

Teaching of Botany in higher education: representations and discussions of undergraduate students

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Abstract: The teaching of botany is characterised as being taught in a theoretical and uninteresting way for students. The purpose of this work is to discover what students think of the way Botany is taught and their views on the subject. In order to achieve this goal an open questionnaire was presented to the first year undergraduate students studying Biological Sciences. 221 students from 3 different universities filled in the questionnaire. From the results gathered, students in our sample were in favour of a more practical teaching of Botany, and if they were the professors, they would transfer the class into the field after theoretical lessons. This inversion of positions (from student to teacher) brought a modification in the way they feel Botany should be taught, in spite of the players being the same. This article has pointed out that the representation of a concept can vary depending on the subject's point of view and that it is important to pay close attention to the training of these future Biology teachers.

Keywords: teaching methods, Botany, undergraduate students, teachers training, higher education.

Introduction

Conceptions and representations of teaching and how to teach are part of the imaginary of the students in training, mainly of those who will become teachers. "How should I teach classes of certain topic? What should I do in the classroom? How should I deal with personal differences?" These questions arise during a teachers' formation and permeate the discussion during the curriculum subjects.

Considering that botany is a topic rarely discussed in elementary and high school, the representations of this theme can greatly say about how these classes are and how students would like the classes to be. Several students already arrive at the university with a preformed construction of the teachers' role and of how they would like to educate.

The present text aims to analyse how the university newly entered students represent the activity of teaching, in special about the botanic knowledges, and how they see themselves teaching this subject. The students' representations could indicate ways to help teachers not only to prepare subjects for classes, but to organize university courses as well. This recognition of functions allows teachers to better organize their ideas about

their classes, about their educational approaches, being useful not only for university professors in the botanic and education area, but also in other areas of knowledge.

Theoretical foundation

The teaching of Botany has concerned several teaching sectors, from basic to higher education, pointing to a need to improve this teaching (Rawitscher 1937; Hershey 1996; Barradas and Nogueira 2000; Hershey 2002; Senciato and Cavassan 2004; Kinoshita et al. 2006; Silva et al. 2009; Towata et al. 2010; Guimarães 2010; Guimarães and Santos 2011; Zompero and Laburu 2014; Silva and Sano 2014; Silva and Ghilardi-Lopes 2014).

The Teaching of Botany is characterised as being very theoretical, demotivating for students and undervalued within the Teaching of Sciences and Biology (Kinoshita et al 2006). Furthermore, a study carried out by secondary school students in Germany and Austria pointed out that Botany is the scientific subject that less inspires interest in students (Elster 2007). According to Carter (2004), the interest in Botany decreased quite a lot after the decade of the 40s in the 20th Century and held less ground in some curricula in the USA. Even with the recognition of the importance of plants for human beings, the interest in plant biology is so little that plants are rarely perceived as anything other than components of the countryside or decorative objects. Wandersee and Schussler (2001) call this Botanical blindness.

Within this context, the teaching of Botany in the classroom has been reduced. Guimarães (2001) highlights that whilst science in school is becoming more complex and presents new areas of research which bring about new knowledge, the study of Botany in school is becoming emptier and more simplified, covering a limited area. Besides the "limitations" of space set aside for the study of plants in schools, a study carried out by Silva et al. (2006), on the improvement of Botany teaching with primary and secondary school teachers, highlighted that many teachers understand improvement in teaching as the incorporation of teaching resources, alleging that teaching conditions have an influence on the method chosen to give classes. When considering these aspects, one may ask: what is the social representation presented by students on the teaching of botany? How the teaching of botany could be thought in the classroom by those students? How the practice of teaching botany is represented?

Representation of concept

The representation of a concept or a theme is related to what human beings think about a certain matter, how they perceive this or that situation and the opinion they have on a certain matter (Franco 2004). This type of representation, known as social representation, was described for the first time by Moscovici in 1961 (Moscovici 2013). Moscovici and Doise (1991) characterise social representation as an individual's view on a subject or object based on the historical, social or ideological context he belongs to. Leontiev (1978) affirms that social representations are people's behaviour in miniature. Sêga (2000) states that social representation is a way of interpreting and thinking daily reality, a way of knowing the mental activity

developed by individuals and groups to assert their stance in relation to situations, events, objects and communications which concern them.

