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Mathematics and agricultural sciences: contributions of a contextualized teaching in the light of didactic transposition

Matemáticas y ciencias agrícolas: aportes de una enseñanza contextualizada a la luz de la transposición didáctica

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Abstract
This article presents the main results of doctoral research in Science and Technology Teaching that aimed to analyze the contributions that a didactic material of Mathematics, elaborated in the light of didactic transposition and contextualized with themes of Agricultural Sciences, could bring to the teaching in this area. The results reveal that the use of examples and exercises contextualized to their areas of training promoted, motivation, facilitation, increase, and stimulus of learning.
Keywords: mathematics teaching. agricultural sciences. contextualization.

Resumen
Este artículo presenta los principales resultados de una investigación de doctorado en Enseñanza de las Ciencias y la Tecnología que tuvo como objetivo analizar qué aportes , puede traer a la enseñanza un material didáctico de Matemáticas, elaborado a la luz de la transposición didáctica y contextualizado con temas de las Ciencias Agropecuarias. Los resultados revelan que el uso de ejemplos y ejercicios contextualizados a sus áreas de formación, promovió, motivó, facilitó, incrementó y estimuló el aprendizaje.
Palabras-clave: enseñanza de las matemáticas. ciencias agrícolas. contextualización.

1. Introduction

Countless difficulties are still encountered by students regarding learning Mathematics in Higher Education. Concerns converge on the growing number of failures and the retractions and difficulties in Mathematics subjects. A strategy that may be able to improve learning and motivate higher education students is the use of contextualization.

Thus, in the context of Agricultural Sciences, contextualization can occur when there is an articulation between the basic and specific disciplines of the courses. The teacher must maintain a dialogue with the teachers of

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technical subjects and use data, experiments, contextualized examples that can give meaning to Mathematics and thus give more motivation to classes.

Because of this, this article aims to present the results of a research that sought to analyze the contributions that a math didactic material, elaborated in the light of didactic transposition and contextualized with themes of Agricultural Sciences, could bring to the teaching of this area.

2. Methodological paths

The research was conducted at the UniversidadeTecnológica Federal do Paraná - Campus DoisVizinhos - Paraná - Brazil, in the year 2018. The data collection instrument was a questionnaire with 8 questions, applied to students from two undergraduate classes.

The text and the coding used for the answers obtained in the questionnaires are described in Table 1:

Table 1
Coding

Subjects	Encoding
Special Calculus A students	CA01, CA02. ..., CA37.
Linear Algebra students	AL01, AL02, ..., AL52.
Survey questions - students	Q1, Q2, ..., Q8

Source: Authors

In possession of the answers from the questionnaires, it was possible to use an information analysis methodology of a qualitative nature, called Content Analysis, which has its focuses on messages and categories to manipulate messages to confirm indicators that allow making inferences (Bardin, 2016).

It is noteworthy that Content Analysis consists of describing the content of messages that allow inference of relative knowledge (Bardin, 2016) and can be organized through a categorization process. The categories, according to Bardin (2016) " é uma operação de classificação de elementos constitutivos de um conjunto por diferenciação [...]as quais reúnem um grupo de elementos sob um título genérico, agrupamento esse efetuado em razão das características comuns". (Bardin, 2016, p. 147).

Thus, to better organize the texts obtained in this research, it is necessary to categorize the elements of common characteristics.

Given the above, Table 2 shows the categories used for this research and their respective subcategories.

Table 2
Research categorization

Categories	Subcategories
Didactics Transposition	Examples and contextualized exercises
Math Teaching	Teaching Evaluation
	Contextualized education

Source: Authors

The categorization performed took into consideration the texts generated by the answers to the questionnaires answered by the academics participating in the research.

However, it is also worth mentioning that the research project that guided the research was submitted to the UTFPR's Ethics in Research Committee, under registration CAAE: 57081916.6.0000.5547, with opinion number: 1.675.

3. Theoretical framework

Contextualization, considered a starting point for interdisciplinarity (Spinelli, 2011) can occur when there is an articulation between concepts of basic and technical disciplines of the courses. To this end, the teacher should maintain a dialogue with teachers of vocational subjects and use data, experiments, and contextualized examples, which can give meaning to mathematics content and thus promote more motivation to the classes and also through this action, stimulate interdisciplinarity.

