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A THEORY ABOUT THE FEDATHI SEQUENCE AS A TEACHING METHODOLOGY

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ABSTRACT

The teaching posture is a significant variable in the processes developed in a didactic session, being contemplated as an object of studies in a teaching methodology born at the Federal University of Ceará and which presents solutions to problems related to the way knowledge is formed by the student from of the teacher's actions. In this article, as part of the results of the thesis work, we discuss the origin and theoretical development of this scientific method applied to the classroom and it's influence and transformation in the production of knowledge for the teacher's work. The objective was to understand the development of the Fedathi Sequence (FS) by interpreting and explaining the concepts that can be applied in all areas of knowledge. Methodologically, we adopted the qualitative paradigm to answer the established objective and considered the original research as a systematic descriptive review of the literature of scientific works whose theoretical foundation is based on the FS methodology. The analysis carried out of the data obtained from the theoretical study showed results indicating the strengthening of the systematization of the teacher's actions, showing through the FS, the possibility for a student to perform the path taken by the scientist, as well as representing a training for the teacher.

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INTRODUCTION

In the study developed by A. O. Júnior (2006), it's described about the importance that should be given to the understanding of concepts and the valuation of their applications, while suggesting a weakening of the role of traditionally prioritized manipulative and algorithmic skills. It is possible to affirm that some actions of the professors who remain with this practice, probably, contribute to aggravate the difficulties with some contents. Based on this problem, how can the teacher overcome such obstacles? In this case, the research problem falls on the mediation of the teacher in the classroom and his actions to overcome the difficulties. What to do when students do not have the primitive concepts that will guide them in learning future content? A proposal to be outlined in this work will be the teaching methodology Fedathi Sequence (FS). The Fedathi Sequence is a teaching methodology that was developed in its genesis to be applied in didactic sessions with the content of Mathematics. Subsequent studies and experiments by researchers from other areas provided the adaptation of this methodology in other fields of knowledge besides Mathematics, such as in Physics, Pedagogy, Technologies, Inclusive Education, among others, that is, in several fields of application "[...] whether it is Educational Informatics, Distance Education, Teacher Training and Digital Inclusion, being operated in an articulated manner with the themes that the Laboratory develops ". (TORRES, 2014, p. 154). The following guiding question was formulated: is it possible to understand the development of the Fedathi Sequence (FS) by interpreting and explaining the origins and steps that can be applied in all areas of knowledge? What triggered, using the context of Bloom's Taxonomy, as an objective "to understand the development of the Fedathi Sequence (FS) by interpreting and explaining the origins and steps that can be applied in all areas of knowledge".

To achieve this objective, a qualitative research and systematic descriptive literature review of scientific works will be carried out as a methodology, whose theoretical foundation is based on the FS methodology. The continuation of this research will describe the conceptions that supported the development of the sequence.

DISCUSSION

At the end of the 1980s, at the Federal University of Ceará, more precisely in the Bachelor's Degree in Mathematics, there were the first attempts to write something more understandable in academic works focused on Pure Mathematics for the public that was not so mature. It was the work of Vasconcelos (1983), entitled "A natural approach to Dedekind's rings", whose supervisor was Professor Hermínio Borges Neto. This work gave rise to one of the first in-depth foundations: a problem passed by the teacher must have the characteristic of being generalizable in order to refine, but one must start from the general to the particular. The dissertation was designed in order to be an accessible source of studies for students in the beginning of the undergraduate course in Mathematics. As a consequence, the Mac Lane sequence emerged as a teaching methodology proposal still in an initial theoretical phase. It was learned as a lesson that it is not studying specific situations that will lead the student to learning in a more accessible way. Still in that period, with the pseudonym "Prof. Fedathi Cebê", professor researcher Borges Neto introduced a vision called Fundamental Theory to teach his Topics classes at the Mathematics unit at UFC. This meant teaching mathematics not with ready models, but in search of investigating ideas from mathematical thinking. His theory was rooted in the fact that the whole of everyday life is permeated by mathematical concepts and, before them, it would be possible to develop mathematical models under the aegis of fundamental definitions, thus valuing the naive and intuitive way of ideas. A decade later, Borges Neto went on to carry out postdoctoral studies in France, at the Université Paris Diderot, and his main concern was to understand what the attitude of a teacher would be to conduct a didactic session in which mathematical learning was constituted and so the developed knowledge.

