

SEÇÃO VII - ENSINO DA CIÊNCIA DO SOLO

A METHODOLOGICAL PROPOSAL FOR A PRACTICAL TEACHING OF SOIL MICROBIOLOGY⁽¹⁾

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SUMMARY

The most interesting effect of introducing research into teaching is the assimilation of knowledge as a theoretical construction shared by the scientific community. The idea of temporary and subjective knowledge must be developed in the classroom. But, how can doubt arise during the study of a subject? At the Agricultural Microbiology Course at Faculty of Agricultural Sciences (Universidad Nacional de Entre Ríos) a team work has been conducted for five years, characterized by the use of problem-solving to motivate the learning process. In the classroom, teachers co-ordinate activities and students design experiments based on the outlined problems in order to obtain results. These results are analyzed and discussed, followed by new problems and new questions. This methodology has been evaluated and it has been concluded that learning thus acquired may be more significant.

Index terms: teaching methodology, soil microbiology.

RESUMO: *PROPOSTA METODOLÓGICA PARA ENSINO DE MICROBIOLOGIA DO SOLO*

A consequência mais interessante de inserir pesquisa no ambiente de atividade educacional é a assimilação do conceito de conhecimento como uma construção teórica compartilhada pela comunidade científica. A idéia de conhecimento temporário e subjetivo deve ser desenvolvida na sala de aula. Mas, como um problema pode ser criado durante o desenvolvimento do conteúdo? Em Microbiologia Agrícola da Faculdade de Ciências Agropecuárias (Universidad Nacional de Entre Ríos), foi desenvolvido um trabalho de grupo

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durante cinco anos. Este trabalho foi caracterizado pelo princípio metodológico da resolução de problemas para auxiliar o processo de aprendizagem. Na sala de aula, os professores coordenaram as atividades e os estudantes desenvolveram e projetaram a experiência, baseando-se nos problemas levantados para obter resultados. Depois de analisados e discutidos, verificou-se que novos problemas e questões surgiram. Este método foi avaliado por meio de entrevista com os alunos leva a crer que sua utilização em sala de aula, tenha tornado a aprendizagem mais significativa.

Termos de indexação: metodologia do ensino, microbiologia do solo.

INTRODUCTION

The problem of generation of knowledge and logic in scientific research is often posed in science. Generation of knowledge implies an analysis of the scientific work, helping to understand the role played by certain perspectives of treatment of reality, which have been historically consolidated as disciplinary traditions (defining the object, using a certain language, etc.). The formulated analysis of knowledge, although interesting, is rarely considered as affecting the educational practice. This creates a gap between the scientific research environment - where knowledge is generated- and the educational environment -where this knowledge is transmitted- (Britos, 1998). As a result, the object of classroom study is established as something unrelated to the subject. The way concepts are transmitted in college makes students accept what they are taught as “the truth” since knowledge is rarely formulated as something provisional and connected to the historical context in which it was “produced”. To what extent is the idea that knowledge is provisional present in the classroom? When dealing with certain contents, do we allow students to question authorized knowledge?

One of the most important aspects of introducing research into the teaching environment is the assimilation of the concept that considers knowledge a result of the production of theoretical constructions accepted by the scientific community sharing the same paradigm. As a consequence, university teaching consists of transmitting knowledge related to its form of production. It is important to emphasize that the practices of knowledge are not understood from its results but from the questions and problems that move them (Britos, 1998).

Teachers often question themselves about how a state of uncertainty can be transmitted to students when the subject is developed. What mechanisms can be used to make students link assumptions to build ideas that constitute a discovery for them? To sum up, how to help the inner organization of the structure to which knowledge is incorporated? (Freire & Quiroga, 1985).

The epistemological conception of the provisional character of scientific knowledge and the idea that scientific progress is neither cumulative nor convergent, has made us face the course Soil Microbiology from a perspective in which knowledge construction is taught recognizing it as marked by historicity.

Learning is intended not to be fragmented as a consequence of a gradual and ordered presentation of knowledge, in which a stepwise sequence is developed from simple to complex, and in which steps are given great importance.

Based on the assumption that knowledge is rendered significant in the light of a detected problem, as long as it is possible, a basic proposition is realized from which problems and questions arise.

Thus, from the particular situation presented here, it is intended to avoid arriving at foreseen results through the application of guides leading to different steps.

Instead, the available analytic alternatives and the possible results are presented to the students so that their application and the different uses these results represent are discussed. Educators play the role of formal leaders that organize the task and coordinate the teaching-learning process. Students work actively together with teachers sharing their doubts, experiences, and opinions (Pasel, 1990). This methodology promotes student participation in constructing knowledge.

This enables the group to select techniques that allow characterizing different situations on the basis of its interests and time. Thus, apart from learning how to use the different techniques of soil microbiological analysis, they can also analyze the limitations of applying each of them. This contributes to their understanding of the provisional character of knowledge, related to the development of better analysis methodologies.

Operational groups work towards a specific task as their main objective. This implies that the members of the group should participate cooperatively, giving ideas, working and playing a specific role. Throughout the learning process

students modify their Operative Referential Conceptual Scheme as they are learning. Students read and interpret reality based on this scheme. Team work experience helps student ask themselves and others about knowledge from the point of view of their own experiences.