According to Leontiev (1978) from what an individual says it is possible to deduce what are his conceptions of the world and also his daily routine (in this case applying to teachers as well as to students), which the author calls guidance for action. Sêga (2000) states that social representation is a practical knowledge which gives meaning to events that are formal to individuals, forges an awareness of the individual's consensual reality and helps him in his social construction.

As for researching the conditions in which the representations are produced, Alexandre (2004) warns that we should take care to investigate the origins and the amount of information provided by a group or a community on a given social subject, as well as the set of dominant ideas used by the members when referring to the subject. From that point, it is possible to unveil the thoughts and actions of social groups.

Context and method

Problem of research

It is important to clarify one question: why choose students from Brazil and Portugal? The universities, in both countries, follow a model of French education. Thus, the university teaching followed the same pattern of learning until the university reform in 1968 on Brazil. In Portugal, The new reform occurred in 1999, with Bolonha process. Over the years, the two countries have followed different curricular patterns (Novoa 1999; Berbel 1994; Ponte 2006). When considering this relationship between teaching in Brazil and Portugal, it is possible to debate about this kind of teaching and what is important to teach, just to establish a comparison between the two countries and this initial formation of teachers.

Faced with the difficulties tackling the subject of Botany, the objective of this article is to check the students' representations (future biologists and biology teachers, covering primary, secondary and higher education) on the teaching of Botany. To do so we will look for the opinions these students have on the teaching of Botany when they begin at University and what they would do if they were Botany teachers. The idea in this case is to compare the views on how the teaching of Botany should be with how they would teach Botany, in order to establish a parallel between the students' discussions.

This work suggests another aspect: having this previous knowledge, about the of the student's opinion, the teachers will be able to reflect on the teaching suggestions of their public, in order to demystify and make Botany as attractive as possible.

Sample

The research was carried out in 4 Universities. 3 in Brazil and 1 in Portugal, with students from the courses of Biological Sciences, Biology-Geology and Applied Biology. 4 classes were subjected to the research in Brazil and 2 in Portugal. 221 students gave their consent for their replies to be used, from these, 137 are attending Brazilian Universities and 84

Portuguese. The majority of the students who replied to the questionnaire are less than 20 years old (74.6%), 37.1% (82) being male and 62.9% (139) being female.

Methodology

For this study, an open questionnaire was carried out asking the following questions: Define what is "to give classes"? How should a course in Botany be taught? If you were a teacher, how would you teach a course of Botany? Set out the main activities you would develop if you were a Botany teacher.

All the students started the course in the same year of the research; therefore, it was taken before the students had even started any Botany subject at University.

Analysis of the data

The data was analysed by theory of Strauss and Corbin (2008), in which concepts are identified through data. Using this method of analysis, concepts are extracted from the data and are codified into categories. This theory is based on the absence of preconceptions, trying to neutralise researchers' possible biases. For this study the model of selective codification, described by Strauss and Corbin (2008), was used. In this model, categories are created through the selection of the most representative data in the replies analysed. In other words, all the opinions are considered and then grouped selecting the most obvious and relevant from the data. According to Crewell (2007) these claims of socially constructed knowledge are based on social constructivism. The objective in this case is to use the views that the participants have of the situation that is being studied as a basis.

After the categorization, a quantification of the data was carried out, having this data, the frequency was drawn up based on the total number of students at each University/country. In this way it is possible to analyse the data and establish relations between the conceptions of the Brazilian and Portuguese students.

Results

On teaching

When asked what teaching means, the most frequent student's reply is related to the transmission of knowledge. This is the meaning for 39.37% of the students: "To teach, pass on knowledge to someone"; "To pass on knowledge, to teach what you have learnt". The second category, mentioned by 21.72% of the students, is related to the way in which that knowledge is dealt with: "To transmit knowledge, whether didactic or personal"; "To teach is to transmit, in a didactic way, your knowledge of a certain subject". 21.27% of the students think that the act of teaching is related to learning, with an understanding of the knowledge: "It is to allow the student to learn about a certain subject"; "to make the student understand the subject in addition to the knowledge described in books". Some students highlighted that the activity of teaching is a exchanging of learning (10.86%): "An interaction between pupil-teacher where both swap knowledge"; "It is to learn while teaching". A last category mentioned is

related to the interaction of the individual with the knowledge, making him change his view on the subject (6.33%): "To produce knowledge promoting learning"; "To teach is to transmit the knowledge that you possess, in order to help someone form their own opinion on the subject (knowledge) learned".

