

Physics teaching in high school through the collective systematization of knowledge

ABSTRACT

This article addresses a research-teaching focused on the pedagogical practices of teachers and the study practices of high school physics students having as its epistemological axis the concept of theory as an expression of practice. Its objective is to bring to reflection the Collective Systematization of Knowledge as an alternative for teaching and studying in this area of knowledge. The data were produced through the speeches and texts prepared by the students in the experience of four moments of the Collective Systematization of Knowledge methodological process, based on pre-established theoretical references with the research participants describing, analyzing, problematizing, discussing, explaining and understanding both their study practices and the pedagogical practices of high school physics teachers. The study shows that the deconstruction and reconstruction of teaching based on transmission-assimilation both in teacher practice and in student study practices can be modified if the Collective Systematization of Knowledge is carried out favoring the critical-reflective appropriation of contents inherent to Physics.

KEYWORDS: Physics Teaching. High school. Indicators for Pedagogical Practices.

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INTRODUCTION

Basic Education in Brazil has been significantly changed in recent decades. In the second half of the 1990s, High Schools as the conclusive stage of Basic Education (BRASIL, 1996), rekindled the debate about its functions. In 2015, the government updated the National Curriculum Guidelines for the Training of Basic Education Teachers with Resolution No. 2, from July 1, 2015 (BRASIL, 2015) in which it defined new guidelines for higher-level training (undergraduate courses, pedagogical training courses for graduates and second college degree courses) and for continuing education. This resolution is close to the theoretical line of this research, the Collective Systematization of Knowledge, as it values practice as a training space.

Currently, CNE's Resolution No. 02 from December 20, 2019 (BRASIL, 2020) defines that the curriculum of teacher training courses from Licentiate Degree courses be prepared considering students' whole development having as a parameter and foundation the Common National Curriculum Base (BNCC), defining the National Curriculum Guidelines for Initial Teacher Training for Basic Education.

The establishment of the BNCC awakened the need to overcome the dichotomy between knowledge and practice as well as between cognitive and socio-emotional development. This paradigm shift, according to Brazil (2020), represents an advance in what is estimated to be a quality education that by ceasing to focus on the classic transmission of content becomes focused on the objective of enhancing students' full human development in a way connected with the demands of the 21st century.

As a result of this understanding, based on the testimonies of teachers regarding the relationship between their pedagogical practice and the training received in undergraduate courses, it was also possible to raise the epistemological basis of their actions and demands, that is, the understanding of theory as an expression of practice (MARTINS, 2009).

The movement of awareness of teachers about the professionalism constituted in the practice of teaching in order to change the state from "determined by the system" to "determining oneself as a teacher", as a movement it would be occurring, however, its result is far from being accomplished. We live in a time in which teacher education has been seen as an element capable of changing the state in which the school finds itself. In this sense, the professionalization of teachers is seen as a possibility to increase the prestige and social recognition of the category (ROMANOWSKI et al., 2017).

Thus, the critical reflection of teacher training courses is relevant for transformations in the teaching activity to have a direction that aims at justice and social change. In this sense, Zeichner (2008, p. 547-548) points out that:

Due to the current political and economic situation in most of the world, teacher reflection will easily become a tool for tacitly controlling teachers. The real change would be to work against this situation so that work in teacher education contributes to mitigating these destructive trends and linking what we do in our classrooms in teacher education courses with the struggles of educators and other citizens, in all places, to bring us closer to a world where the children of all have access to the means and conditions that help them lead a productive and

rewarding life. The purpose of working for social justice is a fundamental part of the craft of educator trainers in democratic societies.

Still on teacher training for Basic Education, data from Brazil (2015) showed that almost all teachers (95.3%) who taught the subjects in High School had a college degree and the vast majority (77.9%) had a bachelor's degree. However, only 48.3% of teachers were licensed with specific training to teach in these areas of knowledge and, similarly, only 9,754 professionals out of the 50,802 teachers who worked in the discipline of Physics in High School had a degree in Physics.

