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Problem solving in Technical and Vocational Education: a student's view

La resolución de problemas en la Educación Técnica y Profesional: una visión de los alumnos

Resolução de problemas no ensino técnico e profissional: a visão de um aluno

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ABSTRACT
Problem solving is a very effective mathematics teaching methodology, since it fosters a mobilization of knowledge in the sense of seeking the solution. This study aims to analyze, according to the vision of the students involved in the study, which skills can be developed in a class based on the teaching-learning methodology of mathematics through problem solving, as well as contributions and limitations of this methodology in the context of the future training area, of the Technical and Professional Education of those involved. Therefore, the theoretical framework that discusses the conceptions of problem solving adopted in this research is presented, with a mixed approach, using observation and survey as methods. In the sequence, expressing the vision of these students about solving problems in mathematics classes, the story and the analysis of the data are presented. The results indicate that students identify the development of collaboration, adaptability, communication, creativity and persuasion skills as possible to be developed in classes oriented by the methodology, which is conducive to the orientations of the Technical and Professional Education guidelines. In addition, they also indicate as a contribution that the students were actively involved in solving problems, understanding and doing Mathematics while looking for solutions, which at the same time is indicated as an obstacle to be overcome in relation to what they are used to in class traditional.

Keywords: Technical and Professional Education; Problem solving; Mathematics.

RESUMEN
La resolución de problemas es una metodología de enseñanza de la matemática muy eficaz, pues propicia una movilización de saberes en el sentido de buscar la solución. La investigación estuvo dirigida a socializar una investigación, que tuvo como centro la visión de los alumnos cuales habilidades pueden ser desarrolladas en una clase basada en la metodología de enseñanza aprendizaje de la matemática a través de la resolución de problemas, así como las contribuciones y limitaciones de esa metodología en el contexto de la futura área de formación, de la Educación Técnica y Profesional de los implicados. Por tanto, se presenta el referencial teórico que discute las concepciones de resolución de problemas adoptadas en esta pesquisa, de abordaje mixto, utilizando como métodos la observación y la encuesta. En la secuencia, expresando la visión de esos alumnos acerca de la resolución de problemas en las clases de matemática, se presenta el relato y el análisis de los datos. Los resultados indican que los estudiantes identifican el desarrollo de habilidades de colaboración, adaptabilidad, comunicación, creatividad y persuasión, como posibles de ser desarrolladas en clases orientadas por la metodología, lo que es conducente con las orientaciones de las directrices de la Educación Técnica y Profesional. Las conclusiones estuvieron en la contribución de los alumnos y su implicación activamente en la resolución de los problemas, comprendiendo y haciendo Matemática mientras buscaban las soluciones, que al mismo tiempo es indicado como un obstáculo a ser superado con relación a lo que están habituados en las clases tradicionales.

Palabras clave: Educación Técnica y Profesional; Resolución de problemas; Matemática.

RESUMO
A resolução de problemas é uma metodologia de ensino de matemática muito eficaz, pois promove uma mobilização do conhecimento no sentido de buscar a solução. A pesquisa teve como objetivo socializar uma investigação, que teve como centro a visão dos alunos quais habilidades podem ser desenvolvidas em uma aula pautada na metodologia de ensino-aprendizagem da matemática por meio da resolução de problemas, bem como as contribuições e limitações dessa metodologia no âmbito da futura área de formação, da Formação Técnica e Profissional dos envolvidos. Assim, apresenta-se o referencial teórico que discute as concepções de resolução de problemas adotadas nesta pesquisa, com abordagem mista, utilizando como métodos a observação e o levantamento. Na sequência, expressando a visão desses alunos sobre a resolução de problemas nas aulas de matemática, é apresentada a história e a análise dos dados. Os resultados indicam que os alunos identificam o desenvolvimento de habilidades de colaboração, adaptabilidade, comunicação, criatividade e persuasão como possíveis de serem desenvolvidas em aulas pautadas na metodologia, que está condizente com as orientações das diretrizes da Educação Técnica e Profissional. As conclusões recaíram no contributo dos alunos e no seu envolvimento ativo na resolução dos problemas, compreendendo e fazendo Matemática na procura de soluções, o que ao mesmo tempo é apontado como um obstáculo a ultrapassar face ao que estão habituados no aulas tradicionais.