On the teaching of Botany

When questioned on how Botany ought to be taught, the students from the two countries prioritized characteristics from different classes (see Table 1). The most mentioned category, adding together all the students (33%), represents the second most mentioned category by the Brazilian students (25%) and the most representative category for the Portuguese students (46%). Here the students highlight the importance of classes being more practical than theoretical: "Practical I think, in order to learn all those terms more easily"; "It should not be too lecture-based, as this becomes monotonous. This teaching must become more dynamic". Theoretical classes followed by practical were the most mentioned by the Brazilian students and represent the second most mentioned category in this study: "The teaching of Botany should merge theoretical classes, where students come into contact with a new topic, with practical classes, where the topic of the theoretical class is seen in practice"; "Besides theory, which is essential to get to know the plant kingdom, it is also important to observe the different species mentioned and to apply what was taught in theory". In this category, we must note that the practical classes serve to demonstrate what has been taught in the theoretical classes.

Question: How should a course of Botany be taught?	Students from Brazil	Students from Portugal	Total students
Classes more practical than theoretical	24.82	46.43	33.03
Theoretical classes applied in practice	30.66	14.29	24.43
Fascinating, motivating class	0.00	22.62	8.60
Interdisciplinary classes	9.49	3.57	7.24
Contextualized classes	8.76	4.76	7.24
Lectures	8.03	3.57	6.33
Others	9.49	0.00	5.88
Do not know or did not respond	8.76	4.76	7.24

Table 1.- Categories established from the students' conception of how Botany should be taught. Results are showing as percentages.

The third most mentioned category was mentioned purely by Portuguese students (22.6% of all Portuguese's students), showing its relevance for these students, where the teaching of Botany should prioritize motivational classes, which encourage the student to search for knowledge: "it must above all else be fascinating in order to interest everybody"; "above all it should be fascinating as it is quite an extensive curricular subject, and at

times a little dry"; "appealing as plants face prejudice from the Biology students".

The other categories added up to 30% of the whole sample, and represent different ideas and strategies in teaching. Some students highlighted the inter-disciplinarily of the Botany classes in higher education: "The Botany course should be focused only on the essential to understand the plant structures and the relationship between the organisms". Others believe in a contextualised class: "Dynamic, realistic, involved in the environment in which the student is placed". Others prefer a more theoretical type of class: "It should be quite illustrative, as there are many details to be taught". The rest of the categories added up to 5% and were mentioned only by Brazilian students (see Table 1).

The students were also questioned on how they would give a course of Botany, setting out what they would do if they were the teacher. The categories created are similar to the categories in the previous question, precisely to compare the results and set out the similarities and differences in the teaching of Botany. Some categories were created to adapt to the new answers.

Two categories were the most popular; the first is related to teaching in the style of lecturing giving analogies and examples, using the available resources. This category was well represented by the Portuguese University in its two sampled courses (see numeric data in Table 2): "In a Botany class the use of pictures and summaries helps in the understanding of what is being taught as well as a good explanation"; "I would explain the matter, focusing on the essential points, to make it easier to study for the test". The second category showed a percentage close to the first (see Table 2) and represents a conception of the theoretical-practical class: "I would try to group together as much as possible the practical with the theoretical, using the types of plants for example, so that the student has direct contact with the material. I would try to use diagrams and graphs that simplify the content"; "I would quite often use plants even in theoretical classes, as it focuses the attention of the students".

The first two categories were the most mentioned in the previous question and appear here with the approximate number of students who would choose for that teaching strategy (see data in Table 2). One of those categories is the theoretical model followed by the practical: "Firstly, the theoretical class to give the student the background to the subject. Then, the practical class for him to visualize what is happening and in that way understand the theory better"; "initially, I would teach all the concepts, mechanisms, etc. in a theoretical way, resorting to theoretical materials and examples and following that I would try to put the knowledge acquired theoretically into practice". The other category relates to a more practical and dynamic lesson: "I would try to let the students have more contact with the study material, making the lesson less abstract"; "I would develop practical classes and examples to aid visual and memory retention".

