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Ratio, Proportion and Rule of three: Reflections on Contextualization in the Area Agricultural Sciences

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Abstract

This article aims to reflect on the contextualization of the content of ratio, proportion and rule of three in the area of Agrarian Sciences. For that, a little history of the Rule of Three algorithm is presented according to the authors Mol (2013), Boyer (2012, Garding (1981) and Broocks (1880). Following on the literature is research on this subject related to teaching and learning. Also analyzed some examples of activities contextualized in some sub-areas of Agricultural Sciences. It follows that the contents of ratio, proportion and rule of three must be taught in a way that ensures that when the student needs to establish relations between proportional quantities and calculate a rule of three in the most diverse disciplines of his course, they can do so successfully. The examples of activities analyzed show that it is possible to contextualize the teaching of the content of ratio, proportion and rule of three with diversity in the area of Agrarian Sciences. There are many other contexts that have been cited by the teachers surveyed and show the need for students to develop the ability to work with proportions.

Key words: Contextualization. Agricultural Sciences. Teaching of mathematics

INTRODUCTION

The teaching and learning in higher education has been a debate of many researchers in the various segments. The questions range from a personal reflection to the search for theoretical bases that sustain the act. Faced with this, some questions arise: what to teach in the subjects of Mathematics in higher courses? What mathematics teach? What is important to teach? Does interdisciplinary facilitate learning? Bring contexts from the area of student training can improve learning?

Baldoino (2012, p.) When reflecting on the construction of knowledge in Higher Education points out that it is necessary to aim for "a learning that helps students to understand and intervene in the world, especially in the professional environment in which they intend to act."

In this sense, it were understand that the professor of Mathematics of Higher Education needs to select contents that contribute to the professional environment that this student will act, so that it reflects on the knowledge with the aim of apprehending it.

To solve problems in several contexts that apply to Mathematics, it is common to use an algorithm that involves calculating an unknown term using the proportionality relation between two or more magnitude. This algorithm gives the denomination of Rule of Three, and can be classified in rule of three simple or rule of three compound, according to the number of magnitude involved. Besides this classification, the rules of three both simple and compound can assume the direct or inverse characteristic.

Silva e Guerra (2011) emphasized that we can consider that the Rule of Three is not a specific object of Mathematics, but that it were built in the social practices consolidated by society as a practical procedure for the use of their professional activities.

In the area of Agrarian Sciences, it is common to use this mathematical procedure in several contexts, including the daily routine of farmers who use Rule of Three, for example, to calculate the amount of seeds needed for planting in an area, for the regulation of agricultural machinery, among other calculations. Therefore, this article aims to reflect on the contextualization of the content of ratio, proportion and rule of three in the area of Agrarian Sciences.

In order to do so, it presents a bit of the history of the algorithm of Rule and Three to show that the algorithm first appeared and later the relations of magnitudes, ratios and proportions. In the sequence, it is located in the literature research on these contents related to teaching and learning in higher education. Finally, to fulfill the objective proposed in this text, several contextualized examples were present with the area of Agrarian Sciences.

Literature Review:

The rule of three is a mathematical calculation procedure that runs through historical time. Mol, (2013), discussing the introduction of the history of Mathematics reports that in 499 a. C., the mathematician and astronomer Aryabhata published the Aryabhatiya, a work classified as a Siddhanta. In this work, he described rules of calculation in astronomy and measures in mathematics, without making use of deductive methods. For Mol, Aryabhata using verses described that:"In the rule of three multiply the fruit by desire and divide by measure. The result will be the fruit of desire. The verse refers to the proportion a : b = c : x, where a is the "measure," b is the "fruit," c is the "desire," and x is the "fruit of desire", solved by doing x = bc / a. In its second half, the Aryabhatiya is devoted to calculating time and spherical trigonometry. The work provides tables of sine's and procedures for their calculation. (MOL, 2013, p.64)."

In this line, the most important Chinese mathematical production is also highlighted: the book Chui-Chang Suan-Shu, which was published in the first century. In this book are presented 246 problems about land measurement, agriculture, society, engineering, taxes among others, where part of them were solve by

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rule of three. These problems highlight the role of the three-rule in social practices (Boyer, 2012).

