Américo Junior Nunes da Silva
André Ricardo Luca Vieira
(Organizadores)

Incompletudes e Contradições para os Avanços da Pesquisa em Matemática 3

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APRESENTAÇÃO

A Pandemia do novo coronavírus pegou todos de surpresa. De repentemente, ainda no início de 2020, tivemos que mudar as nossas rotinas de vida e profissional e nos adaptar a um “novo normal”, onde o distanciamento social foi posto enquanto a principal medida para barrar o contágio da doença. As escolas e universidades, por exemplo, na mão do que era posto pelas autoridades de saúde, precisaram repensar as suas atividades.

Da lida diária, no que tange as questões educacionais, e das dificuldades de inclusão de todos nesse “novo normal”, o contexto pandêmico começa a escancarar um cenário de destrato que já existia antes mesmo da pandemia. Como destacou Silva (2021), esse período pandêmico só desvelou, por exemplo, o quanto a educação no Brasil é uma reprodutora de Desigualdades.

E é nesse cenário de pandemia, movimentados por todas essas provocações que são postas, que os autores que participam dessa obra reúnem-se para organizar este livro. Apontar esse momento histórico vivido por todos é importante para destacar que temos demarcado elementos que podem implicar diretamente nos objetos de discussão dos textos e nos movimentos de escrita. Entender esse contexto é importante para o leitor.

O contexto social, político e cultural tem demandado questões muito particulares para a escola e, sobretudo, para a formação, trabalho e prática docente. Isso, de certa forma, tem levado os gestores educacionais a olharem para os cursos de licenciatura e para a Educação Básica com outros olhos. A sociedade mudou, nesse contexto de inclusão, tecnologia e de um “novo normal”; com isso, é importante olhar mais atentamente para os espaços formativos, em um movimento dialógico e pendular de (re)pensar as diversas formas de se fazer ciências no país. A pesquisa, nesse interim, tem se constituído como um importante lugar de ampliar o olhar acerca das inúmeras problemáticas, sobretudo no que tange ao conhecimento matemático.

É nessa sociedade complexa e plural que a Matemática subsidia as bases do raciocínio e as ferramentas para se trabalhar em outras áreas; é percebida enquanto parte de um movimento de construção humana e histórica e constitui-se importante e auxiliar na compreensão das diversas situações que nos cerca e das inúmeras problemáticas que se desencadeiam diuturnamente. É importante refletir sobre tudo isso e entender como acontece o ensino desta ciência e o movimento humanístico possibilitado pelo seu trabalho.

Ensinar Matemática vai muito além de aplicar fórmulas e regras. Existe uma dinâmica em sua construção que precisa ser percebida. Importante, nos processos de ensino e aprendizagem da Matemática, priorizar e não perder de vista o prazer da descoberta, algo peculiar e importante no processo de matematizar. Isso, a que nos referimos anteriormente, configura-se como um dos principais desafios do educador matemático e sobre isso, de uma forma muito particular, abordaremos nesta obra.

É neste sentido, que o livro "***Incompletudes e Contradições para os Avanços da Pesquisa em Matemática***", nasceu, como forma de permitir que as diferentes experiências do professor pesquisador que ensina Matemática sejam apresentadas e constituam-se enquanto canal de formação para professores da Educação Básica e outros sujeitos. Reunimos aqui trabalhos de pesquisa e relatos de experiências de diferentes práticas que surgiram no interior da universidade e escola, por estudantes e professores pesquisadores de diferentes instituições do país.

Esperamos que esta obra, da forma como a organizamos, desperte nos leitores provocações, inquietações, reflexões e o (re)pensar da própria prática docente, para quem já é docente, e das trajetórias de suas formações iniciais para quem encontra-se matriculado em algum curso de licenciatura. Que, após esta leitura, possamos olhar para a sala de aula e para o ensino de Matemática com outros olhos, contribuindo de forma mais significativa com todo o processo educativo. Desejamos, portanto, uma ótima leitura a todos e a todas.