Contextualizing in mathematics teaching is the "possibilidade de assegurar aos alunos interpretações suficientemente abrangentes para os conhecimentos matemáticos que construíram", (Spinelli, 2011, p. 12). Therefore, "o conhecimento exige ser construído com base nas relações estimuladas por múltiplos contextos, com diferentes características", (Spinelli, 2011, p. 13), so that the subject builds its knowledge by relating various conceptual meanings, composing a network of meanings.

However, teaching in a contextualized manner requires great care, because the contexts must make sense to the students and also provide interdisciplinary knowledge. It is not advisable to present contextualized examples from areas far from that in which the students are becoming professionals or even to present contexts disconnected from reality. For Fazenda (2014, p. 13), " interdisciplinaridade na formação profissional requer competências relativas às formas de intervenção solicitadas e às condições que concorrerem ao seu melhor exercício".

Thus, contextualization and interdisciplinarity become fundamental so that the student of Agricultural Sciences can articulate concepts and reason critically about the facts. But contextualization alone is not enough to guarantee learning; the concepts must be transposed didactically. Therefore, a support that can be used in the process of didactic transposition, which according to Chevallard (2005) and pointed out by Silva, Isaia e Rocha (2015), will occur according to the teacher's perception of teaching in a given context, from their methodological choices to their actions related to the content.

Didactic transposition is the essence of teaching (Chevallard, 2005) and is a concept that is formed through the adaptation and/or transformation of knowledge, resulting in the understanding and reconstruction of this knowledge.

In a narrow sense, didactic transposition is understood as the passage from scientific knowledge to taught knowledge. This passage is not only a change of place but a transforming passage of knowledge. For,

> [...] a knowledge content that has been defined as knowledge to teach then undergoes a set of adaptive transformations that will make it suitable to occupy a place among the objects of teaching. The "work" that makes an object of knowledge to be taught an object of teaching is called didactic transposition. (Chevallard, 1991, p. 39).

Thus, the process of didactic transposition requires the teacher to recognize the importance of this transposition teaching in the subject. In a broader sense, punctuating the spheres of knowledge, Brockington, and Pietrocola (2005), based on Chevallard (1991), describe that Wise Knowledge is then:

> [...] aquele que aparece em revistas especializadas, congressos ou periódicos científicos. Este tipo de saber nasce da produção e trabalho de cientistas e intelectuais que, mesmo possuindo diferenças

> idiossincráticas ou diferentes visões de Investigações em Ensino de Ciências fazem parte de uma mesma comunidade de pesquisa, com perfil epistemológico bem definido. Trata-se, assim, de um saber que é desenvolvido por cientistas nos institutos de pesquisas, e que passa pelo julgamento da comunidade científica, com suas normas e regras próprias. Por isso, o Saber Sábio possui especificidades intrínsecas deste ambiente em que ele é gerado. (Brockington & Pietrocola, 2005, p. 393–394).

In this way, it is understood that Wise Knowledge, in the classroom, is the content presented to the students and that it needs to have a reliable reference source coming from a specialized scientific environment. The sphere of Wise Knowledge is pointed out by Chevallard (1991), and interpreted by Brockington and Pietrocola (2005) with an extremely diverse composition; the members of this sphere are "os autores de livros didáticos e divulgação científica, os professores, os especialistas de cada área, todo o *staff* governamental envolvido com educação e ciências e, até mesmo, a opinião pública". (Brockington & Pietrocola, 2005, p. 394).

At this stage, it is feasible that the teacher considers the social function of his content, according to the context in which he is working, establishing integration between his specific area and other areas of knowledge of the students, to whom he is being professionalized. Accordingly, it should be noted that:

> A transposição didática possibilita que o conhecimento construído em sala de aula possua uma linguagem adequada à compreensão dos estudantes, de forma que seja possível a apreensão deste conhecimento. Assim, cabe ao professor fazer a transposição didática de seu conhecimento específico, fazendo a seleção ou recorte dos conteúdos, hierarquizando, dividindo e reforçando alguns temas, organizando uma sequência e/ou buscando estratégias de ensino. (Silva, Isaia & Rocha, 2015, p. 251).

Thus, to make the content selections and language adjustments during teaching, the teacher needs to develop the ability to plan. Almeida (2009, p. 57) reiterates the importance of planning for the consolidation of the didactic transposition because it is when one " lança o olhar para os conteúdos que são definidos para aquele momento e traduzem, em seguida, quais os pontos fortes, as prioridades e, com que objetivo lidar ao tratar com eles ", this action is configured as a necessary condition for learning to occur.

