices are unique to me, they are singular!

Emerson: Thank you very much, professor. We see in your speech, in your texts, this concern regarding the arrival of Mathematical Modelling in Basic Education, right? You even mentioned that you worked hard to make this happen. Could you tell us a little bit about the importance of Mathematical Modelling in teacher education?

Dionísio Burak: Of course. I consider that Mathematical Modelling, I do not even currently call it Mathematical Modelling, I call it Modelling in Mathematics Education, to differentiate what Mathematical Modelling is and what Modelling in Mathematics Education is. I make this distinction for reasons that I can explain. First, Mathematical Modelling has its roots in Applied Mathematics, while Mathematics Education emerged from Mathematics itself. It was due to problems in Mathematics that Mathematics Education emerged; otherwise, there would be no need for Mathematics Education. Where was the problem, Emerson and Karina? It was precisely in the communication of Mathematics, not taking into account aspects that were priorities for teaching and considering Mathematics as ready and finished, its form of teaching, the approach to contents that children had difficulty understanding. And look, it was not just my doubt. When I read Higginson's texts, I found that even Hardy, who was a pure mathematician at the University of Cambridge, worked on education for famous mathematicians, participated in many types of those famous exams at the University of Cambridge, he himself acknowledged that there are differences in students, there are differences! Some like it more, others less, some have more dedication, others less, some understand better, others have more difficulties! In short, he himself acknowledged this, right? Hardy was president of the London Mathematical Society from 1926-1928. Hardy's great question: why do children not learn Mathematics? Why do children have so much difficulty learning Mathematics? Why do children not enjoy studying Mathematics? Many children are even traumatized when faced with Mathematics. This caught Higginson's attention, and he also began to see that teaching Mathematics involved four dimensions involved in teaching Mathematics. So, when I talk about Mathematics Education, I am referring to Higginson's conception (1980), which is a theoretical or scientific construct, interdisciplinary and formed by Mathematics, Philosophy, Sociology, Anthropology, but also Technology and Language. Because these are axes that are very important in the formation of the being. So, I saw in this structure of Mathematics Education by Higginson all the elements capable of providing

learning, teaching with the potential for learning. So much so that I say: teaching and learning process because it is not just teaching. The teacher does not only teach. When the teacher only teaches, it seems to lack something in the process because the process is the whole: teaching and learning, it is a cyclical process. So, he, the teacher, teaches while learning, the student learns while also teaching. For this, there is a need to give voice to the student. I see that this is the great difference: when I talk about Mathematical Modelling, I am referring to Mathematics teaching in a conception of Natural Sciences. When I talk about Modelling in Mathematics Education, I refer to Mathematics teaching with links in the area of Human and Social Sciences. So, there is this epistemological difference, right? The epistemological statute of Mathematics Education is different from the epistemological statute of Mathematics. So, these differences for me, they are clear. The difficult part is to convince others [laughs] to try to follow this new paradigm. I also understand the difficulties because I dedicated myself a lot to it, you know? And I see that sometimes people are not so concerned, and also talk about Mathematics Education simply as an expression that is in vogue, but deep down, it does not make much sense to them. For them, Mathematics makes more sense than Mathematics Education, because when I talk about Mathematics Education, I mean more than simply Mathematics; I understand it as a set of areas that can provide teaching aimed at learning. All this understanding depended on my persistence in not giving up and, even initially, being alone, I had confidence in the studies conducted. In 1998, it was the first time I published an article showing the change between what I had worked on in Basic Education, trying to involve mathematical models and now doing Modelling from a new perspective. I mean, it no longer made much sense to repeat the assumptions of the natural sciences because, in the initial stages of schooling, the concern is to help children, students to form concepts, mathematical ideas, and gradually build their mathematical knowledge, so it was like that, right? My view of a model expanded. I began to consider models as representation, a sketch, a drawing, a price table. For mathematical models, I have another understanding. So, this way of seeing Modelling in Mathematics Education is what made the difference and perhaps became the only one that differentiates among all those talking about Mathematical Modelling. So, I consider myself the “Ugly Duckling” who thought differently. A difficult decision, but I found support in my own conviction, through experience, by an epistemological backing, and a set of coherent references, so I felt blessed with the decision taken. That is what is important! Because I felt that this is what I had to do, and if someone joined later, it would be great, they would be welcome, and so, initially, I started walking alone, but along the way, I met other people who also believed in the proposal and who joined and continued on the journey, and we got here. Some people like it; some do not like it in this way. Because some people do not understand well and say: “Ah Burak, you start from the student’s interest, so how does the class go, does it become chaotic?”. I say: no, it does not become chaotic; on the contrary, right? I start from something that most teachers working in Basic Education initially omit, which is starting from interest, and by not sharing the teaching process, and thus, they have a lot of work to motivate students, to accept what they already have programmed, right? While if I start from what they like, it is easier; part of the energy for convincing is saved,

and that is where we will see where things are, how that knowledge is being constructed, forming the concepts, they will form their concepts and so on. It is a different way of seeing and conceiving Mathematics, Education, the teaching and learning process, and I also have clarity that everyone has the same purpose which is to improve Mathematics teaching. However, these differences exist, and these differences are important because they are epistemological differences, different ways of seeing knowledge, students, and the teaching and learning process and so on. If we see it like this, from an epistemological point of view, the scientific method of Natural Sciences, and Mathematics, there is no difference between the natural and the human. Thus, producing nails and working with teaching and learning is the same thing. In this view, objectivity lies in the method; primacy lies in the method, right? But for the Human and Social Sciences, there is a big difference; objectivity does not lie in the method but in the object. So, when I want to work with teaching and learning, I have to do my best, seek new approaches, seek different paths to reach the objectives, respect the students' being, their development, know the gaps in the students' mathematical content, evaluate processes and not results. All these points constitute the concern of the mathematics educator and Mathematics Education. They are not measured in numbers; that is why the methodological statute of the Social and Human Sciences is more qualitative research. I do not know if I managed to explain a little.

Karina: Professor, it is very good to hear your speech, the know-how you have, the experience as a teacher, as a teacher educator in Modelling in Mathematics Education, right? And you mention that sometimes teachers find it difficult to work with students' interests, thinking *it might become*, as you said, *chaotic*, right? But it is important to work with interest to motivate. And teach while learning and learn while teaching. And it ends up seeming chaotic, but you learn to manage this movement...