Brooks, (1880) e Garding (1981) emphasized that the rule of three is a Golden Rule, being the "principal and most excellent rule of all arithmetic," for "for all other rules there is need have it, and it pervades all others" BROOKS, 1880 p.330). Garding (1981, p.290) refers about the rule of three and describes its usefulness in commerce: "Shortly after the invention of the press appeared many compendia of elementary arithmetic, some of them dealing also with fractions and commercial mathematics, in particular the equivalence of currencies, problems of shares and interest rates. The fact that x = ac / b solves the equation a / b = x / c (rule of three). It proved to be extremely useful. A writer calls it the golden rule, claiming "it is so valuable that it goes beyond the other rules, just as gold goes beyond other metals" Garding (1981, p.290)".

Thus, the notion of proportionality, cited by the Rule of Three algorithm is one of the oldest in Mathematics. Because, the human need to solve their problems of a practical or scientific nature led man to seek a way of reasoning proportionately. In contemporary times, the notion of proportionality becomes increasingly important, being used by scientists, engineers, traders, among others. (GONÇALVES, 2010).

History shows us that the importance of this concept is due to its applicability in practical problems and in the mathematical context, as well as in several areas of knowledge.

When one questions the teaching and learning of Rule of Three, one turns first in Basic Education, especially the 7th grade (6th grade), in which there is the introduction of the content of Ratio and proportion of which the Rule of Three Algorithm is part. The National Curricular Parameters - PCN (BRAZIL, 1998, p.65), suggest the exploration of learning situations involving day-to-day and other areas of knowledge that lead the student to "observe the variation between magnitudes, establishing a relationship between them and building strategies for solution."

Therefore, since the introduction of the concept it is suggested that the teaching of the content of Rule of Three be taught in a meaningful way, for Silva (2011, p.82) "To foster an understanding of three-rule practices, such as school practice not restricted to mathematics discipline, but also of physics, chemistry, biology, geography, and other disciplines,". Thus, the author emphasizes that the teaching of rule of three needs to be contextualized in other areas of knowledge and defends the importance of this concept directed to a teaching trend that is Mathematical Modeling. Barbosa (2004, p. 67) calls Modeling in service courses, when applied in courses for non-mathematicians, here fits the courses in the area of Agrarian Sciences, the author emphasizes that by its "interdisciplinary nature, Modeling is a privileged front door to meet some of the expectations of students in service courses." In this way, students of courses for non-mathematicians need to learn how to connect Mathematics to the contexts that are essential for them.

Confirming with Favero and Marques (2012, p.9) "the emphasis on the learning paradigm is based on the assumption that all knowledge that passes through the formative process must be meaningful for the learner." Thus, the Mathematical Modeling allied to the contextualization in the teaching of Rule of three brings meanings to the students when relating mathematical calculations with subjects of their area of formation.

In this sense, in the courses in the area of Agrarian Sciences it is possible to search for an implementation of the rule of three as a practice of Mathematical Modeling with the aid of interdisciplinary. This fact makes it possible to: "evidencing the rule of three as a model for coping with situations in various human activities, and more, can reveal the mathematical doing as a human doing in order to construct or change realities in order to fulfill what he desires, and therefore, to show that this modeling task is subordinated to the interests and intentions of social groups, as it is to reveal critical mathematical education (SILVA and GUERRA, 2011, p.13)".

In this perspective, even though the content of Rule of Three has its focus still in elementary school, it is possible to give a differentiated focus in Higher Education with examples and applications of the professional area chosen by the student.

Methodology:

This text is an unfolding of a doctoral research. The objective of the research was the mapping of contexts, through a questionnaire, of the application of Mathematics in the area of Agrarian Sciences. This questionnaire was applied to 80 (eighty) teachers who teach courses in Agronomy, Forest Engineering, and Zootechny at the UniversidadeTecnológica Federal do Paraná- CâmpusDoisVizinhos (UTFPR-DV) – Paraná - Brasil. In the questionnaire they mentioned the discipline they were in, they answered whether or not they used mathematical concepts and when they used they mentioned the subjects in which they used Mathematics and the concept involved.

The content most quoted by the teachers was Rule of three, quoted with this nomenclature by 28 (twenty eight) teachers. Still, we have cited terms that refer to such content as proportion and percentage.

Given this result, we searched for some examples of applications in several sub-areas of Agrarian Sciences and in this text we will list 8 (eight) examples that contextualize this content in order to reflect on the importance of this to this area of knowledge.

The examples were formulate from existing bibliography on the topic or elaborated by the authors of this text.

The Ethics Council of Human Beings of the University in which the research were approve this research (Opinion: 1.675.433 / 2016).