In an interview with Fernanda Cíntia Matos, PhD student in Education, on May 22, 2017, Borges Neto (2017) tells the story of the origin and development of the Fedathi Sequence. Professor Hermínio Borges Neto is a mathematician by training and career with an influence on the formation currents of the American formalist and specialized mathematician (works the mathematical language so that people become mathematicians as soon as possible), European, particularly Russian (follows the French line) and French (since the time when Napoleon created the polytechnic school, in which he trained mathematicians as engineers whose conception was to train for some purpose), English (follows the American) and German, in between. The teacher received influence from both the French and the American schools, but it was the French that in the weekly meetings of his studies with mathematical teachers of that current, it was noticed that they worked on contents that were possible to understand from the knowledge that existed among the students. In addition, based on the problems presented, the objective was to transpose mathematical knowledge to other areas of knowledge. In his group of orientation studies at the Institute of Pure and Applied Mathematics (IMPA) he received an intense influx, also, from German teachers, realizing greater breadth and more comprehensive training, while still having knowledge of his specific area. This experience made his work with Applied Mathematics with computational tools possible in the mid 1980s, already as a fellow at the National Council for Scientific and Technological Development (CNPq). In the late 1980s, head of the Mathematics Department at UFC, identified a major problem with the teaching of Mathematics in Exact Sciences courses for which Mathematics offered subjects in which there were many failures and dropouts by students, at which point he noticed that the service provided to the other courses was deficient. Hence, programs were carried out in an attempt to mitigate these difficulties. The first concerns with the teaching of Mathematics began. Department professors who were studying for a master's degree in mathematics, and who were having some difficulty following the course, were invited to engage in the graduate program at the Faculty of Education. Five teachers from the UFC Mathematics course were taken and the first difficulty was to make the Education Program grant differentiated access to "differentiated places" to these professionals without favoring, but within a "cooperation plan" of so that there was an internal selection between them. So, four teachers finished their Masters in Education and there were already five, along with Professor Hermínio, the number of teachers with a new look at the teaching of Mathematics. As a result of the master's dissertations, these teachers concluded that the problem was in the formation of the mathematics teacher, thus having to rethink mathematics from its purpose, what is it for, etc.

Initially, the Fedathi Sequence was not conceived with any theoretical basis from educators, including Freire's work, which supports the teaching methodology, it was only known by the teacher after returning from France. As a conception, FS was based on the idea that whoever can and should speak how to learn "Mathematics" is the mathematician, the one who creates Mathematics. Thus, the initial idea of FS emerged, in which the teacher could transform the classroom into an environment of mathematicians working since the problem lay in how the teacher was transmitting knowledge to the student. How does a mathematician prepare his problems? This question was one of the reasons for the initial project that would come to be called the Fedathi Sequence. Some excerpts from the history are relevant for the continuation and better understanding of this study, namely: the competition for the area of teaching in Mathematics by prof. Raimundo Barbosa for the Faculty of Education, and the creation of the subject Topics of Mathematics, in the Department of Theory and Practice of Teaching, with the consent of the professor. Ana Iório, then coordinator of the Pedagogy course. The break in the evaluation paradigm for the Mathematics teacher for the Faculty of Education no longer conceived only a good teacher (a concept that will be well structured in the following chapters) in the areas of methodologies and didactics, but now it was necessary to know the mathematical content, thus falling specific questions in the test that measured the mastery in Mathematics.

According to Borges Neto, in the course of his testimony, Professor Ana Iório, coordinator of the Pedagogy Course at the time, created the subject Topics in Mathematics at graduation; there was no preconceived schedule, as his objective was to teach classes in the French "mold", the teacher directed the course according to the enrolled public. The discipline had an open bias and this could hinder the work of the teacher who already had everything pre-programmed to carry out the course, but it was in this context that the topics studied were being implemented in the discipline, through contextualized questions, in which the students they even had the necessary tools for resolutions, but they were not yet as sophisticated for the conclusions expected by the teacher. During the class, the students went to the board to present their results and the teacher then systematized the axiomatized mathematical

pattern involved in the problem. In the course of these experiments involving the teaching of mathematics at undergraduate level, a proposal for teacher training for the Secretary of Education of the State of Ceará emerged, with the constructivist bias, and hence the proactivity of the mentioned teachers led this work and culminated in the creation of the group. Fedathi, around the years 1991/92, composed of mathematical teachers and pedagogues. Thus, the systematization of a teaching method, initially called Fedathi Sequence (verbal information), begins. Around the 1990s and with studies focused on the issues of mathematics didactics, the group entitled Fedathi began to study a teaching methodology formally called Fedathi Sequence (FS) and is currently studied by the Research Group on Multimedia Mathematics Teaching (GEM²) of the Multimeios Laboratory that develops research in education and in the Teaching of Mathematics (BORGES NETO; SANTANA, 2003). The Fedathi Sequence idealized based on the studies carried out in Borges Neto's post-doctorate, who has a bachelor's degree in mathematics with a master's and doctorate in mathematics, a professor at the Federal University of Ceará (UFC), linked to the Faculty of Education (FACED), whom he affectionately named the name Sequência Fedathi due to the beginnings of his three sons Felipe, Daniel and Thiago; and can be defined, according to Borges Neto (2016), with theoretical-methodological basis based on the logical-deductive-constructive proposal, by a behavior, a different attitude on the part of the teacher, towards his students, that respects and tries to reproduce the method of work of a mathematician.