Dionísio Burak: You see, Karina, just an addendum there. When you start from a theme that the teacher does not know, when students propose a theme, you see, normally, the teacher feels lost. Because they want to have control of the actions, the primacy of the process, when they do not have this control, they get confused. So, I say when the teacher wants to fulfill the curriculum, just with that purpose, do not work with Modelling in Mathematics Education, work in another way because if they have to make a big effort to change, take away the possibility of the student speaking, and themselves, the teacher, leading to reach a certain subject, not following the principles of Modelling in Mathematics Education, it is better to continue doing it the usual way. The big concern is working with the pre-determined curriculum contents. Everywhere I went, they always said: “Ah, professor, I want to work with functions, how do I work with Modelling?” I said: well, if you want to work on content, work in any way; it does not need to be with Modelling because you want to reach functions, you just want to see functions. There are other interesting contents, there is symmetry, there is geometry, there is algebraic thinking, why do you only want functions? And they respond: “It is

because we have to fulfill the program!" This thing about fulfilling the program is serious. The program is made on a linear basis; the contents are tied, as if Mathematics had been born this way. It was first structured by Euclid, a first model of hypothetical-deductive science. Mathematics was not born this way, structured linearly. It was worked by the social needs of that time, shepherding, agriculture, practical purposes. So, other forms were needed; thus, mathematical knowledge was built. Furthermore, the Mathematics of books and the programs we want to impose on our students in school is organized linearly, as if the number appeared first, then the properties, then the operations, and so on, when in reality, life is not like that. These aspects I consider quite important and should be better considered by teachers, it is a reductionist, methodological teaching.

Karina: Could you share with us, considering your experience in teacher education, what are the most common challenges faced by teachers in integrating Modelling into the classroom and in educating these teachers? What are the challenges? And you already mentioned fulfilling the curriculum program. Would you like to add more challenges?

Dionísio Burak: I can complement. First, the big concern is teacher education to work with Mathematical Modelling. Because I think that, perhaps complementing Emerson's question, in our curriculum, I remember the work of our friend from *Campo Mourão*, Amauri, in which I participated in the qualification, he made it clear: all our universities offer the discipline of Mathematical Modelling; most of our degree course syllabuses include Mathematical Modelling. When we look, what is there: the great emphasis on classical models: predator-prey, population growth, among others. If you are working in a licentiate, you will educate a teacher to work with children, in Basic Education, from Early Childhood Education to High School. I understand that the teacher should have another type of education. This syllabus of the Mathematical Modelling discipline can complement the teacher's education, but it does not prepare the teacher to work in a classroom in the early and final years. So, the first big flaw I consider is these Modelling disciplines that do not focus on the Basic Education classroom. No one gives what they do not have to give! It is difficult to do something you have not experienced. So, it is no use knowing a mathematical model that uses differential equations, whatever it may be, but you will work in school with what? With equations, systems of equations, direct and inverse proportionality, simple direct and inverse rule of three, with geometry, plane and analytical, with functions, etc. You will work with these contents in Elementary School. So, I consider that Modelling is not present in the classroom, even though it is foreseen in the licentiate course syllabuses. The explanation is the inadequate way it is worked in the degree, which does not prepare the teacher to work with Modelling at the Basic Education level. This needs to be very clear, to be perceived, right? But many licentiate professors, more linked to Pure Mathematics, are not concerned with the formative part of the student for the school, their future field of action, and thus work with Mathematical Modelling important for teacher education, but

inadequate to place Modelling in school classrooms. The teacher goes for a doctorate, does their studies in Pure Mathematics, or Applied Mathematics, the first idea is to bring this knowledge to the licentiate. Normally, in our universities, attempts are made to create licentiate courses with the face of a bachelor's degree, to highlight their knowledge, right? In this way, a bachelor's in mathematics is not educated, much less a good licentiate for Basic Education schools. I consider that the teacher willing to work in the licentiate must commit to educate a competent teacher, capable of mobilizing their knowledge to improve the quality of Mathematics teaching. And what happens in our licentiate courses? It is the lack of identity! First, work with the licentiate with the purpose of educating the teacher to work in Basic Education, but educate well, educate that teacher so that they can reach Basic Education and know various types of approaches, new teaching methodologies. What did Higginson himself say? That there will be no advances in Mathematics Education, regarding the issue of teaching and learning until full knowledge of its foundations is achieved. And still, over all these years, I have been talking, at least for 30 years, about these things. I also took more than 10 years to come to know other things and have clarity to do differently. And, in the last 30 years, it seems that Higginson's guidelines have not yet been understood. Then it is no use. Because everyone says, "I will work my way and that's it"! They can do that, of course, everyone has the right to do what they consider right. However, when we decided to change, it was not for me, Dionísio, but for the people I committed to teaching better, to educate these people not just as mere students to take exams, to pass the year, but to form a citizen, to form a person who could have more clarity about things, argumentation to express their ideas and opinions, develop their autonomy. And for that, I had to provide another type of pedagogical practice, a teaching approach that was not a mere reproduction, or that considered the student a passive being, but active, and for that, the approach had to be different so that the student could develop. And so, the idea of freedom was a point to be considered and also as a way of allowing the student to speak, project themselves, have a voice, be heard, and express themselves. Why? Because as I give them freedom, I am sure they will take this as a lesson, and possibly, in an analogous condition, they will provide this to their students as well. So, all this has many implications, not just or only the change, what is behind all this change has very strong implications in Education: maintaining the *status quo* or innovation?

Emerson: Professor, as you spoke, we already perceive several challenges that have been faced, and there are still many we need to deal with. For example, you commented on the need for a closer approximation, perhaps, between schools and Universities, because of the disciplines more focused on a content-oriented curriculum, and it turns out that we do not think much about what Mathematics is taught in Basic Education. This reflects on the identity we have, or the lack of identity, for the mathematics licentiate course. And then, when you comment on these challenges, you also point out some issues, changes you believe are necessary, right? So, this question goes in that direction: what changes, innovations do you believe are necessary for better integration of Mathematical

Modelling in the classroom and even in teacher education, considering the identity of the licentiate course? Is Mathematical Modelling a path to this constitution of the licentiate course identity?