Palavras-chave: Educação Técnica e Profissional; Resolução de Problemas; Matemática.

INTRODUCTION

The Technical and Professional Education (ETP) focuses its efforts on its end of level "Training a patriotic, comprehensive, competent and broad-profile mid-level professional who fully integrates into society and is an active agent of its improvement." (Ministry of Education, 2020, p. 1).

From this perspective, considering that knowledge is used to project solutions, to make decisions and to build continuous improvement processes, competencies must be developed in increasing degrees of complexity throughout the training course, so that students not only accumulate knowledge, but also seek, integrate, create and produce their evolution in the course.

To achieve this goal, the Mathematics discipline plays a central role, as it is an essential part of socio-technological actions and everyday contexts. Through this area of knowledge in the ETP it is possible to create situations, analyze them in detail and understand the hypothetical state of occurrences arising from such situations, relating knowledge, action, and reflection. In this logic, Mathematics means, above all, a process, and not a product (Meléndez and Páez, 2020).

Beyond an educational perspective, Mathematics must be considered from a philosophical and sociological point of view because it represents a significant variety of integrated cultural techniques in the most varied aspects, such as manual arts, daily routines, science, technology, economy, business, agronomy, among others. In this scenario, the ETP has an important role in giving access to the reserves of knowledge that are important for the maintenance and improvement of the mechanisms that sustain globalization and the economy associated with it, being essential that competencies are developed in students to interact, act and transform in economic, social and political situations structured by Mathematics.

Epistemologically, the treatment of Mathematics at school can be approached from two perspectives: the first, as a science, in its autonomy, and the second, as technology, instrumental for the technique, which allows the modeling of situations that favor the development of scientific and technological education (Barros Nunes et al., 2019).

Mathematics, originated by the needs to count, measure, beyond understanding and explaining nature, technical, political, social and economic phenomena, has been treated, however, academically, with privilege from the first perspective, as an autonomous discipline and isolated. Emphasis is placed on formalized and deductive mathematical knowledge, within the conceptual structure of science, so that the issues under study do not originate from problems of reality, concrete situations and technology.

So, the scientific treatment privileges abstraction, with the accumulation of deduction of formulas, resolution of equations, in a strict algebraic work. In the school activities of the Mathematics discipline, the search for theoretical and decontextualized knowledge of the world of work and social, economic and political life has priority (Almeida, 2021).

Contrary to this didactic position, the teacher is expected to create a new school environment of questioning, encouraging the student to propose solutions, explore possibilities, raise hypotheses, justify their reasoning, run simulations, enter the network, analyze and justify results using the mathematics as instrumental in solving problems arising from construction and creativity in work, technical, economic and social situations (Meléndez and Páez, 2020).

For Arnaiz Rey et al. (2019), regarding the teaching of mathematics, there is a need for methodological changes in search of meaningful teaching and learning, becoming increasingly important and urgent studies that find ways to achieve the objectives proposed by mathematics education. Thinking about how to develop the teaching processes that have as their north the thought of the construction of knowledge by the student in collaboration with the teacher, the teaching-learning process of mathematics in the ETP becomes relevant, through the resolution of problem.

Thus, learning to solve problems should be the main purpose of teaching mathematics, a perspective that is manifested explicitly, in the general objectives of the discipline, in the Curricular Adaptations for ETP, in Cuba (Povea, 2020).

For Possamai and Silva (2020), problem solving is one of the most complex topics to be worked on in the classroom. It is very common for students to know how to perform the algorithms and not be able to solve a problem that involves one more of those algorithms. This is due to the way in which mathematical problems are approached in the classroom and presented in didactic books, many times just as exercises to fix the contents dealt with.