From this perspective we seek to change social relations in the classroom in the direction of the Collective Systematization of Knowledge methodology, which contributes in this sense and, according to Martins (2016), develops in four fundamental closely related moments, which are: i) characterization and problematization of pedagogical practice; ii) explanation of the practice mediated by a theoretical framework; iii) understanding of the practice at the level of totality; iv) elaboration of intervention proposals.

Thus, the objective of this article is to reflect on the methodological process of Collective Systematization of Knowledge as an alternative for teaching and studying Physics in high school, based on the experience of this process developed in the research-teaching modality (MARTINS, 2016), having as epistemological axis the conception of theory as an expression of practice. It presents the following questions as a central problem: Does the Collective Systematization of Knowledge both in the teacher's teaching practice and in the students' study practice favor the critical-reflective appropriation of the contents of Physics? What indicators does the experience of this process in research-teaching bring to these practices?

DIALOGUE WITH THE AUTHORS

The teaching practice in teaching, the study of Physics in High School, the pedagogical relationship in the classroom, as well as outside it, among peers, are addressed in this article in search of a theory that expresses its practice, as mentioned by Martins (2012). In this way, the author observes that an attempt should be made to "break the transmission-assimilation axis of contents, even if critical, for a teaching process that changes, in practice, its basic relations towards the collective systematization of knowledge" (MARTINS, 2012, p. 88).

In this process of seeking change, the teacher is divided between complying with the curriculum imposed on him by educational bodies and teaching to think. The time that educational bodies understand as sufficient for the teacher to problematize and systematize a content is less than the time that the teacher needs for their pedagogical practice in the classroom (SANTOS, 1992).

The concern with time is placed by Vergana and Vieira (2005) where the perverse side of organizational control, for example, improves and becomes more oppressive. Thus, expanding the power of organizations over individuals. The fundamentals of time-space have gained high expression today from the latest technologies in communications and computerization techniques. Currently time-space in the organizations fragments and interacts the productive age multidimensionality in a global ratio, operating on the same scale the center of action and the place of action. Time is being accelerated, spaces are shortened,

time-space is shaping and explaining traditional dimensions in organizational studies, even though teachers feel, according to Martins (2008, p. 44), that:

[...] they play an important role in determining significant changes in the teaching process, they are frustrated when in the search for alternatives they do not always get good results. Significant changes will only be possible as the teacher has a deep understanding of the reason for their practice and a clear political choice about their pedagogical act. Without this understanding it will be difficult to achieve changes that lead to significant results.

In this way of thinking, Freire (2015a, p.32) complements by saying:

Why not discuss with students the concrete reality to which the subject whose content is taught should be associated, the aggressive reality in which violence is constant and people's coexistence is much greater with death than with life? [...] Why not discuss the political and ideological implications of such neglect by the dominants.

Another study that supports this article is the perception of Gasparin (2012) about the importance of the student being challenged, mobilized and sensitized to perceive some relationship between the content and their daily life, their needs, problems and interests. For the author, one of the ways to motivate students is to know their immediate social practice regarding the proposed curricular content, as well as to hear them about it, that is, that practice that does not depend directly on the individual, but on social relations such as one.

Thus, there is the problem of those who intend to study the evolving reality related to the difficulties of teaching Physics in High School, as is the case in this article, which according to Bernardo (1977, p. 45),

It is necessary to define the most important characters verified during the transformation process in order to define in this process what we call typical stages, building for each of them a model that articulates its main characteristics and defining the main axes of its development and mobility of transformations from the internal contradictions and delays of each stage.

Regarding the lack of understanding in the construction of knowledge about something addressed, Salem (2012) mentions as reasons for learning difficulties the fact that the teacher does not contextualize the contents being worked on, does not consider the knowledge that the student already has, does not allow students' interactive communication, or even not welcoming the student according to their human condition. In general, in the school context, the author continues, such difficulties are constantly observed, caused by several factors, whether by the way teachers teach, lack of attention from students and inefficiency of the education system, among others.

In the teaching of Physics these difficulties are increasingly present. Some High School students express that there is no affinity for learning Physics, they consider it a very difficult subject. However, it is up to the education system to observe such difficulties that prevent good learning and, thus, seek together with education professionals to include effective methods that can significantly change the educational reality.

