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A Study of Student Actions in the Classroom of a Campus of a Federal Institute of Paraná

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This research presents a proposal of analysis of student actions in the classroom for the subjects of Physics, Mathematics and Chemistry of an Integrated Vocational High School of the state of Paraná in Brazil. The research has as theoretical support the concept of learning of Illeris; Charlot's studies of the relationship to knowledge and learning as a practice of knowledge. The research question that guided this study was: What are the categories of student actions in Physics, Mathematics and Chemistry classes? The methodological were conducted according to Discursive Textual Analysis. The data analyzed is derived from the recording of the classes and field notes. Among the results, we highlight seven emerging categories of student actions that answer our research question: To Organize, To Interact with the Teacher, To Interact with Classmates, To Practice, To Wait, To Disperse and Other Actions.

Keywords: Student action; Scientific learning; Relationship to knowledge.

Introduction

This investigation is part of a research program, which studies teacher actions since 2010. In literature it is possible to find numerous studies about teaching activities, such as: the development of professional knowledge, Schön (1992); the concepts of class management and content management, Gauthier et al. (2013); the transmission of content and the management of the interaction with students, Tardif (2014); among others. Based on these and other studies on teaching practice and in conjunction with the relationships to knowledge provided by Charlot (2000), a proposal was elaborated for the analysis of teaching actions in teaching and learning relationships in the classroom (Arruda, Lima, & Passos, 2011). The advances obtained from this study, allowed the expansion of the investigations beyond teacher actions (Andrade, 2016; Andrade, Arruda, & Passos, 2018; Carvalho, Arruda, & Passos, 2018; Dias, Arruda, Oliveira, & Passos, 2017), involving other subjects of the school universe and their actions, such as: the actions of supervising teachers (Carvalho, Arruda, & Passos, 2018); student actions (Benicio, 2018; Arruda, Benicio, & Passos, 2017); and the possible connections between student and teacher actions (Dias, 2018).

This article deals with student practice in the classroom, i. e., student actions.

When we look at the student's actions in the school environment, we are interested in identifying the different actions performed and their implications for student learning. The references that supported the research were Illeris (2013), Charlot (2000), Leontiev (2014) and Weber (1978). The first author presents a definition for human learning, in which different areas and conditions have been brought together to develop a comprehensive model. The second theorist presents the theory of the relationship to knowledge, which deals with a sociology of the subject. Charlot (2000) also defines learning as an intellectual activity, associated with the practice of knowledge, which considers the concepts of activity and action, based, respectively, on the studies of the last two mentioned theorists, which we discuss in the next section.

The methodological approach adopted for this research was the qualitative approach, due to the descriptive and interpretative characteristics of the data. Within this approach we opted for Discursive Textual Analysis (DTA) proposed by Moraes and Galiazzi (2011), which, due to their analytical procedures, allowed us to reach the objective of elaborating categories of student actions in Physics, Mathematics and Chemistry classes. We dedicate the second section after this introductory section to present DTA, describe the research context and provide details regarding the organizational movements of the data and the interpretations.

Then, we elaborated a section with the data analysis[1], which had its initial movements based on the description of the classes elected for study. The descriptive and interpretative information was organized into seven emerging categories, related to the student actions observed in the investigated context: To Organize, To Interact with the Teacher, To Interact with Classmates, To Practice, To Wait, To Disperse and Other Actions.

Finally, we make our considerations about what the data indicated and the conclusions that the investigated phenomenon provided.

Theoretical foundation

There are innumerable learning concepts that we find in literature, even when limiting ourselves to what was produced since the nineteenth century to present day. For the development of our research we build on what Illeris (2009, 2013) presents in the book *Contemporary Theories of Learning*, more specifically in a model that, according to the author, synthesizes the general and current understanding of this field of research.

The definition for learning presented by Illeris (2009) is a broad formulation that considers several processes and conditions. Learning is defined as "any process that in living organisms leads to permanent capacity change and which is not solely due to biological maturation or ageing" (Illeris, 2009, p. 3). Such a model encompasses two different but integrated processes, as can be seen in Figure 1.

1 The data in its entirety can be accessed in Benicio (2018).

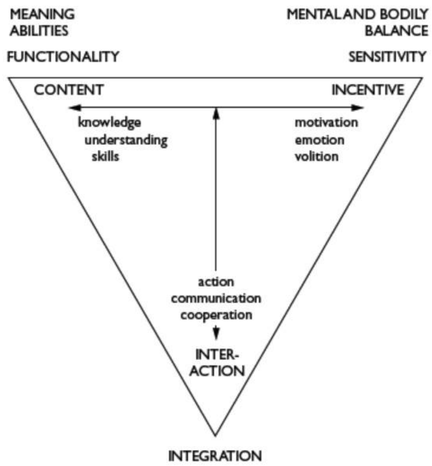

Figure 1.The three dimensions of learning

Source: Illeris (2009, p. 10)

The first is the external process of interaction between subject and environment. The second is the internal psychological process of elaboration and acquisition, which involves two psychological functions: the function of managing learning content and the function of incentive and of providing the necessary energy that drive the process (Illeris, 2013, p. 17). Together they form a triad with three elements: content, incentive and interaction, which are also called dimensions.

Given the above about learning it is noticeable that it comprises three aspects. One is the epistemic, since there is the elaboration and acquisition of specific content. The second facet is personal, which involves the subject's emotion as an incentive for learning, personal experiences give meaning to what is learned, and learning contributes to the construction of the self. Another facet is the social aspect, present in the interaction with the external environment or in the need to participate in scientific practices and communities.

Charlot's (2000) and Illeris's (2013) theories present learning in a broad sense, which considers aspects of sociology, psychology, and anthropology. For Charlot (2000), learning is a human need and occurs when the subject, in his relationship with the world, with the other and with himself, engages in a practice of knowledge.

According to Charlot (2000, p. 33) a subject is:

• A human being, open to a world that cannot be reduced to the here and now, bearer of desires [our emphasis], moved by those desires, in relationship to other human beings, which are also subjects;

• A social being [our emphasis] born and raised in a family (or a surrogate family) that occupies a position in a social space, which is inscribed in social relations;

• A singular being [our emphasis], a unique case of the human species, who has a

> history, interprets the world, gives meaning to that world, its position in it, its relations with others, its own history, its uniqueness (Charlot, 2000, p. 33, our translation).