Therefore, a problem is any situation that requires the mathematical way of thinking and specific knowledge to solve it. The authors emphasize that a good problem must: be challenging for the student; be real; to be interesting; be the element of a really unknown problem; not consist of the obvious and direct application of one or more arithmetic operations; Have a suitable level of difficulty.

A good problem must be capable of inciting the student to solve it. It must be interesting, creative, develop his thinking and constantly challenge him, otherwise he will be demotivated.

For Meléndez and Páez (2020), the objectives of problem solving are:

- make the student think productively;
- develop student reasoning;
- teach the student to face new situations;
- give the student the opportunity to engage with the applications of mathematics;
- make Math classes more interesting and challenging;
- equip the student with strategies to solve problems;
- give people a good mathematical background.

From the reading, interpretation and analysis of the problems, it is possible the involvement of the student in the search for resolution strategies, in the persistence in finding a solution, in the extension and in the redefinition of concepts and ideas that he already knows. .

According to Arnaiz et al. (2019), the problem should not be treated as an isolated case, but as a step to reach the internal nature of mathematics, as well as its uses and applications. They define as a problem everything that one does not know how to do, but is interested in solving.

From this perspective, the methodology of teaching and learning mathematics through problem solving must take into account the following sequence: (a) preparation for the problem; (b) individual reading; (c) joint reading; (d) resolution of the problem; (e) observe and encourage; (f) analyze the resolution on the board; (g) plenary; (h) seek consensus; (i) formalization and (j) proposal and resolution of new problems.

Therefore, the teacher must keep in mind the objectives he wishes to achieve so that he

can make the proper use of problem solving, whether it is to apply some developed technique or concept, work with open problems in which there is more than one possible solution, provoking debate and argumentation in defense of each resolution, working with problems generated from game situations or from the interpretation of statistical data (Caraballo et al., 2022; Nunes et al., 2019). The selection of the problem should be consistent with the objectives to be achieved.

According to Díaz & Careaga (2021), teaching problem solving is a more difficult task than teaching mathematical concepts, skills and algorithms. The teacher should ask questions so that students can understand the problem. Students should be encouraged to ask questions of the teacher and of each other.

The teacher must manage this process, providing situations that allow a variety of procedures to arise in the classroom, socializing them, comparing them, emphasizing the resolution process and not obtaining correct answers.

According to Caraballo et al. (2022), the teacher's role will be to encourage, facilitate, and mediate the ideas presented by the students, so that they are productive, leading the subjects to think and generate their own knowledge.

In view of the above, note the importance of the teacher knowing this methodology, since his proposal is for a student-centered work, where he can develop his learning, build his knowledge, where the teacher will only mediate that construction.

From the analyzed perspective, in order to be successful in using the problem-solving methodology, the teacher must know it and be willing to face new situations, since it is not an easy task. It demands great effort from the teacher and their preparation is essential.

Then some questions arise, which constitute objects of study:

- Could it be that teachers know this methodological proposal?
- Do teachers feel ready to work in this perspective?
- What is the real scenario that occurs in ETP schools in relation to the adoption of this methodology?

The objective of this work is to answer these questions, seeking to propose an initial diagnosis of the scenario in which Mathematics classes are found in ETP schools in the municipality of Mantua. Once this reality is known, it is possible to think about future actions seeking improvements and promoting a higher quality education for adolescents and young people.

MATERIALS AND METHODS

The study was carried out at the "Combate Tumbas de Estorino" polytechnic center, in the municipality of Mantua, in which the subjects who were involved in five problems covering the content of equations and exponential and logarithmic functions were 34 second-year students of Agronomy. During the research, the students were accompanied by the researcher and by the teacher of the Mathematics subject, in carrying out the activities related to the explored content. The intention of each problem is described by the following learning objectives:

- Problem 1: Identify the previous knowledge of the students regarding the concepts and calculation of linear and quadratic equations, and their relationships with exponential and logarithmic equations, as well as

exploring the practical contexts for the area of agronomy.