Based on these assumptions, Martins (2016) places social relationships as a central axis because he understands that theory expresses a relationship that is

material and social at the same time. Material, because it takes place in the workplace, in the concrete actions of the production of people's own lives and is independent of thoughts and representations; and social, because this production is not done individually, but collectively.

We realize that the experience of the research-teaching methodological process from the perspective of the Collective Systematization of Knowledge, together with groups of teachers from various levels of education, as mentioned by Martins (2016), has consolidated a more articulated proposal for teacher education with reality of the schools where the teacher works, rescuing his role as an agent in the work process in such a way as to enable him to make his student also an agent of his learning process. In the disconnection between theory and practice, moving to the new process that is based on a proposal for Collective Systematization of Knowledge, the content to be worked on is defined based on the needs arising from the social practice of those involved, giving rise to new knowledge, collectively constructed, theory expressing this practice, instead of transmitting the content ready and defined a priori by groups of experts, that is, theory that guides practice (MARTINS, 2016).

That said, we see the possibility of a methodological change for the teaching of Physics in High School, however, it will only become a reality if the role of the teacher and students in the classroom is also modified, assuming new discourses and new practices beyond the traditional ones.

Due to the fact that Physics represents an empirical science, very mathematized and which, as a rule, has transmission-assimilation as its axis, as Carvalho (2007) mentions, it shows a teaching that falls far short of the need for a new student of a new teacher and a new school, with new perceptions of reality in each case.

THE METHODOLOGICAL REFERRING

The study presented in this article has a qualitative approach in the research-teaching modality through action research. Research-teaching because on one hand its form of realization constitutes a clue to redimension teaching practices in a perspective of collective systematization of knowledge ("teaching"). On the other hand it enables the experience of an action-reflection-action process through which practical didactics is problematized, explained and understood in its determinants favoring the elaboration of concrete proposals for action. All this in order to open new paths in a transformative perspective so that the Collective Systematization of Knowledge generated from new practices about the object of study ("research") occurs (MARTINS, 2016). Its epistemological axis is the conception that "theory is the expression of a particular practice and not any practice. In this paradigm, practice is not guided by theory, but theory will express the practical action of subjects" (MARTINS, 2009, p. 47).

Thus, in this study the research-teaching process was carried out in a pedagogical practice with five meetings of two hours each involving sixteen senior High School Physics students from a private school in Curitiba/PR. For this, all ethical procedures of the research were observed which was approved by the Research Ethics Committee (CEP) of the institution of the second author, CAAE

28937114.10.000.0020. It was based on Martins' Collective Systematization of Knowledge (2016), developed in four fundamental Moments related to each other, which enabled the description, problematization, discussion and interpretation both individually and in groups of the study practices of the sixteen students and of the pedagogical practices of their teachers working on content from the Physics (Acoustics) program. It is noteworthy that the content-methodology relationship will enable critical-reflective understanding, changing the teaching-learning relationship of Acoustics.

The First Moment: characterization and problematization of the participants' practice, it was carried out in the first two meetings. The students produced an individual text with the characterization and problematization of their study practices as well as their respective views on the pedagogical practices of their teachers.

In plenary, they raise issues of practice for reflection and analysis with the help of a theoretical framework, collectively systematized by the group, in the Second Moment: explanation of practice mediated by a theoretical framework. This corresponded to the third meeting that sought to enable the participation of each and every one through the Integrated Panel Phase I and II technique. In phase I, the students were divided into four groups with an equal number of participants who received a text on a part of the study topic - "Acoustics", pre-established from a Physics book approved in the National Textbook Program - PNLEM (BRASIL, 2014), group 1 – notions of acoustics, mechanical and electromagnetic waves; group 2 - physiological sound qualities, sound level and intensity; group 3 – interference, standing waves and strings; group 4 - sound tubes. Students do a detailed reading applying their study practices in these texts, producing notes referring to the most relevant points, with collective discussion. In phase II, new groups were formed with a representative of each group in phase I for an overview of the collectively systematized theoretical framework.