Contextualization of Reason, Proportion and Rule of Three in the Area of Agricultural Sciences:

The concept about Rule of Three has been use historically by several areas that use this procedure to solve problems. Below are some examples of activities that prove how important is the teaching and learning of the concept of Proportion ratio and Rule of Three in the courses in the area of Agricultural Sciences. In order to present the activities, exercises existed in the literature and others elaborated by the authors of this text.

Quoting the discipline of *Agricultural Mechanization*, BARRETA and GONÇALVES (2011) present in their work the use of the Simple Rule of Three in the regulation of planter.

Example 1 - If, for example, the use is 450 kg / ha of fertilizer, what is the quantity that we should use in 100 ha?

In this type of relation, we should note that if the area increases and the amount of fertilizer increases we say that area and amount of fertilizer are directly proportional magnitude.

Example 2 - If, for example, we sow the 100 ha in 40 hours at a speed of 8 km / hour, how many hours will we take to sow if the speed is 5 km / hour?

In this case, it were observe that decreasing the speed increases the planting time, thus, this ratio between the time and velocity magnitude is inversely proportional.

Also in the discipline of agricultural mechanization, an example of using the compost rule of three in the calculation of working hours were cite.

Example 3 - A large soybean producer intends to plant in an area of 630 hectares in a maximum period of three days to anticipate the rains forecast for the region. For this, he has three tractors of the same power equipped with planters of the same operational capacity. It known that the three machines working at the same time are capable of planting the entire area during the three days, working 10 hours for day. However, at the end of the first day of planting, when operators returned to the machine shed, a problem made impossible the use of one of the planters for that moment. Given this situation, how many more hours each of the other two planters will have to work to complete the planting within the expected time?

Table 1: Scheme of resolution of compost Rule of three Source: authors.

N° of planters	Working hours / day	N° of days	Planted área
3	10	3	630 hectares
2	X	2	420 hectares

It is note in the example that there are four magnitudes being relate, but that the magnitude working hours / day is inversely proportional to the number of planters and to the number of days, for that reason, in the resolution algorithm the reasons need to be place inverted.

Therefore, the regulation of seeders and the calculation of working hours is a calculation widely used in agriculture in the stage of planting crops and reaffirms what Silva says (2008, p.182), "proportionality is a content that is present in several daily activities of the citizen, and an important school content to be worked in school."

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In the discipline of Animal Nutrition, an example is give, on formulation of feed:

Example 4 - How much corn (in kg) should we add to the animal feed so that it contains 1.45 kg of NDT (total digestible nutrients), knowing that corn has 80% NDT?

If corn has 80% NDT, this means that 100 kg of corn contains 80 kg of NDT.

Therefore, the calculation takes the following form:

100 kg of corn ---------- 80 kg of NDT

X kg of corn ---------- 1.45 kg of NDT

X = 1.81 kg corn

Equation 1 - Solution of the Rule of three

Source: authors

The presence of value in the percent form were observe in this example. The percentage calculation is an application of the concept of ratio and proportion and can be calculate with the aid of the rule of three algorithm. The use of proportionality in Animal Nutrition improves the financial results of the producer, reducing waste and providing the animal with the amount of nutrients needed.

In the sub-area of *Soil Fertility / Fruticulture*, we have an example about fertilization recommendation in the melon crop.

Example 5 – (EMBRAPA 2010): For the mineral fertilization of the melon, 40 kg ha-1 of nitrogen, phosphorus and potassium were recommend, according to a soil analysis, to were apply in foundation, before planting. If 40 kg ha-¹ of Nitrogen, 40 kg ha-¹ of phosphorus and 40 kg ha-¹ of potassium were applied before planting (planting fertilization) and 80 kg ha-¹ of Nitrogen and 40 kg ha-¹ of potassium in cover fertilization.

a) What is the amount of fertilizer needed to supply the amount of nutrient recommended for the crop, considering that there is 10% of phosphorus in the fertilizer formula?

b) For cover fertilization, a nitrogen fertilizer, such as urea, is used. If 100 kg of urea has 45 kg of Nitrogen, what is the amount of urea needed to grow the melon?

c) If 100 kg of potassium chloride, also used for cover fertilization in the melon crop, has 60 kg of potassium, what is the amount of potassium chloride required?

Note that in this example and also in those already mentioned, that the concept of percentage appears constantly, remembering that the percentage is an application of the concept of ratio and proportion and that its solution is possible by means of the algorithm of Rule of Three, but , is not unique.