- Problem 2: Awaken students' perception of working with analytical and graphic models based on relationships with exponential and logarithmic equations, with the purpose of involving them in the generalization of their solution procedures.
- Problem 3: Relate and apply the procedures developed to a practical agronomy situation, involving analytical and graphic models for working with exponential and logarithmic equations.
- Problem 4 and 5: apply the procedures developed in professional contexts of the agronomy area.

The application of the problems indicated above happened during normal class time, following the steps of the methodology through problem solving.

From a mixed approach and with the purpose of achieving an overview of the students' perspective of solving problems from the situations described, a survey was applied. In this, questions were addressed such as skills that they indicate, which can be developed with a type of class, benefits and difficulties encountered in relation to a class oriented by the problem-solving methodology and what is the main difference that they verified in this perspective when It is compared to a traditional class. Among the students who participated in the research, seventeen answered the questionnaire. For this, analysis criteria organized into three strata were listed, as presented in Table 1.

Table 1- Analysis criteria _

Strata	**Criteria**
Skills	• Collaboration; • Adaptability; • Communication; • Creativity; • Argumentation.
Implications of the problem-solving methodology	• Application in professional practice; • New knowledge and adaptations; • Collaborative work and development of oratory; • Reflection and mathematical understanding.
Experience in relation to traditional teaching x problem solving	• Math comprehension; • Practical application; • Collaborative work; • Autonomy and teacher as mediator of the process.

The criteria identified in the first layer have as reference the indications of the Curricular Adaptations of Technical and Professional Education (Ministry of Education, 2020). In the second layer, the criteria involve the principles related to the methodology through problem solving and, finally, the third moment analyzes whether the students perceive the development of skills related to their future profession in classes oriented by the methodology of Problem resolution.

RESULTS

In the first part of the analysis of the answers to the questionnaire, we sought to assess which skills are perceived by the students as a result of the practice developed (the skills were indicated to the students in the questionnaire who chose different options with which they identified).

The results indicate that, of the aforementioned skills, the ones most frequently indicated by the students (in decreasing order) are related to collaborative work, adaptability, communication, creativity and persuasion.

Of the total responses obtained, in relation to the collaborative role of the students, 82.4% answered that they were collaboratively involved, knowing how to work in groups and with people who thought differently from them, and 17.6% reported that they liked working in a group, but that they presented difficulties in accepting opinions different from theirs.

Regarding adaptability, it was the second ability that the students pointed out to be more present, for which 70.6% highlighted that they felt adaptable, managing to evolve through criticism and suggestions.

The third ability evidenced by the students is related to communication, for which 23.5% reported having good communication with people who have a closer relationship, 47.1% said they had good communication (in general) and 29.4% stated that they had difficulties in communicating, presenting shyness. This is an aspect that a little less than half of the subjects studied present having facilities, in general, in communicating with people who are not part of their circle of friends, social and/or family life. Part presents a better propensity and security to speak and communicate when in contact with people who have already had some kind of experience and/or coexistence, and there is a part that denotes shyness when communicating with other individuals or in public.

Throughout the application of the problems, it was found that the greatest difficulty is related to the fact that the students explain what they built for the group, since during the process of solving the problem, which includes individual reading, group reading and changes of ideas through spoken and written communication, the involvement of students is established so that they connect their conceptions and learning in a network of meanings in front of the group, which they had the opportunity to choose and structure. In this, the process of knowledge construction occurs in a smaller group, through members who already know each other and have exchanged experiences at some point, but which may also include a participant who is not known to them and, thus, this have the opportunity to be welcomed by them, introducing themselves, talking and proposing their reflections on the problem. The fourth ability most mentioned by students was creativity, with 52.9% reporting being creative in finding solutions to problems.

The fifth skill pointed out by the students was argumentation, where 47.1% evidenced giving arguments, to be able to convince someone of what was proposed to them, in contrast, 23.5% reported preferring to comply with an activity and comply with it rather than lead a discussion process.