Understanding how the content learning process takes place and the stages of intuitive reasoning that students must establish, requires a primary component: a methodological teaching resource. The proposal as a teaching methodology is to use the Fedathi Sequence as didactic mediation in order to promote the intuitive reasoning to be studied during the research. The Fedathi Sequence, in this process, has the purpose of guiding the teacher's action, which will lead the student as an active subject and not as a recipient of ready-made answers and a finished math. Thus, the Fedathi Sequence achieves this function the instant it translates into the classroom a moment when the teacher is a conductor that gives students the opportunity to discover Mathematics, starting from challenging situations that designate them to act on the proposed content, assimilating and accommodating new knowledge.

This fact occurs according to the steps to be followed in a didactic session: *positioning, maturation, solution and proof.* The correct use of these steps translates a new vision in the classroom with regard to the positioning of the teacher and the student, so that the student should be an active participant during the class, either solving the activities, discussing the solutions found or checking the formalization of the content carried out by the teacher. When elaborating the teaching sequence, however, more precisely, the didactic session, it is essential that the teacher is aware of the students' level of knowledge (*plateau*), that is, if there are conditions to assimilate the content to be presented and, in addition In addition, prepare for possible questions, doubts and points of difficulties that may arise, which will provide the teacher with greater preparation. In the reports by Sousa (2013), before there is a lesson plan, there must be a transformation in the teacher's idea, that is, there is no way to put something into practice that is not used in their way of thinking. Here is the author's reflection:

> [...] to organize a class according to the methodological script of the Fedathi Sequence, the change of conception must precede the change in the way of planning. [...] we understand that the teacher's ideas, his way of thinking, is what makes the difference when the plan is executed, when it is put into practice and can effectively be called a curriculum, in the sense of the way to be covered.

The teacher's way of thinking and acting is essential for the success in the use of the Fedathi Sequence, because, conscious or not of his teaching and learning conceptions, the elaboration and execution of his classes will tend to be based on these bases. An example of the applicability of this methodological strategy is the use of computational resources, as according to Alves and Borges Neto (2011), the exploration of such a tool allows the development of cognitive structures and the perception of mathematical aspects by the students. We emphasize that each stage of the Fedathi Sequence represents different moments of the lesson, which must happen naturally, as many times as necessary, according to the lesson plan, and make up all the moments when a researcher creates a certain knowledge, leaving the teacher to best teaching tools to be used in the process. The Sequence is based on the scientific method and is the scientific method applied in teaching, hence the proposal to transform the classroom into a research, discovery environment. How to do this? You have the basics and some basic concepts (like hand in your pocket, question, plateau ...) Who can help do this? Didactic engineering (DE), for example, in its analysis, the priority is preliminary, but not only DE can help. For example, active methodologies such as inverted room, PBL, CBL or TBL, PP (project pedagogy) can also help and even be included in the didactic session in which the Fedathi Sequence methodology is applied.

The initial conception of FS was not based on education theorists, but on mathematicians, but with the sophistication of studies, experimentation and reflections, David, Hersch, Morris Klein, Dieudonne, Fermat, Russel, Brower, Polya Lakatos (which was already used in the mid-1990s as a theoretical basis for the Fundamentals of Mathematics course taught by Professor Hermínio, as it explained what mathematics was for with its practical function in life) etc. The maturity of studies in the area of Education converged to the understanding that the theorists Piaget and Vygostky also supported and with their theories supported the sequence. It was noted, then, that the Fedathi Sequence was the scientific method itself. Most training centers centered their studies with a focus on the student, the teaching sequence envisioned by the teacher; on the other hand, it aimed at behavior and the teacher, that is, it recommends behavior, posture, way of interacting with the student, starting from the general to the particular with challenging problems and, as a consequence, changing the way the student learns and making flexible the understanding. These characteristics that will affect the teacher are in line with the ideas developed by Education theorists mentioned above. In the Fedathi Sequence, it is important to solve the problem, so that Mathematics solves. This we call mathematize, that is, it is essential that the student is able to develop a reasoning based on research and creation of a model based on the data provided. And the feasibility of using this methodology in the face of a gap in knowledge in the classroom? This is not the problem, since the methodology has a way out of this situation, but the

number of teachers and monitors reduced to the high number of students in the classroom, which can make it difficult to use this methodological tool.

Before the teaching method, there is also a moment of great importance, which is called Plateau, and which configures the preparation of the class. It is concerned with the knowledge necessary for students to successfully develop the activity. The teacher must conduct an investigation to find out how well the students are. This moment in the sequence is the first step for the teacher to know his students. As you get to know the students, you will also get to know their deficiencies through questions, challenges and, also, the constancy in getting them to actively participate in the process. Thus, the discrepancy may decrease and Plateau, the average knowledge necessary for the acquisition of new knowledge. Plateau is a level at which the student needs a minimum knowledge base to advance the content with tranquility and security. Such a challenge cannot be so easy that good students feel childlike, nor so difficult that students who find it most difficult find themselves unable to solve. The Plateau's origin goes back to studies in Differential Geometry when studying the minimum surface area of the Mathematics professor in the Pure Mathematics Program at the Federal University of Ceará, LuquésioPetrola de Melo Jorge, when he had a notable publication. It is the example of Plateau that, in this context, means a sign of balance and mainly stability for the starting point. That said,