Dionísio Burak: Good question, Emerson, but maybe I do not have all the answers for it. Look, within the various trends of Mathematics Education, our big umbrella is Mathematics Education, but there are several methodological trends to work with, right? When is this worked on in our licentiate courses? Under what epistemology point of view? Maybe this, people in the licentiate, teachers are not concerned about epistemology because they believe there is only one! When teaching Mathematics, it is only the Natural Sciences. So, it is necessary to review the curricula with these aspects of the licentiate. I am not saying that applied Mathematics should not be worked on because Applied Mathematics is that. You know Mathematics and try to apply it in everyday situations, for example, in floods, in cases where you need models, etc. However, licentiate students need Mathematics to help Basic Education students think, develop ideas, Mathematics that has meaning for them. Mathematical ideas are the most significant thing that remains in Mathematics teaching when well worked! Do you know the expression of the apothem of the inscribed equilateral triangle? Maybe you do not remember the formula, but if you have the idea, you will find a way to reconstruct the ideas of how to get there, put the shape, the little figure, do the deduction, etc. That is what is missing! Geometry, geometric drawing. When I started working with geometric drawing, I taught more geometric drawing than I had in university. Constructing triangles, constructing hyperbolas, constructing ellipses, parabolas, all these helped in forming continuous thinking, right? Because then our geometry was completely algebraized. It went from being the distance between two points to being the coordinates of the points. How many things were sought in the name of newer Mathematics, or more current Mathematics? It can be important, but so many things came, the computer came to school, the computer came to the licentiate. Look, right now there is a seminar at our institution where a professor is researching the use of GeoGebra in school to see how the licentiate has educated teachers in technology for schoolwork. In the licentiate, you acquire many ideas, but you get to school, and often, there is no computer, or teachers do not know how to use the available software, or there is no laboratory, no library, or when there is, access is restricted. Therefore, many things need to be addressed in Basic Education. Look, in Paraná, in our Paraná, how is it? Technology is at full steam! It is part of the daily life of teachers and students. Everything is mediated by technology, and the teacher's work. They are left with the bureaucratic service. We need to be aware of the loss of autonomy of the teacher and students. Technology is important, it is established, but we need to be alert, to be the subjects because we risk becoming the object of this same technology. Another risk is the impoverishment of human relationships in Education. If it is not contributing to teaching itself, creating access inequalities, how does it work? In the past, we taught in calculus, students constructed the curve, a third-degree function, they determined where the curve intersected the axes, growth, decrease, inflection points, right? We also worked on this in numerical calculus teaching.

Now, nowadays, the person puts the parameters, and the curve comes out ready, and they do not have to study anything. Often it is given just to say, look, see, nice, look how the curve looks beautiful, you put this here, you put, but it lacks study, it lacks reflection on that. I advise constructing with pencil and paper, then show how it happens on the graph, what it means here, then show. So, the ways of approaching, for example, our Calculus, Algebra, Algebraic Structures disciplines, the teacher sometimes works without making a connection with Basic Education contents. This makes it difficult for the graduate to establish these relationships! This also happens with polynomial division, how it is placed in Basic Education and how it will be treated in this licentiate discipline? Show the relation! This should happen with all disciplines involving Basic Education. It is teaching devoid of meaning; it seems to me. That is what is missing a lot in our teaching today, right? So, I believe the problem is in school, in the current school organization, when the school is organized in a very technological way, but forgets the main thing about school, which is the student! We still see such a large number of deficiencies, failures, and school dropouts. So, the school that offers opportunities, the school that becomes technological, where everything is functioned by technology, where the teacher cannot do different things because they have to fulfill a program. In relation to Modelling, it breaks. My God, there is a program, a list of contents to be worked on in the eighth grade. Let it be fulfilled as much as possible with different methodological forms. If it is not fulfilled, do it in the usual way, but have the opportunity to do different things. So, it is like this, the school does not communicate with teaching, with Basic Education, the university teacher when going to Basic Education to talk to teachers, it seems they are always the holder of all knowledge. They have great knowledge, but sometimes they have none about the student! They forgot they were students. There are many things, you know, that we need to think about and rethink seriously in Education because otherwise, the teacher, now we are almost falling into what started in the 70s, teaching, programmed instruction.

Karina: That is true, professor, you saying this makes it seem that there is even a setback in Education, in teaching. And when you come into contact or work with teachers in initial or continuing education, working with Mathematical Modelling, how do you evaluate the impact of Modelling practices on these teachers' understanding of Mathematics teaching?

Dionísio Burak: Well, I no longer work in undergraduate programs. It has been some years since I retired. So now I work only in postgraduate programs. And where I am now, I see that there are people for whom it is the first time they are hearing the expression, what they call Modelling in school. School teachers, right? And teachers who come to the University sometimes have not heard about Mathematical Modelling yet, it does not matter if it is Burak's, Almeida's, Bassanezi's, Biembengut's, it does not matter, they have not heard of it. Because sometimes the school is so closed to these new trends. And there are teachers who cannot, with the justification: how am I going to work the content? How am I going

to do this? I have a supervisor who is on top of me to fulfill a certain program. How is it going to be done? So, the school also closes itself to innovations because it thinks that if you do not do it in that way, students will not learn! And it is not today that I hear this, it is a long time ago, doing new things and almost having to do it as if, let's say, circumventing certain guidelines to do different things because the school is organized in a way that they have concerns that prevent more innovative pedagogical initiatives, such as Modelling, which I am sure would revolutionize school pedagogical practice. Even with justifications like, what if there are student transfers during the year, then you cannot do anything different, because if they go to another school and that school has not yet seen this content, it will be a problem. It is a series of things! So, I think our initial education must work better in the licentiate. To work with Modelling in school, licentiate students must experience practices with Modelling in various situations during their education. This will credential them, give them security so that, when in the role of a teacher, they can feel more secure. Another difficulty currently observed is in internships, as some students declared they could not work with Modelling as they wished, as they have told me: "look, professor, we go to school to work on supervised internships, but upon arrival, the teacher is teaching a certain content, and they want us to continue that content, we cannot bring new things because otherwise it will disrupt their program, their schedule will not be fulfilled, so they do not allow us to work with other things." So, there must be more interlocution between school and University, this needs to improve a lot. Maybe it is something that we, who have this concern, I know you have, it needs to be improved. That this interlocution between school and University should be for the future teacher an opportunity for greater interaction with students and that there is more dialogue and the opportunity to experience, besides Modelling, other methodologies. I think there should be a greater partnership between school and University, mainly to give identity to the licentiate. The big problem of our universities is that they neither educate the licentiate nor the bachelor nowadays. They try to make a mix of things and cannot do either. Both end up discredited. Our universities lack licentiate students because no one wants to do the licentiate anymore, but this also happens in the bachelor's degree! So, we are educating two or three licentiates a year, five at most, while in the past the licentiate educated 25 to 30 teachers a year. So, all this is a configuration that needs to be reconsidered. When we want to do hybrid things, it does not work very well. It is a decision to be made by institutions. So, if the vocation is for the licentiate, let's be good at the licentiate, let's educate the best teacher, it does not matter if there are no other courses in the area, like the bachelor's degree. Most of our regions work with teachers. So, our vocation is predominantly licentiate. There is a huge shortage of Mathematics teachers in Brazil.