Concerning the sphere of Know-How Taught, this is the phase in which the teacher teaches. The subjects participating in this sphere are "os alunos, os proprietários de estabelecimentos de ensino, os supervisores e orientadores educacionais, a comunidade dos pais e, principalmente, os professores ". (Brockington &Pietrocola, 2005, p. 394).

However, the spheres of knowledge are configured as stages for the effectiveness of teaching and learning and identify the participants in each domain. When the spheres of knowledge come into effect, didactic transposition takes place.

To effectively instrumentalize the didactic transposition, two resources are necessary: interdisciplinarity and contextualization. The complex formed by these resources is fundamental to the teaching process and has as its objective:

> [...] transformar o conhecimento científico em conhecimento escolar a ser ensinado; definir o tratamento a ser dado a esse conteúdo e tomar as decisões didáticas e metodológicas que vão orientar a atividade do professor e dos alunos com o objetivo de construir um ambiente de aprendizagem eficaz. (Mello, 2004, p. 1).

Therefore, it is visible and understandable that the three concepts: contextualization, interdisciplinarity, and didactic transposition are fundamental and complementary parts of the same phenomenon: teaching.

4. Results and discussion

The elaboration of Mathematics teaching material with contexts of Agricultural Sciences and its relationship with Didactics Transposition configures the sphere of knowledge to teach that:

> Ao ser transposto para o ambiente escolar, o Saber transforma-se em um outro tipo de saber, passando a integrar novas demandas e ajustando-se a elas. Este saber deverá estar revestido de uma forma didática, visando sua apresentação aos alunos. O Saber a Ensinar é, então, o saber que aparece nos programas, livros didáticos e materiais instrucionais. (Brockington &Pietrocola, 2005, p. 394).

Therefore, in the following, the contents and chapters of the didactic material will be presented. The basis for the organization of mathematical concepts and contextualized subjects was an initial stage of the research, not described in this text, which consulted teachers from the technical areas of Agricultural Sciences, employing a questionnaire.

The didactic material was organized in 12 chapters, as follows:

- Chapter 1 - Basic and complementary operations;
- Chapter 2 - Units of measurement;
- Chapter 3 - Ratio and proportion;
- Chapter 4 - Topics in financial mathematics;
- Chapter 5 - Geometry topics;
- Chapter 6 - Equations;
- Chapter 7 – Matrices;
- Chapter 8 - Linear Systems;
- Chapter 9 - Trigonometry Topics;
- Chapter 10 - Real Functions of a Real Variable;
- Chapter 11: Notions of Limits and Derivatives;
- Chapter 12 - Notion of Integral Calculus.

The didactic material was prepared to meet the rules proposed to guide Didactic Transposition in teaching, as listed by Chevallard and Joshua (1982).

The contextualized examples and exercises were taken from various sources, among them: journal articles, articles from event annals, technical bulletins from the Brazilian Agricultural Research Corporation (Empresa Brasileira de PesquisaAgropecuária – EMBRAPA), undergraduate and continuing education course conclusion papers, dissertations from academic and professional master's degrees, theses, textbooks, questions from the National Exam of to High School (Exame Nacional do Ensino Médio - ENEM), and college entrance exam questions.

3.1. The category "didactic transposition"

This category deals with the interlacing of the research with its main theoretical reference and aggregates the subcategory: Examples and Contextualized Exercises.

This category includes the data from questions Q2, Q3, Q5, and Q6 of the questionnaires applied to the Special Calculus A and Linear Algebra - Agronomy classes.

When asked about the exercises and contextualized examples in the area of Agricultural Sciences (Q2) that were used throughout the semester, most students considered them "good" and three students considered them "regular". The positive justifications for the questions included terms such as: "helps a lot", "easiness", "reality", "well-elaborated", and "interesting". And in the regular justifications, the terms "difficult" and "difficulty" appeared.

According to the students, "they were examples from which it was possible to make a correlation with the course" (CA03) and that when this occurs, the mathematical concepts "are closer to reality" (CA11), allowing a "better understanding of the subject" (CA18). They also pointed out that "the applications are well done" (CA27) and "easier to understand" (AL23), that "the use of contextualized exercises is very stimulating" (AL29), and that, besides "interacting with the practical environment" (AL24), they also "help stimulate the students" (AL33).