Another sub area that uses ratio, ratio and rule of three to solve their problems is the *Bovine farming*. This is an area of prominence in the course of Zootechny, but which is also a discipline of complementary training of Agronomy.

Example 6 - Aiming for a greater gain of live weight per day (GWD) in the rearing of beef calves, a producer decided to supplement their diet with a protein-energy supplement in the dry season of the year. Knowing that 150 animals with an initial average of 270 kg and a final of 330 kg of live weight (LW) will were use for 90 days and that a supplementary amount equivalent to 0.75% of the PV will were offer for each animal, what will be the total quantity of supplement that the producer will use during this period? (Grifo dos autores)

One possible solution is to use four steps; first, the calculation of the average live weight using a simple arithmetic mean were perform. In the second step, by means of the algorithm of rule of three is calculated the amount of supplement per animal for each day. In step three, the amount of supplement for the animals for the 90 days were calculate, as prescribes the problem. Finally calculated the amount of supplement for the 150 animals for 90 days. Given this, it is possible to agree with Silva, (2008, p.12) who reports, "It is no use teaching the content of proportion only through the algorithm of rule of three. It is better to teach the student to think about alternative ways of solving a problem so that he can take advantage of existing knowledge and build new knowledge. "

In the sub-area of Forage farming, we have an example:

Example 7 - In order to know the forage mass (MF, in kg of dry matter / he) available in an area, random samplings are performed in the pasture using metallic squares of known area. These samples were weigh green, and some are stored in paper bags, weighed in a greenhouse for 72 hours and weighed again to obtain the forage dry matter (DM) content. From the values of the *in natura* masses and the DM content, in addition to knowing the area of the cut, one can estimate the mass of forage. Knowing this, a producer made 5 cuts (1500g, 1735g, 1600g, 1650g and 1825g) using a square of 1 m², removed a sample of 500g, dried that sample (obtaining a post-drying weight of 175g) and calculated the mass of forage per hectare. What were the value found? (Grifo do autores)

The presence of the rule of three were emphasize here, but in order for the student to arrive at the algorithm, an interpretation that goes beyond the mathematical calculation is necessary. The student, when interpreting a problem like this, needs to identify the quantities that will relate and when finding the result must verify if this result is feasible for this problem. For, "the various professionals who use mathematics in their areas must have a critical view of their potentialities and risks, so that they can thus also act critically" (BARBOSA, 80, 2004).

Again it is possible to observe in this example that it is necessary to follow a logical sequence to arrive at the result of the mass of fodder per hectare, besides, the accurate knowledge of proportionality the student needs to know and articulate in the problem the concept of magnitude and measures. Faced with this: “One of the great tasks of higher education in this context is to make the formative process a space of education of the eye in order to develop in the apprentices the capacity to perceive the problematic phenomena that they encounter in the exercise of their profession, as well as to develop the capacity to understand the complexity of the social world in which we live.” (Fávero and Marques, 2012, p.09)

This fact reaffirms that it is necessary in Higher Education to develop abilities in the students that take them and to succeed in solving problems of their future profession, and this is a part of Mathematics, even though in the first periods, it can through contextualization given meaning to students' learning.

Finally an example *of Forest Energy Resources on bioenergy* of Eucalyptus wood, area of Forestry Engineering.

Example 8 - Some bullfighter’s assistant peel has 370,6 dry tons of bark entering the peeler. What is the amount of dry logs if the bark represents 8% of the dry weight of the logs? (Grifo dos autores)

If the logs contained 370,6 dry tons of bark and the bark represented 8% of the dry weight of the logs, we have:

100 a. d. tons of logs ---------- 8 a. d. tons of logs

X ----------370,6 a. d. tons of logs

X = 4.632,5 absolutely dry tons of logs

Equation 2 - Solution by rule of three

Source: authors

In this example, it is clear that resolution strategies involve proportional reasoning and require qualitative and quantitative thinking. According to Gonçalves (2010) the quantitative makes possible the previous analysis of the problem and the judgment of its conclusion by means of the comparison of rates or reasons and calculations and the qualitative one makes possible the analysis of the results and the judgment of the coherence of the context.

Therefore, in the higher courses of the agricultural sciences, it is essential to recall these concepts already in the first period, and preferably in a contextualized way, so that the student can make relationships and use mathematics to solve their professional problems.