Américo Junior Nunes da Silva
André Ricardo Lucas Vieira

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SUMÁRIO

CAPÍTULO 13

COMMENTS ON THE PERCEPTION OF THE STUDENTS AND TEACHER IN A MATHEMATICAL MODELING DISCIPLINE IN AN ENVIRONMENTAL SCIENCES GRADUATION – A REMOTE EDUCATION EXPERIENCE

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ABSTRACT: The teaching of mathematics with quality, generating learning, is a challenge for modern pedagogy. The new teaching technologies are hardly finding space within a structure that is rooted in the old processes proven insufficient to teach properly. The problem in learning mathematics comes from the base and seems to continue in the student's life without a continuity solution until appearing in graduate school, where the need to apply mathematical reasoning is imperative for the production of knowledge in the many fields and more specifically in research that needs of a logical basis. Mathematical modeling seems to be a more efficient proposal to enable the undergraduate and graduate students to meet the need for the practical application of mathematics in research and real cases. At this time, when the student is forced to learn for himself due to social isolation, there is a great opportunity for researchers of the pedagogy to verify the benefits of active methodologies in which mathematical modeling and problem solving are part. In this chapter, we begin with comments on mathematical education and continue to associate it with mathematical modeling with an emphasis on undergraduate and graduate studies, as examples in show the need of the student's situation in relation to mathematical reasoning. In this sense, we analyze a real case and make general comments as an example of learning problems, data that are corroborated by other studies at various levels of education.

KEYWORDS: Mathematics teaching, Mathematical Modeling, Problems Solving, Academic Education, Active Methodologies.

1 | INTRODUCTION

The difficulties to teaching mathematics adequately, i.e., to make easier for teaching students is a challenge not yet overcome by teachers. That is a capital subject the involves educators, teachers directly and the society indirectly. The new purposes for teaching were not completely implanted and must be tested and tried in many levels of students live. Probably, the more significative problem to teaching using the new technologies for teaching is in the academy and graduation because very usually the pupils arrive without enough knowledge about the mathematical basis. This situation is worst for no exacts courses in order. In a tentative to close the mathematical basis reasoning for graduation students a discipline of mathematical model was purposed for an Environmental Sciences Graduation.

The goal was to give to students a material for help them use the mathematical

models for dissertations/thesis. Some students come from biological courses, others from biotechnology, environmental engineer, therefore, they presented different mathematical knowledge and a challenge for the teacher.

An unexpected fact was the necessity of the stop the presential discipline and after to continue in a remote education system, then the experience become more difficult for a side, however, more thought-provoking on the other.

The purpose of this work, was to analysis the use of the Mathematical Modeling methodology in a discipline of the Mathematical Modeling Applied for Environmental and Biological Sciences, offered in an Environmental Sciences graduation (MSc and PhD) course in a tentative to development cognitive abilities, favoring the reflection and questioning into the Mathematical Modeling, a critical reasoning (Lupinacci and Botin, 2004) and provide to students to obtain their own knowledge (Ferreira, Silva, Nunes, 2015), which are useful skills for future scientists.

In this experience relate, students and teacher told your perceptions about the discipline of Mathematical Model with partial use of the active methodology and remote learning with intention to contribute for mathematical education experience from both view from teacher and students

2 | SOME COMMENTS ABOUT THE MATHEMATICAL EDUCATION

Educational methods of teaching have been studied by mathematicians for a long time (Alves and Aversi-Ferreira, 2019) and used by others exact and no exact fields, sometimes because the absence or scarce studies in didactic purposes in those areas.

The concerning about the mathematical education led the pedagogic researchers to search for the elderly philosophy conceptions as the Plato, Aristoteles, Kant and/or Descartes (Machado, 1987; Piaget and Beth, 1980), as bases for the use of new technologies, problems solving, math modeling, teaching of history of mathematics (D´Ambrósio, 2008), since the Middle Age, that were and hodiern are tested in the practical teaching (D´Ambrósio, 1998; Biembengut, 2014).

A study of the classic works could generate an understanding of the causes of the modern methods of education (Nosella, 2004).

Specifically, both, Solving Problems and Mathematical Modeling are intimately linked, because the solution of a problem must use a creation of a modeling for math language (Faccin, 2015).