A new category was created to be able to observe the view of some students. This category is related to field lessons as an alternative strategy, in addition to the theoretical and practical classes (see Table 2). This category was mentioned quite often by the Portuguese students: "In a

Botany class, I would take the students to an environment with lots of plants, I would show the shape of the leaves, the flowers and their parts, the importance of plants for the animals who live in that environment and depend on them"; "I would give more dynamic classes, with field trips, I would give my students a taste for Botany". Some students stated that they would talk to their students and contextualize the classes: "I would give a more open class, requesting the constant participation of the students"; "I would try to make the students interact in the lesson and I would try to show them objects and events that happen from one day to the next". It is noticeable here a greater concern with an effective learning rather than the teaching process itself.

Category	Students from Brazil	Students from Portugal	Total students
Lecture with analogies and examples	21.90	29.76	24.89
Theoretical-practical class	21.90	25.00	23.08
Theoretical followed by practical class	16.06	10.71	14.03
Practical class, using various resources	15.33	11.90	14.03
Field class combined with theoretical and practical classes	8.03	15.48	10.86
Dialogue and context-based class	6.57	3.57	5.43
Classes using the textbook	2.19	0.00	1.36
Does not know or did not reply	8.03	3.57	6.33

Table 2.- Categories constructed from the students' conception of how they would give a course on Botany. Results shown as percentages.

The students were questioned about the main measures they would develop in the classroom as a teacher and which activities they would develop in a lesson (see Figure 1).

For this question the students could list several measures or highlight one activity. The most mentioned activity is related to the carrying out of field lessons and the use of non-formal spaces in teaching, followed by practical classes and theoretical followed by practical. It is noticeable in this context a new perspective of activity; the field lesson becomes essential for many students (around 50% of them). We can also highlight the two teaching strategies, which remained amongst the measures most mentioned, the method of theoretical classes followed by practical, and classes that are more practical and dynamic. More than 10% of the students did not reply to this question.

The Portuguese students brought two new measures to the teaching activity. They are items 8 and 13 in Figure I. Note that the number of Portuguese students whom given importance to class's interaction is very large. Corresponding with these students' responses throughout the

questionnaire, for the Portuguese students item 8 would be third most relevant only behind the field lesson and the practical classes.

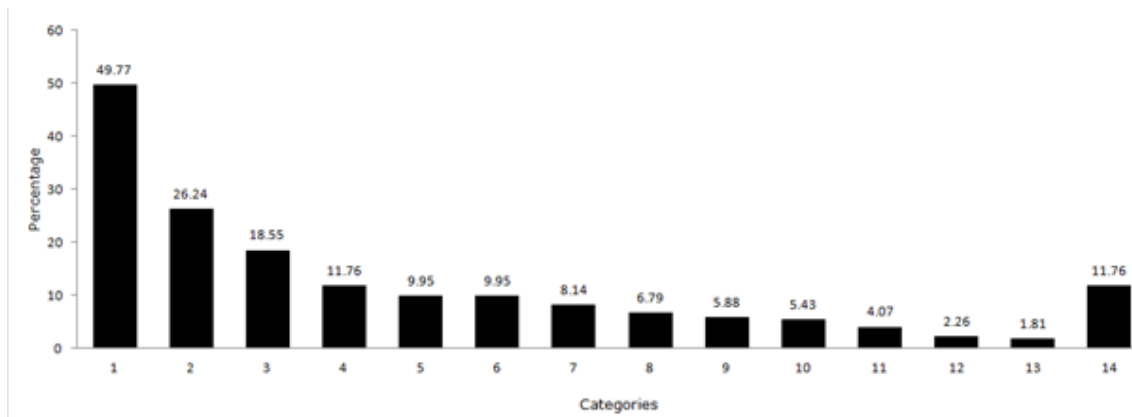


Figure 1.- Main activities that would be developed by the students in a Botany class. The numbers below represent the categories mentioned and the ones above the bars the percentage of students who mentioned that activity: 1. Field classes/use of non-formal spaces in teaching. 2. More practical classes. 3. Teaching the theory and showing in practice. 4. Discussion of current issues and the importance of plants. 5. Relating the subject to mankind. 6. Botanical Research. 7. Talks and seminars. 8. Interactive class using different methods. 9. Exhibitions and videos. 10. Collections and planting of vegetable gardens. 11. Old theories X current. 12. Use of bibliographies and guidance. 13. Group work. 14. Does not know or did not reply.

Correlation between representations and expectations of the students regarding the teaching of botany

When we establish a comparison between the students' replies on how Botany should be taught and how they would deliver a Botany class, it can be seen that students hope to have more practical lessons, the teaching strategy most mentioned by the students, different to the strategy that they would apply if they were the teachers. It is noticeable in Figure 2 that, when they take the role of the teacher, they apply a teaching strategy different to the one they wished to receive as students in Botany class. No complaints appeared regarding the way the subject is taught when they were in the role of teachers, nor questions relating to the capability of the teacher to motivate the students.