Emerson: Professor, this issue of dropout, I think, is something that is troubling all licentiate courses in the country. I think Higher Education as a whole is taking a hit, so to speak, as the number of students is greatly decreasing. But the licentiate courses are the ones that suffer the most and are the most influenced by the situations we live in. This makes us think about the need to rethink teacher

education in general. Given this, specifically regarding Mathematical Modelling, what do you think is necessary in a teacher education program in Mathematical Modelling? How do you see this education in Mathematical Modelling in the licentiate courses? How do you think about it?

Dionísio Burak: Look, actually, I have tried several ways to bring the teacher to the University, but I still see that it is always us going after the teacher to bring them to the University, to do this type of work. So, at the beginning, when I started, in 1984 and 1985, doing this work with teachers, I went to schools. There was a day in the week when we could work with the teachers; we went to do this work in the schools. Later, things changed, at that time, everything was different! The teacher had 10 classes, had a good salary! Then the classes doubled, then quadrupled, but their salary remained a quarter still. They quadrupled the number of classes, and that is how the changes were made, always decreasing the possibility of a teacher doing better, improving, better education. It was a moment when the teacher began to have much more commitments with the school and less preparation time. So, this also contributed. Our licentiate courses were four years in the past, then became three; there are licentiate courses that educate in two years! If you notice this, you will see it is a continuous deterioration happening every year. When I started my master's degree in Rio Claro, it was four years. Although I finished in three, it was four years! The doctorate in Campinas was eight years, although I finished in four, it was eight years. So, you saw there… as there was a scholarship, practically, people were doing 955 credits when only 100 were needed. Because it became a source of income for the teacher or subsistence for the teachers. So, everything that happened in Education was degrading Education. The teacher earned x to work 10 hours, started earning almost 0.8 of x to work 20, or when they worked 40, they earned 1.2x. It was like that; the salary was not proportional to the workload. The teacher needs dedication time; they need better education; they need to live more with the school because many people go to do a licentiate and do not want to work in school. It is with this justification that institution people say, "so let's do the bachelor's degree too". But when trying to do the bachelor's degree to satisfy this group that perhaps would not go to school, but they also did not manage to do the bachelor's degree. They did not do one thing, nor managed to do the other, right? What would be needed? Perhaps rethink the licentiate and schools more attentively. Not only working with new methodologies. I say: Modelling may not guarantee success because it is not the Modelling methodology itself; it needs the teacher's action; it needs this teacher's mediation action with things. It is not like this! The teacher uses such a methodology; this will not guarantee anything, right? Well, let's work with Problem Solving, let's work with Games, with technology; all this can be good, but it is necessary to have a theoretical foundation consistent with what you want with that work. These trends need foundation; we cannot use new names to reproduce what we wish to see surpassed. It is a problem we must address: What is the epistemological statute of the trends in Mathematics Education? Let's do serious work! It needs to have a foundation! So, if we want to adopt Higginson's Mathematics Education conceptions, we need to strengthen that. Because if you

look at our own Curricular Guidelines of Paraná, what is there when talking about Modelling? It is the vision of Professor Bassanezi, Biembengut, indicated for that schooling level. Go to Problem Solving; the references are the classics of problem solving. Currently, works are emerging with a vision closer to Mathematics Education. We need to be clear that: as long as we do not have clarity about the foundations of Mathematics Education, any experience, any change made without considering these foundations, we will not progress in teaching and learning issues because the issues will remain open. So, we need to be clear about what differentiates one epistemology from another and its educational implications. And this in teacher education is important. So, it is a lot we need to stop and think about, but within the current circumstances of Education, technology is predominant in everything, and they think technology will solve everything, no, it will not. The teacher has to assume their role, not the teacher's role. It must be their responsibility a pedagogical practice capable of producing the effects we want, good teaching aimed at learning. So, like this, will everyone educate in Mathematical Modelling? No need! Modelling itself guarantees nothing, just like any denomination, methodology, alternative, strategy, or whatever it is called. It is necessary to have clarity and theoretical coherence to base actions. That these actions make sense for the student, have meaning for them. If this does not happen, we fall back into what we seek to overcome, lack of meaning, without context, just operation for the operation, as in the old days of the way: set up and perform. And there were huge lists involving set up and perform operations, and what did that mean? You know, meaningless things, just using memory. Memory is important because it is one of the higher functions, as Vygotsky said, but it is not everything. Look, group work is a source I considered quite important in working with Modelling, but this can also be in Problem Solving, in Games, in other types of methodologies. Without a doubt, the field of Modelling gained from all this because there were people who persisted in it and believed in this way of doing Mathematics teaching. Regardless of the Mathematics Education trend, we need to change the ways of approaching content, develop other capacities in our students, give them freedom to create thinking strategies. These changes I consider necessary to rethink Mathematics teaching, primarily in Basic Education. Kilpatrick himself considers it important to have different paradigms. These paradigm differences can be important; however, when it comes to harming the formation of a being, then it is no longer that important. It can be different, but it must be adequate for the level of schooling you teach, with the students' level of development. You have to respect the age group, the cognitive development; you have to respect that in the child. So, it is not because they count one, two, three, four, five... that they already know Mathematics, it is all different. I mean, they need a little more to say this, right? We need to be a little more careful about things. I think these trends in Mathematics Education can be quite successful as they say, right? They can bear good fruit and everything, but they need to be better understood in their foundations by the educating teachers in Mathematics and Pedagogy licentiate courses. You go to schools, and teachers seem to only want to fulfill the curriculum because they have little incentive for new changes. Maybe all this is a reflection of a lack of identity to the licentiate courses and also greater motivation for teaching in Basic Education. I think, as John Dewey himself said,