For instance, one of the purposes for improve the mathematical teaching, as Solving Problems, is innate from human nature (Caon and Cardona, 2015; Rodrigues and Magalhaes, 2012) as demonstrated by history of Chinese, Egyptians, Greeks (Stanic and Kilpatrick; 1989) as observed in the Hind Papyrus, Moscow Papirus (Disperati, 2015), trigonometric problems in the clay tablet known as Plimpton 322 confectioned by Babylonians (Mansfield and Widberg, 2017).

From the Greeks we obtained the heritage of the heuristics steps for the problems solving as 1) task, 2) indication, 3) thesis, 4) construction, 5) demonstration and 6) conclusion, that is a still used method (Groenwald et al., 2004).

Following the reasoning, the mathematics became the base for exact sciences, collaborating, inter alia, with the language, descriptive analysis, modeling and simulation, providing the tools for more trustworthy projects (Onuchic, 2012).

However, it is important separate the epistemology of the Mathematics Sciences and Mathematical Education, because the last one is not an exact science, it is empiric and multidisciplinary and the objective is more social, pedagogical, i.e., the student learning (Onuchic, 2012).

Into the studies of the Mathematical Education, a proposal for perform the mathematics teaching is the use of modern methodologies, in a tentative to do the mathematics pedagogy as a tool to generate appropriated knowledge for different students (Onuchic, 2012).

Historic approach indicates the long time that educational researchers have studied changes for the mathematics teaching, although the conservatism education has prevailed, putatively because the difficulty in changing ingrained behaviors (Alves and Aversi-Ferreira, 2019).

Indeed, a common and hodiern problem is that despite of research and reflections about mathematic teaching, the new methodologies of the Mathematical Education are not yet applied in classes frequently and satisfactorily, where the traditional principles still remain, at least, in Brazil (Rodrigues and Magalhaes, 2012; Groenwald et al., 2004).

In fact, the new methodologies are used scarcely in the teaching (Groenwald et al., 2004); in many countries this situation have occurred into a same convergence points, but topics to modify this situation has been purposed as the use of the 1) problems resolution, 2) quotidian mathematics and 3) math problems found in other disciplines; these ideas are also cited in Brazil by the National Curricular Parameters in Brazil (Brasil, 1998).

Furthermore, the purpose of the use of the Mathematical Education is, in the context for students, to purpose the use the think critically (Lupinacci and Botin, 2004), with the objectives of: 1) improve the investigation methods, 2) elaboration of the complex thinking process, 3) catenation of ideas using math and logical proceedings; generating, at least the critical thinking, for comprehension of the hypothesis formulation and generalization (Groenwald et al., 2004).

These are purposes for became the students the author of own knowledge that is the base of the Active Methodologies.

In this way, for instance, the new purposes do not match with the use of long lists of exercises (Ferreira, Silva, Nunes, 2015), as preconized by the method of the mental discipline theory (Groenwald et al., 2004), that is usual but based in a conservative teaching far from the modern society needs (Ferraz, 1983).

Many Mathematic Education methodologies are unknown by most of educators (Groenwald et al., 2004), and students; in fact, these methodologies are difficult to be understood efficiently (Stanic and Kilpatrick,1989) by teachers of the math and correlated fields (Alvces and Aversi-Ferreira, 2019).

It is very knowledge that most of students present difficult in learning mathematics in classroom, because, inter alia, and perhaps, the lack of interest or accommodation of pupils since the fundamental school. This aspect depends, also, on the demotivation of the teachers (Prediger, Berwanger and Mörs; 2009), because the passivity of some ones encouraging the demotivation of others and vice versa (Alves and Aversi-Ferreira, 2019).

Into of the perspective of the new methodologies, presented problems to students must be challenging, as possible real, generating interest (into an unknown perspective for generate motivation, not be only application of algorithm) and presenting some difficult level (Dante, 1998), for do not generate demotivation (Rodrigues and Magalhaes, 2012)

The enthusiasm of pupils additionally also dependent on the teacher's and of the teacher/student relationship (Lupinacci and Botin, 2004), to obtain a positive feedback, and this is a complex subject that need deep studies by educators.

According, new methodologies for education play a very important role for new approach in the teaching, generating a new perspective of learning, in general and for mathematics (Alves and Aversi-Ferreira, 2019).