Charlot discusses that man is not like other animals in nature, which are born finished. On the contrary, man is born in a pre-existing world already structured throughout the history of mankind and must become man, which occurs through education. In incompleteness man seeks to learn, to appropriate the historical-sociocultural legacy that was created over time by the human species:

> To be born is to penetrate the human condition. To enter a story, the singular story of a subject inscribed in the larger history of the human species. It is to enter a set of relationships and interactions with others. Enter a world where man occupies a place (including a social one) and where it will be necessary to exercise an activity (Charlot, 2000, p. 53, our translation).

Learning, for Charlot (2005), is a process that becomes possible to the subject when he/she engages in a practice of knowledge. In this sense, for the subject to learn it is necessary to enter into relationship systems with the world, with others and with oneself, to engage in practical, reflexive and relational activities. The author describes some types of learning, which he calls learning figures and which we highlight in the following quote.

> To learn can be *to acquire knowledge* [our emphasis], in the strict sense of the word, that is, an intellectual content. . . . But learning can be *mastering an object or an activity* [our emphasis] (tying shoelaces, swimming, reading ...), or *participating in relational forms* [our emphasis] (greeting a lady, seducing, lying ...) (Charlot, 2000, p. 59, our translation).

Regarding the school context, Charlot (2013, p. 107) states that it is the student who learns. If you do not wish to, refuse to engage in intellectual activity, you will not learn, whatever the teacher's method may be. The mobilization of the subject is necessary for the development of directed and contextualized actions, with the objective of learning.

To address the issue of activity, Charlot presents Leontiev's perspective (1984, quoted in, Charlot, 2013), which defines it as a series of actions and operations, with a motive and a purpose. Leontiev (1978) states that necessity, object and motive are structural components of activity and necessity is the first condition. What distinguishes one activity from another is its object, and this is what gives it a certain orientation. What drives the activity is the motive, it is determined when the necessity, which can be met, meets its object.

Leontiev (2014, p. 184) writes that "the basic components of separate human activities are the actions that perform them. We consider action the process that corresponds to the notion of the result that must be attained, that is, the process that obeys a conscious objective".

> Human activity exists as action or a stream of actions. [...] When we consider the

> unfolding of a specific process - external or internal - from the angle of the motive, it appears as human activity, but when we consider it as a goal-oriented process, it appears as an action or a system, a chain of actions (Leontiev, 2014, p. 190).

Taking the concept of action as primordial in our investigation, we cannot fail to cite Weber (1978), when discussing the classic typology of action and presenting a study of social action. According to Weber:

> We shall speak of 'action' insofar as the acting individual attaches a subjective meaning to his behavior – be it overt or covert, omission or acquiescence. Action is 'social' insofar as its subjective meaning takes account of the behavior of others and is thereby oriented in its course (Weber, 1978, p. 4).

In this sense, in learning as a practice of knowledge, the subject is faced with the task of developing activities and actions, according to the needs, motives and objectives in a specific context and according to the internal and external conditions to perform them. In the relationship to knowledge, more broadly with learning, as already mentioned, the epistemic relationship presents three distinct forms of learning. In each of these three figures of learning there is an activity of different nature, such as the "constitution of a universe of object knowledge, action in the world, regulation of the relationship with others and with oneself" (Charlot, 2000, p. 71). In each of these situations there is a conscious subject who performs these activities and controls his/her own actions.

Following this brief exposition of what we consider learning, knowledge, activity and action, together with the theorists who present them, we continue the article by clarifying the methodological procedures selected for the development of this investigation and describing details of the research situation.

Methodological Procedures and the Research Situation

DTA was chosen for this study since it is an organizational and methodological approach to data used in research that deals with information in textual form. DTA seeks the elaboration of new knowledge about a phenomenon or discourse. Through this approach and with the purpose of deepening the understanding of student action and the relationships built in the classroom, we sought to categorize student actions in Physics, Mathematics and Chemistry classes. According to Moraes and Galiazzi (2011, p. 112), discursive textual analysis can be understood as the process of deconstruction, followed by reconstruction, of a set of linguistic and discursive materials, thereby producing new knowledge (about the investigated phenomena and discourses).

The materials submitted for analysis, i.e., our corpus[2] consisted of records written in the form of field notes elaborated during the observation of the classes and the transcriptions of audio and video recordings, also from these same classes. The analysis consisted of describing and interpreting the information contained in these documents. As DTA itself indicates, the interpretation went beyond what was said or written,

2 The set of documents taken into account to undergo the analytical procedures (Bardin, 2011, p. 126).

reaching meanings that, sometimes, even the analyzed subjects were not aware of.

We also highlight that DTA can be understood as a self-organized process of understanding and building of new knowledge that emerges from the cycle created by three stages: disassembly of the text; establishment of relationships; the capture of the new emerging comprehensions.

Moraes and Galiazzi (2011, p. 49) call the first stage unitarization, which is part of the effort to build meanings from a set of texts, understanding that a reading makes it possible to elaborate more than one meaning. Unitarization finds its purpose when units allow direction for the construction of categories. In the present investigation this stage comprised the deconstruction of the research corpus. Field notes were fragmented into context units (denomination assumed by us in the development of this research) or units of analysis (Moraes, & Galiazzi, 2011), which contained a verb representing the descriptions of student actions observed in the classroom.

The second stage, called categorization, corresponds to the organization and classification of the context units, which allows expressing new understandings of the phenomenon under study. Categorization can assume the role of the classification process or the analysis process. Through categorization it was possible to organize the units obtained in the unitarization considering the verb used that represented student action and the context in which it was used. In this sense, the same verb can be allocated in different categories due to the distinction of the context in which it was used. Categorization allowed us to group these units based on their similarities within the phenomenon.

The third stage, the capture of the new emerging comprehensions, consists of moments in which one seeks to express the understandings reached. This means that in this phase the metatext is constructed, that is, a written production is elaborated in which the analyzed facts can acquire new meanings and promote new understandings of the investigated phenomenon. The research presented here allowed the elaboration of the metatext in two interpretative movements. The first was in the process of constructing descriptions of categories emerging from the observation of the investigated situation. The second was the writing of the new emerging comprehensions presented throughout the data analysis section, which presents the meanings, nuances and understandings obtained from the research situation.