> The connection between minimal surfaces and soap films motivated the famous Plateau Problem, a Belgian physicist who dedicated him self to experimenting with soapfilmsinthemid-1850s. The results of Plateau's experiments were explained physically. Thus, Plateau's problemarose: toprovethat, for each closed curve$C \subset R^3$, there is a surface S of minimum area having C as a boundary. That is, we want to minimize the area among all the surfaces of the $\mathbb{R}^3$ with given border C. (ARRUDA and DIÓGENES, 2017, p.2)

As more experiments were carried out and their results generated articles, monographs, dissertations and theses, other knowledge was linked to the Sequence and, thus, further developing its theoretical contribution. In studies carried out on French didactics, it was realized that it would be possible to devise a method that would complement some gaps in this research. This story continued when Borges Neto returned to Brazil from his studies and brought with him ideas that contributed to mathematical education in Ceará. When analyzing the productions that deal with the Fedathi Sequence, its main objective is attested: to promote the change of posture of the teacher who becomes the mediator of the teaching process (SANTOS; LIMA; BORGES NETO, 2013). In addition, the FS also aims to awaken the student's autonomy, pointing out a reflection on their practice and looking for the final result, which may be different from the conventional way expected by the teacher. FS represents a link between student, teacher and knowledge, as the challenge and mediation provide interaction of the group's components, that is, FS is used in the search to develop in the teacher a mediating posture that stimulates a more active participation of the student in his knowledge construction process, thus contributing to student autonomy. (CARDOSO, 2015 p. 36). According to Torres, "Sequência FEDATHI considers the entire didactic process, from the most initial planning of the class / course, involving preparation, study and evaluation of the means to be used". (2014, p. 151). Teachers who use the sequence allow students to experience the path of a mathematician, as reported by Borges Neto et al.:

> "In this model, when faced with a new problem, the student reproduces the steps that a mathematician uses when looking at his essays: he approaches the data of the question, tries several paths that can lead to the solution, analyzes possible errors, seeks knowledge previously acquired to help in the solution, it tests the results found to know if it was wrong and where it was wrong, corrects itself and assembles a model."(2014, p. 6)

It is of utmost importance that it is not just student behavior, as the responsibility must be of all parties involved in the process.

> It's important that the mathematics teacher knows the steps that mathematical knowledge has taken throughout history, knows the mental and social needs that led man to produce this knowledge and use it in the classroom, so that his students can reconstruct (in their own way, and this time living with a different reality) their knowledge and using it (already updated) in the environment in which they live. (BORGES NETO, 2016, p. 07)

Being everyone's responsibility, it is necessary to pay attention to active methodologies aimed at the figure of the student, that is, he is responsible for his learning; while FS is concerned with teaching behavior, even Didactic Engineering, which does not direct its attention specifically to the student but to the teacher, when it comes to executing the didactic session, leaves it under the responsibility of the teacher to do as he sees fit; in contrast, the theorists Papert and Valente were very concerned with the computer-assisted classroom, but did not prioritize the behavior of this teacher in each activity performed. If the concern is with the teacher, then the processes work and naturally slide positively on the students.

Active methodologies, on the other hand, can be structured with FS as a support, just as the sequence can establish an interdependent link with Didactic Engineering. In FS, the teacher interferes as little as possible so as not to disturb the student's reasoning. The principle of the active methodology is to make the student reflective, while the Sequence is one of the active methodologies, but not all active methodology is a Fedathi Sequence. The sequence cannot be seen from the perspective of reductionism to the four stages according to Borges Neto (2018), since it permeates principles beyond the four stages: pedagogy hand in the pocket, work from the general to the particular, the fact that the teacher never respond positively to the student, as opposed to the topaz effect, work always based on questions and inquisitive teacher, questions, adidatic situation, counterexamples and conception of error. It was the work presented at the XII National Meeting of Mathematical Education - ENEM, held in July 2016, in the city of São Paulo entitled: The Application of Problems on Fees Related to the Methodology Fedathi Sequence analyzed a practice that had the initial objective of using the teaching methodology called Fedathi Sequence. The didactic session dealt with the content of derivatives in the discipline of Differential and Integral Calculus and motivated this research even in the initial doctoral studies, however it did not obtain the expected results, since we did not correctly perform the

experiences and the fundamentals of the sequence as will be seen in chapter four.

The Fedathi Sequence is a methodological proposal that suggests a change in the conduct of the class by the teacher "and its development had the initial objective of being applied in Mathematics classes, but with later studies and experiments by researchers from other areas (Pedagogy, Physics, Engineering, games, etc.), its adaptation / application in other sciences was possible. As Borges Neto notes (2016, p.15):

> The Fedathi Sequence articulates three epistemological conceptions of mathematical knowledge: the proposal for problem solving, explored by Polya in the 1970s, the logic of mathematical discovery, by Lakatos (1978), and Brouwer's intuition.