In the new mathematical methodology, a very studied purpose is the Solving Problems that indicates to students a new routine and stimulate of thinking, with emphasis on the process, generating situations that requires reasoning to solve problems themselves (Lupinacci and Botin, 2004; Caon and Cardona, 2015). Increasing an elaborate process of thinking (Ferreira, Silva, Nunes, 2015) applying deductive and inductive reasoning, for improve notions of graphic proportions, improving the capabilities for build conjectures and mathematical arguments, following logical arguments and to validate their own construction (Mendes, 2009).

Differently of conservatism teaching, only the formulas are not a true way to be solve problems (Carraher, 1986, Caon and Cardona, 2015); it is important to stimulate students to use procedures and previous knowledge to analyzes formulas and real situations using critical thinking (Lupinacci and Botin, 2004), generating, self-confidence, that is a heuristic not only mechanical process (Caon and Cardona, 2015).

Into those contexts, is of the education interest to verify whether students leave your courses, as well as university in adequate conditions and efficiently prepared to face the market and graduation and whether they attend to continuous formation (Oliveira et al., 2001, Cintra & Oliveira, 2001). Indeed, some professions need of specific disciplines for improve them competences, both in labor and academic work.

As cited above, academic works have indicated which didactic methods to teaching mathematical disciplines fail in the education purpose (Telles *apud* Cintra & Oliveira, 2001).

Studies about as to teach those disciplines are scarce, or is in the incipient period for graduation level, at least in relation and compared to the material dedicated to the same subject for basic and high schools.

Nevertheless, it would be difficult to implement new methodologies for teaching in universities but attempts to use real problems associated studies of scientific papers as example would keep the student's attention by more time (Ferreira, Silva, Nunes, 2015).

All those runs through by a serious teachers' training, but, in general teachers imitate their ancient teachers (Lima and Alves Neto, 2015), mainly the new ones, maybe because the insecurity (Smaniotto and Gentil, 2014). Many teachers in the universities, in the under and graduation, do not present previous didactic preparation for teaching, and it seems a very important problems, specifically, for teaching mathematics and correlated disciplines (Alves and Aversi-Ferreira, 2019).

In this perspective, this kind of teacher could keep the continuation of the ancient conservatism and, by deduction, the non-integration of the students' behavior in a very mutant world (Lester and Koehler, 2003; Lesh and Zawojewski, 2007).

It is reasonable to think that those problems it is a heritage from fundamental for under and graduation education because the demotivation of both, students and professors (Massa, 2015).

On the other hand, there are many possibilities to teaching differently from the conservatism that is suggested, today, by the new methodologies, as methods of the Mathematical Modelling, in specific, for non-exacts courses. If a deep care is necessary to teaching math for pupils that have an attraction for exact sciences, teaching for disciplines linked to mathematics for students of non-exact courses must be done seriously into a very good preparation for do not worst the disappointment of the students with math.

For teaching adequately, is necessary a good class preparation, discipline, organization (Ferreira, Silva, Nunes, 2015). For more pedagogic details about that subject, see Onuchi (2009) and Felder and Silverman (1988) for techniques to reach all types of students.

The teaching practices are not easy, require knowledge, abilities to keep good relationship to students and to wait for the unknown reactions (Lima and Alves Neto, 2015), and avoid being just a communicator (Godoy, 1983) according the new purposes to teaching.

In general, the higher education in Brazil shows a technical and mechanical approach in teaching, that is inconsistent with modern society (Alves and Aversi-Ferreira, 2019, Moraes and Torres, 2004) and the necessity of multiple abilities for individuals, teamwork, adaptation to changes (Belloni, 2008).

Frequently, for the higher education teaching are required master and doctorate degrees, however, a didactic formation could be also required (Fernandes, 1998) because, not necessarily, the graduations prepared teachers (Garcia, 2013), in the bachelors' courses, or the preparation is insufficient (Onuchic, 2012) in pedagogic courses.