The data collection for the research described in this article was carried out in 2016, during which we followed in the first two months, a class in the third year of an Integrated Vocational High School course in Industrial Automation in the campus of a Federal Institute of Paraná, Brazil. The class consisted of thirty-one students, which all agreed to participate in the investigation. All students were asked to provide the informed consent form signed by their legal guardians.

The data collected were descriptive and organized into context units that described what students were doing in the classroom and what was captured by video recordings and listed in the field notes. It is noteworthy that the actions were identified by observing the students in locus. It is known that cultural and socioeconomic aspects can interfere in the behavior of research subjects and motivations regarding their action. However, during the data collection, only the occurred and observable actions were considered, the reasons that triggered such actions were inferred from the classroom context. In order to preserve the identity of the subjects involved in the research, the students were designated by the letter S. Since the class in question consisted of thirty-one students, the subjects were coded by S1, S2, S3, ... S31. In the coding process, for the teachers, the letter T was used in conjunction with the first letter of the subject they were teaching. Thus, the abbreviations TP, TM and TC refer to the Physics, Mathematics and Chemistry teachers, respectively.

The results we bring in this article are part of a set of two consecutive classes for each subject (Physics, Mathematics and Chemistry). That is, to perform the data analysis presented here we conducted a study in these six classes, which we considered representative of the performance of each of the teachers during the two months in which they were observed. This representativeness is justified by the similarity in structure, planning and execution with the other classes that took place in the academic quarter for each subject.

Taking into account this corpus and the analysis methodology assumed in this investigative process, it was possible to elaborate categories of student actions in the classroom, which is directly related to what we set out to answer: What are the categories of student actions in Physics, Mathematics and Chemistry classes? Information and explanations about these results are described in the next section.

Data Analysis

This section was organized as follows: first, we bring a brief exposition of the characteristics observed in each class analyzed; Then we describe the categories of actions that emerged during the interpretation of the corpus records; Finally, the context units are framed according to the categories of actions shown, allowing us to visualize the distribution of what the students were doing during each of the subjects and form an agile comparison between these frameworks through diagrams.

The Classes Analyzed: Some Highlights

The Mathematics classes listed for analysis took place in the beginning of the first two months of 2016. Two main moments of the class stand out, the moment of exercise correction and the moment of presentation of new content. At first, the teacher corrected the exercises about the content: distance between two points, indicated as homework in the previous class. In the second moment TM introduced and presented the concept of linear equations, addressing the ways of determining a line and its equation. The Mathematics classes observed were characterized by their formality, having the teacher as the center of attention, who constantly requested the maintenance of order in the classroom. The teacher (TM) took a serious and organized position and the students corresponded to the teacher's way of acting. Most students arrived on time and complied with the agreements[3] between the teacher and students.

During observation it was noticed that there were dispersive conversations in less quantity and intensity (compared to the observed classes of the other teachers). The students remained seated and got up only as they approached the teacher for permission to leave the room. The interaction between teacher and student was lower than in the other disciplines observed. There were few questions asked by the students and much of the interaction was due to the questions the teacher asked.

The Physics classes chosen for analysis took place in the beginning of the first two months. The subject of the classes was Coulomb's Law, which was conceptually started in a previous class and presented again in the next class with the formalization of the concept through mathematical language. TP structured the class similarly to the Mathematics classes, in two moments. In the first class the teacher used slides as a resource, and in the second moment focused on the presentation of exercises with corrections on the board.

In the Physics classes we can highlight that the focus shifted to the students, unlike the Mathematics classes. TP organized the classes so that the students could participate and get involved in the discussions and the accomplishment of the proposed activities, which leads us to characterize them as having a flexible and relaxed class style. Students were generally respectful of the teacher and interested in the content presented, seeking to participate in the proposed activities and discussions. On the other hand, they subtly looked for ways to delay class and the progress of activities. Nevertheless, when the teacher started to explain the content, students collaborated by paying attention, or by simply remaining silent.

The relationship between teacher and student was marked by proximity. Students interacted with the teacher during the discussions, seeking to understand the concepts addressed through questions and comparisons. The questions asked by the teacher during the explanations allowed the students to structure the reasoning and reflect on the content, therefore, they allowed themselves to risk answering the teacher's questions.

The Chemistry classes selected for the investigation took place at the end of the first month of class. As in the classes of the other teacher subjects, there were two distinct moments: the correction of exercises and the presentation of new content. The correction was performed in the beginning of class and was related to an exercise list given to students in previous classes which addressed the classification of carbon chains. The presentation was done through slides which discussed alkanes.

The Chemistry classes had as a main activity the presentation of new content, making the teacher the center of attention. Regarding the class style, we noticed doses of formality and flexibility. There were agreements between the teacher and students

3 These agreements refer to a didactic contract discussed collectively and signed between the teacher and the students in the first class of Mathematics of the academic quarter. In this agreement some rules were established, including permits and prohibitions, which should be respected by the parties throughout the school year.

and these were respected; In contrast to the Mathematics classes, these rules were more flexible. It was also noticed a form of initial organization of the class, by the teacher, and the tranquility in conducting conversations and games, without the need to draw the attention of students (a fact that was very present with TM).

The relationship between TC and the students also reflected this balance between formality and flexibility. The students acted naturally and relaxed while interacting with the teacher, they expressed their doubts, their apprehensions about the errors that could occur in solving the exercises and their difficulties with the process of learning the chemical content. TC, in turn, stressed the need to always ask questions and advised them to study and look for ways to overcome these problems.

Having learned about some details of these classes analyzed, we now present the seven emerging categories: To Organize (O), To Interact with the Teacher (IT), To Interact with Classmates (IC), To Practice (P), To Wait (W), To Disperse (D) and Other Actions (OA), which we coded as in parentheses, and their descriptions, which for us mean the criteria used for the allocation of what students performed in each category.

The Emerging Categories of Student Actions

In interpreting the corpus, we realized that our context units, which were descriptions that represented what we observed students were doing, could be organized into groups of actions with common characteristics - which led us to highlight the seven categories of actions.

By fragmenting such units of context, we came to identify the verb (transcribed in the infinitive, linguistic position taken by us from the beginning of the corpus constitution) that indicated what the students were doing, directly related to a way of acting, an action. As indicated earlier, these organizational and interpretative movements are part of the first stage of the DTA procedures.