Discussion

The main difference between the Portuguese and Brazilian students is in regard of their views over the teaching of Botany. Note that some Portuguese students (see the percentage in Table 1) believe that the teaching must be motivating for the student, or that the teaching method should attract him/her to study Botany. Unlike the Brazilian students that don't demonstrate much concern regarding motivation in teaching methods. It is noticeable that in the subsequent question, students from both countries didn't include the motivational factor in their answer when taking the role of teachers. This concern is also set out in the question about measures developed in the classroom (see Figure 1) as an interactive class with various teaching methods.

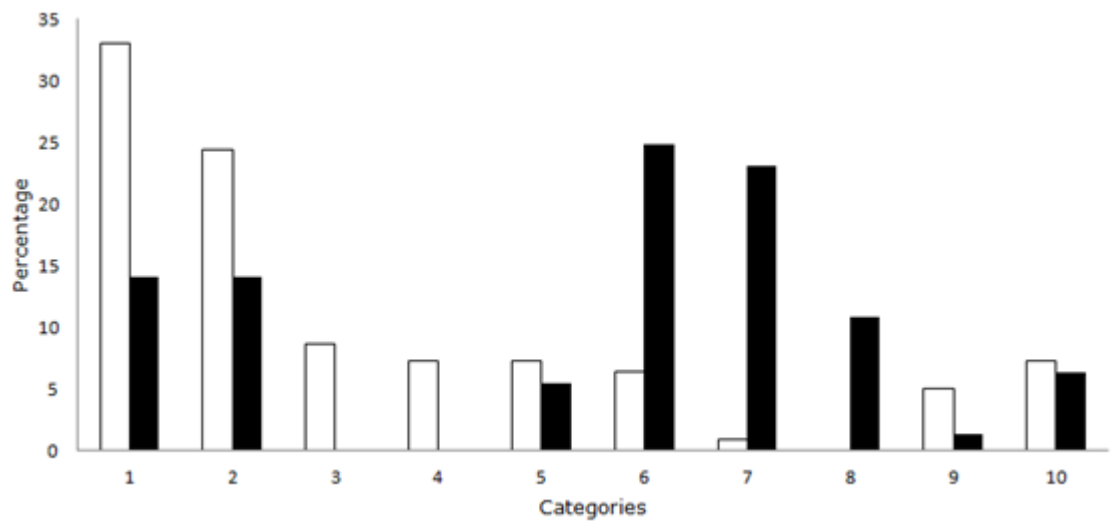


Figure 2. Main strategies thought of by the students from the Universities analysed. What is coloured white represents how they would like the teaching of Botany to be and what is coloured black how they would minister the Botany course. The figures represent the categories created: 1. More practical, dynamic classes. 2. Theoretical classes followed by practical classes. 3. Motivating, inspiring classes. 4. Interdisciplinary classes covering Botany subjects and other areas. 5. Contextualised, realistic and dialogue-based classes. 6. Lectures. 7. Theoretical-practical classes. 8. Field lessons. 9. Others. 10. Does not know or did not reply.

One possibility to awaken students' interest in Botany is to use non-formal spaces to teach. Faria (2011) highlights that these spaces promote learning in addition to scientific knowledge, they may or may not be associated with scientific knowledge and with a social context. Another possibility is contextualizing knowledge; this activity was brought up by both sets of students in different proportions (see Tables 1 and 2). Silva (2007) questions the possibility of training undergraduate academics with a perspective of "teaching to think" about reality critically in the subjects of natural sciences, more specifically in Botany, despite the contents being distanced from reality.

The use of non-formal spaces in teaching or the development of the field class mentioned by the students is another alternative for the teaching of Botany. Silva et al. (2009) state the importance of contextualizing teaching in natural environments, making a closer relationship possible between scientific knowledge and reality.

One of the important points in this work is the representation of teaching Botany in a practical way or in a theoretical way followed by practical. This method shows the importance the students give to the practical activity and to this form of teaching. According to Krasilchik (2008), practical classes stimulate the students to participate in the activities being developed. The author highlights that this practical class depends on how it is planned by the teachers, stating that practical classes aimed at demonstration and confirmation of "the correct answers" reduces the activity to a simple manual exercise. This model of demonstrative lesson is represented here as the model of the theoretical class followed by the practical (the second most mentioned by the students).