The second aspect analyzed in this study is related to the benefits and difficulties that the students found in the application of the methodology through problem solving, both in terms of learning the content of Equations and exponential and logarithmic functions, like professional training.

Of the subjects studied, 37.5% answered that the proposed methodology benefited them to visualize applications of the content in professional practice. Some of the student responses were expressed as follows:

> A3: Application in practice.
>
> A4: This medium helps in understanding how this function can be applied in our work context.

> A6: One of the greatest benefits seen by me was having checked in more depth where I will use calculus learning in my profession.
>
> A9: The creation of a problem about the irrigation of crops from a river, was the situation that I found most interesting, because it made me see how working with exponential and logarithmic equations can be used in a very simple and fast way in the practice.
>
> A13: It was very stimulating to apply the learning about exponential and logarithmic equations in my technical area.
>
> A17: It was excellent to put into practice the studied methods.

In the category of new knowledge and adaptations, 31.25% of the students stated that the problems proposed, through this methodology, helped in the search for knowledge, in different forms of problem solving, through research, who, according to with the A3 student are possible to be suitable for other activities.

> A3: It helped me with work in another subject and made me think of other similar forms of activity.
>
> A9: Being able to know other methods to calculate a specific problem.
>
> A11: It provoked adaptation and research for problem solving, which proved to be both a benefit and a difficulty.
>
> A10: Objective answers, but not exact.
>
> A13: Different ways of thinking about applications as given in the proposed exercises.

Regarding A4's comment, he addresses that the methodology helped him to develop group work, as well as public speaking.

Regarding the fourth category related to the implications of this methodology, 25% of the students mentioned that problem solving provided reflection, challenges, and mathematical understanding, essentially in the theory-practice relationship, as well as in the satisfaction of what they produced, because they understood the process, according to A6 comments.

> A6: Through it it was possible to work on the content avoiding the traditional method, using various resources available to make the graphics. And it is so satisfying when the material we made corresponded to the calculation presented.
>
> A7: Benefits, logical reasoning for problem solving.
>
> A15: Better theory-practice understanding.
>
> A16: It made me reflect and challenge myself more with the content, presenting a range of problems different from the one shown in class, leaving the discussion richer.

As for the difficulties encountered, only 25% of the students reported having them, which are related to the interpretation of the problems; to the non-socialization of the

students to execute the last problem, which involved the construction of a prototype or leaving the traditional classes to investigate.

> A4: The difficulty was in interpreting the proposed problems.
>
> A5: The biggest difficulty was time.
>
> A6: Difficulty only for the prototype production part, because we couldn't help the friend, we only talked about the ideas, but only 1 person did.
>
> A11: It provoked adaptation and research for problem solving, which proved to be both a benefit and a difficulty.
>
> A16: The difficulty was in solving the problems in oneself.

The third moment analyzed in this research is related to the perception of the use of the methodology through problem solving in the subject of Mathematics, analyzed based on the experience of students in traditional classes.

Based on their descriptions, it is perceived that the category related to mathematical comprehension constitutes one of the main differences in problem solving when compared to a traditional class, identified in 80% of the students.

The category that corresponds to the practical application constitutes a difference from the proposals indicated by the students, in which 20% report:

> A2: The demonstration of how this method exists in our daily life.
>
> A5: I think the biggest difference was solving real problems, which we will find in our profession, in classes, taking into account that, in most conventional classes, we only solve lists of exercises without much application in a future profession.
>
> A14: Practice.
>
> A19: Link with practical situations.
>
> A14: relationship of the contents with the practical situations of the agronomist.
>
> A19: Link with practical situations in which we can solve agronomy problems.

Still, 20% of the students emphasize that the main difference identified was the opportunity to work collaboratively, through which they were able to discuss, feel free to speak and present their ideas, with greater freedom, as well as listen to the opinions of others. groups.

A3: The biggest difference was that everyone collaborates and discusses the various forms of resolution for the proposed problem.