Given these results, we then proceed to the categorization process bringing together all these similar ways of acting and organizing them into groups, which culminated in the emerging categories described below in Figure 2.

Categories	Descriptions
Category 1: To Organize (O)	The actions allocated to this category are of two types: bureaucratic actions and normative actions. Examples of bureaucratic actions include: signing up for projects, answering calls; actions regarding the functions of the class representatives, such as passing on announcements, organizing discussion meetings, and doing the roll call for student assistants. The normative actions are those associated with the Institution's norms and the didactic contract between teacher and students, such as: staying at the Institute, arriving on time, fulfilling the activities proposed by the teacher, remaining seated, wearing the uniform, and being silent during the explanation. This (sub) category also includes classroom organization and classroom activities such as helping the teacher hand out class material, closing or opening doors and windows, organizing materials on the desk, pasting exercise lists to the notebook, among others action. It is noteworthy that actions that go against the organization, norms and procedures, or that reflect omission to them, are allocated in another category (To Disperse). There are some actions with these contrariety characteristics that fall into organizational actions, such as: delaying the entrance in the classroom, not performing the activity, not returning from the break.
Category 2: To Interact with the Teacher (IT)	This category includes actions of interaction between teacher and students directly related to teaching and learning, such as: paying attention to the teacher's explanation, asking questions, answering the teacher's questions, asking for help, etc. These actions of interaction with the teacher originated sometimes from the student and other times from the teacher. For example, the origin of these actions is attributed to the student when he/she made comments and reflections on the subject, suggested subjects of interest to the teacher, argued and insisted on his/her opinions during the discussions. When the student answered the teacher's questions, this action was placed as linked to the ask action, previously performed by the teacher.
Category 3: To Interact with Classmates (IC)	This category refers to interactions between two or more students, also related to learning and teaching. Two types of actions were observed, which we call collaborative or teaching interactions. In collaborative interactions students had the same level of knowledge about the subject they worked on and developed the learning process together. When students had some difference in the level of understanding of the concept, those who had more knowledge assumed the position of instructor, establishing the interaction as teaching. Among the interactions that occurred in the classroom, the actions that indicated collaboration: discussing, outlining paths and strategies for solving problems, raising hypotheses. In the case of interactions that indicated teaching, there were actions in which students assumed the role of learners such as seeking peer help, asking questions, and learning from each other. Correspondingly, there were students who temporarily assumed the role of the teacher. According to the content, they performed actions such as: teaching their classmates, explaining the content, confirming the reasoning of classmates and correcting their answers.

Figure 2. Description of emerging categories of student actions (to be continued)

Source: The Authors

Categories	Descriptions
Category 4: To Practice (P)	This category represents the actions that students developed that could be characterized as direct learning actions, such as: participating in research and extension projects, studying, researching, doing the tasks, which could occur both within the classroom, and outside of it, at school or in other environments. Typical classroom actions could have a mechanical feature, such as copying, erasing, and correcting. However, there are actions that involved more reflection and reasoning, such as solving or trying to solve the exercise, making associations, thinking, making mistakes and noticing mistakes.
Category 5: To Wait (W)	In this category we allocated actions that indicated the students' waiting in the classroom. Waiting for the teacher to arrive, waiting for the teacher to begin the explanation, waiting for the teacher to return to the classroom, waiting for the classmates to copy, waiting for permission to leave at the end of class, among other actions. It is important to highlight that only the purely waiting actions were allocated in this category, that is, when the student did no action other than waiting. The waiting period was often occupied by other actions, when this occurred, they were allocated to the other categories. Talking, studying or studying for another subject and asking questions to the teacher are some examples of how they filled or enjoyed the waiting time.
Category 6: To Disperse (D)	This category consists of the actions that took place in the classroom and had no relation to learning or the classroom itself. The action was done by both students and the teacher in the interaction between the subjects in the classroom. Most of these actions diverted the student's attention and disrupted their learning. For example, using the cell phone, throwing paper at the classmates, exchanging paper messages, fighting, teasing and talking. A variety of dispersive actions occurred as students arrived in the room. Singing, clapping, dancing, whistling, gesturing to cameras were common actions at the beginning of class. There are also actions that allowed the relaxation of the class. Collaborating or disrupting learning in the classroom depended on the intensity of these actions. Some examples to illustrate these situations are: playing with the classmate or teacher, commenting on outside situations with the teacher, laughing, interrupting the activity, make mischief with the themes addressed by the teacher, among others actions.
Category 7: Other Actions (OA)	This category was created to allocate actions that did not fit into any previous category.

Figure 2. Description of emerging categories of student actions (continuation)

Source: The Authors

After the presentation of the categories, we describe the categorization of the actions (subcategories) performed by the students, for the six classes chosen for analysis. This movement made the elaboration of the interpretations of the investigated phenomenon possible. By categorizing the actions observed, it was possible to explore other aspects revealed by the student actions, among them: the categories that have greater or lesser representativeness for each subject; the common actions for these subjetcs. The different readings of the phenomenon presented here characterize the capture of the new emerging comprehensions, as it seeks to express the understandings reached throughout the development of the research.

To better guide the elaboration of the text of this article, we will now consider that students' way of acting can be represented by verbs or a set of verbs, as will be clarified below, which we will call actions.

The Classes Analyzed and Their Action Categories

Before describing the actions concerning the two classes of each subject, we will clarify some positions we take regarding the writing of verbs.

At first the actions were written with the verb in the infinitive and, when classified according to the action categories, it was noted that in some of them the verb used during registration did not represent the action in its specificity. For this reason, there were cases in which these actions were represented by two verbs, constituting a single context unit. The first verb is what was used in sentences in the field notes and the second is what was actually done by the student at the time of viewing and transcribing the video recorded during class.

To illustrate this situation, we give an example: in the field note we have the notation, "to say" to represent the following record "[...] A24 says: Division by zero does not exist because on the calculator an error appeared", however, when we observe the video recording, we note that the verb to say did not fully represent what had happened, because the student said this in response to a question from the teacher, that is, said answering, so the necessary complementation is "to say: to answer".

In Table 1, in columns 2, 3 and 4, we have the percentage of verbs related, respectively, to the subjects of Mathematics, Physics and Chemistry, for each of the categories of student actions shown in column 1.

