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Questioning patterns and teaching strategies in secondary education

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Abstract

Presently one of the main aims of secondary education is the development of the critical and creative thinking. These competencies can be achieved through the stimulation of students’ deep learning, namely through questioning. This essay presents a study of classroom questioning in secondary education, in different disciplines. Here, we are concerned with the role of both teacher’s and students’ questions in classroom interaction, and with the relationship between the questioning patterns in the classroom and the teaching strategies. Data were collected by audio recording one class for each teacher: a chemistry teacher, a portuguese teacher and a philosophy teacher participated in this study. The overall results suggest that the three teachers involved in the study showed diverse questioning patterns, as well as their students, and also adopted distinct teaching strategies.

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1. Introduction

Classroom questioning is an extensively researched subject. Questions play a central role in the processes of teaching and learning because students’ learning, thinking, participation and their level of engagement depend on the kind of questions teachers formulate and use in the classroom (Wilen, 1991). The high incidence of questioning as a teaching strategy and its consequent potential for influencing student learning (Gunel, 2008), have led many researchers to explore relationships between teaching questioning methods and student achievement and behaviour. According to the traditional concept of learning occurs when the teacher asks the questions and the students can answer them. However, the reality is that learning does not occur until learners can raise their own questions. Thus, in this paper we are concerned with both teacher’s and students’ questioning patterns. The purpose of this study is to: i) identify the teacher and the students’ questioning patterns during Philosophy, Portuguese and Chemistry classes; ii) discuss the role of the teachers and students’ questions in the process of constructing knowledge; iii) investigate the relationship between teachers and students’ questioning patterns, and teaching strategies, characterized according to Sternberg and Spear-Swerling (1996), and iv) discuss the influence of the discipline on questioning patterns of both, teacher and students.

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2. Methodology

This study was conducted with a sample of three secondary teachers: a male philosophy teacher and two female teachers, one teaching portuguese (native language) and the other teaching chemistry. Since one of our aims was to investigate differences among classroom questioning patterns in different disciplines, we decided to choose teachers from different subjects: science, languages and philosophy. The three teachers and their students \((N=56)\) volunteered to participate in this research project. The chemistry teacher was teaching grade 10, the philosophy teacher was teaching grade 11 and the portuguese teacher was teaching grade 12. Each teacher audio-recorded a 45-minute class of his/her choice. Later, the three classes were transcribed verbatim using the Express Scribe software and content analysis was carried out with the support of NVivo 8.

3. Results and Discussion

3.1. Communication time

The communication time was calculated through the sum of all the oral discourse of the teacher (teacher’s communication time) and the sum of all oral discourse of the students (students’ communication time). The results show that the chemistry teacher spent 83% of the class talking, while the students only talked 17% of the class time (see Table 1). The portuguese teacher used 67% of the class communication time. The distribution of the communication time was more balanced in the philosophy class: 56% for the teacher and 44% for the students.

Table 1. Distribution of the communication time between teacher and students.

| Subject   | Teacher’s communication time | Students’ communication time |
|-----------|------------------------------|------------------------------|
| Chemistry | 83%                          | 17%                          |
| Philosophy| 56%                          | 44%                          |
| Portuguese| 67%                          | 33%                          |

3.2. Number of questions

At first glance, questions are easy to define. However, in practice they are not so easy to distinguish. Here we consider as a question any statement, interrogation or affirmation, intended to evoke a feedback. This feedback can take the format of a verbal response or a reaction or behavior. Drawn out from our study, two instances of questions are:

- Does anyone know the meaning of the word allegoric?
- So, we can say that the calcium mass is...

Along the three 45-minute lessons, were asked 96 questions (see Table 2). These were differently distributed in the three classes: 57 in the chemistry class, 22 in the philosophy class and 17 in the portuguese class. However, teachers’ questioning dominates the classroom discourse in the three classes, regardless the subject. Even if the number of questions asked by the chemistry teacher \((n=45)\) and the portuguese teacher \((n=14)\) are clearly different, these represent similar percentages of the questions raised during each class (chemistry – 79%; portuguese – 82%). In the philosophy class, the students raised about one third of all the questions asked in the class (36%), this is a higher percentage than those of the chemistry class (21%) and of the portuguese class (18%).