In the fourth meeting, the Third Moment was held: understanding of the practice at the level of totality, which involved returning to the data obtained in the first two meetings for analysis and theoretical systematization of the pedagogical processes of study experienced by them. At that time, the understanding of the study practices at the level of totality was carried out, with the understanding of the study practices of the participants, enabling them to move from the condition of passive recipients to active ones in the experienced methodological process and its results. With the theoretical framework of Physics studied (Acoustics), students socialize their study practices, forming a circle with the students (a large group) so that the participants of the initial groups of the First Moment had the opportunity to compare and understand the teaching approaches presented by the researcher. These served as clues for the elaboration of intervention proposals in the study practice and in the pedagogical practice of teachers in the Fourth Moment of the process.

In the fifth and last meeting, the Fourth Moment takes place: elaboration of proposals for practice, which implies the discussion and elaboration of proposals for transforming the participants' study practices. And, also, indication of clues for the transformation of the pedagogical practice of the Physics teacher in High School. This was done in plenary. The analysis and discussion of practices was carried out through the identification and comparison of the initial study

techniques and after the experience of the process. Finally, individual texts for self-assessment and assessment of the methodological process of Collective Systematization of Knowledge were produced.

The systematization of indicators for study and teaching practices was carried out by analyzing the data obtained during the five research-teaching meetings, supported by Bardin (2011). In this way, it was possible to prepare texts based on the categories of analysis and theoretical foundation, in the search for the organization of concepts and the relationship between them to obtain new knowledge and better elucidate the objectives of this article.

To preserve the identity of the students participating in the research we chose to identify them with fictitious names.

TRENDS IN THE PEDAGOGICAL PRACTICES OF TEACHERS IN THE PERCEPTION OF STUDENTS

In the presentations and discussions of students' study practices and teachers' pedagogical practices from the students' point of view the research participants highlighted the clarity of each one's responsibility in the groups' activities with a view to the Collective Systematization of Knowledge. In the words of the participating student:

I have now noticed a huge increase in my time use in my studies. I can study more and better in less time, thanks to the discussions and techniques presented in the classroom. I set up a different study plan than the one I had before the course with the diversified techniques I learned. Without a shadow of a doubt it will be important for my approval at the end of the year (student Lauro).

Other students, when describing the pedagogical practice of their teachers, indicate clues for changes regarding the need for contextualization of content, as well as for more attention to social relations in the classroom environment. This is how they express themselves:

In high school physics classes, according to my point of view, there is little interaction between teachers and students. Despite the content being worked out in a clear way and there is contextualization of the issues discussed there is not enough space for further reflection and group discussions. Few questions are asked during classes (student Diana).

Physics classes do not have groups to debate the contents taught. However, the classes have spaces for doubts, reviews of the subjects taught and for contextualization. Regarding how Physics is taught in college, there are many theoretical classes that do not directly involve mathematical applications, but specific knowledge needed to solve theoretical exercises (student Arthur).

In these speeches, we realize that the student starts to have a critical-reflective performance with colleagues, at the same time, the Collective Systematization of Knowledge modifies learning, alters the understanding of the knowledge worked on in a critical-reflective perception, allowing to associate the content with the daily life of those involved in this methodological process. Another student comments:

Physics classes in high school today are conducted according to the style of each teacher, with the majority following the standard content explanation – solving exercises. There are no groups for content discussions, nor many questions during the class. Teachers are flexible about student interventions and willing to answer questions. The moments of reflection are not as frequent as the contextualization present in most classes. In these classes they manage to demonstrate that Physics goes beyond the application of formulas and mathematics, I see that it largely involves logic and everyday applications (student Vitória).

We noticed contradictions in the teachers' pedagogical practices from the students' statements, reinforced by student Vitória who points out: "There aren't many questions during the class. Teachers are flexible about student interventions and willing to answer questions". Because the fact that there are no questions can mean that they have no doubts or nothing is understood, so there is nothing to ask.