Table 1. Action categories and context unit percentages for each subject

Action categories	Mathematics	Physics	Chemistry
To Organize (O)	28.38%	23.53%	36.23%
To Interact with the Teacher (IT)	22.97%	23.53%	20.29%
To Interact with classmates (IC)	6.76%	7.35%	1.45%
To Pratice (P)	10.81%	10.29%	7.25%
To Wait (W)	1.35%	1.47%	1.45%
To Disperse (D)	28.38%	33.82%	33.33%
Other Actions (OA)	1.35%	0%	0%
Total	74 actions – 100%	68 actions – 100%	69 actions – 100%

Source: The Authors

In advance we highlight that 74 verbs or a set of verbs that represent our context units were evidenced for the Mathematics classes; 68 for the Physics classes; and 69 for the Chemistry classes. These percentage values represent quantitatively the intensity of context units for each category, that is, 28.38% of what students' actions represent, is allocated to the To Organize category in both Mathematics classes analyzed, while in Physics classes this category accounted for a percentage of 23.53% and for the Chemistry classes 36.23%.

The Other Actions category was only included in the Mathematics classes, with a single representative action. The category To Wait allocated the smallest number of actions to the three disciplines. Most of the inventoried actions belong to the To Organize and To Disperse categories. These two categories in all disciplines had a higher percentage. This is because they accommodate the largest number of verbs or set of verbs that describe the context units that occurred in the classes. This larger number is due to the diversified nature of these two categories that present a larger range of actions that represent them in different contexts.

The To Interact with the Teacher category was the third category with the highest incidence of actions, followed by the To Practice and To Interact with Classmates categories. These three categories, for us, manifest direct relationships with learning. Analyzing both categories of interaction, from the perspective of Illeris (2013), students use their own actions of the interaction process to learn. According to Charlot (2000), and Illeris, students use relationships to each other in order to acquire knowledge.

The To Practice category can be understood as the actions students do to learn. In the comprehensive theory of learning proposed by Illeris (2013) this category mainly involves the internal psychological process, involving the dimensions of content and incentive for learning. According to Charlot's Theory of Relationship to Knowledge (2000), this category is associated with the actions that compose an intellectual activity with the intention of learning content.

As mentioned earlier, the classroom "dynamics" for each of the subjects was different, especially when considering the uniqueness of each teacher, but the percentages representing the students' way of acting were similar. In this sense, to better understand the various nuances about what happened in these classes, when we focus on what students really do, we continue our proposition to present other ways to accommodate this information. With this, we seek to highlight the common context units for the three subjects through the action categories, as well as the actions that occurred specifically in the class of each subject. For this purpose we elaborated five Venn diagrams, disregarding the categories To Wait (for having a very small percentage incidence) and Other Actions (for being evidenced only in the Mathematics classes). The diagrams follow the order in which the action categories were organized in Figure 2.

The coding used for the verbs or set of verbs was conducted according to the following criterion: the first letter is related to the subject M for mathematics, P for Physics and C for Chemistry; the second (and third) letter(s) represents the coding of each of the seven emerging categories shown in Figure 2, for example, To Organize was coded by O; Finally, after the two letters we have a number, which represents the position of that verb or set of verbs in the action list, arranged in alphabetical order. Thus, MO1 refers to the first action of category O for the two Mathematics classes analyzed.

In Figure 3, we have the first diagram concerning the To Organize category (O). In the central region the context units were accommodated - described by verbs or set of verbs - that were present in the classes of the three subjects. In the other regions the coding was maintained as described above.

This form of data representation and organization allows us several interpretations that present details about what actually happened in these classrooms, regarding what the students did. We present several comments, however we know that other arguments would be possible.

Category O for the Mathematics class comprises preparatory actions for the beginning and closing of the class (MO1 – To arrive and MO17 – To leave class); actions to maintain order in the room (MO8); regarding the elaboration of didactic agreements and the (non) compliance with established norms, either by the school or the agreements made with the teacher (MO3, MO19 and MO20); and organizational actions in general (MO11). These are actions that commonly happen in the other disciplines, being presented only with the specific coding for each of them. However, the diagram reveals specific occurrences in the Mathematics classes, such as: classroom organization actions (MO7 and MO13), actions regarding the instructional material (MO2 and MO15) and class time (MO18).

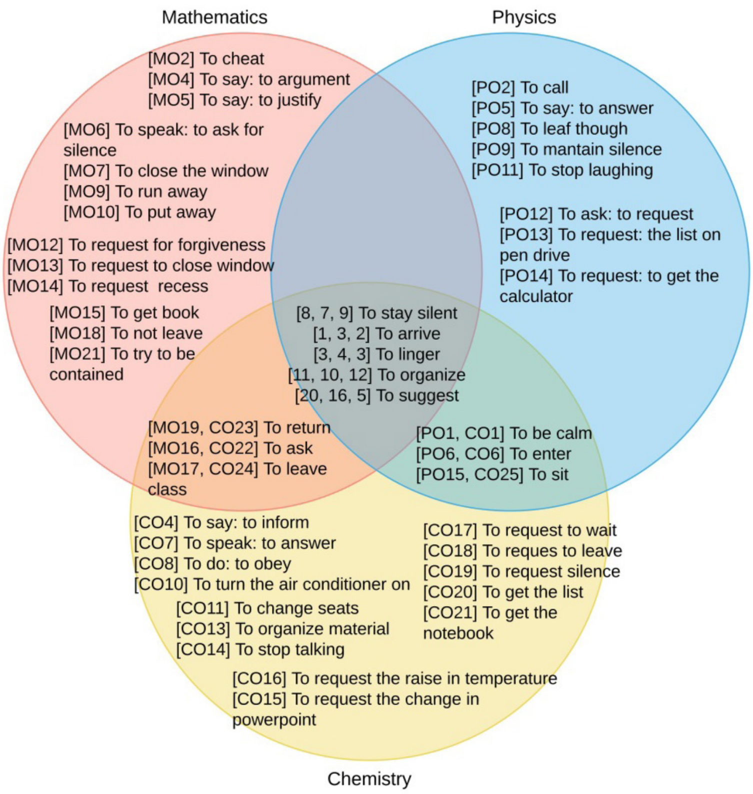

Figure 3. Diagram of the action category To Organize

Source: The Authors

In the category O for the Physics class, in addition to the actions common to the other subjects, there were also actions of interaction with the teacher at the organizational level. TP together with the students organized how the exercise lists would be passed on (PO13) and discussed about the use of the calculator and the cellphone in the classroom (PO5, PO12, PO14).