Table 2. Number of students’ and teacher’s questions.

| teacher’s questions | Students’ questions | Total |
|---------------------|--------------------|-------|
| Chemistry           | 45 (79%)           | 12 (21%) | 57 |
| Philosophy          | 14 (64%)           | 8 (36%)  | 22 |
| Portuguese          | 14 (82%)           | 3 (18%)  | 17 |

The results of the Chemistry class match those reported by several researchers, for example Kerry (2002), confirming the high number of questions raised by the teacher in a short period of time (a 45-minute class). The Philosophy and the Portuguese teachers asked fewer questions than it was expected according to the literature.
3.3. Types of questions

More relevant than the number of questions asked is the kind of questions asked by the teacher and the students. Teachers’ and students’ questions have been classified through numerous and diversified categorization systems, most of them based on the cognitive level (Bloom, et al., 1956), for example: open and closed questions (the most commonly used categorization), clarification, interpretation, extension, critical and associative questions (Shodell, 1995), basic information and wonderment questions (Scardamalia & Bereiter, 1991), confirmation and transformation questions (Pedrosa de Jesus, Teixeira-Dias & Watts, 2003), acquisition, specialization and integration questions (Almeida, Pedrosa de Jesus & Watts, 2008). Here we decided to categorize questions according to their communication function as well as according to their cognitive level.

Regarding the communication function of questions we classify them as content-related or not content-related (Almeida & Neri de Souza, 2009). Content-related questions are those directly related to the class subject. Drawn from our study, some instances of these questions are:

**Teacher’s content-related questions**
- Is there any other ion that you cannot identify?
- Nobody argues rationally?

**Students’ content-related questions**
- What is B12?
- In this statement I can’t understand the meaning of the word allegoric.

Not content-related questions include questions that are not related to subject issues, namely rhetoric, routine and management questions. Drawn from our study, instances of these questions are:

**Teacher’s not related to content questions**
- Did you have a relaxed holiday?
- Are you distracted again?

**Students’ not related to content questions**
- Can I sharpen my pencil?
- Can I go to the blackboard?

In Table 3 we present the teachers’ and students’ questions distribution according to their communication function.

| Course        | Not content-related | Content-related |
|---------------|---------------------|-----------------|
| Chemistry     | TQ 10 (22%)
                 | SQ 9 (75%)
                 | TQ 35 (78%)
                 | SQ 3 (25%) |
| Philosophy    | TQ 4 (29%)
                 | SQ 0 (0%)
                 | TQ 10 (71%)
                 | SQ 8 (100%) |
| Portuguese    | TQ 1 (7%)
                 | SQ 1 (33%)
                 | TQ 13 (93%)
                 | SQ 2 (67%) |

The results found in the three classes are quite different. In the philosophy class, all the students’ questions are content-related and the teacher asked 4 not content-related questions. This was the first class after the holidays, and those four questions were raised in the beginning of the class, as a way of creating a relaxed environment. The teacher did not ask any other not content-related question during the class. In the portuguese class, the teacher asked only one not content-related question, as well as the students. In the chemistry class the results are very different: 75% of the students’ questions are not directly related to the subject of the class. Maybe this result is related to the kind of class: in the chemistry class, part of the lesson was used to develop a group work activity, and we believe that this strategy encouraged the raising of a larger number of questions that were not content-related.

To deepen the analysis of classroom questions we decided to analyze the cognitive level of the questions previously classified as content-related. We decided to categorize the cognitive level of teachers’ and students’ questions according to the acquisition, specialization and integration categories (Almeida et al., 2008).

