

## The uses of evidences and their evaluation in written arguments about a codominance case

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### Abstract

In this paper, we show an investigative didactic sequence (IDS) composed by activities about genetic of the colours of pelage's cats, which promote argumentation. The present paper discusses the challenges of promoting argument in the biology classes. We use the model of Toulmin (2006). However, in this work, we agree with Jimenez-Aleixandre (2010), when we consider the evidence as similar to data of Toulmin. The evidence has a slightly different characteristic to the Toulmian data, because of its function or its role. The criteria to evaluate evidence are specificity (if the evidence has relation with the conclusion), sufficiency (if a set of evidence or only one evidence is sufficient to reach the conclusion) and reliability (the probability of evidence supports the conclusion) (JIMÉNEZ-ALEIXANDRE, 2010). The objective of this work is to analyse which evaluation criteria of evidences are present in argumentative texts in biology classes about genetics. The students of secondary school should to answer the question: "Why only female cats can be tricolour?" We collected 25 texts, but only 16 were arguments. The students belonged to 2nd degree of high school (16 until 18 years old) of a public school. In each text was verified the presence or absence of the criteria for evaluation of evidence. The findings are 100% specificity, 80% sufficiency and 31% reliability. From the data presented, we conclude that the argumentative texts present the evaluation of criteria for evidence in high percentages, especially the specificity and sufficiency. The reliability presented on low percentage. A few students could represent the location of alleles on chromosomes. The students developed argumentative in the classroom, with simple activities. Although the activities are simple, genetic problems are more abstract than other areas of biology.

**Keywords:** Use of evidences; argumentative skills; genetic teaching; argumentation

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## Theoretical Background

In this paper, we show an investigative didactic sequence (IDS) composed by activities about genetic, which promote argumentation. This theme is used to contextualize the genetic topic of the colours of pelage's cats. The present paper discusses the challenges of promoting argumentation in biology classes. The argumentation is to assess theoretical assertions by means of empirical data or from other sources, correlating data and conclusions (JIMÉNEZ-ALEXANDRE and DIAZ, 2003).

Argumentation is important for scientific work. The argumentation is a dialectic and dialogical, social and intellectual, oral or written, verbal or non-verbal communication activity, which comes by the divergence of opinions. In Science, the argumentation is a way that researches use to convince the other members of scientific community about their ideas (1996; KUHN, 1993).

The argumentative skills development in biology classes is of great importance for the teaching of biology. To develop skills search on the construction of a critical thinking in students so that they can give opinion in the most different situations involving the biological knowledge. These skills offer the opportunity to understand how the appropriation of biological knowledge by students, offering the opportunity to think about ways to learning.

In classes of biology, the argumentation promotes scientific thinking and this is important because the students learn that the teacher is not a holder of absolute truths. When the teacher develop argumentation in class, the students have active role in the construction of knowledge (SASSERON; CARVALHO, 2011; OSBORNE; ERDURAN; SIMON, 2004).

We use the model of toulmin (2006), in a model (called Toulmin Argumentation Pattern – TAP). The relationship between elements of TAP are as illustrated in figure 1.

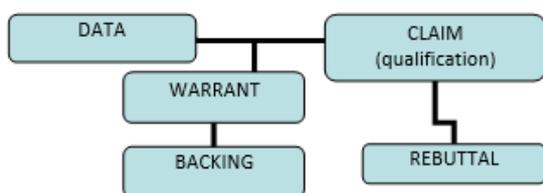


Figure 1. Elements of Toulmin Argumentation Pattern

In the TAP the data are the reasons that bolster the conclusion. The claim is the conclusion of the argument. The warrant are principles that connect the data to conclusion. The backing are the reasons, theories and justification to back up the warrant. The Rebuttal are exceptions to the claim and the

qualification is specification of limits to claim, warrant and backing. However, in this work, we agree with Jimenez-Aleixandre (2010), when we consider the evidence as similar to data of Toulmin. The evidences have a slightly different characteristic Toulmian data. In accordance to Jimenez-Aleixandre (2010, p74) "We refer to what we call evidence with the purpose of showing that a statement is true or false. What makes it be an evidence is its function or its role."

Another important question are the criteria for evaluation to evidences. According to Jiménez-Aleixandre (2010), the criteria are specificity (if the evidence has relation with the conclusion), sufficiency (if a set of evidence or only one evidence is sufficient to reach the conclusion) and authenticity (the probability of evidence supports the conclusion). When students understand the criteria for evaluation of evidences, they develop skills argumentative (idem). When we find criteria for evaluation of evidences in student's texts, we conclude that the students developed argumentative skills.

## Objective

The objective of this work is to analyse which evaluation criteria of evidences are present in argumentative texts in biology classes about genetics.

## Research Design and methodology

The texts analysed are part of the activities which the students should discuss contents about genetics. The students received an activity about the genetics of colour of pelage's cats. This is an interesting case because there is a codominance between alleles of sexual chromosomes and alleles between autosomal chromosomes. The students of secondary school (25 students) should to answer the question: "Why only female cats can be tricolour?" The students have information about the colours of pelage, the dominance of alleles, the difference between males and females. They should submit the phenotypes of cats through a drawing.