The representative circle of the Chemistry class presents actions in all the regions that compose it. In the region between Mathematics and Chemistry, we highlight the flow of students during class (CO23 and CO24). The region between Chemistry and Physics (CO1, CO6 and CO25), refers to the actions common to the initial moment of classes. Organizational actions that took place exclusively in Chemistry arose from the need: for students to better view the information on slides (CO15 and CO11); of time for making notes (CO17); of the organization of the classroom and school materials (CO8, CO10, CO16, CO20 and CO21).

In Figure 4 we accommodate the systematized information about the IT category. The Interaction with the Teacher actions that took place in the three subjects were: To Say: to reflect; To ask; To pay attention; To answer.

The common region between Mathematics and Chemistry presented student actions such as: comments in agreement with the teacher's speech and explanations (MIT4 and CIT6); and presentation of doubts regarding the content (MIT17 and CIT6). Regarding the intersection between Mathematics and Physics, we highlight the actions: MIT12 and PIT10 referring to the omissions regarding the questions made by the teachers; and MIT13 and PIT13 that characterized requests for help from teachers for the solution of the exercises. Specifically in the Mathematics class, students became involved (MIT7), gave their opinions (MIT5) and insisted on their positions (MIT8) during discussions. And the way found by students to clarify their doubts about the content was to explain to the teacher how they solved the exercises (MIT2).

The intersection of the actions of the Physics and Chemistry classes for the IT category contains actions that indicate that the students followed the teacher's explanations, orientations and corrections (PIT1 and CIT1) and participated in the interactions between teachers and students (PIT12 and CIT10). The Physics classes also contained the actions of correction during the discussions. As the teacher led the explanation of the content through questions, the students made mistakes, TP communicated to the students the mistake made, and they returned to the content by reworking the process, correcting the manifestation (PIT4). Conversations about the content (PIT3 and PIT8) and suggestions of subjects of interest to be addressed in the Physics class (PIT7) could also be observed.

For the Chemistry class, the IT category presented the lowest representation among the three subjects. Particular actions to the Chemistry class were the students' reactions to the nomenclature of the carbon chains. In this sense, the students reacted with surprise (CIT3) and uttered exclamations of amazement (CIT5). They also showed enthusiastic reactions (CIT13) when they could understand a doubt.

Figure 4. Diagram of the action category To Interact with the Teacher

Source: The Authors

Then, in Figure 5, we have the diagram that shows information related to the IC category (To Interact with Classmates). As it is evident, the number of actions for this category was small, when compared to the categories commented above and the incidences in the three subjects considered. Although students interacted continuously at many times in the class, interactions that could have promoted content learning were few, highlighting that in these two categories, which we take interactions with teachers and peers, our considerations were focused on the learning processes that such interactions could provide.

The IC category for the Mathematics class consists of only five actions and two of them are common to the Physics class. The latter were actions in which students talked about content (MIC1 and PIC2) and discussed exercises (MIC2 and PIC3). The other learning interactions between classmates (MIC3 – To explain, MIC5 – To exchange ideas and MIC4 – To try to learn with others) occurred mainly at the moments of the Mathematics class designed to solve examples and exercises.

The Physics class also presented five actions for the IC category, although TP allocated a longer period of the class to perform exercises compared to the other subjects. We observed that the employment of moretime did not motivate a wide range of actions for this category, but we noticed that there was an increase in the frequency in which they occurred. In the Physics class there was greater collaboration among the students, they chose whether to form groups, or to try to solve the activity alone. Some of them circulated around the room (PIC4), teaching classmates solutions (PIC1), or seeking help with learning (PIC5).

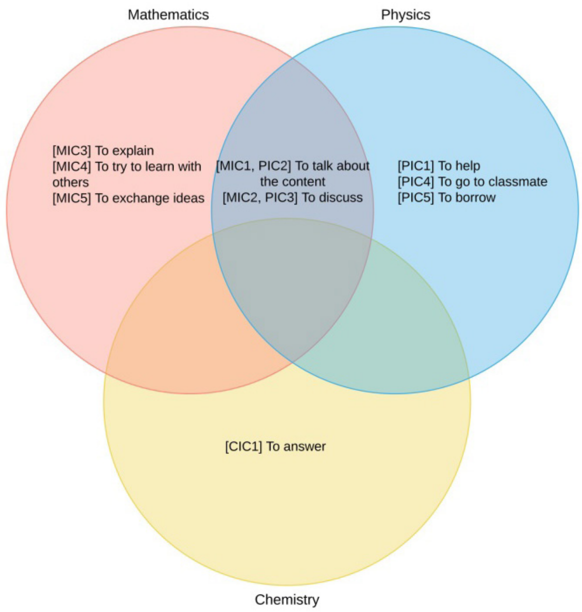

Figure 5. Diagram of the action category To Interact with Classmates

Source: The Authors

The IC category for the Chemistry class presented the lowest amount of actions compared to the two other sets of classes analyzed. This category consisted only of the action To answer (CIC1), in which one student answered the question of another, which had been directed to the teacher. We consider that one of the reasons for this low occurrence of interaction with classmates was the lack of moments for exercise solving in the Chemistry classes analyzed.

It is noteworthy that, in addition to the moments intended for the exercises in those classes, which enhanced the occurrence of learning interaction actions with classmates, the way teachers conducted their classes is also a factor to be considered. The classes under analysis were all taught by the teachers in a presentation manner. TM and TC developed few moments of discussion about the contents covered. The questions they asked were more likely to confirm students' understanding of the explanation. The discussions that arose were rarely explored or remained at the level of interaction between student and teacher. TP fostered interactions among classmates about class contents, leading to more discussion.

In the next diagram - Figure 6 - we focus on the To Practice category (P) present in the classes analyzed. Similar to the previous category, it brought, according to our analytical criteria, little variety of actions, that is, from what we could describe regarding the students' performance in the classroom.