Thus, in the new proposal for the Collective Systematization of Knowledge the understanding of a Physics content begins with a thorough study of the content collectively and in parts, and in solving exercises, the interpretation of the text comes first, locating the subject to be worked on, the relation of units and the context in which it applies. Only after this understanding comes "formulism" and mathematical calculation that are conclusive tools of analysis. Favoring the critical-reflective analysis by the Collective Systematization of Knowledge in the understanding of concepts and not just their assimilation lacking meaning for the student.

According to Carvalho and Gil-Pérez (2001, p. 91) Albert Einstein emphasizes that:

No scientist thinks with formulas. Before the scientist starts to calculate he must have in his brain the development of his reasonings. The latter, in most cases, can be exposed with simple words. Calculations and formulas are the next step.

Indeed, in the research-teaching dynamics the understanding of the students' study practice by the students and the critical analysis based on the various practices when studying the content of Physics during the experience of the Collective Systematization of Knowledge process, were relevant and indicators emerged from the statements, such as: the collective issue, autonomy, contextualization, formation of a web of solidarity and the role of students, which served as clues for the elaboration of proposals to redirect teachers' pedagogical practices.

Other techniques follow showing that the students had chances for questioning provided by the teacher, even with a lack of chances of theoretical reflection and discussion in the classroom, agreeing with the students' previous ones, but without the necessary time for reflection. This is how student Lauro expressed himself:

Currently, Physics classes in High School are the same as other subjects, the teachers teach the content and then solve exercises. We usually see people more interested in the subject asking questions and, in this case, teachers open a space to clarify doubts. Discussion groups are practically non-existent and when they occur they are not in the classroom. Some teachers

contextualize the subject given in the classroom with everyday examples or showing ways on how the subject can be found on the tests. Rarely does a student have the opportunity for questioning (student Lauro).

This happens because its focus is centered on the transmission-assimilation axis of content and on assessments (test, college entrance exam, ENEM) leaving the student as a passive recipient, losing interest in the subject. It is a fact that in daily practice it is common to find teachers who ask if anyone has a doubt, but time is not available for the student to formulate their question, as the question is quickly asked by the teacher who continues to explain the content. A study practice that emerged as an alternative in this process was that of doing and redoing exercises by the teacher in the classroom, which, properly understood, became the basis for the student's reasoning to understand the subject.

In line with this thinking, as a criticism of transmission-assimilation, Freire (2015a, p. 74-75) points out that:

One of the primary knowledge [...] is the knowledge of history as a possibility and not as a determination. The world is not. The world is being. As a curious, intelligent subjectivity that interferes with the objectivity with which I dialectically relate, my role in the world is not only that of someone who notices what happens, but also that of someone who intervenes as the subject of occurrences. I am not just the object of history, but its subject as well. And so, "... knowledge is a donation from those who think they are wise to those who think they know nothing".

Student Antônia highlights that:

I believe that practice plays a very important role. The student must be able to see that knowledge is useful for their daily lives and not just for a test. If I had the possibility to work in a laboratory instead of a classroom, it would be much more profitable. The student would be more involved with the subject (student Antônia).

Regarding the possibility of working in a laboratory, Pena and Ribeiro Filho (2009) note that despite the importance that experimental activities have for the teaching of Science and the significant number of works and research in the Experimental Teaching thematic line, it is possible to say that this research still seems to lack "forums" for discussion and dissemination about its relevance, efficiency and benefit for the teaching-learning process in Physics.

So, Gatti (2017, p.1163) in line with the objectives of this research and on the necessary updates in the pedagogical practices of teachers in general, adds:

In schools, teachers have the role of creating and recreating ways to provide their students with more effective, cognitive and socio-affective learning. The classroom and fields of knowledge, the dialectics in the daily relationship of teachers and students, the moral scope of this relationship, the intervention of knowledge, universal or local, in the sociocultural clash of different partners demand practices with foundations that will adequately support the educational act. [...] New challenges for teaching practice in the daily lives of classrooms arise and we are encouraged to build motivating modalities to work with the education of new generations.

Students Suzana and Diana describe that:

First, I pay maximum attention in class and I usually write down information that I think is important. I try to write down following the sequence of the teacher's reasoning (student Suzana).