Given this information, should agree with Fiorentini and Lorenzato (2009), who, when interpreting the term didactic transposition, state that: ”this concept was elaborated by Chevallard to problematize and highlight the need to transform (transpose) the historically and scientifically systematized mathematical knowledge in contents of school knowledge situated, contextualized, and relevant to students. (Forenzato & Lorenzato, 2009, p. 48)”.

In this context, Domínguez-García, García-Planas e Tabernas (2016) point out that due to technological advances, the teaching of Linear Algebra must emphasize the development of mathematical strengths associated with modeling and interpretation of results, which are not limited to just calculus skills.

Therefore, the use of examples and exercises contextualized in the area of Agricultural Sciences had the function of situating mathematics in the professional reality of these students, with the objective of teaching in a relevant way, and facilitating learning.

When pointing to the preference regarding the type of exercise used (Q3), in the Calculus A class, 23% (7 students) prefer calculus and determine exercises, but they did not justify their choice, 71% (22 students) have a preference for applied/contextualized problems, and they justify that "seeing the contents in an applied way makes it easier because it is something that will be used or is being used in some way in the day to day of the profession" (CA03) and 6% (2 students) say they prefer figures/drawings/graphs, one of them points out that the choice is due to being the "way that is easy to learn" (CA31).

In this sense, Carrocino (2014) when researching contextualized questions in Mathematics, points out that "a boa contextualização é aquela em que o aluno é levado a ler um texto objetivo, interpretá-lo e tirar conclusões corretas em um ambiente onde apareçam situações práticas e concretas e que representem algo palpável ao seu cotidiano" (Carrocino, 2014, p.60).

Given this, contextualization in the classroom is effective in interpretation, because:

> [...] requer abstrações, de maneira que a natureza interpretativa do conhecimento conceitual origina-se na percepção dos atributos concretos do objeto e manifesta-se por meio das abstrações que o sujeito realiza a partir dos significados que reconhece no objeto [...] Conhecimento teórico é, pois, o feixe de relações de significados que coube ao sujeito construir ou ampliar, partindo dos conhecimentos pré-construídos sobre o objeto e mobilizando as abstrações que lhe foram permitidas e estimuladas. (Spinelli, 2011, p. 25).

In this sense, the contents worked on the subject of Calculus, especially Functions and Ratio and Proportion, were contextualized to approach the professional reality. As the class was special and contained students enrolled in various periods, including the last ones, those who had already taken professional courses, the relationship between Mathematics and Agricultural Sciences may have been more significant.

In the Agronomy Linear Algebra class, when analyzing Q3, 40% (19 students) prefer calculus and determine exercises and there was a justification reporting that this occurs due to "difficulty in interpreting problem situations" (AL36). 45% (21 students) have a preference for applied/contextualized problems and point out that this "makes the content easier" (AL19) in addition to "transforming the content into something less abstract" (AL40) and 15% (7 students) marked the three options, in addition to the two already mentioned, claiming to prefer also figures/drawings/graphs, a justification received was that it is necessary "to have all kinds of exercises" (AL33).

The mentioned class was the first period, and they are still adapting to the university routine and the course they chose, so it is possible that establishing contextual relations with Mathematics is not yet something easy. In this sense, it is worth reflecting that "apesar dos alunos sempre indagarem a respeito da praticidade de alguns assuntos abordados em Matemática, os mesmos ainda preferem a resolução algébrica de uma questão, a ter que raciocinar sobre a mesma". (Carrocino, 2014, p.32).

Given the above, this question aimed to test the satisfaction of the use of application/contextualization of mathematical concepts, considering that the didactic material also brings questions of calculating and determine, as a way to understand the reasoning used and also presents graphs, drawings, and figures to illustrate and explain the situations. This form of articulation of mechanical calculations and contexts can be understood as the introduction of new knowledge articulated with other knowledge already inserted. For Astolfi and Develay (1990) the fact of radically denying content in the traditional way of the education system can generate distrust in students.

From the perspective of interdisciplinarity Masola and Allevatto (2016) call horizontal interdisciplinarity the fact that it promotes:

> [...] a integração entre os conteúdos lecionados nas disciplinas do mesmo período; e a integração vertical, isto é, a interdisciplinaridade dos conteúdos dos vários períodos, demonstram ao aluno a integração entre as diversas áreas contempladas e o caráter de continuidade dos estudos, enfatizando, assim, a interdisciplinaridade das ações didático-pedagógicas estruturadas. (Masola & Allevatto, 2016, p. 66)

Thus, contextualizing the mathematical concepts with subjects that the students will still see in other subjects, helps the students to better prepare themselves for the challenges that the course will bring and also motivates them to continue these courses.