without due interest in the subject, in content, the teacher spends a lot of time trying to motivate children, students to learn, because they are so demotivated, and the teacher is also demotivated. They may even have reason for this, but it does not help Education. We, who have this responsibility, to do the best all the time of our life, must continue, we must persist. Now I am at an age where, let's say, putting the "boots aside", but you, Emerson and Karina, as well as others, are young, have a lot of time ahead, and you are the hope that the attempt to make Education better does not stop! You are realizing that maybe, from the time you started until now, you have found more difficulties in school, you find less prepared teachers. Look guys, I remember that in 1984, a teacher said: "Professor, we are unprepared; the University does not prepare us for these teaching levels here", referring to Basic Education. When working with Didactics or Psychology in teacher education, it is important to know about Piagetian experiences, it is important to relate to their work in school, with the cognitive development of children. The idea of conservation of continuous and discrete quantities, what does that have to do with Mathematics teaching? The mathematics educator must have this concern, know why this happens and what it represents for the understanding and formation of concepts by children. A lack of greater understanding of some fundamentals by the teacher can "resurrect" the law of exercise let's give exercises. Ah, they do not know how to perform operations, so let's give exercises! But it is no use if they do not understand if it does not bring meaning to the student, it is no use giving a thousand exercises. They will do it, but it makes no sense to them. So, there is a lot to be reconsidered. We could spend three days talking about this, you know Emerson and Karina? Because it is a problem that affects us. Look, we educate the teacher for Basic Education. Today we have a shortage of teachers in the exact sciences of almost 200 thousand. With the large number of dropouts and abandonment of the profession, this number will possibly increase. And also, teaching is not only the professional part; you need to love and enjoy what you do. Look at how many things you do, Karina, Lourdes, and everyone at the Universities of Paraná to educate committed teachers who teach Mathematics. It is because there is an intentionality to make Education better; we cannot do all this. So, it is sad! Look, I just completed 54 years of teaching. In these 54 years, I have gone through all the laws that govern Education since 4024/61, then 5692/71, then 9394/96. This LDB 9394/96, people, could give such a great space to improve Education, and also the licentiate, but people criticize this law. It has the alternation, which is when the student is there in their rural property working with their father, they have a week to stay in school, then they stay a few days at home. So, it is for what? Even if they are still helping their parents in the rural property, they have the opportunity to study. But then the calendars, then it is a bureaucratic problem in the secretariat. There are people who have to work and have to work! It is not today. Many people, even in my time, had to work and not attend school at the regular time. Then came Adult Education, and it was another type in the past, article 91 and 99, and so on, which were possibilities for a student who missed their regular phase, let's say, to complete their studies. Our guidelines have the possibility to do this, but people do not want to interpret correctly, do not want to do it because there will be four or five calendars, so no, we cannot have four or five calendars. How do you want to serve the unequal if it is not also unequally?

The calendars must be unequal, otherwise you will not serve these people who need, for example, sometimes the harvest, the people who work in the fields, work in agriculture, who have to harvest a cotton crop, for example, because it is in September. However, they cannot because if they leave school now, they will lose the year. There are all these things, if the education authorities had a little more goodwill, many things could be solved. So, when we say that Modelling is a possibility, it is a possibility, but alone, the way it is, and with the way teacher education is being carried out, and the working conditions of teachers, it will always be an alternative, never a methodological core. We do not wish for it, Modelling, to be an alternative; we would like it to be a methodological core in schools. This also applies to all trends in Mathematics Education. We will continue fighting, no doubt about it, right? I believe that those who believe that Education is a way to improve people's lives, improve society, an Education that enables a better understanding of the world, knowing what is important, what is not important, respect, solidarity, and developing the ability to think critically, have independent thought, and be able to argue – all of this is important, and school is the place where this can be done. However, it is not, perhaps, this school, the way it is currently organized.

Karina: Professor, you even mentioned in your response that not all teachers need to be educated in Modelling, right? Some seek this education, and you emphasized that it's important to discuss theoretical foundations and that many times the courses do not focus on the classroom. Often the course is in the syllabus, but it doesn't focus on the classroom, where teachers need to make interventions for group work, and pedagogical interventions in group work to discuss Mathematics, to discuss the context in which the situation of student interest is being addressed. Even though not all teachers need to be educated in Modelling, for those teachers who are interested in pursuing education in Modelling, do you have any recommendations for researchers, institutions with a structure, an organization, for an environment aimed at this teacher education in Modelling?

Dionísio Burak: First, undergraduate students should receive a type of education in Modelling that could address the very content of Basic Education curricula. So, look, not only from the perspective of Mathematics, but everything together. So, I will take the area I am most familiar with as an example: when we choose a topic. Look, this topic involves the psychological dimension, because it's a moment where one discusses, it's the moment when decisions are made, when there is critical thinking, when the subject has to make a decision. Because when they make a decision, they have to think about A, B, C, D, they have to consider several hypotheses, sometimes, to make decisions. So, there is a cognitive decision there, and Psychology is important. When they choose a topic, they select things from their reality, from their moment, but that does not mean they should only choose what is immediately relevant to them, right? For example, many times, works start with problems related to the family, the social, the economic aspects,

the very activity the family engages in. I don't mean that they can't work on another occasion, to study the solar system, because that is not part of their daily life! It is not part of their everyday life, but I mean it is part of their world, their life. It may not be close to them, but they developed an interest in it, and it is that interest that motivates them, the interest is what makes people search for things, the interest acts like a vector, creating a relationship between the subject and the object. So, all of this is what needs to be thought about when educating the student, so that they can provide this opportunity. For example, by developing practices. I think schools could have what we would call those application schools, I don't know what they are called now, but those schools run by universities, where there is the possibility for licentiate students to test new methodologies, materials, and other resources. If the licentiate courses had these spaces, these methodologies would be well grounded both methodologically and epistemologically, with consistent theoretical references to back all the actions, with results discussed, analyzed, and reflected upon. Generally, people want to implement new things, but they still want to use old paradigms, so that doesn't work. It is not because you change a word, an expression, that it will change the outcome. The outcome may change when a new way of approaching a subject is created, when it is done differently, when more consistent and coherent theoretical references are sought, aligned with the paradigm or method of performing the actions. So, these things, I think, need to be more present. Let's put it this way, the courses in the licentiate should, whenever possible, make the connections with Basic Education content more explicit. The courses in Calculus, Algebra, Number Theory, Topology, Geometry, and Analysis need to make these relationships explicit during the development of their content in relation to Basic Education: in Elementary and High School. It's a change, but the teacher who is willing to work in the licentiate is the teacher who truly wants to form students, and they need commitment. That teacher needs to be dedicated to providing education that can contribute to the student, so that when they reach school, they can bring new ways to approach the content, understand some techniques, involve methodologies, and new approaches to content. Mathematics in Mathematics Education does not change in its structures and principles, nor in the content; what changes are the ways of approaching the content! What changes is the way of approaching the content of teaching under the dimensions of Mathematics Education. Modelling, for example, starts with the interest of the participants, which is its first principle. Small groups of 3 to 4 participants are formed, according to the participants' own criteria. It takes into account the art, the culture of the participants, their traditions, and customs in the selection of topics. That is why the teaching process is shared. The dimensions of Mathematics Education are present in the purposes, in the values of that study. The stages of Modelling provide the students in the groups with actions that promote the ability to gather data, develop the capacity to formulate problems, solve these problems, and critically analyze the solutions found. The student becomes the protagonist. A large number of practices should be carried out to build confidence in teachers so they can develop Modelling practices in classes. This new way of carrying out teacher education requires giving up our convictions, opening ourselves to new

experiences. Changes are slow, but they will come to the benefit of the student and Education.