Indeed, many papers versa about mathematical teaching for elementary and secondary education, for Solving Problems, for instance, (Lupinacci and Botin, 2004; Chiréia, 2010; Clement and Terrazan, 2011; Silva, 2012; Caon and Cardona, 2015; Freitas, Goi and Giuliani, 2015; Frizzarini and Cargnin, 2016). However, for higher education, papers about math teaching are scarce, and for graduation much scarcer, as well.

Teachers of math in under and graduation schools could start using modern education methodologies to prepare students to learning to explore better the papers, for example. On the other hand, teachers without educational formation or with ancient formation in pedagogical course, could attend specific courses for teaching for, at least, know the new methodologies.

The use of new educational technologies in the mathematical teaching could indicates a way based on abstract, auditory, verbal, deductive, passive and sequential analysis (Felder and Silverman, 1988) and that could diminish the student's evasion in the exacts courses (Ferreira, Silva, Nunes, 2015) and to evoke them for looking for stimulants' disciplines.

3 I MATHEMATICAL MODELING

The purpose of the use of the Mathematical Modeling in Education is more recent in history, according some authors, it was initiate in 1970's decade in Brazil. However, in other conceptions, it is linked to Mathematica History because the use of modeling is intrinsically associated to diary routine of the ancient people (Biembengut and Hein, 2003; Silveira et al., 2013).

In specific, the Mathematical Modelling methodology begins from the applied mathematics (Frizzarini; Cargnin, 2016) and, posteriorly, different approaches were purposed by Mathematical Education epistemology (Almeida; Silva; Vertuan, 2013).

Some arguments justify the use of the Mathematical Modellings' courses in Superior Education and other teaching levels (Almeida e Silva, 2014), as: 1) to include extracurricular disciplines/knowledge in the course, i.e., multidisciplinary approach; 2) math application and development of mathematical concepts; 3) curricular integration of different disciplines (Frizzarini and Cargnin, 2016), at least.

The Mathematical Modelling method is located between an initial problem situation and the final situation (in the resolution of the problem), i.e., the way is to create proceedings and to obtain information added to search for mathematical knowledge target for a goal (Frizzarini and Cargnin, 2016). In this way, the use of mathematical modelling in the education is inserted in the active methodology if the student searches a solution by own reasoning.

The application of Mathematical Modelling in the education begin in 1960's decade into a utilitarian movement (Biembengut, 2009), in it is begin in the 1970's decade in Brazil

(Silveira et al., 2013). A landmark in Brazil about the teaching of Mathematical Modelling was the creation of the graduation course about the Mathematical Modelling and in 2001 the Brazilian Society of Mathematical Education creates the Work Group of the Mathematical Modelling (GT10) (Frizzarini and Cargnin, 2016).

A book intitle "Mathematical Modeling in the Brazilian Mathematics Education: Researches and Educational Practices" [Modelagem Matemática na Educação Matemática Brasileira: pesquisas e práticas educacionais] was published indicating the follows items of concentration field of Mathematic Modelling Education: 1) Theoretical aspects of Mathematical Modelling; 2) Modeling and practice in the class to test the strategies; 3) Mathematical Modeling and the tendencies of the information and of the communication; 4) Mathematical Modeling and teachers formation (Barbosa; Caldeira; Araújo, 2007).

In 2015, a second book was published about the Mathematical Modeling by the GT10 intitle: "Practices of the Mathematical Modeling: Relates of Experiences and Pedagogical Purposes" [Práticas de Modelagem Matemática: Relatos de Experiencias e Propostas Pedagógicas] (Almeida; Araújo; Bisognin, 2015) including interdisciplinary purpose for biological phenomenon.

The initiation of the use of the Mathematica Modeling in the classroom exist for more than two decades, however, as happens with other Mathematical Education field, it is scarcely explored in teaching, mainly in under and graduation.

Indeed, the studies of new methodologies in higher education is new (D'Ávila, 2008; Pimenta e Anastasiou, 2010; Garcia, 2013) presenting few papers indicating as to use the new technologies in mathematics and correlated disciplines (Barros and Sousa, 2015), as well, for graduation.

4 I METHODOLOGIES

The students answered a structured questionnaire and added spontaneous information about the discipline conducted using an active and traditional teaching, from March to July of 2020.