Astolfi and Develay (1990) point out that Wise Knowledge, when possible to be transposed, is capable of generating a wide variety of didactic exercises and activities. And they point out that this action is fundamental to motivating attendance in the classroom. Because of this fact, the students' opinions were collected about the examples and contextualized exercises used during the classes (Q6).

In the Calculus A class, one student (3%) answered "indifferent", 10% (6 students) claimed that the activities are "easy", 87% (22 students) marked as "challenging" and justified that "they are examples that can at some point in their professional life add, challenge and stimulate thinking" (CA03) and also that "the contextualized exercises challenge thinking, challenge new knowledge about the content covered" (CA05), inducing to think more (CA11) and helping to persist in the exercise by arousing curiosity (CA02).

The comments made by the students corroborate the notes of Lima (2004, p. 141) who points out that " as aplicações constituem a principal razão pela qual o ensino da Matemática é tão difundido e necessário, desde os primórdios da civilização até os dias de hoje, e certamente, cada vez mais no futuro". Carrocino (2014, p.21) also understands that "as aplicações do conhecimento matemático, incluem a resolução de problemas, essa arte intrigante que, por meio de desafios, desenvolve a criatividade, nutre a autoestima, estimula a imaginação e recompensa o esforço de aprender".

In the Linear Algebra class, 11% (5 students) claimed it was "easy", and did not justify it, 85% (40 students) judged that the examples and contextualized exercises are "challenging", claiming that this type of activity "makes us learn to reason about" (AL31) facilitating "the line of reasoning and helping to know where to use each calculation" (AL38), one student considers it "difficult", justifying that "the words used make it difficult to understand" (AL13) and one student marked it as "indifferent".

It is possible to argue that the students, even though they have previously mentioned that they have difficulties reasoning in contextualized exercises, believe that they are challenging and promote learning. This fact converges to guarantee that mathematics taught in a contextualized way contributes to:

> [...] despertar o interesse dos alunos e aumentar a capacidade que terão no futuro de empregar, não apenas as técnicas aprendidas nas aulas, mas, sobretudo a capacidade de análise, o espírito crítico agudo e bem fundamentado, a clareza das ideias, a disciplina mental que consiste em raciocinar e agir ordenadamente. (Lima, 2004, p. 177).

Therefore, it is understood that contextualization in the area of Agricultural Sciences, besides showing the scenarios in which mathematics can be present, also stimulates the art of reasoning, challenging the student to think critically in their area of training. For Almeida (2009), the contextualization of content, when it occurs in a live educational environment, becomes the most powerful weapon in favor of didactic transposition. Regarding the objective of promoting students' motivation by relating mathematical content to their area of training, the question was about the feeling of motivation in learning when the teacher brought contextualized examples (Q5). Of the 31 students who participated in the research, from the calculus class, thirty (30) answered "yes" and one scholar pointed out that it is indifferent. In the comments left by the students, they pointed out that "it is an easier and more didactic way to absorb calculus content" (CA03), and that the "exercises applied in the area motivate more to interact with the content worked" (CA05) and also that "when one knows where it will be applied, it awakens a greater desire" (CA14).

In the Linear Algebra class, there was unanimous agreement that there was motivation to learn. The comments below provide some justification for the response:

> You know what you are learning for and where to encounter similar situations. (AL01)
> To have the why. (AL15)
> It makes sense to study something with application in our area. (AL23)
> I feel very motivated. (AL25)
> You end up seeking more knowledge. (AL30)
> A lot more. (AL32)
> Because when we see something studied being applied, it makes more sense because it brings more motivation. (AL36)
> Because I know that I can or will use these concepts in the future, it's not something vague. (AL37) (Survey Data, 2018).

From this perspective, giving meaning to mathematical concepts is configured as a process of contextualizing abstraction, that is:

> [...] os contextos de ensino são agentes que dão vida às abstrações, na medida em que configuram o objeto de estudo sobre uma rede de significações, em que diversos conceitos se associam, permitindo, dessa forma, que o objeto de conhecimento seja visto como um feixe de relações, estabelecido a partir do conjunto de circunstâncias que caracteriza o contexto adotado. (Spinelli, 2011, p. 5).