Emerson: The professor mentions very important issues for us to consider when organizing an education program. Interest, of course, is evident even in the very concept that the professor presents of Mathematical Modelling, which is so widely cited, disseminated, and spread. And the professor draws attention to the need for us to be careful about how we work with these actions with teachers, so they don't follow a script, because that would limit the practice of Modelling, but that they become aware of how they can provide students with experiences in these interest-based situations and develop Modelling activities. I agree with the professor. I believe these are very important aspects when considering the development of a Modelling practice. This view, as the professor puts it, is highly regarded in the field of Mathematics Education because it speaks to the care we must have for the student, the perspective, the respect, and it brings a whole context that goes beyond understanding how to approach Mathematics, right? And given the impact that this conception has had, I would like to understand a little more, to learn a little more, as we approaching the professor's 80th birthday, right? Let's note here that on November 3rd, the professor will complete 80 years of life, already having more than 54 years of work, as the professor mentioned. So, I would like to know how the professor feels about all this repercussion, seeing these various works emerging about the professor, the professor's conception, and works influenced by it. And, beyond knowing how the professor feels, I would also like to know how the professor views the future of Mathematical Modelling in the field of Mathematics Education.

Dionísio Burak: Well, obviously, I feel happy, but I've always started from a principle: I've never been concerned with reaping the fruits. My concern was always about planting, about sowing. That has been my main concern. Because I always think this way: why should I want to harvest now, if I know how long it took for me to mature? We are all the result of a paradigm that has guided us and still guides our education. We must have patience and persistence. How can I want people to mature in a time that may not be mine? Everyone has their own time. But sowing is what I want, because I thought about the future of my children, who when I started were small, and now they are already adults. I think about my grandchildren, I think about the children who sometimes go to school with such great expectations and become disillusioned so quickly. So, this is my main concern throughout these 54 years. Overcoming the dominant paradigm is a tough task, it needs patience and persistence. Recently, I participated in a lecture at the Ceará Academy of Mathematics - ACM, which gathered around 200 Mathematics teachers. A person, with whom I participated in their doctoral qualification, came up to me after the event and said: "Professor, you said you didn't expect the results of your sowing, but now know that I am a result of your way of thinking about Modelling." It wasn't just her, if you think about it, right? There's Tiago, then Samuel, Carlos, Ventielen, Laynara. Ventielen, from Pedagogy, won the CAPES

honorable mention award in 2019, for her work on Modelling aimed at the mathematical education of pedagogy students. So, I say: without intending to harvest the fruits, I am already reaping them. Right? But I don't get carried away by it because I believe that I always have to keep improving, I feel that there's still some aspect that needs to be improved. Look, people, it's like a marriage, you know, Karina? This is a marriage that I can say is eternal, because there's no divorce! There are conflicts, perhaps internal ones, about how to improve the relationship, but never thinking about separation. So, all of this is what drives me to speak so enthusiastically about Modelling that I could talk about it for three or four days. People here say: "Oh my god, professor, you bring the world in one answer!" I say: well, this too was the result of this search of mine, but especially of what I found along the way. For example, when I don't understand something, I seek to understand it, I research, and I see how it relates to Modelling in Mathematics Education, how it contributes to its foundation. Does this word serve the purpose I want to express here? So, I take care of this, that's why I have been changing. I've changed many things, even in language, in words, and everything. Also, as they say, "why don't you like the word 'student'?" I say: I actually used to like it quite a bit, but since I adopted a conception of being, from the emerging paradigms and complexity, the word "student" no longer fits, but "student-participant." And, for me, the student only needs the opportunity, and we must provide that opportunity. Many teachers ask: "How do I start a practice with Modelling? How do I start it? There are many teachers willing to carry out Modelling practices, but they simply haven't experienced it in their initial or continued education. One can see how our licentiate programs do not adequately prepare future teachers for new methodologies, for the results of new studies, since the subject doesn't know how to start addressing something! So, I explain that at each level of schooling, it can be done in different ways: it starts with a conversation! It can start with a problem or a problem situation. How do preschool teachers proceed? The teacher does that little circle with the children, that conversation, and listens to what the children like to do, what they are interested in. And starts from there! There's no model for that. Look at Laynara's thesis, my other advisee, it was different, because at the school, she worked with an undergraduate student and the classroom teacher! Look at how interesting that was because there was a teacher with a good teaching experience and an undergraduate student doing their internship, and they carried out Modelling! The topics emerged in different ways, it wasn't started with the choice of the topic, the teachers didn't know, and how did they do it? They sensed security in the student, and the student also felt secure with the classroom teacher. They brought ideas from a hypertext, brought a video for the children to choose the topic, because the students couldn't even choose the topic! You see how our teaching model dulls people's minds? The students couldn't choose topics, they were so used to only choosing topics involving Mathematics, like studying operations. So, they brought hypertexts, other videos, they brought new things, talks, about many things. There's no single way to do it—not even the stages I use are rigid! We are in a methodological path of developing the practice: it starts with the theme, goes to research, collects, selects, and organizes data, raises the problems, moves on to the resolution, and carries out a critical analysis of the results obtained. Critical