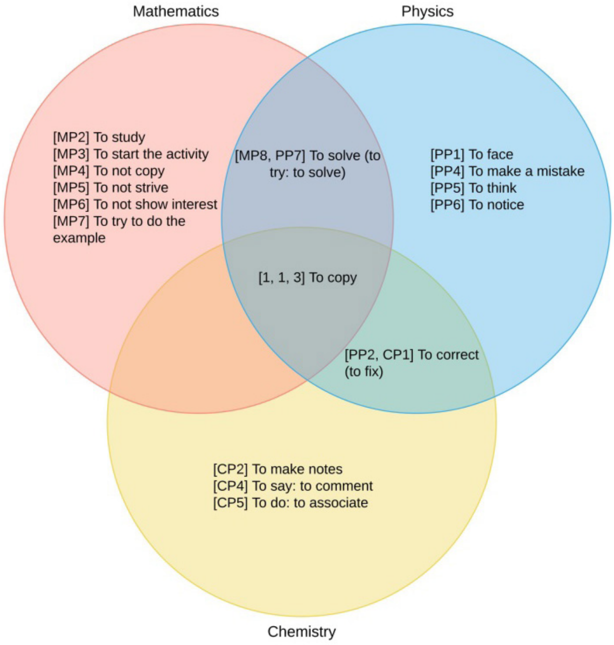

Figure 6. Diagram of the action category To Practice

Source: The Authors

What students commonly practiced in the three disciplines was to copy the content or solutions of the board examples and exercises. As can be seen from the diagram, there were no common actions in the intersection region for the Mathematics and Chemistry classes.

The actions allocated in category P are associated with the moment of the class in which they occurred. At the beginning of the Mathematics class, while waiting for the other students, those present took the time to study (MP2). During the period for the exercises, the students performed actions such as: to start the activity (MP3) and to solve the exercises (MP8), an action that also occurred in the Physics class (PP7). The omissions of not copying (MP4), to not show interest (MP6), to not strive (MP5), characterized the way some students faced the Mathematics class.

The category P actions for the Physics class are mainly related to the periods of correction and solving of exercises. During the correction, the students' practical action was to correct (PP2 and CP1), a fact that also occurred in Chemistry. The exclusive actions of the Physics class were coping with difficulties (PP3) and actions with reflexive bias such as: to make a mistake (PP4); to think (PP5) and to notice the error (PP6). Actions PP4 and PP2 also reveal the student's freedom to take risks in class discussions.

Despite the absence of the moment of exercise solving in Chemistry class, category P did not change much in relation to the percentage value of the other classes observed. Specifically for the Chemistry class, the students' actions were: to make notes in their notebooks following TC's orientations (CP2); to associate the topics covered in the class with familiar concepts (QP5) and finally, there is a student comment to the researcher

(CP4), regarding the nomenclature of an example used by the teacher.

In Figure 7 we enter the information regarding the To Disperse category (D). As already indicated, it was the category with the largest variety of record units, that is, the one that, according to our descriptions, comprised what the students did, the largest number of verbs or sets of verbs representative of these students' actions. An agile reading of what we have described in the diagram shows this diversity. We highlight in this paragraph only those that make up the triple intersection: To Play; To Talk; To Gesture; To handle the phone; To Show something on the phone; To Laugh.

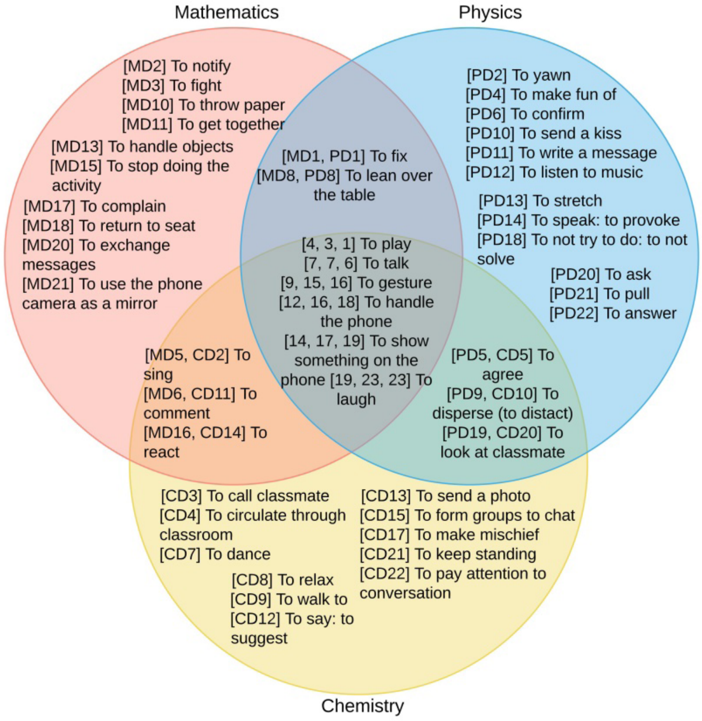

Figure 7. Diagram of the action category To Disperse

Source: The Authors

The classroom being a social environment, the exchanges made by the participants do not only refer to the content, but go beyond the curricular subjects. The beginning of the class is one of the periods in which social interactions occurred with a greater number of actions. In the Mathematics and Chemistry class the students came to the classroom excitedly. They sang (MD5 and CD2) and commented on the subjects of the day (MD6 and CD11). During the Mathematics and Physics class, some of the students who did not express an interest in what was approached became drowsy (MD8, PD8 and MD18). The use of the cell phone was a recurring action in all classes, even though, specifically in Mathematics, it was forbidden. This prohibition promoted greater variability of the communication media (MD7 – to talk, MD12 – to handle the phone, MD20 – to exchange messages and MD9 – to gesture). Students found ways of distracting, such as interacting with school materials (MD13 and MD10) and the researcher's materials

(MD21). There were also actions indicating some students' dissatisfaction with some moments of the class (MD17).

For the Physics class the actions were similar to those that occurred in Mathematics, what differed was the use of the cell phone. In Physics class the teacher allowed the use of the device, mainly by sharing the exercise lists. However, permission entailed other actions of a dispersive nature: to listen to music (PD12); to send messages (PD16 and PD17); to access social networks (PD11). The dispersive student actions common to Physics and Chemistry were the actions of: to agree (PD5 and CD5) with the teacher on topics that did not concern the content; to distract (PD9 and CD10) and to observe classmates (PD19 and CD20). The teacher's interaction with the students also became a source of dispersive actions. In this case the students interacted with the teacher addressing personal topics (PD20), events (PD6), movies and TV shows (PD22) and making jokes (PD4 and PD14).