The author's points converge to the objective of this research, which is to contextualize the student's training area to achieve effectively the didactic transposition.

However, the analyzed category showed through the reports, the importance of contextualizing in Higher Education and its benefits for obtaining an effective didactic transposition. It is worth mentioning that in teaching, everything that is thought to promote or improve the student's learning can be considered valid, because the research involving the practice itself, at the same time, helps in the continued formation of the teacher and contributes to the student's learning.

3.2. The category "mathematics teaching"

This category presents the contributions that contextualized teaching brings to the teaching of mathematics, from the perspective of the student's reports. This category consists of two subcategories: Teaching Evaluation and Contextualized Teaching.

The subcategory "evaluation of Teaching" deals with the analysis of the researcher teacher's work in the classroom, with the contextualized examples that were organized in the teaching material.

When evaluating the Calculus A classes during the semester, in question 1 (Q1), among the options: good, regular, and indifferent, the students were unanimous in selecting the option "good", and when justifying this opinion they made comments that presented expressions such as "good didactics", "easy to learn", "clear content", and mentioned that the content applied facilitates the understanding, as pointed out by the comments of the students CA03, CA05, CA13, and CA28:

> The classes, in my opinion, were very good, because the teacher presented a very good didactic approach, facilitating the understanding of the contents. (CA03)
> Most of the exercises are applied and the understanding becomes easier. (CA13)
> The content of the classes was clear and easy to understand. (CA06)
> The way the teacher approached the subject facilitated the understanding and absorption of the content. (CA28). (Survey Data, 2018).

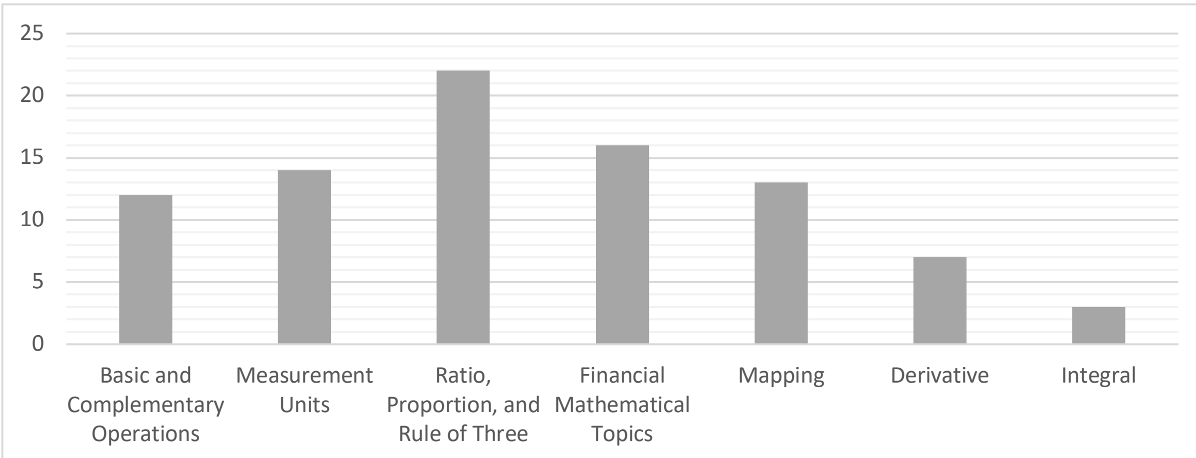
For Chevallard (1991), the didactic practices that teachers carry out are the result of internal didactic transposition and are part of the third stage of the knowledge being taught, which in turn, according to the students' reports, brought about transformations in the knowledge being taught, through the necessary adaptations to the student's understanding, that is, didactic modifications in this knowledge.

The Linear Algebra class, when evaluating the classes during the semester (Q1), said it was "good", an answer given by 46 (forty-six) students. One student marked it as regular and justified that he has "difficulty learning mathematics" (AL22).

In the comments left by the students, it is noteworthy that they considered that the subject "had an even greater application about agronomy" (AL01), and that "applying the content in the agronomic area is essential" (AL25), because it leads them to "assimilate some information that will be useful to the profession" (AL23). In addition, they pointed out that the classes "are didactic, with good explanations" (AL09), "dynamic" (AL15), "easy to understand" (LA37), and that "the teacher presents all the proposed content clearly" (AL40).