Soil microbiological analysis presents particular problems derived from the fact that microbial population colonizes a physically and chemically heterogeneous environment. These problems are also related to edaphoclimatic conditions acting on the microbial world, while microorganisms determine many of these conditions. That is why microbiological studies must be completed with ecological studies that allow to obtain information on the real activity of the population in its natural environment, and on which conditions are modified by the intervention of man in agricultural ecosystems (Paul & Clark, 1989; Tate, 1995; Frioni, 1999).

The teaching proposal consists of a team work, coordinated and advised by the teachers, in which students select the steps to be achieved in each task. Thus, they express and exchange their ideas to one another, recognizing and appreciating their mutual contribution (Pasel, 1990). A team work allow its members to learn to think and act together with others, in a propitious atmosphere for active learning, where the student is the receptor and producer of information and the educator is a facilitator, not stereotyped as the owner of knowledge. In such atmosphere, they elaborate and give significance to working patterns and criteria of evaluation.

The objective is to promote the manifestation of interests and needs of the team at the beginning of learning the dynamic and structural unit: Soil Microbiology. The central aim of this proposal is to allow the student to see knowledge as an unfinished construction, and not something closed, promoting the idea of provisional knowledge. Consequently, the student is expected to understand the significance of soil microorganisms and to analyze the effect of the ecological factors on their development, to apply some of the various approaches used in the study of microorganisms, and to develop skills on techniques related to soil microbiology.

MATERIAL AND METHODS

An investigation on the effect environmental conditions have on microorganism development is proposed, apart from an analysis on the impact cultural practices have on populations through the changes they cause on edaphic conditions.

The task is part of the course Agricultural Microbiology (1 semester), and evaluates different situations such as: soil profiles, plowing systems, prairie effect, agricultural lots, and natural field.

Each team works on a sample, proceeding from one of the situations. The objective is to compare situations using some techniques applied out at the Laboratory of Agricultural Microbiology of the Faculty of Agricultural Sciences. For selecting the analysis techniques, students are provided with bibliographic material. In general, two types of analyses are proposed: (1) evaluation of the global population; (2) evaluation of functional groups related to cellulolysis, nitrogen mineralization (ammoniphicators, nitritators, and nitratators), and free living nitrogen fixing bacteria.

For the first case, they may use any of the available techniques: microbial biomass, CO₂ production, and total microflora, or others in literature, as long as they are feasible. Selecting a technique reflects the aim established by the group itself and, according to this aim, it is decided what to characterize and what to quantify, the proper characteristics of the selected method and time availability of the group members.

In the second case, they use plate count methods for the evaluation of cellulose - decomposing aerobic bacteria and free living nitrogen fixing bacteria. And for microbial groups related to nitrogen mineralization, they are advised to use the most probable number method in selective liquid media (Frioni, 1990; Page et al., 1992; Alef & Nannipieri, 1995). The characteristic initiatives of the different groups often lead to the use of other methodologies proposed by the students for bibliographic analysis.

Students should program their activities and materials, substances and tools needed so that different moments may be recognized such as: problem identification and delimitation, hypothesis formulation, selection and execution of the adequate experimentation to support the established hypothesis. On each stage, it is essential to know why the student is conducting such operations.

RESULTS AND DISCUSSION

The results are elaborated, analyzed, and interpreted. Finally, the group may share results to realize the possible comparisons between situations. At this stage, it is intended to enlarge the analysis by some reflection exercises: what edaphic variables are affected by the tilling system, rhizosphere and how are they related to this or that microbial group? Are these effects similar to all the microorganisms analyzed in this work? etc. This situation promotes discussion and exchange of ideas among students, which permits, with the teacher coordination, to re-elaborate and strengthen the achieved knowledge. Conclusions are elaborated, establishing new doubts or questions that may have arisen and a report is presented.

This methodology has been applied for the last five years. Students have been asked to evaluate the positive and negative aspects of this teaching method. They appreciate different aspects and agree that, in general, it takes a greater effort to achieve results but learning becomes more significant.

Different aspects of the practical work are highlighted. The methodology used is useful for different reasons. First, the students' need to discuss with other students how to approach the performance and foundation of a given activity; the reduced number of students per group allowing more participation, the freedom to choose the work timetable, the relationship of theoretical development of the subject to the activity being performed, and the non-conventional way of evaluation. Secondly, they value the choice of subjects, which they consider important for their future professional performance. As a negative aspect, they underline the lack of bibliographic material in Spanish and their inexperience in following tasks with this methodology. The students' evaluation was supported by teachers of later courses related to the subject, who state that students are better prepared for incorporating new learning and contextualizing them adequately.

This methodological proposal favored communication and the exchange of ideas between members of the group. This coincides with the idea of PICHON RIVIERE (1978) that group interaction allows students to recognize themselves and the group. This relationship is a complex structure that includes a subject, an object and their connections and communicative and learning processes.

CONCLUSIONS

Operational group work, analysis and problem solving are methodologies that allow students to play an active role in their learning process. Knowledge thus acquired, permits students to be better prepared for the incorporation of new learning.

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