

49 - ALTERNATIVE CONCEPTIONS OF STUDENTS X EPISTEMOLOGY OF LAKATOS

KARINE ARIELE ROSKOSZ
ELENISE SAUER

Universidade Tecnológica Federal do Paraná
Ponta Grossa – PR, Brasil
karineroskosz@gmail.com

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Introduction

The agrototoxic theme is addressed in the teaching of sciences, and presents rich relationships that can be exploited since its denomination that in Brazil replaced the agricultural defensive term, after mobilisation of organised civil society due to toxicity to the environment and human health (SIQUEIRA; KRUIZE, 2008).

It involves historical aspects, with records of use in the old age for more than 3000 years, in the modern age in the synthesis of organic and inorganic substances (SANTOS; MÓL, 2013). In particular diclorodifenil-trichloroethane (DDT), organochlorine that derived various substances, and the toxicity led to the development of new compounds, the organophosphates (BRAIBANTE; ZAPPE, 2012).

The extensive manufacture, marketing and use of these compounds constituted of desired active principles (BRAIBANTE; ZAPPE, 2012), and unwanted, generates damage to the biotic and abiotic environments of ecosystems (RIBAS; MATSUMURA, 2009).

The low relation of scientific knowledge to the agrototoxic subject in the preliminary results of students in the final phase of high school, directed the objective of contributing to the teaching of sciences, simulating the genesis of scientific theories in a constructive perspective of the relationships between alternative conceptions and the epistemology of Lakatos.

Alternative Conceptions

The alternative conceptions of students, even if they constitute a simplistic connotation of explaining the phenomena of their context, should be valued by the importance of the link with their reality (OLIVEIRA, 2005). Its significance has contributed to the development of constructive pedagogical practices in teaching-learning, facilitating the student's active involvement in the construction of knowledge (DAMASCENO; OLIVEIRA, 2014).

In this sense, an important resource in the teaching of sciences highlighted by Silva Nardi; Laburú (2008) and Arthury; Peduzzi (2013) is the involvement of historical and epistemological issues within the meaning of Lakatos, where the discussion on the operation of science serves as a model for teaching practices under the approach of the nature of science in a rational reconstruction of history, called Didactic Rational Reconstruction (RRD).

The RRD considers several criteria of choice between theories of a scientific field, being the core of a theory difficult to be refuted, the counter-examples originate auxiliary hypotheses keeping the nuclear conceptions intact, and, under an evaluation in the sense of experience for theory, emerges a successor theory (SILVA, NARDI; LABURÚ, 2008).

In this dynamics of mediating the similarity between the operation of science and the student's perceptions about its social context, it is possible to perform the so-called lakatosian analysis in a process of obtaining knowledge (ARTHURY; PEDUZZI, 2013), treating the students' alternative conceptions to the same extent as scientific theories as part of a "scientific program", covering methods, concepts, values and epistemological assumptions (LABURÚ, 2003).

Epistemology of Imre Lakatos

The epistemology of Imre Lakatos in the 20th century stands out in the philosophy of science by the importance in the development of scientific theories, when considering the history of science portrayed in the methodology of scientific research programs, in an evolutionary way, which qualifies the process of scientific development as a competition between rival research programs (SILVA; NARDI; LABURÚ, 2008).

The constitution of these research programs involves elements of a heuristic structure that enables the understanding of the dynamics of science, characterized by a firm core, a protective belt and heuristics associated with the maintenance of both (ARTHURY; PEDUZZI 2013).

In the development of a research program auxiliary hypotheses are established to protect the core from anomalies and inadequacies, during the theoretical prediction and empirical finding, aiming at the stability and protection of a direct attack, forming a protective belt, in a dynamic of constant restructuring according to needs (ARTHURY; PEDUZZI, 2013).

These programs present methodological norms called "negative heuristic", specific to the "core" of the program, which dictates the search paths to be avoided, considered irrefutable by methodological decision of its protagonists. Opposite to the positive "heuristic", specific to the "safety belt", which determines the paths to be traveled, which can be refuted, modified and sophisticated (SILVA; NARDI; LABURÚ, 2008).

In these methodological principles of the epistemology of Lakatos, it was proposed as an objective the development of pedagogical practice that treats the alternative conceptions of students as scientific programs, mediated by discussions, analysis, reflections on the characteristics and definitions related to the agrototoxic theme.

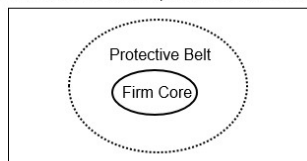
Methodology for the development of the proposal

The methodology for the development of the proposal started in the data collection through a questionnaire consisting of nine questions, covering relations of pesticides as to concept, means of information, food consumption, and with chemistry discipline. It involved thirty students, aged 17 and 18, from the 3rd year of high school, from a state school in the South of Paraná, Brazil.