The questions were:

1. What were the reasons that led you to look for the Mathematical Models course at PPGCA?

2. Has the change of the teaching system from the classroom to the Special System of Remote Studies changed your enthusiasm to follow the discipline? If possible, explain the reasons.

3. Do you have pedagogical training, at undergraduate or postgraduate level?

4. Do you know the teaching method called Active Methodologies? If so, write down the concept you have about him.

5. Do you believe that finding solutions to problems on your own can improve your learning? Please, if possible, justify.

6. Do you prefer traditional classes [teacher explaining with you studying for tests, activities] or looking for information on your own? Justify, please.

7. Do you believe that distance learning has affected your learning in the discipline of mathematical models?

8. Have you improved your knowledge of mathematical models and will you be able to prepare one for your dissertation / thesis?

The relate was used to obtain a free expression of the students about the discipline and its methodology.

About the teacher, he has degrees in Biology [bachelor], Civil Engineer and Mathematics [with pedagogical formation] and some papers published about the under-graduation teaching and education in the embryology, physiology, anatomy and Civil Engineer subjects.

About the discipline preparation, the teaching menu of the "Mathematical Models applied to Environmental Sciences" was "Elementary Mathematics Notions, functions, calculus differential and integral, mathematical modeling definition, steps for mathematical modeling construction, examples of application"; separated into three units with the following topics:

Unit 1: Elementary Mathematics Notions – operations, functions, limits, differential and integral calculus.

Unit 2: Mathematical modeling - definitions, mechanical models, empiric models, semi-empiric models, construction of mathematical modeling – steps

Unit 3: Application of the mathematical modeling – in the sciences in general, in the environmental sciences.

The objectives were "to supply the students an integrated view, theory and practical of the mathematical modeling uses in the research in general and, in specific, for environmental sciences.

The teaching methodology was the "expositive classes with group discussions and active purposes".

The methodology must be altered because the necessity of remote teaching after just one presential class. Then, the teacher recorded classes with all purposed subjects in the menu available in the YouTube channel and online classes were performed into 15 and 15 days. The suggestion of the university was avoiding the online classes because the difficulties of some students in to access the internet and possible loss of signal during the classes, because the classes were performed in the cited time.

Most of the classes were the students presenting papers about their master or doctorate subjects. In all classes before the presentation there was a time for solve

doubts about the recorded classes or other. The first class was used for explanation of new methodologies and that active methodology shall be used. A WhatsApp group and e-mail address of the teacher were available for pupils solve doubts. Some classes and explanations about the mathematical modeling were performed by the teacher, mainly for populational models.

The evaluation in the discipline was made via presentation of the seminaries and resolution of an exercise about the populational models of the Malthus and Verhulst and a comparison between both. On the final, in a meet with all students, with one absence, the students suggested your scores according the dedication for the discipline, and an average of the scores generate the final score.

5 | RESULTS

5.1 From students

The discipline had 11 students, but two don't responded the questionnaire and don't write the relate about the discipline, one Environmental Engineer and one mathematic.

In relation to first question [What were the reasons that led you to look for the Mathematical Models course at PPGCA?], 8 different answer were obtained with more than one for students most time. Three answer that the reason was they teacher request; four to obtain more knowledge about the subject; just one with the goal to obtain autonomy in mathematical model; one because have mathematics difficulty; four to write the dissertation/ thesis according the purposed project; one because no other discipline in the graduation program have mathematical subject; one for complete credits; and one because the similarity of the purpose with a discipline in under graduation.

The second question [Has the change of the teaching system from the classroom to the Special System of Remote Studies changed your enthusiasm to follow the discipline? If possible, explain the reasons], shows 6 responses linked to diminish of enthusiasm, 3 increase one and one responded as no change. Interesting, two pupils responded that increase for a side and diminish for other. The main reasons for the enthusiasm diminish were difficult for solve doubts, 5 of them; lack of academic environment [3]; problems of connection [2]; absence of human relation [2]; many distractions in home [2]; change of experiences with colleagues [1]; problems in follow the classes chronogram [1], increase of anxiety. The increase of stimulation was the distance between of university and home (around 100km) [1], use of recorded classes for revision [1]. For one student, there was no effect the change of teaching for remote teaching.