These epistemological conceptions have a caveat in the method presented by Polya (1978), centered on the student. The Fedathi Sequence is directed at teaching action, which, consequently, is projected in the student's action. The objective of the theorist Polya is to awaken the student's autonomy, pointing out a reflection on his practice, in addition to looking for a result, which, when found, may prove different from the conventional way expected by the teacher. FS, on the other hand, represents a link between student, teacher and knowledge, in which challenge and mediation provide the interaction of the group's components. Teachers who use this methodology provide students with the opportunity to experience the paths that a mathematician has taken for their discovery, as reported by Borges Neto et al. (2014),

> In this model, when faced with a new problem, the student reproduces the steps that a mathematician uses when looking at his essays: he approaches the data of the question, tries several paths that can lead to the solution, analyzes possible errors, seeks knowledge previously acquired to help in the solution, it tests the results found to know if it was wrong and where it was wrong, corrects itself and assembles a model.

We infer that the Fedathi Sequence stabilizes conflicting methodological qualities with those of the traditional teaching method, since the subject of conflict remains the teacher, but, now, with the role of mediator, to conceive conditions and an appropriate environment for reflection and search, as the Fedathi Sequence is opposed to traditional teaching, giving teachers the appropriation of a teaching model in which teachers and students are motivated and engaged in learning situations [...] (SOUZA, 2013; p. 39)

Ideal conditions are established for the formation of more productive human beings. We live in a world dominated by renovations, in which technology is always highlighted, thus requiring more flexible and accessible people to diversity, to escort the changes that occur frequently in the various sectors of society. According to Souza (2013), however, the Fedathi Sequence has no vanity of presenting itself as the ideal methodology to be followed by the teacher in the classroom, however, it evidences significant assistance for the strengthening of the methodological practices developed by the teacher.

The Fedathi Sequence, unlike other proposals, is directly concerned with the teacher. It becomes evident that the denomination of stages would go beyond the concept of classification, since the term experience was soon established. According to Sousa (2015, p.43), the essence of the Fedathi Sequence is the teacher's posture in the classroom during his experience, because he does didactic mediation. Then, he must use this moment to instigate students to solve the problem and reflect on the results they find, both in the case of successes and in the case of errors. In such a way, changing behavior by itself is not enough, but one must experience the stages in their daily practice. In effect, all experimentation will be expressed in the teacher's real experience by taking a position, maturation, solution and proof.

RESULTS AND ANALYSIS

With the work of theses, dissertations and books analyzed from the perspective of origins and phases, it is undertaken that in the first stage of the sequence, Taking the Position, the teacher launches the problem, that is, proposes the activity and waits for the search for the solution on the part of the student with his knowledge, choosing the path he finds most correct according to his previous knowledge. In the initial period, a challenging situation, a direct exercise or a specific content for the student can be expressed. Thus, the problem presented must be challenging, in such a way that it is possible to make a connection with the object of study, which will be understood by the class, thus representing the backbone of the stage. Souza (2013, p. 20) assures that "[...] it is important that the problem has as a means of solving the application of knowledge at stake". It is a generalizable situation, in other words, in a direct way it means that its way of execution can also solve many other situations. We emphasize the care in working with an accessible technical language, so that students are not lost on the way but are familiar with the environment, as the contextualized problem must be adequate to the students' knowledge. The teacher has an important role in the process, as he assumes stimulating behavior in which he dialogues with students with support in their concerns and inquires about the proposed question with a different attitude, knowing the learning situation in which the student is. Finally, the problem presented, briefly obeys three criteria: challenging, generalizable and contextualized.

The problem presented at the time of taking a position should be well understood by the students with a brief and clear explanatory action by the teacher, not letting their students start to execute without the full mastery of the objective question. A question arises: the path to be taken will be deductive, since FS is a logical, deductive and constructive proposal, however how does it happen in practice? It is conceivable that from a particular exposed case, the student can aim at a general situation in which he can answer that specific argument. For example, are the representatives of the protist kingdom autotrophs? Therefore, students should look for the concept of autotrophs, in general, to characterize any living beings that are part of the set, taking a path from the general to the particular. This also avoids the experience of repetition exercises, which can be helpful at other times. Regarding time, it does not mean leaving the student alone thinking, but it is the teacher's job to talk, talk and dialogue with the student (*handshake*), which is the foundation of a FS principle: hand-in-pocket pedagogy. Thus, the student will execute and be motivated to create solutions and apply in other situations, generating reflections and forming more critical students. In FS there are no faster or slower moments during the stages, however there are situations