About the contents worked throughout the semester, as previously mentioned, the students were able to judge which contents worked in a contextualized manner that would have been more interesting (Q7). Figures 1 and 2 illustrate the answers obtained by the two classes:

Figure 1
Preference of Calculus A content by special class – 2018.

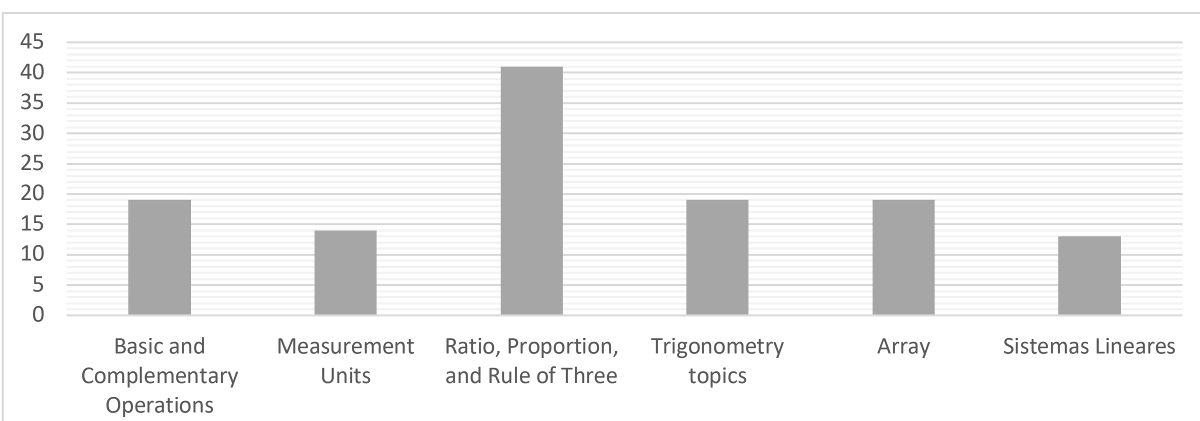


Source: Authors

Figure 1 shows that the ratio, proportion, and rule of three contents stood out among the students of the calculus subject, followed by financial mathematics, units of measurement, and functions. Basic and complementary operations had a good number of choices (12 students), but the mandatory contents of the curricula of the three courses: Derivative and Integral had a lower number of marks, even though they were worked on in a contextualized way.

In this perspective, Resende (2007, p.63) states that "o conhecimento pedagógico do conteúdo supõe uma transformação dos conteúdos específicos para fins de ensino", so that " possa ser compreendido pelo outro, na sua individualidade, no seu contexto ". (Resende, 2007, p. 63. This fact leads to the inference that the contents closer to daily and more usual contexts are susceptible to a better understanding.

Figure 2
Linear Algebra subject content preference – 2018



Source: Authors

In the students' preference for the subject of Linear Algebra, presented in Figure 2, the Ratio, Proportion, and Rule of Three contents were the most preferred by the students. In the sequence of choices, there is a tie between the contents of Basic Operations, Trigonometry Topics, and Matrices, which accounted for 19 choices, Units of Measurement (14 choices), and Linear Systems with 13 preferences.

Given this fact, the preference for the contents of Reason, Proportion, and Rule of Three coincides with the contents cited by the teachers of the technical areas, already pointed out in the interdisciplinarity category. Another relevant fact for the preference may be the number of contexts covered in the textbook since there is a diversity of applications from the three courses that could be allocated.

This subcategory reports the main contributions of contextualized mathematics teaching in the area of Agricultural Sciences, according to the students of the two disciplines.

When asked to agree that working with contexts contributes to learning in mathematics, all Calculus A and Linear Algebra students answered "yes" and commented that such action "helps for the future in the course" (CA08) and that "calculus is fundamental for professional training" (CA09). This leads us to revisit Carvalho and Ching (2016, p. 12), who point out that it is necessary for new professionals to "compreensão dos fenômenos naturais, à construção de argumentos e ao conhecimento das principais questões sociais". And that in fact "essas competências auxiliam no entendimento das habilidades, cuja materialização se dá pelas práticas profissionais, incentivando o raciocínio e a resolução de problemas " (Carvalho & Ching, 2016, p. 12).

From the learning perspective, students also commented that contextualization "stimulates logical thinking about agronomy subjects" (AL22) and that "contextualized exercises instigate more willingness to look for what is needed to solve them" (AL29), moreover, they said that "exemplification facilitates understanding" (AL23), "because it works in practice" (AL24).