thinking permeates all the stages, even in the theme to be worked on, like it was in a case, where the group was sensitive to a student's request. The group showed sensitivity and changed the topic. So, these things can happen, because sometimes we don't know how our students live in their homes, in their lives, and everything. If the topic is sensitive, I say: change the topic, there's no problem. There are so many things, and you don't have a recipe for it, the priority is common sense. Over time, I understood the difference between what we call a Modelling activity and practices with Modelling, but everything happens in its time and through the experiences we acquire to understand it better. Another positive point of practices with Modelling is the development of students, the gains they present as results of their search actions, organization, and awakening criticality as a cognitive skill. The teacher's role is to mediate, guide, and challenge the student. I believe that when we give everything ready and finished to the students, we take away an opportunity for them to develop, discouraging them from searching for things themselves. Do they face some difficulty at first? Yes! However, it's the moment when you have to understand that they will struggle, because they've always been used to receiving ready-made problems, they didn't need to search and gather data, and that's what prevented them from growing. How long did it take me to mature for everything I now experience? So, when I say that I never had the intention of reaping the fruits, it's because I am aware that the path is long, but we get there. But look, thank God, I know that people across many states in Brazil, people are working with Modelling. I feel this from the interest, the article requests I send, the doubts I answer, the lectures I give, and that makes me happy. This year, for example, I came to Ouro Preto as a visiting professor. I just asked God to allow me to be useful to people here in the Graduate Program in Mathematics Education at UFOP, and everything was fine! I consider that my visit may have been an opportunity to experience another reality. And it was. And look, I felt that my presence did well for many people. Now I have my advisees there who also went to do an interview with me. I've never seen my journey in Modelling be talked about so much. I say: my God, I didn't expect to receive so much affection, respect, consideration, and to be a beacon for some people. What a responsibility! I think it's the return to doing things for the pleasure of doing them. Because Modelling is enough for me to do this, you know? I feel happy when I speak, when I discuss. I can see that in: "Ah, professor, I liked this, I didn't like that!" Because not everything will go right either! Modelling is not everything! But when you do it, do it differently, try to do it differently, try to do it in a way that extracts more from the student than just talking all the time. You are a mediator. Perform this function of mediation. Our students haven't been encouraged to think over all this time because everything is given to them ready-made. They are just reactive to the teacher's things, but when you start giving them the opportunity to think, to hypothesize, to make mistakes, let them make mistakes! That's good, in life we don't always get it right! You go back, revisit things in a way that moves forward. So, that's wonderful! That's what makes me happy! I don't know, Emerson, if I fully answered, because so many things come to mind, a thousand things come to my head! Since I've been living this for so long, and how many times a day I talk about these things, my mind is full of ideas! Sometimes, I talk so much and still don't fully answer the question asked.

Emerson: Yes, professor, you did answer. Thank you!

Karina: Professor, your concern for humanity, for the students, for the teachers is very clear. Professor Dionísio Burak is a reference in Mathematical Modelling in Mathematics Education and has certainly taught us so much and still has much to teach us about humanity, about being a better person, and about caring for others. We feel very happy and honored by this historic moment in our lives! You have already sown so many seeds that a forest has been created, a beautiful forest full of gas and energy to sustain Mathematics Education. We would like to thank you immensely, and I take the liberty of speaking on behalf of Emerson as well for marking us. Once again, marking our history as individuals and professionals. We learn so much from you when we hear the words spoken with serenity, love, passion, and compassion. In this context, is there anything you wish to add that hasn't been addressed in our questions and comments so far?

Dionísio Burak: Oh Karina, so many beautiful words! I loved the lovely forest, but I'm not sure if I missed anything. I think I tried to speak, but, you know, it's about persistence, right, Karina? About believing that you can always do better than what we've done. I had to change; I had to break free from many things within me, strip away what I had internalized and build or rebuild new things. Because when I decided to let go of the more classic perspective of Modelling, it wasn't easy. However, it was a moment when we prove ourselves strong, capable, and resilient, so you must believe in yourself. When you do things with love and care, you can overcome anything! And today, after almost 80 years, with 54 years of teaching, I say: Education can always improve. Every day we can improve a little; a person can improve every day. You can't just aim to be better. Your biggest struggle is with yourself. Do enough so that you can be at peace with yourself, with your conscience, and see that you didn't spend your time here on earth just passing through. You built something. And nothing is more important than building something permanent! The values you impart to people are permanent. The things of Mathematics itself may fade, but attitudes, values, responsibilities, understanding, and empathy—they are enduring; they stay with people for their entire lives. And this is what Education can do for students: it helps them become people who think, reflect, argue, make decisions for themselves, develop autonomy, and, finally, see the world in a broader way. The world is no longer the one we had, a disciplinary view, as still have in schools. The world's problems are complex, so teaching must be conducted in a way that accounts for the multidimensionality of today's times. Two epistemologies sustain the practices with Modelling in Mathematics Education: the emerging paradigm of Boaventura de Souza Santos and the complexity paradigm from Edgar Morin. I believe that teaching Mathematics through Modelling can broaden teaching perspectives, make them deeper and more global—let's say, beyond just the mathematical aspect. For example, when working with a garden, I see it differently: how am I going to work with this soil? I need to know what type of soil it is. I need to analyze it. I need to know what I want to produce—whether it's carrots, beets, cabbage,

or lettuce. What is it? How do we do this? Prepare the soil! What type of soil do we have? What type is needed to plant what we want? So, it's much more than calculating the distance between seeds, making a matrix, and doing calculations. It's much more than that! This is how I see Education—as something bigger than Mathematics itself, bigger than the Sciences, bigger than everything! It's something that transcends all these disciplines, and it can't be seen as a single discipline. And Morin has this approach! He seeks to rebuild the fragmentation of knowledge that occurred through the paradigm of modern Sciences, while we have moved toward hyper-specialization, which is the fragmentation of knowledge. In contrast, Morin advocates for the recomposition of knowledge. In school, we have Geography, History, Science, and so on, with knowledge separated into its boxes. So, Modelling, in this view of Mathematics Education, presents itself as an opportunity to unite fragmented knowledge. We seek broader knowledge. How would a child talk about a garden? They wouldn't say, "we planted every 30 centimeters." No! They would say, "Oh, we worked with the soil, I learned what kind of soil it is, we corrected the soil, figure out what can be planted, and how long it takes for each type to grow, you know?" That's what I want from Education! An Education that is greater for people's lives than for a school moment, okay? Look, I'm very grateful, I was really moved, you know? You moved me! [laughs]

Emerson: Oh, professor! Well, we can say that your story is admirable! Listening to you speak about it and about Mathematical Modelling is always captivating! Seeing your determination, persistence, and your concern not only with the formation of a person, let's say, educated through Education, but also with humanity, your concern with the human being itself. I agree with Karina when she says that the time to reap has come. I believe the fruits are already out there, and you deserve to reap more. We hope that you can still share much more with us so that others can know your perspective, your vision of Education, and that you can inspire many more, just as you inspire us. So, on behalf of the entire group that organized this special issue, I thank you for sharing your experiences, your knowledge, and it was an immense pleasure and a moment of great learning. Thank you very much!

Dionísio Burak: I thank you, Emerson and Karina. Look, everyone, I'm truly happy for the opportunity to speak a little about Modelling in a different context than at an event. Because for people who sometimes have a different view than ours, this is very good! I show us that we don't need to do the same things, as long as we do them with love, with care, and understand that everyone has their own journey, right? And not all of them can be the same!

Karina: Thank you so much, professor! You are the one who always moves us, the one who always embraces us. I have always felt very welcomed by you, the way you come and embrace us with so much care and respect. This is the reception that makes us continue with Modelling. You are the one who touches us, who

motivates us, who encourages us to believe. Thank you so much! The word is gratitude! Gratitude for accepting. We are very happy. Thank you for taking the time to answer us and speak with us, being distant but at the same time close. You are always very close, even when you are not physically present, like at EPMEM; you were there because you were often mentioned, remembered, and recommended. Thank you so much for your existence, professor! Thank you so much for your time! May God bless you greatly! And may we celebrate this November 3rd with great joy.