planned by the teacher. There must be the patience of waiting, that is, didactic time, which is quite different from class time (or clock time). In traditional teaching, in particular, the expository, the problem is given and the teacher immediately tells how to do it. The student, in general, remains able to solve, but scientists cannot solve it without experimenting. And one of the characteristics of this situation is that it misses more than it hits, that is, emblematically, it is the case of the amount of "crumpled papers" in the waste basket of a career researcher that signifies his attempts to reach a correct result (culturally, it is emphasized the importance of kneading and not tearing, in order to perhaps use some data under a new perspective, even if it is ecologically "immoral".). In a similar way, it occurs in many films and even in study places on slates where no one erases a work that was started by someone else, only the creator of those calculations can move, under penalty of significantly altering an idea to be realized and worked. That's the way to learn! Even in a virtual way, the scientific phenomenon occurs in the plane of thought and, the more one experiences, the more one learns and, thus, there is a two-way correspondence between the researcher's work and the act of studying. These experiments lead the student to error, and a fundamental principle is the provocation of the counterexample that further destabilizes the student's possible doubts, but he tries new strategies until an adequate result is achieved. If maturation, second stage, does not exist, that is, even if he is a good teacher, if he does not instigate the student with another one, there is no measurement, and this goes against the behavior of a researcher who, when interacting with another, often , insights emerge that show new paths. Therefore, it appears that the technical work of a scientist is mathematician, historian or physicist, for example, is individual, but the discoveries are collective. Students at a traditional school are reactive, but they should be proactive and this is a dynamic of the Fedathi Sequence. This is the role of the teacher in the mediation of new, more effective processes, so that Mathematics can be worked on, but it is not the conservative and traditional one that does not generalize problem situations.

Therefore, the initial idea is to work on a generalizable question that allows creation and, thus, a more sophisticated and richer mathematics to be learned. The maturation time is sometimes misunderstood by some scholar, however, in Mathematics, if the curriculum was worked with the foundation of FS, many contents were already implicitly covered in others, thus avoiding the numerous classifications in unnecessary topics, which it would imply a content reduction and, consequently, an increase in time to better work with mathematics. What is relevant, then, to be taught? Maturation, the second stage, occurs when the students, in possession of the problem, seek their understanding for a solution and then start looking for a resolution. The teacher must be attentive to the class questions as a sign of understanding the content and give answers that lead them to reflect even more about their intentionality and attitudes. In conducting the maturation phase, the teacher must give the opportunity for students to be independent and, if there are questions from students about any passage to solve the proposed question, they can use counterexamples and applications in other contexts to, through reflection of the student, find different options. An important point of the Fedathi Sequence is the use of the question, as used in Sousa (2015). In this work, the curiosity aroused in the student and the power of reflection that a questioning can generate are addressed. In addition, the teacher needs to be attentive to the questions asked by the students, since their inquiries will create possibilities in the sense of knowledge, knowledge learned.

The development of Maturation should be very close to the planning carried out by the teacher, as any unusual situations can happen and the principles established by the FS must be considered: hand in pocket pedagogy, counterexample, conception of error, adidactic situation, question, mediation and didactic agreement. These fundamentals permeate all stages, directing them in a way that always qualifies the student to be on the right path for the understanding of his object of study. The interim that occurs from one stage to another is practically imperceptible from a cognitive point of view, however this division includes moments of differentiated work on the part of the student and the teacher. The Solution is the phase of the Fedathi Sequence in which the representation and organization of schemes and / or models found that aim to solve the problem presented in the Position Taking place through the exchange of ideas, the role of the teacher as a mediator, use of counterexamples and the presentation of several solutions to the same problem. The student, after maturing and reflecting, offers, with arguments, his answer or multiple trajectories to be analyzed and debated by the other colleagues, who may have walked different paths, and by the teacher, who formulates examples, gives counterexamples, thus verifying if they are satisfactory or if they have errors, limitations, and if necessary, return to the previous phase or go to the test. The methodological option in the use of exposing the problem and its immediate resolution on the part of the teacher may reveal a deficit in the learning item, since its focus is teaching. This model is only concerned with passing on formulas and memorizing rules and recipes, instead of allowing the student to understand and give meaning to the contents, strengthening their autonomy, which is indispensable for school life. In contrast, the path in which the investigative act became the main objective of the didactic process, it is possible to reestablish new responsibilities. The teacher is not only what he teaches, nor the students mere subjects of a learning process. In the Solution phase, cognitive imbalances occur in the student, in order to conceive knowledge and clarify the hypotheses, as reported by Borges Neto, Lima and Santos (2013). This perspective promotes independence and autonomy to show what was thought in the previous phase.

For the exposure, by some student, of strategies for solving a problem that was developed by him alone or in a group, after reflection and the consequent development of reasoning, it is necessary that the classroom environment be established to give security to the student. student, who favors him to overcome his fear of making mistakes, his anxieties and blockages (ROCHA, 2008). Does the teacher become passive at this moment when presenting the solution? The Fedathi Sequence centralizes its importance in the figure of the teacher, the protagonist in the scientific act of the student to research. Then a teacher is expected to try to elucidate what the student thought and, for that to happen, he can use a resource called counterexample. According to Sousa (2015), it is the use of the counterexample that can be done when, when questioned, the student exposes a correct answer, as a counterweight, challenging him to argue in favor, to defend his proposition or solution. The teacher positions himself as a mediator, that is, he must work with the group to decide which is the best solution among all those mentioned. Solutions that did not approach the expected response should be refuted with the presentation of counterexamples. After choosing the most appropriate solution