The content analysis of the students' responses to the questionnaires was performed in the MAXQDA 10 program, stratifying categories and subcategories, and the corresponding percentage values were obtained in the Excel program.

The development of the teaching proposal based on the epistemology of Lakatos presented in this article, was restricted in this phase, interpretive analysis of the answers to the question on the students' alternative conceptions about the concept of pesticides, used as data in the simulation of Scientific Programs 1 and 2, formed by firm core and protective belt (see Figure 1).

Figure 1: Firm core schema and protective belt of Lakatos Theory



Source: elaborated by the authors

Results and discussions of alternative conceptions on pesticides x epistemology of Lakatos

The students' alternative conceptions on the agrototoxic subject were investigated through the question: What do you mean by agrototoxic? The answers are presented in Table 1.

Table 1: Students' answers to the question: What do you mean by agrotoxic?

Subcategories	% (answers)
Products to inhibit parasites/kill bacteria/pests	36
Products used in agriculture/plant	25
Poison/chemical/toxic substance	25
Harmful to health	3
Preservatives for planting	3
Preservatives for food products	3
Food protection and durability	3
Didn't answer	3

Source: elaborated by the authors from the students' answers

It was found in 36% of the responses that students relate pesticides to products to inhibit parasites and kill bacteria, insects and pests; 25% defined pesticides as products used in agriculture or plant; 25% as poison or chemical/toxic, 3% as harmful to health, and 3% did not answer this question.

These results indicate that most students have an alternative "previous knowledge about agrotoxics, associated with products used to inhibit parasites or products used in the plantation, characteristics found in the literature related to this type of product.

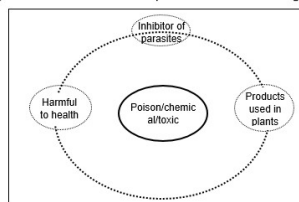
However, in 9% of the responses, the students classified pesticides as plant and food preservatives, food protection and durability, characteristics or functions that do not correspond to definitions found in the literature. These results are the starting point of the teaching proposal, used in mediation with the intention of not disregarding these conceptions, but to treat them as alternative concepts in the dynamics for the elaboration of scientific programs that lead to the construction of knowledge.

In this conception the present proposal consists of the teacher presenting to the students the representation of a program based on the theory of Lakatos, in order to define the firm core and protective belt of "competing programs" represented in the diagram in Figure 1.

It follows in the orientation to the students, distributed in teams for formation of "rival programs", distributing the conceptions according to their similarities. In this case, two programs, the first one being composed of the first four conceptions presented in Table 1, while the second one is composed of the other conceptions, except that portion that did not respond, by not actually presenting a formulated conception.

According to this reasoning, the respective schemes for the firm core and the protective belt of the "competing programs 1 and 2", structured from the alternative designs of these students are presented in Figures 2 and 3.

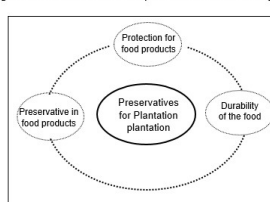
Figure 2. Firm core outline and protective belt of the "Program 1"



Source: elaborated by the authors

The firm nucleus of the "programme 1", the firm core consisting of the concept that pesticide is a type of poison, a chemical with a degree of toxicity, characterizing a firm nucleus as the conceptual basis that will preserve the program (SANTOS, 1996) We're here. While the protective belt is constituted by the concepts that agrotoxics is an inhibitor of parasites; a product used in plants and harmful to health, as a set of auxiliary hypotheses and stratagems of protection to the firm core, which can be constantly modified, expanded and sophisticated according to needs (ARTHURY; PEDUZZI, 2013).

Figure 3. Firm core outline and protective belt of the "Program 2"



Source: elaborated by the autor

In the "program 2" it is observed that the firm core constituted by the concept that agrotoxics is a preservative for planting, and the protective belt constituted by the concept of preservative for food, where the agrotoxic would be a food preservative giving durability.

After the structuring of the "programs" by the students, starts reading texts on the agrotoxic theme, followed by analysis and discussion. The discourse and positioning of the students on the subject converge in order to evaluate which programs presented best conceptualize the term agrotoxic.

Conclusions

The analysis carried out by means of the similarities between the operation of science, as described by Lakatos from the students' alternative conceptions on the agrotoxic subject. It made possible a teaching process based on the students' role in choosing a concept that best characterizes the term under study.