The teacher suggested the content of classes. He wanted activities about genetics, because he said us that is a difficult content. In our researches, we use a form to organize the activities to teach biology called investigative didactic sequence (IDS). IDS are sets of activities with a special attention to production of written texts. In these texts, the students give their opinions and express scientific concepts. The IDS promote moments to discussions and systematizations of contents (MOTOKANE, 2015)

The IDS has nine classes, and the texts analysed are about class number nine. The problem involves content as determining the sexual chromosomes, genes, alleles, first and second laws of Mendel, gametogenesis and pedigrees. We analysed 25 texts, but only 16 had arguments. Five students did not do the activity. The students belonged to 2nd degree of high school (16 until 18 years old) of a public school in the rural area of the state of São Paulo. The

research group, the teacher of biology and undergraduate students (in biology), produced the investigative didactic sequence. These undergraduate students belong to a program to encourage teaching (Programa Institucional de Bolsas de Iniciação à Docência - Pibid).

The **specificity** was present when the text presented the relation between the colours and the genes.

Example:

*... In the text, the author said that there are genes for colours (black, orange, white and spots white). These genes are dominant. (Student 05)*

*... Genes determine the colour difference; it is possible to identify different colours from different genders. (Student 06)*

*...The female sexual gene has characteristic to 3 colours, the male gene don't have it. (Student 16)*

The **sufficiency** was considered present when the dominance of genes, assigning the black and orange colour for chromosome X and the white spots and white for autosomal chromosome.

Example:

*... some chromosome X has characteristics that the chromosomes Y don't have. If a female cat is black and orange with white spots, it has two chromosomes X, and a male cat is different.... (Student 11).*

*...Because the black and orange colours found only on the X chromosome, so a male who has sex chromosome XY will have chances to have black and orange together. (Student 04)*

...

The **authenticity** was present when the text represent the genotypes or propose crossings mentioning colours.

Example:

*...Only the cats are tricolour because the gene determining the black and orange colours are the female sexual chromosomes then P<sub>x</sub>L<sub>x</sub> are females and P<sub>x</sub>Y<sub>y</sub> or L<sub>x</sub>Y<sub>y</sub> are males. (Student 15)*

In each text was verified the presence or absence of the criteria for evaluation of evidence specificity, sufficiency and authenticity. The table 1 presents the criteria per student's text.

Table 1. Criteria found in the texts. The X mark indicates the presence of the item.

STUDENT	SPECIFICITY	SUFFICIENCY	AUTHENTICITY	TAP
01	x		x	x
02	x		x	x
03	x			
04	x	x	x	x
05	x		x	x
06	x			x
07	x		x	x
08	x		x	x
09	x		x	x
10	x	x	x	x
11	x		x	x
12	x		x	x
13	x		x	x
14	x			
15	x	x	x	x
16	x			
17	x			
18	x	x		x
19	x	x	x	x
20	x			x
Total	16	5	13	16

We analysed 16 texts. For each criterion we calculated the percentage of attendance, as the following results: 100% specificity; 80% sufficiency and 31% reliability.

The figure 2 illustrates these results.

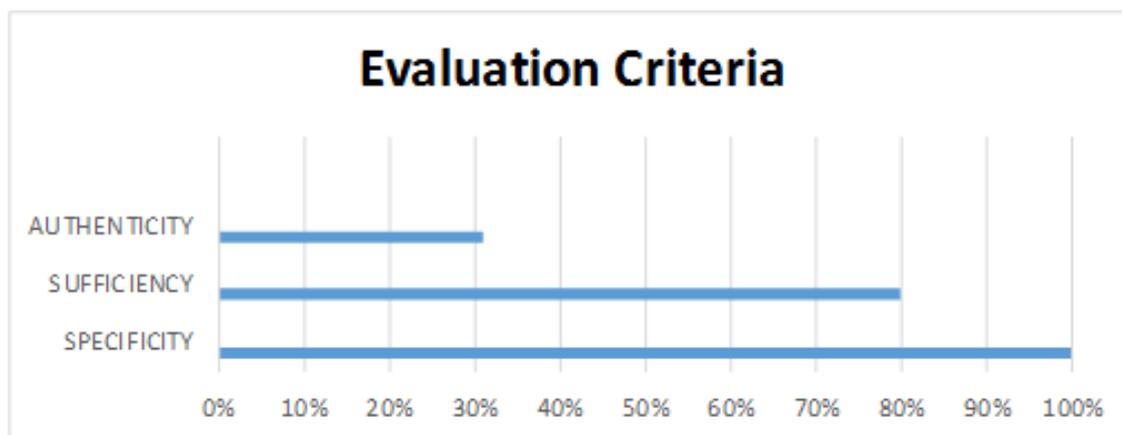


Figure 2. Frequency of evaluation criteria in the texts.

It is interesting that all the texts have specific, but only 31% have authenticity. Authenticity is a more complex criterion because it involves the use of a specific genetic language.

### Conclusions

From the data presented, we conclude that the argumentative texts present the evaluation of criteria for evidence in high percentages, especially the specificity and sufficiency. The authenticity presented on low percentage. There is a difficulty in presenting the representation of genotypes (use of a specific language and representation). Few students could represent the location of alleles on chromosomes.

The teacher developed argumentative skills in the classroom and the evaluation criteria of evidence are present in the texts. The IDS is a framework for biology's classes to develop argumentative skills using simple activities. It is necessary to think about genetics problems. Although the activities are simple, genetic problems are more abstract than other areas of biology. Teaching Genetics is a challenge for biology teachers. Many studies show that there are lot of abstract concepts and that students do not understand the biological processes clearly. The proposal of an IDS on genetics was important because it allowed the teacher used a different teaching materials and propose a problem to be investigated by the students.

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