Given this assumption, Souza (2009, p. 15) understands that:

> Uma aula contextualizada leva o aluno a interagir com o que está sendo ministrado [...] a aprendizagem é associada à preocupação em retirar o aluno da condição de espectador passivo, em produzir uma aprendizagem significativa e em desenvolver o conhecimento espontâneo em direção ao conhecimento abstrato. É preciso fazer os alunos verem a matemática na vida real, [...] ligar a matemática que se estuda nas salas de aula com a matemática do cotidiano.

In this way, the real-life mathematics of college students is configured into the mathematics of professional life, which is or will be part of everyday academic and work life.

When collecting students' opinions about contextualized mathematics teaching in the area of Agricultural Sciences (Q8), all students from both classes left comments. Among them, they highlighted that teaching in this way is "extremely valuable, because throughout the course we see mathematics and calculus in other subjects" (CA01) and also pointed out that the use of problems that are close to reality "arouses interest at the time of any resolution of any question" (CA02), collaborating with "good applications in different areas" (CA04), making "the content more interesting and easy to understand" (CA06), stimulating learning (CA29) of content that will be used in practice (CA20).

Still in this context, the students suggested that the contextualized practice should "be adhered to in other disciplines, because it facilitates the understanding of the content" (CA03) and that "it should be applied more and more" (CA13). Corroborating with Lima (2018, p. 87) "a contextualização deve ser praticada no ensino de cada conteúdo escolar, pois, além de promover aprendizagem relevante e significativa do conteúdo em questão, ela motiva a atividade de aprender como um todo".

Regarding the learning of the contents in the subject, comments were obtained showing that the contextualized practice "makes learning much easier" (CA15) and that the exercises used to increase and stimulate learning (CA17, CA29), because, "it allows a better understanding" (CA18) using "good applications in different areas" (CA19). In this aspect, Lima (2018, p. 94) points out that independentemente do tipo de contextualização, quanto mais representativa a necessidade for para o indivíduo, mais eficiente será para promover sentido".

In professional terms, the students considered mathematics "essential in agricultural science courses" (CA05) and that "an agronomist cannot graduate without a basic knowledge of mathematics" (CA07). In addition, they pointed out that mathematics "is the basis for technical education in college" (CA10), that the contents covered "will be covered in some way in the future" (CA22), and "they believe that in their future work they will use it frequently" (CA25).

Because of the answers given by the students of the special Calculus A and Linear Algebra courses about contextualized Math teaching, we conclude that the use of contextualized examples and exercises in the Agronomy, Forestry, and Zootechny areas of the UTFPR-DV promoted facilitation, increase, and stimulation of learning, besides motivating through applications that lead the student to visualize possible practices that use Math concepts in professional life.

4. Final considerations

The contributions listed in this text were the most important for the research because it was the moment to verify if the math didactic material, with contextualized exercises and examples in the Agricultural Sciences area, brought contributions to the students' learning.

According to the comments received from the students of both classes, the use of contextualization: Facilitated learning; Stimulated the learning of the concepts; Motivated them to learn; Helped in the understanding of the content; Improved understanding of the content; Required more concentration; Provided the development of logical thinking; It awakened their interest in solving questions; It made learning mathematics more exciting and interesting; It provided the opportunity to compare practice and theory; It brought mathematical calculations closer to real situations.

Thus, the analysis of the comments from the students of the two classes in which the Mathematics contents were approached in a contextualized way reveals that the elaboration of the material contributed to meaningful learning, besides facilitating learning through contexts that are part of the technical disciplines of the undergraduate course they are taking.

It is worth mentioning that this step made the didactic transposition effective by transforming the knowledge to be taught into taught knowledge and that the competencies required to accomplish the didactic transposition, such as: knowing how to select relevant content, master the knowledge in question, relate the knowledge to other areas, know how to contextualize, and know-how to organize learning situations, were competencies put into practice during this research.

However, the present text ends by pointing out that the didactic material developed is not the solution to all problems of teaching and learning Mathematics in Higher Education, but it is an aid to facilitate and motivate learning, and it is a material that will be available for consultation by students, Mathematics teachers, teachers of technical areas, in short, anyone who needs to visualize or show some contexts of the Agricultural Sciences area, in which Mathematics can be applied and is at the service of.

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