However, when these students are put in the position of teachers they take in consideration a theoretical and/or theoretical-practical representation for teaching Botany. Krasilchik (2008) reveals that the theoretical model is the most common to be found in the teaching of biology. The popularity of this method is linked to two factors: it is an economical process, which requires just one teacher for a large number of students and it allows control of the class and confidence in carrying out the activity.

It can be observed in this work that when placed in another social position the students present another idea of how Botany should be taught. The different stances strengthen an idea of Bakhtin's (1993) on a person's viewpoint in society. When asked to give an opinion on how they felt Botany lessons should be, the students gave a personal wish, an inner speech, of what they consider important for the teaching of Botany. When placed in the social position of teacher there was a change of speech and "naturally" there was a change of attitude for the teaching of Botany. In this sense Bakhtin (1993) reveals two important aspects; the first is related to the speech of others, the author reveals that in all our speeches there is the discourse of others, the words of other discourses that have been incorporated into our speech. In this sense, much of what we say comes from an adaptation of what we understand as coherent within that social group. The other aspect mentioned by the author is related to the context, which is the factor that frames, pencils the contours of our speeches and carves out an image. Within this point, the context where the students have been put gave them that opinion.

According to Franco (2004), in the majority of cases social representations are a reflexion of common sense, they are spread by different means of communication and consequently absorbed, without a more critical reflexion on the real, concrete, historic, scientific and theoretic foundations that justify them. By analysing this aspect, it can be said that the students represent the teaching of Botany on two levels: one as a student who receives the teaching and the other as the teacher. The separation of these social actors is important, as it portrays the view, which is held on the teaching of Botany in today's society, with teachers being theoretical and not very practical; and students being more practical than theoretical. It can also be noted that if the student considers teaching as an act of transmission of knowledge, then as Botany teachers they should expose that knowledge.

Conclusions

The students presented a wide variety of teaching methods, which allows professors to apply them in the way they teach Botany, or other areas of science. The great concern arising from the results of this work is not related to the type of approach that the students indicated as applicable to the teaching of Botany, but instead, it is the change of attitude regarding the teaching model adopted if they changed from students to teachers. The result of this work shows that students recognise Botany should be taught in a more motivating way, however if they were teachers, they would adopt the same practices as the teachers applied to them, or the practice that they feel safer carrying out. This result also points out that the same person

can change their point of view over a concept when placed in another situation or function.

One of the positive points of this research is that these students are at the beginning of their training, and are therefore able to reflect on the better teaching practices that awaken the students' interest in the subjects of the lessons. It is important to emphasize that there is no correct practice or better model of teaching, but the unusual practices could be more inspiring and better promote the learning process. There is also room here for the teachers to think about their training practices and if their performance in the classroom corresponds with what interests the students the most.

Reflecting about the teaching practice is one of the key points that can be discussed with these students being taught. However, in these Universities, the training of the biology teacher (Botany is included here) is quite separated from the rest of curricular units in biological sciences. One possibility for a reflexion on the most effective teaching practice is to bring together the teachers who will train these professionals, creating an opportunity for both, students and teachers, reflect on the quality of the teaching, so that the first may also work as teachers one day (whether in schools or in Universities).

More research will be carried out with these students after they have attended the course on Botany, to check if there has been any change of attitude regarding the teaching methods of Botany, and if anything in the subject attracted their attention and motivated them to study more about Botany. That research will set out the ideas that the Botany teachers can try out regarding the students' conceptions of how Botany should be taught and the degree to which they may have influenced the construction of that conception.

Implications

The result of this study implies that the formation of teachers needs to review the way how teaching is proposed in classroom. One of the greatest discussions of education is between doing and being (Carvalho and Gil-Pérez 2011; Tardif and Raymond 2000). This result pointed out that: many students feel that the teaching method should be different from the way it is, nevertheless, they would execute the same practices, for they'd feel comfortable and secure using them. Thereby, it is important that teachers work out with the students, future teachers, the perceptions of how the teaching process practiced inside the classroom should be.

Thus, the results indicate that the universities, especially college professors, should look carefully the representations of students and the ways they can recognize the teaching. From this study, it can be considered that the teaching of botany needs to shape these representations to serve to the interests of both teachers and students in the classroom.

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