for the proposed problem-situation, the teacher should emphasize the importance of the content in focus and show different situations that can be solved through that new knowledge produced (JUCÁ, 2004). And should students already be able to write in a technical language? No, since in this process the teacher must propose to students to organize, systematize and structure their responses to the situations in question (models that can be written in mathematical language, or simply through drawings, diagrams or even through verbalizations), considering that the proposed ideas must be expressed to the group so that they can be compared, discussed and discussed among students (ROCHA, 2006). The student must reflect on the achievements developed during the experience of maturation, evaluate their responses through trials, errors and attempts. He acquires autonomy and must realize the importance of each path taken in the elaboration of his learning. The teacher must analyze the different representation modalities expressed by the students, in order to, based on them, seek the support of the new technical concept involved. The answer suggested by the student in the Solution phase is manifested in accordance with the Position Statement, that is, it can be a demonstration, a resolution of an exercise or even a discussion on a topic raised initially and must already have previously thought in the planning of the teacher.

In Exact Sciences, the solution phase can express responses such as demonstrations, interpretations of proposed situations. In the Human Sciences, the Solution phase can become broader, since it works with structures of thoughts not closed and that deserve to be investigated as to their interpretative value. Indeed, in any area of knowledge, this phase requires careful support from the teacher, so that the path shown by the student is literally dissected and that everyone perceives the established structure of thought. The Solution is the moment when the student expresses his / her proposed resolution, which may be the expected result or not. When not expected, the student may have taken other paths that led to the answer found and this should be valued by the teacher. The discussion of the process with the student is important, as it can guide him in the points where he had difficulty in the task and will make it possible to reflect on his action. The knowledge in question begins to be scientifically delineated at the time of the Solution, which can be presented in a complete, superficial or poorly elaborated way, since the teacher's attitude in analyzing the data allows students to systematized visualization and makes them more aware consistent, helping them not to make the same mistakes. Was it, then, a way to learn from mistakes? Also, because the cognitive structures formed through the study of the various responses develop reasoning that previously the student might not be able to promote. This occurs, however, when the teacher's didactic and theoretical skills converge for the students' participation and understanding when the Solution is structured. The last phase of the Fedathi Sequence is called Proof and is characterized by being the moment of the teaching action to synthesize or model the situation presented in the position, formalizing and synthesizing the content in order to generalize so that the solution found is applied in other situations and contextualizations.

> "Therefore, it is praiseworthy that the teacher involves students at that moment, trying to make a connection between the results that they presented and the arguments necessary to formalize the content. When asking, for example, - what do these answers have in common? Do these same strategies apply to solving another problem? - the teacher can direct students to formalization, to the generalization of a model." (SOUSA, 2015).

It's undeniable the existence, even deficient, of learning in the binomial problem and explanation, but what would be said if there was an intermediate phase in which the students thought about the problem and exposed the solution? Would it be easier to understand after the teacher's explanation? Could this so-called solution phase end the course of the didactic session promoted by the Sequence Fedathi methodology? Suppose that, if this happened, the students could leave with the impression that their conjectures about the problem would be correct, even with several different answers and, in addition, the role of the teacher would be reduced to the monitoring of the students' maturation process and shows of the solutions developed disregarding the necessary mediations of validations and refutations that converge to learning. The work provided by the teacher transforms the student into a student-researcher, because, when making the maturation path to the solution, it can reveal some results, such as the occurrence of some redundant or obscure moments, the complete adjustment of the proposed situation and , even, to have found an incomplete answer that could be improved. In this path, it would not be presumptuous to state how effective the next moment can become, the test phase, as students would not only participate in the problem presentation and teacher exposure phase, as is the modus operandi of most didactic sessions; instead, they would mature and create an algorithm capable of sustaining a possible answer, making them able to more easily understand the formalization of the proposed situation with the guidance of the teacher through the use of similarities and differences in the paths taken.

It's hoped, then, that learning has been achieved and another step has been developed in knowledge, that is, that a solid foundation has been established. Thus, the Test phase is the moment when the "aesthetic beauty" of the discipline comes into play with the display of a logical-deductive argument through precision in the definition and careful use of technical language. The general model that is reached, according to Soares (2014), can be a formula to solve a problem that needs quantitative analysis and numerical solution, or a function for determining a graph in the Cartesian system that represents the variations between the quantities involved. The test is, therefore, according to Alves (2011), the stage in which the pedagogical dynamics of the teacher will influence the retention of new knowledge, with the review and verification of elements that could have caused some misunderstanding. The Exam is the stage in which the teacher systematizes the students' responses, showing and discussing the redundant stages. In addition, the teacher can simplify, sophisticate or even generalize the contextualized situation initially formulated and, finally, validate the answers, elaborating his model of results based on scientific knowledge and on the path found by the student. After the definition of this phase has been detailed, it is necessary to examine the inappropriate actions at that time, at the risk of disfiguring the Test Phase. Showing only the answer, the teacher neglects to explain the scientific content and prevents a link with the solutions exposed by the students. If concepts are introduced in addition to those necessary to learn the proposed situation, some imprudence would be occurring, as there would be no certainty that students could understand what was explained. When asking students, when faced with what was presented in the solution, to research whether their answers are correct, to ask them, who got it right,

to explain their solution in more detail, or even not to explain it due to lack of knowledge about the subject, the teacher is acting imperfectly, which is not allowed in the Fedathi Sequence, since, to conduct the entire session, the full mastery of the content on the part of the teacher is of paramount importance. In the specific case of Mathematics, for example, Ávila (2006) points out that enunciating and demonstrating theorems is one of the central occupations of every teacher or student of mathematics; and it is not permissible for such a person to feel deficient in demonstrations.