Final Considerations:

The ratio, proportion, and rule of three need to be "remembered" in Mathematics disciplines of Higher Education in the area of Agrarian Sciences. Since its introduction is in elementary school, it need to be taught in a way that ensures that when the student establishes relationships between proportional quantities and uses the concept of Rule of Three in a calculation in the most diverse disciplines of his course, they succeed. And not only because they obtain approvals in the disciplines, but rather that through well-calculated calculations they can act as professionals and solve the most varied problems that their daily life presents.

Another factor that can were consider is that many students who choose the area of agricultural science already have a link with the field and therefore know in practice, for example, a regulation of seeder, a calculation of dry matter, among others. In this way, it is possible to make sense and establish relations with previous knowledge of these students and to place the students who do not have ties in the professional context that they have chosen.

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The examples analyzed from the perspective of the contextualization in the area of Agrarian Sciences show that it is possible to contextualize the teaching of the content of ratio, proportion and rule of three with diversity. Agricultural mechanization, animal nutrition, Bovine farming, Soil Fertility in Fruticulture, Forage farming and forest energy resources are some of the contexts that can be used to illustrate the teaching of reason, proportion and rule of three for higher education courses in the area of Agrarian Sciences. There are many other contexts that be cite by the professors surveyed and which show the need for students to develop the ability to deal with proportions.

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REFERENCES

Baldoino, E.F., 2012. Ensinar e Aprenderna Educação Superior: Possibilidades de Uma PráticaProgressista. UNOPAR Cient., Ciênc. Human. Educ., Londrina, 13(2): 25-34.

Barbosa, J.C., 2004. Modelagem Matemáticaemcursos para não-matemáticos. In: Cury, H.N (org). Disciplin as mathematic as emcursossuperiores: reflexões, relatos ,propostas. Porto Alegra: EDIPUCRS:66-83.

Barreta, D. Gonçalves, A N (2013). Regulagem de Semeadoras com Dosadores Mecânicospormeio do MétodoLógico Comparadoa Utilização de Fórmulas. In: OsDesafiosaa Escola Pública Paranaense Na Perspectiva Do Professor PDE. Volume I.

Boyer, C. B, 2012.História da Matemática; 3ª edição. São Paulo: Edgard Blucher.

Brasil, 1998. Secretaria de Educacao Fundamental. PCNS (5.a a 8.a series) Parâmetroscurricularesnacionais: matematica / Secretaria de Educacao Fundamental. Brasilia: MEC / SEF.

Brooks, E., 1880. The philosophy of arithmetic as developed from the three fundamental processes of synthesis, analysis, and comparison containing also a history of arithmetic. Lancaster, PA: Normal publishing company.

Embrapa, 2010. Sistema de Produção do melão. Agosto, Disponívelem: http://www.cpatsa.embrapa.br:8080/sistema_producao/spmelao/nutricao_e_adubacao.html

Fávero, A.A., M. Marques, 2012. Aprender e Ensinarna Universidade: a Docênciana Perspectiva da Epistemologia da Aprendizagem. ANAIS...IX ANPED SUL. Caxias do Sul.

Garding, L., 2010. Encontro com a matemática. Trad. deCélio Alvarenga e Maria Manuela Alvarenga.Brasília: EditoraUniversidade de Brasília,1981.

Gonçalves, M.J.S.V., 2010. Raciocínio Proporcional: estratégiasmobilizadasporalunos a partir de umaabordagemenvolvendoaoralidade. Dissertação de mestrado – PPGEM – Universidade Federal do MatoGrosso do Sul. MatoGrosso do Sul.

Mol, R.S., 2013. Introdução à história da matemática. Belo Horizonte : CAED-UFMG.

Silva, D.P., R.B. Guerra, 2011. Para queensinarregra de três? XIII CIAEM – Conferênciainter americana de educaçãomatemática. Disponívelem: http://www.gente.eti.br/lematec/CDS/XIIICIA EM/artigos/1337.pdf.

Silva, D.P., Da, 2011. Regra de Três: prática escolar de modelagemmatemática. Dissertação (mestrado) Universidade Federal do Pará, Programa de PósGraduaçãoem Educação, emCiências e Matemáticas. Belém.

Silva, E.A., 2008. Pensamen to proporcional e regra de três: estratégiasutilizadasporalunos do ensino fundamental naresolução de problemas. Dissertação (Mestrado) – UniversidadeTuiuti do Paraná, Curitiba.