Acquisition questions are those questions that deal with relatively straightforward ideas, objects, processes, or concepts which do not require evaluation, judgment, or the drawing of conclusions. These are 'stick-to-the-facts'
questions, testing for information and reassurance. Acquisition questions have one correct or ‘best’ answer or one from a narrow range of answers. Drawn from our study, some examples of these questions are:

**Teacher’s acquisition questions**

*Could you tell us, briefly, what is the poem’s subject?*

*The mass of each ion in this volume is...*

**Students’ acquisition questions**

*How can we calculate the molar concentrations?*

*What does good faith means?*

Specialization questions tend to go beyond a basic search of information. These questions involve the establishment of relations and the understanding and interpretation of the meaning of related issues. Specialization questions move beyond a specific or detailed level of understanding in order to generalize or relate these specifics into meaningful patterns; these questions require the use of previous knowledge. Drawn from our study, some instances of these questions are:

**Teacher’s specialization questions**

*Why is true argumentation always philosophic?*

*Bearing in mind that the recipient of the poem is also a poet, what is the value of this poem?*

**Students’ specialization questions**

*I believe that presently all the argumentation is based on seduction. I can’t find it, but is there, nowadays, any example of reasonable argumentation?*

Integration questions require reorganization of concepts into novel patterns and the hypothesis of new or different applications of principles. These questions are attempts to reconcile different understandings, resolve conflicts, test circumstances, force issues, track in around complex ideas and their consequences. Such questions my have some direct relevance to the classroom topic being taught, tough questions may be triggered by tangential issues or are stimulated by something from outside the class entirely. Drawn from our study, one example of this kind of questions is:

**Teacher’s integration questions**

*Could problematic situations be solved through argumentation? Who knows how to use arguments, uses weapons? Or argumentation will not be always enough...*

Students did not ask any integration question, as shown in Table 4.

|                        | Acquisition questions | Specialization questions | Integration questions |
|------------------------|-----------------------|--------------------------|-----------------------|
|                        | TQ        | SQ     | TQ     | SQ     | TQ     | SQ     |
| Chemistry              | 35        | 3      | 0      | 0      | 0      | 0      |
| Philosophy             | 7         | 6      | 2      | 2      | 1      | 0      |
| Portuguese             | 10        | 2      | 3      | 0      | 0      | 0      |

Teacher’s questions (TQ) ; Students’ questions (SQ)

During the three 45-minute classes only one integration question was raised by the philosophy teacher. This teacher also asked two specialization and seven acquisition questions. The Portuguese teacher raised three specialization and ten acquisition questions. All chemistry teacher’ questions were acquisition questions. All kinds of questions are important and relevant, and of course teachers need to ask low-level or acquisition questions, before they ask higher-level questions. However, having in mind that several authors (Gall, 1984; Kerry, 2002) suggest that it is necessary to raise open questions to produce deeper levels of learning, this result requires reflection. An important implication of asking mainly low-level questions is the limitation of the co-construction of learning: such questions also have implications for scaffolding students’ learning. Experiencing questions at repetitively low levels limits students’ opportunities to further develop their ideas and to be supported to reach higher cognitive levels. The chemistry teacher’s frequent use of low-level questions can also be one of the reasons for the absence of students’ questions. Teachers nurture the culture of the ‘right answer’ rather than discovering the ‘right question’. If the teacher does not stimulate cognitive disequilibrium through a careful selection of the information provided and through their questions, it is likely that students will not question.
In the philosophy class, the questioning is fairly distributed between the teacher and the students, and even in what concerns the kind of questions, we can observe a reasonably distribution of acquisition and specialization questions. But, even in this class, that seems to have a friendly questioning environment, students did not ask any integration question.

3.4. Teaching strategies and patterns of questioning

Sternberg and Spear-Swerling (1996) identified three different teaching strategies typified by the kind of interaction between teacher and students, which, on its turn, was mainly characterized by the number and kind of teachers’ questions, as well as by his or her feedback to students’ answers and/or questions.

The first strategy is lecture-based or didactic. The teacher simply presents the content to be learned. There is very little teacher-student interaction, except perhaps for an occasional question from the teacher, or a sporadic question from a student requesting clarification. In addition, there is no interaction among students, at least not any interaction relevant to the topic at hand. None of the teachers analyzed in this study adopted this kind of strategy.