The word "Proof", used in the Fedathi Sequence, has the function of characterizing a phase in which the teacher will explain the problem exposed in formal language, relating it to the students' solutions and the paths taken, as an affirmation will not always be proven, or that is, the reference for measuring this moment is the Taking of Position and, of course, the objective of the teacher for a certain didactic session. If taking the position is an objective question, it is natural to expect from students a single answer that will be validated or not at the time of the Test. There are cases in which the teacher proposes a theorem, hence the students in their solutions will point out the possible demonstrations and, in the Test phase, the best optimized algorithm solution will be presented. This observation differentiates the semantics of the functions of the word proof, that is, in the Fedathi Sequence, when that word is used to identify the phase, it will have the meaning of resuming the discussions carried out by systematizing the content linked to the Taking of Position. In subjects such as Biology, for example, taking a position may be talking about the stages of embryogenesis, so that the Professor is expected to expose a unique discursive answer; it is known, however, that disciplines such as History in which critical character predominates and multiple responses can be exposed, so the Test phase may be a discussion about the solutions expressed by students, not determining a single answer. The objective of the Test phase is to establish cognitive interactions of what was thought and exposed (conjectured) by the students with the truths explained by the teacher, aiming at the maximum possible learning. To exemplify some proof models, it is essential that the idea that the Fedathi Sequence can be used in several areas of knowledge is already internalized. According to Soares (2014, p. 59),

> Another relevant point for this stage concerns the re-signification of the positions taken at the beginning of the Didactic Sequence. This process is important for students, as they confront the knowledge organized throughout the process, and also for the teacher, considering that he can reflect on his posture in the interventions performed, as well as the achievement or not of his goals.

In effect, the exposure in this phase allows the teacher to reflect on whether his interventions in the face of the students' manifestations were consistent and, thus, to minimize the possible edges that may have remained in the learning process. Does this phase end the Fedathi Sequence? According to Souza (2015, p. 68), there is still another level after experiencing the sequence: "This activity consists of the teacher's analysis of his own work, which can be used to organize other classes or courses ..." The author called this level of analysis, refers to the critical reflection of what was experienced by the teacher and contemplates the evaluation of the students' performance and analyzes on the fulfillment or not of the objectives previously set. In Sousa (2013), a research was carried out on the teaching of Physics with the use of computational mathematical modeling applied to Education with the Modellus software, having as subjects several teachers. After the application of some sessions of the Fedathi Sequence, it was possible to reach some conclusions about the potential alternative of mathematical modeling and simulation through the computer for the teaching of Physics. This reflects how far the Fedathi Sequence extends, that is, its breadth is not restricted to its application, but its results may have repercussions in the scope of future research.

CONCLUSIONS

As a result of all that has been exposed, reflections on the discussions held throughout the text will be brought up, whose object was the development of a teaching methodology that culminated, as a result, in the notion that concepts can be constructed under the aegis of a mediation in which the student becomes aware of his meaning as a learning subject and the teacher manages to centralize his pedagogical action in the continuous change of his practice. Based on that, let's start with the question that generated concern and motivated the research: *it's possible to understand the development of the Fedathi Sequence (FS) by interpreting and explaining the origins and steps that can be applied in all areas of knowledge?* The answer was developed throughout the text from the construction of the itinerary of the proposal for change in the pedagogical practice of the teacher who in this aspect walks on the methodological trail of the plateau, Taking Position, Maturation Solution and Test, showing the characteristics of relevant, current and applicable research in the area of teacher training. As for a possible measurement of the amount that can be learned by students, it is revealed a limitation and evidence of future research, since the aim was to prove the maturity in the construction of knowledge and, in addition, it was not possible to work in a specific and in-depth study with textbooks and their explicit relationship with a teaching methodology. Therefore, based on this need, it is intended to continue studies in the area in order to fill these gaps.

It was possible, in a qualitative way, to characterize the teaching methodology Sequência Fedathi from the stages of the FS experience, making the students protagonists of their actions, being guided by the teaching behavior. It was noticed in the design of this study, from the perspective of the teaching action, the focus on the necessary previous contents, contextualized, generalizable and challenging questions, mediation of the construction of the student's theoretical knowledge, measurement of the reasoning developed by the student and, finally, solidification the specific content through a technical and formal language. This text was not intended to provide tools for the creation of rigid didactic sessions with an immutable format for teachers to use as a parameter in their classes, but rather to show the potential of how a change in teaching behavior can greatly transform student practices.

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