Dionísio Burak: If God wills. Thank you, everyone. Stay in God's peace. May God bless you. I really enjoyed it! It was very good to be with both of you. Gratitude.

BIBLIOGRAPHY OF THE INTERVIEWEE

Burak, D. (2019). A modelagem matemática na perspectiva da educação matemática: olhares múltiplos e complexos. *Educação Matemática Sem Fronteiras*, 1, 96-111. https://sumarios.org/artigo/modelagem-matem%C3%A1tica-na-perspectiva-da-educa%C3%A7%C3%A3o-matem%C3%A1tica-olhares-m%C3%BAltiplos-e-complexos.

Burak, D. (2023). A Modelagem na concepção de Educação Matemática de Higginson: relações e implicações envolvidas no processo de ensino e a aprendizagem da Matemática. *Educação por Escrito*, 14, 1-12. https://doi.org/10.15448/2179-8435.2023.1.45047.

Burak, D. (1992). *Modelagem Matemática: ações e interações no processo de ensino e aprendizagem*. (Tese de Doutorado em Educação), Universidade Estadual de Campinas, Campinas.

Burak, D. (1987). *Modelagem Matemática: uma metodologia alternativa para o ensino de Matemática na 5ª série*. (Dissertação de Mestrado em Educação Matemática), Universidade Estadual Paulista Júlio de Mesquita Filho, Rio Claro.

Burak, D. (2017). Modelagem na Perspectiva da Educação Matemática: Um Olhar Sobre seus Fundamentos. *UNIÓN*, 13(51). https://www.revistaunion.org/index.php/UNION/article/view/383.

Burak, D. (2023). Modeling in Early Childhood Education: a contribution to the integral development of the child. *Global Journal of Human Social Sciences*, 23, 24-37. https://socialscienceresearch.org/index.php/GJHSS/article/view/103783.

Burak, D.; & Aragão, R. M. R. (2012). *A Modelagem Matemática e relações com a aprendizagem significativa*. 1. ed. Curitiba, PR: Editora CRV.

Burak, D.; & Penteado, D. R. (2019). As práticas que envolvem modelagem matemática na educação básica do Paraná: uma meta-análise do EPMEM. *VIDYA*, 39(1), 21–37. https://periodicos.ufn.edu.br/index.php/VIDYA/article/view/2646.

Burak, D.; & Zontini, L. R. S. (2020). Práticas com Modelagem na formação do professor da Educação Básica: a busca por uma nova racionalidade. *Práxis Educativa*, 15, 1-20. https://doi.org/10.5212/praxeduc.v.15.14239.027.

Ferreira, C. R.; & Burak, D. (2016). Formação continuada de professores de matemática da educação básica em Modelagem Matemática: possibilidades da educação a distância online via software moodle. *Educere Et Educare*, 2, 187-202. https://doi.org/10.17648/educare.v11i21.13079.

Huf, S. F.; Burak, D.; & Pinheiro, N. A. M. (2020). Modelagem Matemática na Educação Básica: um olhar para o currículo. *Educação Matemática Debate*, 4(10), 1–24. https://doi.org/10.46551/emd.e202024.

Huf, S. F.; Pinheiro, N. A. M; Burak, D.; Miquelin, A. F. (2020). Aprendizagem significativa na educação matemática: um olhar por meio de teses e dissertações. *Alexandria*, 13(2), p. 257-272. https://doi.org/10.5007/1982-5153.2020v13n2p257.

Kaczmarek, D.; & Burak, D. (2018). Modelagem matemática na educação básica: a primeira experiência vivenciada. *Actio*, 3(3), 253-270. https://doi.org/10.3895/actio.v3n3.7693.

Klüber, T. E.; & Burak, D. (2008). A Fenomenologia e suas contribuições para a Educação Matemática. *Práxis Educativa*, 3(*1*), 95-99. http://educa.fcc.org.br/scielo.php?pid=S1809-43092008000100010&script=sci_abstract.

Klüber, T. E.; & Burak, D. (2012). Sobre a pesquisa qualitativa na Modelagem Matemática em Educação Matemática. *Bolema. Boletim de Educação Matemática*, 26, 111-133. https://doi.org/10.1590/S0103-636X2012000300007.

Loli, A. C.; Martins, M. A.; & Burak, D. (2023). A modelagem matemática na promoção do letramento estatístico no ensino médio. *VIDYA*, 43(1), 99–112. https://doi.org/10.37781/vidya.v43i1.4322.

Oliveira, D. de; Burak, D.; & Martins, M. A. (2020). Modelagem no Ensino de Matemática: primeiros relatos de um estudo de caso com estudantes cegos. *Perspectivas da Educação Matemática*, 13(31), 1-18. https://doi.org/10.46312/pem.v13i31.6064.

Silva, V. S.; & Burak, D. (2017). A formação matemática no curso de pedagogia: aprendizagens a partir da Modelagem Matemática. *Cadernos de Pesquisa*, 24, 159-175. https://doi.org/10.18764/2178-2229.v24n.especialp159-175.

Silva, V. S.; & Burak, D. (2020). Modelagem Matemática na formação inicial de pedagogos: um caminho para ressignificação do ensino de Matemática. *Práxis Educativa*, 15, 1-14. https://doi.org/10.5212/PraxEduc.v.15.15113.043.

Silva, V. S.; Silva, W. K.; & Burak, D. (2020). Criatividade e modelagem matemática. *Diálogos e Perspectivas em Educação Especial*, 7, 87-100. https://doi.org/10.36311/2358-8845.2020.v7n1.p87.

Veleda, G. G.; & Burak, D. (2020). Avaliação em atividades com Modelagem Matemática na Educação Matemática: uma proposta de instrumento. *Educação Matemática Pesquisa*, 22(2), 25–054. https://doi.org/10.23925/1983-3156.2020v22i2p025-054.

Veleda, G. G.; & Burak, D. (2017). Mathematical modelling in mathematics education as way to develop critical consciousness: a theoretical study. *ACTA SCIENTIAE*, 19(2), 211-223. http://www.periodicos.ulbra.br/index.php/acta/article/view/2785.

Zontini, L. R. S.; & Burak, D. (2018). Modelagem matemática na pós-modernidade: uma proposta de formação continuada de professores. *Educere Et Educare*, 13, 93-111. https://doi.org/10.17648/educare.v13i29.15360.

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