Just one student responded to had pedagogic formation according the question [Do you have pedagogical training, at undergraduate or postgraduate level?], one is attending for complementation; 8 responded have not pedagogic formation and one of them is a teacher in a university.

In the question four [Do you know the teaching method called Active Methodologies? If so, write down the concept you have about him], six students responded NO, two responded YES and one said to know barely the Active Methodology. Just the student that attended pedagogical course of Biology and the teacher in a University gave the correct concept about this methodology that was the active action of the student in your learning.

The number five question [Do you believe that finding solutions to problems on your own can improve your learning? Please, if possible, justify], two of them said to have difficult to learning alone, five, said that to learn your selves seems better, and two answered both in accord the circumstances. Those that responded NO indicated lazy, necessity of the teacher, preference for group studies and long time to learning as reasons of their choice; for the answer YES, the better criticism about the subjects and necessity to more study to learn. Those that responded BOTH, the vantage cited were the preparation for the future work, however, one of them cited difficulties to learning counts alone and general difficult to learning alone.

For question six [Do you prefer traditional classes [teacher explaining with you studying for tests, activities] or looking for information on your own? Justify, please], three students prefer traditional classes because the facilities for solve doubts, for better understanding of subjects in participating of the classes; just one choose the active learning considering as a challenge; five of them choose BOTH, traditional and active methodologies to be used together, however, one cited that for math the traditional could better, but for other disciplines the active methodologies is better; other cited that depends of the quality of the didactic of the teacher, for a “good” teacher the preference is by traditional teaching.

Eight students considered negative for their learning in responding the question seven [Do you believe that distance learning has affected your learning in the discipline of mathematical models?] and just one considered positive the distance teaching. The problems cited were fear for contact the teacher, difficulties for solve doubts, other compromises disturbing the studies, procrastination to study the discipline, however, just one said that have problems, but not so much.

The last question, number 8 [Have you improved your knowledge of mathematical models and will you be able to prepare one for your dissertation / thesis?], shows all responses as YES for improve the knowledge, but four of the students said be uncapable to generate a mathematical model for your scientific work, three said that they are capable, and one does not response about that capability.

Form the free texts the main complaint was about the pandemic that generates the remote teaching into five citations, suggestion for list of exercises and weekly tasks were five citations also, one ask for more online meetings. They cited good actions as the teaching of the logic of the calculus not only counts [2], importance of the basic classes of mathematics as review [2], the opportunity of reflection of the subjects in the active methodology [2], discussion of the articles about the each field of the students [3], study of a case for

mathematics modeling [2]; just one citations as good actions versa about a WhatsApp group for discussion, system of self-evaluation, the understanding of the populational models, the understanding of the types of models, the understanding about the growth of the pandemic via populational models and the recorded classes.

5.2 From teacher

The purposed subjects of the discipline were performed in the recorded classes and the presentation of seminaries were made in the online classes with most of students present. Some lost of signal indeed occurred with some students housed far from the urban centers. Spontaneous group of studies were made by the students for study the recorded classes and for resolution of the exercises about the populational exercises.

The menu of disciplines was constructed to generate basis for the understanding of the populational models with exercises of preparation in the classes, however, many problems for understanding the way for resolution. For resolution of exercises was necessary looking for data from a real population and to organize to use a formula, and this was the main difficulty. Most students show a good attention with the mathematical explanation of the exponential and logarithmic functions linked to real examples.

One of the objectives was to demonstrate in detail the origin of the equations for the Malthus and Verhulst models, however, the difficulties showed for students generate a partial demonstration. Indeed, most of students were biologists, three were environmental engineer, one economist, one mathematician, one biotechnologist. All of them show some difficulties in mathematical thinking, indeed, non-one obtained a correct resolution of the purposed exercise, that was a trivial one.

The seminaries were well presented by the students with some difficulties about the mathematics subjects. In the self-evaluation, with just one absence, all students cited about the delay in following the classes and difficulties in understanding the resolution of the exercise purposed.

6 I DISCUSSION

According the results data, the most of students shown unsatisfaction with the change from the presential for remote classes. In general, they prefer the presence of the teacher in the normal classes and, interestingly they wrote that felt shame to call the teacher in the social medias, WhatsApp and e-mail.