A6: From what I saw in our group, people feel more willing to do what was proposed, because they do not have that pressure of "silence, we are in class", we went to a separate group and there we discussed the work in total freedom, something that in the room many times was already the objective of "conversing there outside", even when we were talking about something related to the subject.

> A11: I found the proposal interesting, because we managed to think in a group,

with different or similar opinions, and also hear solutions from other groups.

A19: The collaboration between us made the difference and the discussion of alternative solutions.

A23: I liked the way we shared knowledge and the discussions we had, regardless of the possible mistakes we made.

A29: It was motivating to discuss different solution proposals and ways to reach consensus in the group.

And, finally, 40% of the student's state that in this methodology the order of learning is inverted when compared to that of a traditional class, in which, in solving problems, the student has autonomy to seek knowledge and the teacher becomes a mediator of the process.

A5: The difference occurs when the problem is understood and a solution is sought. When the problem is not understood, a traditional class may bring greater learning benefits.

A7: Contrary to the traditional one, the methodology allowed us to solve something on our own.

A12: There is a less solid foundation before troubleshooting. I consider the traditional method more efficient.

A18: Make the students have the role of discovering and understanding the situation and developing, with the help of the teacher as a learning mediator, how to solve each given problem.

A24: the development starts from the students; the teacher is an intermediary.

A31: the order of learning.

DISCUSSION

According to the Curricular Adaptations of the Mathematics subject in the ETP, Mathematics teaching must address the development of skills such as communication, collaboration (team spirit), creativity, adaptability and argumentation (Ministry of Education, 2020).

In this sense, the methodology of teaching and learning Mathematics through problem solving, becomes an opportunity for future graduates of Agronomy from the ETP, so that they appropriate collaborative work, bearing in mind that for the group to solve the generating problem, it is necessary to imagine, reason, structure, debate and change ideas, in a respectful, courageous and safe way, in order to find a way to solve it. Which leads to expressing that when students dialogue, this process tends, in addition to developing learning, to improve students' skills that will be useful in all areas and for life, such as: creativity in the search for a solution to the problem proposed; creativity when analyzing their procedure and its result, as well as that of their peers; power of argument to present your proposal to the detriment of others; autonomy in the search for a solution and; finally, the ability to work collaboratively, presenting proposals, discussing possibilities and accepting other alternatives when they are coherently presented.

It is reiterated that what is *totally correct* or *there is only one single answer* are not prevalent in this methodology, much to the contrary, the process of knowledge construction implies that students can make mistakes, which, consequently, leads to disagreements in the group exchange. In this environment of the debate of solutions, the opportunity for the groups to speak and listen to the opinion of the other, leads them to a consensus of what they proposed, through the teacher's mediation, preventing a student from pointing out the error of the " another", which minimizes insecurities and provides an opening for new problems and new discussions. It is emphasized here that it is from the error, the disagreements and knowing how to listen to the other that, many times, the success is built and the solution of a problem is reached (Pico et al., 2018; Nunes et al., 2019).

In view of this, it is important that the teacher of the Mathematics subject have problems, of the ETP, that are adaptable to different topics, answers and ways of reaching a result, so that a student perceives that it is possible to have several models that They allow finding the solution to a problem and, through them, it is possible to improve that ability, mainly, to those who were not characterized as being adaptable.

With this, it is expected that the future graduates of Agronomy, from the ETP, will be ready to operate with more complex tasks in their areas of activity. In addition to the student being trained, with the title of average technician, he needs to be able to undertake in a society that is increasingly complex in terms of problem solving. According to the Curricular Adaptations, the ETP must be able to:

To train a mid-level professional with a general culture and an integral professional technician with a consistent attitude towards life, characterized by [...] human solidarity, collectivism, industriousness, discipline, independence and creativity; with broad and flexible command of the professional model that gives them the possibility of inserting themselves into the socioeconomic life of the country with the professional knowledge and skills required by the profession with equity, gender equality and inclusion, which allows them to competently face the tasks and occupations of jobs in continuous change in a given productive sphere (Ministry of Education, 2020, p. 1)

This methodological approach does not impose that those who have some interaction difficulty, either because they are not part of the circle of friends or because they are a little more inhibited, have to immediately expose themselves to a large number of people, once the first communication occurs in small groups. The purpose is that, through problem solving, communication is built, to the subgroup by that student, who has it as a barrier in his life, and is transformed as he accumulates experience in the communication process (Possamai and Silva, 2020).