Concluding such presentations, in diagram form, we highlight that most of the dispersive actions took place at the initial moment of class, when the students took time to organize for the class. As in Physics, this class allowed the use of mobile phones, generating dispersive situations (CD13 – to send a photo). Action CD17 illustrates a situation that is different from other classes, where students misunderstood the names given to the different chains that represent the alkanes. The students sought to relax (CD8), without hindering the development of the class or attracting the teacher's attention to them.

Evidenced Considerations

Inspired by what Charlot (2005) presents us, associating learning with a practice of knowledge, understood as contextualized and directed actions, whose purposes are to acquire knowledge, we entered an investigative movement in order to follow the daily life of a class with the intention of answering the following question: What are the categories of student actions in Physics, Mathematics and Chemistry classes?

The direct contact with the students in the classroom made it possible to observe what they were doing, culminating in a vast list of actions that portrayed this doing. Given these findings and the resumption of video recordings of all Physics, Mathematics and Chemistry classes, during a two-month period, it was possible to elaborate seven categories of emerging actions, in which the vast list was accommodated, according to DTA procedures.

Given this study we are led to conclude that these seven categories reveal different aspects of the students' experiences in the investigated context and can be represented by the following words or expressions: To Organize, To Interact with the Teacher, To Interact with Classmates, To Practice, To Wait, To Disperse and Other Actions, each with their own characterizations.

It was possible to show that the To Organize, To Wait, To Disperse and Other Actions categories comprise student actions that are not necessarily oriented towards learning. Most are actions that permeate daily school life resulting from the other relationships built in the classroom. We noticed, more intensely, the actions regarding the institutional guidelines and norms, the didactic contracts, the classroom organization, the socialization among the participants, which, in our view, is not directly related to the moments of learning scientific knowledge, however can interfere positively or negatively. The To Interact with the Teacher, To Interact with Classmates, and To Practice categories consist of actions that are directly linked to learning in the classroom, representing the moments when students acted on their own learning. We briefly describe in the conclusion of the article each of these categories except Other Actions (which occurred only once).

In the category To Organize (O) we accommodate the actions related to the norms of the educational institution, the agreements and didactic contracts between the teacher and students, the bureaucratic actions and the organization and maintenance of order in the the classroom.

In the To Wait category (W) we insert the actions in which the student remained inactive, waiting for the conclusion, the beginning, or the resumption of actions by the classmates or the teacher.

In the To Disperse category (D) we grouped the actions that presented a potential to divert to the students' attention from the main activity proposed in the class, away from the teaching and learning processes.

In line with the ideas of Charlot (2000), the first two categories described above do not characterize the learning of content, but rather learning attitudes and relationships that could enhance the learning of specific knowledge in the classroom. The third category, on the other hand, can be associated with relational learning, which is possible to collaborate or hinder the learning of a scientific knowledge. However, the actions of this category indicate that the school environment is a fruitful environment for the student's education, not only in the scientific sense, but for broad learning senses that include various aspects of human education.

In the To Interact with the Teacher (IT) and To Interact with Classmates (IC) categories, we included actions that promoted learning through interactions with each other, be it the teacher or a classmate, and were always permeated by an educational and collaborative process.

The actions of these two categories can be associated with the interaction dimension of the learning model proposed by Illeris (2013). In this case, students use interaction with the external environment to learn. Thinking about learning as a practice of knowledge, according to Charlot (2005), the actions of the categories IT and IC are associated with relational and reflective activities. The first fosters the second through the student relationship with the other, which can contribute to the learning of scientific concepts.

In the Practice category (P) we have the practical actions developed in the classroom and aimed at student learning, among which we highlight: the records and notes related to the content; the solution of exercises; the conduction of experiments; the research moments; the participation in workshops; and the presentation of the seminars. Such actions depended exclusively on each of the students, who needed to be engaged in class discussions to carry them out.

The To Practice category, from the perspective of Illeris (2013), is associated with two processes. The first is the interaction process, since this category consists of actions that involve the student with the external environment. The second refers to the internal psychological process, encompassing the content and incentive dimensions. This is because most practice actions for learning require student involvement, emotion, mobilization for the development of knowledge and skills. Facing Charlot's theory (2000, 2005) this category configures actions for the acquisition of knowledge in the sense of intellectual content, directly involving practical and reflective actions. These actions correspond to a doing both inscribed in the body (indicating the domain of object or activity, such as copying, making notes), as well as a cognitive doing (such as thinking, reflecting, strategizing).

A fact that caught our attention is related to the way each of the teachers planned their classes and organized the classroom, and how this planning reflected directly on what the students did, that is, on their actions. This occurrence observed in the investigative context comes from the perspective of Weber (2012) and the concept of social action, in which the meaning of action is guided by the behavior of others. Here are some examples to elucidate this statement: TM treated the students with more formality than TP and TC, which led to actions regarding omissions by the students, but, on the other hand, met the proposals made by the teacher; TP was more friendly to the students, a fact that encouraged the active participation (of most of them) in the discussions, promoting reflective actions in the moments of practice, which was not evidenced in the Mathematics and Chemistry classes analyzed; TC planned his classes by bringing only the presentation of content and no student exercises, which focused on fewer practice actions and significantly reduced the learning interaction with classmates.

This form of categorization that we are dedicated to presenting in the results of this research brings a unique reading of the phenomenon investigated, however allows us to conclude that the student actions listed for the subjects analyzed are mostly similar for the three subjects (O, IT and D had a higher occurrence in all three subjects). What differentiates these three categories, in short, are the ways in which classes are planned and the classroom organization, characteristics that are related to what the teacher does and not directly to the students' doing. These facts allow us to infer from the context of the classroom-teacher interactions that there is a correlation between teacher and student actions. Investigating these two distinct groups of actions, as well as the possible correspondences between them, represents an advance for science teaching research. We can also highlight that this research contributes to teachers. This is because, when looking at the student's action, teachers can organize their planning, use methodological strategies that favor the triggering of student actions that contribute to learning, restricting dispersive actions and raising the quality of relationships and interactions in the didactic system.

Finally, we conclude this article with the hope that this research can contribute to the understanding of what really happens in the classroom when we focus on what students do, evidenced by their actions and their relationships with teaching and learning. We believe that understanding the student perspective in the didactic-pedagogical relations and understanding the actions performed by them in the classroom is a way to open space in the research field to give students a voice and a way to make the teaching and learning process more humane.

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