According the responses, three students attended to discipline because the request of the advisor and/or to complete credits, that is not a good reason to attend a discipline and could be difficult to implant new methodologies. Other cited as reason to learn about the Mathematical Model and mathematics most for use in the papers and dissertations/thesis, in general, and it is an interesting situation in the search for Mathematical models, indicating the importance this a subject for modern science, however, the teacher observed that most of them had no complete idea about this discipline.

Most of students cited demotivation in change from the normal to virtual classes because many reasons, but it is a strong indication that the new methodologies present some difficulties to be developed (Onuchi et al., 2014), at least for this class.

Just one student had educational formation and less than half of them known about the active methodologies and could been a motive of the cited difficult in to implant Mathematical Modeling in this class.

Indeed, all students shown unsatisfaction with active methodologies and anxiety to solve problems derivate from the theory, probably because the behavior learning in the long time under usual and traditional teaching (Alves and Ferreira, 2019). Problems were shown in the recorded classes and solved by the teacher, but list of exercises was not presented, just the indications for studies in books, because have not enough time to teach complete disciplines from the menu. According the teacher thinking, master and doctorate students must be showing some facility to obtain knowledge form the texts, since that the previous studies about those disciplines were studied before in the under graduation. Indeed, in general, biological courses present mathematics in their menu. However, it was not observed for most of students, including some environment engineer.

All of them understood about the need to study and to solve problems by own effort, but the teacher felt that the absence of a structured algorithm and model that indicate a similar response was the main cause of difficult, i.e., solved examples to direct the solutions for other problems, in that case, the teacher solving problems, providing an exercises list with problems similar to solved exercises. This case there is an incoherence between the necessity and behavior, the thinking indicates the best way to learning, however, the longtime of traditional practices seems overcome the reason.

In general terms, this kind of situation comes from the mistaken interpretation of the teaching methods and philosophy from the philosophers and heritage from the Germany method (Theory of Mental Discipline) based on the long list of problems as training to solve problems emphasizing the final results and not the process (Onuchi et al., 2014), until now used in Brazil (Belhot and Oliveira Neto, 2006).

On the other hand, some students cited the difficulty to learn alone, i.e., in the absence or far from the teacher. That could be explained by the theory of the social-historical-cultural psychology that preconizes the environmental influence on the mind formation and cognitive process (Vygotsky, 1991; Luria, 1937).

An unexpected situation was that all students complain verbally about the time to dedicate to disciplines because the excess of tasks, probably because the implantation of remote studies and the teachers sent so many tasks, and interesting, they do not complain about that in the free text. That is cited problem to implant the Mathematical Modeling and Problems Solving in the teaching, according Ferreira, Silva and Nunes (2005).

According the perception of students and teacher about the discipline of Mathematical Modelling, there were problems for students to accept the remote studies and to absorb the active teaching methodologies, case cited by Beholt and Oliveira Neto (2006).

The teacher observed the difficulties in mathematical bases, a common problem in Brazil (Alves and Aversi-Ferreira, 2019) that could have generated the unsatisfaction with the resolution of problems because of the comfort with the traditional teaching and the very strong necessity of the use the identical model of problems for application of algorithms, then decreasing the effort to solve other problems.

7 I CONCLUSIONS

Teacher and students believe that there is a need of detailed explanation about the new methodologies for students in the first class to try obtaining the adherence for an active methodology of teaching. The implantation of the Mathematical Modeling occurred but not totally so succeed because, manly:

1. The drastic change from the normal to virtual classes.

2. No experience from the students with Mathematical Modeling and Solving Problems.

3. Preference of students of the presence of the teacher in the normal classes.

4. Necessity of the students in training on the solved exercises and a similar list of the exercises to solve problems.

5. Difficult of the students in being auto taught.

6. Difficult of the teacher in the perception of the student's difficulties because of the virtual classes.

The problems cited by other authors as few time and engrained culture in traditional teaching were observed in this work, indicating the need in to introduce the Mathematical modeling and Solving problems in the initial phases of the mathematics teaching.

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