The students' alternative conceptions based on the relations of the epistemology of Lakatos, conducted in a dynamic that simulated the operation of science, has become an important resource in teaching science, valuing the student in the process of building knowledge.

Finally it was possible that the teacher acted as mediator of the process in which the alternative conceptions of the students were organized in a model in which the scientific theories are generated, considered as part of a "research program where methods, concepts, values and epistemological assumptions differentiate the scientific program that is intended to teach.

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ALTERNATIVE CONCEPTIONS OF STUDENTS X EPISTEMOLOGY OF LAKATOS

Abstract

This paper presents a teaching proposal that emerges from students' alternative conceptions on a theme for a teaching sequence based on Lakatos epistemology, that enables the discussion of science through historical aspects, aiming to contribute to the construction of the knowledge in science teaching. The proposal was conceived from the analysis of the results of a research done on the initial conceptions of students about the pesticide theme carried out with a total of thirty students of the 3rd grade of the public school system in the southern region of Paraná, Brazil. The results revealed the possibility of the teacher acting as a mediator of the teaching process in which the students' conceptions were organized in a model in which the scientific theories are generated, produced by the protagonism of the students in choosing a concept that best characterizes the studied theme.

Keywords: Alternative conceptions; Science teaching; Lakatos epistemology.

CONCEPTIONS ALTERNATIVES D'ÉTUDIANTS X EPISTÉMOLOGIE DE LAKATOS

Résumé

Cet article présente une proposition d'enseignement que découle des conceptions alternatives des étudiants à propos d'un thème pour une suite d'enseignement fondée dans l'épistémologie de Lakatos, qui permet une discussion de la science à travers des aspects historiques afin de promouvoir la construction de connaissance dans l'enseignement de sciences. La proposition a été conçue à partir de l'analyse des résultats d'une recherche réalisée sur les conceptions initiales des étudiants à propos des pesticides, la recherche a été réalisée avec trente étudiants du troisième année du Lycée des écoles publiques, dans la région Sud du Paraná, au Brésil. Les résultats ont révélé la possibilité de l'actuation du professeur comme un médiateur du processus d'enseignement dans lequel les conceptions alternatives des étudiants ont été organisées, dans le modèle auquel les théories scientifiques sont produites par le rôle des étudiants dans le choix d'un concept qui bien caractérise le thème de cette étude.

Mots-clés: Conceptions alternatives; Enseignement de Sciences; Épistémologie de Lakatos.

CONCEPCIONES ALTERNATIVAS DE ESTUDIANTES X EPISTEMOLOGÍA DE LAKATOS

Resumen

El presente trabajo presenta una propuesta de enseñanza que emerge de las concepciones alternativas de estudiantes sobre un tema para una secuencia de enseñanza embazada en la epistemología de Lakatos, que posibilita la discusión de la ciencia por medio de aspectos históricos, con el objetivo de contribuir para la construcción del conocimiento en el ensino de ciencias. La propuesta fue concebida a partir de análisis de los resultados de una pesquisa realizada sobre las concepciones iniciales de estudiantes a respecto del agrotóxico, realizada con treinta alumnos del tercer grado del ensino básico de la red pública en la región sur del Paraná, Brasil. Los resultados rebelaran la posibilidad de actuación del profesor como mediador del proceso de enseñanza en cual las concepciones alternativas de los estudiantes fueran organizadas en un modelo en que las teorías científicas son hechas, producidas por el protagonismo de los estudiantes en la escoja del concepto que mejor caracteriza el

tema em estudo.

Palabras-clave: Concepciones alternativas; Ensino de Ciências; Epistemología de Lakatos.

CONCEPÇÕES ALTERNATIVAS DE ESTUDANTES X EPISTEMOLOGIA DE LAKATOS

Resumo

O presente artigo apresenta uma proposta de ensino que emerge das concepções alternativas de estudantes sobre um tema para uma sequência de ensino fundamentada na epistemologia de Lakatos, possibilitando assim a discussão da ciência por meio de aspectos históricos, com o objetivo de contribuir para a construção do conhecimento no ensino ciências. A proposta foi concebida a partir da análise dos resultados de uma pesquisa realizada sobre as concepções iniciais de estudantes a respeito do tema Agrotóxico, realizada com um total de trinta alunos da 3ª série do Ensino Médio da rede pública na região Sul do Paraná, Brasil. Os resultados revelaram a possibilidade de atuação do professor como um mediador do processo de ensino no qual as concepções alternativas dos estudantes foram organizadas num modelo em que as teorias científicas são geradas, produzidas pelo protagonismo dos estudantes na escolha de um conceito que melhor caracteriza o tema em estudo.

Palavras-chave: Concepções alternativas; Ensino de Ciências; Epistemologia de Lakatos.