The second strategy is a fact-based questioning approach. The teacher asks the students many questions, which are designed primarily to elicit facts. The feedback from the teacher revolves primarily around responses such as ‘right’, ‘good’, ‘yes’, and ‘no’. In this strategy, there is much teacher-student interaction, but the interaction tends to be brief and follow-up to individual questions is generally limited. Just as in the didactic strategy, there is little or no student-student interaction. Clearly, this is the strategy adopted by the chemistry teacher. This kind of strategy is congruent with the classroom traditional discourse pattern, characterized by initiation, response and feedback (Cazden, 2001). The teacher initiates with a question, a student answers, and finally the teacher gives the student evaluative feedback and initiates a new cycle with a new question. This pattern places the teacher in a central role and acts to test knowledge, instead of stimulating them to elaborate on their ideas or to extend their thinking. This is clearly the strategy adopted by the chemistry teacher.

The third strategy can be characterized as a thinking-based questioning approach, or simply as a dialogical approach. This strategy encourages the dialogue between teacher and student, and between student and student. The dialogue may be either oral or written. In this strategy, the teacher asks questions to stimulate thinking and discussion. Generally, these questions don’t have one right answer. So, feedback like ‘right’ or ‘wrong’ is generally not given. Instead, the teacher tends to comment on or add to what students have said. If the discussion tends do go too far afield, the teacher may make comments of ask questions that serve to focus the discussion. Thus, in this strategy, distinctions between teacher and students tend do blur, and the teacher becomes more of a guide or a facilitator, rather than a teacher in the traditional sense. Unlike the fact-based questioning strategy, the dialogical strategy has a lot of follow-up to individual questions. There is also much more interaction among students with the dialogical strategy than with the other teaching strategies (Sternberg & Spear-Swerling, 1996).

The portuguese and the philosophy teacher do not fit into one of these specific strategies. The philosophy teacher is closer to the dialogical strategy, asking some higher-level questions and promoting a divergent and evaluative thinking on his students. But he also adopts a fact-based questioning, especially at the beginning of the class, to revise the concepts studied in the previous lesson and to test students’ knowledge. This teacher clearly encourages a discussion learning-environment and promotes the dialogue among students; this kind of interaction was not observed in the chemistry and portuguese classes. The portuguese teacher is closer to the fact-based questioning strategy, asking mainly questions to elicit facts, and giving a ‘right’ or ‘wrong’ feedback. However, this teacher also raised 3 specialization questions.

It is also important to notice that it seems to exist a relationship between the teaching strategy and the communication time. The teacher with a larger communication time adopted a fact-based questioning strategy (the chemistry teacher), while the teacher with a lower communication time adopted a strategy that is closer to the dialogical strategy (the philosophy teacher).

Sternberg and Spear-Swerling (1996) characterized these three teaching strategies mainly according to the kind of questions teachers asked, as well as according to the feedback they give to students. However, we believe that two indicators should be considered: the number and the kinds of questions students raise and the communication time.
4. Main conclusions and limitations

Although this research is based on three classes, which makes generalization difficult, the results indicate that teachers teaching different subjects exhibit distinct teaching strategies and distinct questioning patterns. The philosophy teacher adopted a strategy that was closer to the dialogic: this teacher asked fewer questions, but these were more complex than those asked by the other teachers; this teacher also promoted more interaction between teacher-student and student-student. Since philosophy is a discipline that promotes the discussion, the reflection and the critical thinking, we may think that philosophy classes are more prompt to encourage a questioning friendly learning environment. On the other hand, the chemistry teacher used a fact-based questioning strategy; this strategy does not encourage divergent thinking and does not enhance students’ questioning competence. However, asking questions is fundamental to science and scientific inquiry. Zoller et al. (1987) argue that the development of students’ abilities to ask questions, reason, problem-solving, and think critically should become a central focus of science education. The teaching used in the Portuguese class was closer to the fact-based questioning. This kind of strategy mismatches one of them main aims of the language teaching: to enhance creativity. We can question if the teaching strategies are related to the personal characteristics of each teacher, if the teacher switches teaching strategy according to the aim of the class or the content (Kerry (2002) suggests that teachers use the same repertoire of questioning lesson after lesson), or if teaching strategies are discipline-dependent.

As referred earlier, this study has several limitations, one of them related with the sample size. One of our purposes is to conduct a similar study with a larger sample (more teachers from these three disciplines and maybe include teachers from other disciplines) to answer the following questions: are teaching strategies discipline-related? Are there disciplines that naturally promote a dialogical approach? Are there disciplines that naturally promote a fact-based questioning approach?

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