In this area, objective six of the Curricular Adaptations of the ETP, for the Mathematics subject, provides that students are able to... communicate their ideas, concepts, foundations and mathematical arguments linked to the content of the program orally and in writing. in a coherent and compact way, with and without the support of technologies, in the elaboration and demonstration of conjectures and in general, in the formulation and resolution of problems, using the terminology and symbols of the subject at the level (Ministry of Education, 2020, p.35)

In line with this, it is known that orality is one of the resources that students have greater access to within the school (Caraballo et al., 2022), through which they communicate in a simple, fast way and that can be increasingly more stoned to the extent that they have the opportunity to speak and listen in a

Mathematics class: exchanging experiences among classmates, expanding their linguistic and mathematical vocabularies through concepts, ideas and procedures that are shared by them and formalized by the teacher during the communication process.

According to Barros Nunes et al. (2019) there is a range of verbs associated with creativity, which are part of being creative, such as: do, plan, build, solve, invent, discover, investigate; theorize, write, innovate, relate, adapt, organize; mount, integrate and interpret.

In this sense, it is essential that the teacher is willing to create classes based on problem solving, promoting scenarios to students that, in fact, encompass and require situations related to creativity, which will be essential for the world of work, as indicated by the objectives of the Mathematics subject in the ETP (Ministry of Education, 2020). However, Meléndez and Páez (2020) argue that to help students be creative and become good problem solvers, the first step is to alter the conception that problem solving is a consequence of the concepts taught. Beyond that, problem solving needs to be an integral part of mathematics learning, providing mathematical problems that are truly problematic, those that involve meaningful mathematics and have the potential to provide the intellectual contexts for students' mathematical development.

It becomes crucial that the ETP train, more and more, teachers in the elaboration of activities that promote creativity in their students, essentially in Mathematics, since this discipline can promote creative, critical and reflective thinking when it is aligned with the Problem resolution.

It is verified that problem solving is one of the means for students to become persuasive subjects when they defend an idea or coordinate a team so that they reach an agreement on everything that was built and discussed by them. The teacher must mediate, when necessary, generating discussions that promote skills such as persuasion and self-knowledge.

With respect to the comments of the students, about the benefits of using the problem-solving methodology, second moment of the questionnaire, an interior is made regarding the Average Technician in Agronomy or any other area of knowledge of the ETP, that It is no longer focused on problems unrelated to the construction of knowledge and the practical context of the professional future, since the world after the ETP will demand from these graduates multiple problems and situations that will need to be solved. The knowledge acquired by them must not be insufficient for tomorrow's work, which must be able to learn new knowledge and further develop their skills, based on their experiences and experiences developed throughout their formative trajectory.

It is not intended to reduce the Mathematics subject to a utilitarian function, indicating that only application problems should be addressed. The important thing is that the questions presented, both in the context of Mathematics or in the context of the students' professional practice, are truly challenging (Martínez-Padrón, 2021; Nunes et al., 2019).

The statements of the researched subjects go against the ideas by indicating that the methodology of teaching-learning mathematics through problem solving has been revealed as a context that is quite conducive to the construction of knowledge, placing the student in the center of the activities of the Mathematics class. By defending that this teaching proposal, beyond promoting new knowledge, indicates the proposal and resolution of new problems and ideas that may arise from the conception of the students of what they solved.

It is necessary to highlight the comment of A13, when it points out "Different ways of thinking about applications such as data in the proposed exercises" which, in line with the authors (Possamai and Silva, 2020), shows that the way to incorporate knowledge, in order to promote learning with more meaning and with problems that transcend the textbook, it is still not part of the context of many teachers.

It is emphasized that the student needs to deal with problems that direct them beyond reproducing algorithms in the classroom, which require a process of reflection or decision making. The teacher's contribution becomes fundamental in this process, since he must demonstrate the differentiation of exercise for problem, so that the exercise is placed as a way to improve and exercise a content or algorithm that was formed and developed through a problem. generator. It is believed that exercising something that was not developed on one's own, or, at least, reflected upon, still does not become an exercise, much less the act of repeating what one reproduced, without requiring thought or making sense for those who want to learn (Povea, 2020).

As already explained throughout the text and taking into account the comment of A4, problem solving provides the development of skills such as oral and written communication, group work, all of which are essential for students and professionals who will act in the context. labor.

It is necessary to emphasize that problem solving is a method that proposes understanding and not just memorization, in which students have the opportunity to search for information, investigate and be awakened by a sense of curiosity to solve the problem, working independently. collaborative.

This methodology takes students out of the traditional situation experienced in the mathematics class, which involves solving activities based on the teacher's ideas. The difficulties described are related to the analysis of the application of the problems in which they question the fact of not knowing an immediately accessible method to solve. Some students wonder about the "teacher's lack of explanation" before solving the problems.

Time, as pointed out by A5, is really a difficulty even recorded in the literature (Barros Nunes et al, 2019), however, it is important to emphasize that in order to help students to be efficient problem solvers, teachers must accept that students' problem-solving skills often develop slowly, thus requiring differentiated attention, in the long term, to make problem solving an integral part of the mathematics program (Caraballo et al., 2022).

Regarding the perception of students about the use of the teaching-learning methodology of the Mathematics subject through problem solving, analyzed based on their experience in traditional classes, it is identified that mathematical understanding constitutes one of the main differences in problem solving, an aspect corroborated by Meléndez et al. (2020) by indicating that "Problem solving develops in students the conviction that they are capable of doing mathematics and that mathematics makes sense" (p.39).

The meaning of collaborative work is important to be highlighted, since, in traditional classes, students also solve the proposed exercises in groups. However, when solving exercises there is little collaboration; that sometimes what happens is that each one solves their situation and later they compare the results. But when they are solving a problem for which they do not know a method, discussion and confrontation of ideas are inevitable, since there is no safe and known path that they can follow (Meléndez and Páez, 2020).

In this sense, group work becomes guides for the reflection of each student, being an opportunity to defend their ideas, their points of view and the meaning of their experiences, adapting the learning process to those moments (Povea, 2020).

Just as students express about traditional methods, Martínez-Padrón (2021), point out that in the teaching of mathematics, conventional methods still predominate, in which the teacher addresses a class in an expository manner, followed by examples and, in the sequence, students solve lists of exercises, thus participating passively in classes. From this perspective, learning, most of the time, occurs individually, with evaluations carried out through memorization tests, forms and procedures, through which behavioral skills and attitudes are rarely developed .

As already explored and evidenced by the students, problem solving is based on the presentation of situations that promote active learning, having the opportunity to build knowledge through Mathematics. Teaching them to solve problems is awakening in them the ability to learn to learn, on a daily basis, in the area of accustoming them to finding a way to answers by themselves, disturbing them, instead of immediately having an answer elaborated by some or by some. Mathematics textbooks

According to what was described by A4 and A11, who usually have traditional classes, they have a fragile understanding that there is comprehension only when they know how to solve immediately, when there is an already constituted knowledge base, contributed by the teacher's ideas, however, they do not no matter how skillfully a teacher provides explanations, instructions, students will continue to pay attention to instructions, but rarely to ideas.

Thus, the correspondence between the indication of the professional skills intended for the training area of these students and the proposed methodology is verified, as well as it is verified that the principles that guide this methodology were also identified by the students in the lived practice.

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