During classes I pay attention to the teacher's explanation, following the content, and taking notes in the notebook. I try to write down the content spoken by the teacher that is not found in the material. During break times I try to do the proposed exercises (student Diana).

We can see in the speeches of Suzana and Diana as well as in the speeches of students from the following groups the teacher's pedagogical practice based on the axis of transmission and assimilation:

The criticism of the classic teaching method is that many students may not follow the class and, therefore, be abandoned by it. Transmission-assimilation does not work for most of the students and it seems to make many teachers upset because of indiscipline and we get tired, we get bored and this does not benefit either party. Without interaction between the student and the teacher ends up leaving the class tiring, repetitive and with an always tense atmosphere (Students from Groups 1, 2, 4, and 5).

Reinforcing the emphasis on this teaching approach, Braga (2018, p.48), referring to a study on the teaching learning process, adds that:

Most of the students' speeches show the relationship between teaching and knowledge transmission disconnected from the space for discussion and reflection on teacher education. And one of the lines that most represents this statement is that of LQ 17, "A good teacher is one who knows how to transmit his knowledge to students in a clear and objective way, so that students can learn and transmit what they have learned [...] knowing how to transmit the content in a simple way".

Still in this thinking, Freire (2015b, p. 82-83), reflecting on the oppressive society that encourages contradiction, says:

The educator is who knows; the learners the ones who don't know. The educator is the one who thinks and the students are the ones who are thought. The educator is the one who acts, the students those who have the illusion that act in the role of the educator, and finally, the educator is the subject of the process and the students are mere objects.

In addition to the content to be complied with students mention their concerns about the qualification and disinterest of the teacher in working in study groups:

[...] my learning in Physics in High School suffered a lot of delay due to the difficulty in finding a qualified Physics teacher, unfortunately. Anyway, when we had a teacher the theory was presented briefly, the formulas succinctly, and an average of 10 to 15 pages of the textbook were given for us to read at home. Due to the fact that there is a lot of teacher change most of the time the contents were given in a hurry due to the little time that "was left". And discussions were rare (student Maria).

Student José agrees with student Maria and emphasizes teacher changes and indiscipline:

In my first year of high school I remember that the Physics teacher could not teach the proposed contents because the room was a “mess”. With that I guarantee that we had no practice in groups or questions. In my second year my state high school had a lot of problems with teachers. If my memory is right we had three Physics teachers, but none of them worked out. It was a “lost” year (student José).

The indiscipline in the classroom due to the teacher's pedagogical act in the teaching process shows the need to rethink the methodology to be used in the classroom in the teaching of Physics in High School. These students are in line with the concern of Freire (2015a, p. 89-90) who says:

The teacher who does not take his training seriously, who does not study, who does not strive to be up to his task, does not have the moral strength to coordinate the activities of his class. [...] what I mean is that professional incompetence disqualifies the teacher's authority. Another indispensable quality of authority in its dealings with freedoms is generosity. There is nothing that lowers the task of forming authority than the pettiness with which it behaves.

Coming in line with this thinking, student Júlio states that:

Physics in my high school varied a lot, especially because I changed schools a lot (every year I changed schools) in the first year I chose a different methodology in which we were gathered in groups and themes were pre-selected to work in groups of six people. Thanks to the lack of interest of some students the class was very difficult and often boring. A curiosity about the first year of my high school was that there were no exams and that the teachers were extremely disinterested in the students themselves. Note: many times there was not even a teacher even though it was a private school.

The testimonies reveal that the teacher presents himself as the only holder of knowledge, having to overcome the content aiming at tests and exams, and not interested in making changes or even due to a possible lack of knowledge to alter his social relations with students. Considering these aspects, Roldão (2007, p. 101) shows that:

[...] the dominant reality of teachers' practices and full professional knowledge, lacks deconstruction, unveiling and articulation for its passage to an articulated and systematic knowledge, capable of communication, transmission, without which its development results impossible or tiny.

Putting the way of teaching in its multiple diversities in the social relations of the school environment, ahead of the content, just passing the content organized by the teacher to the students to fill a plan does not guarantee learning. On the contrary, this is where, instead of advancing the content, in the teacher's understanding, time is wasted, as learning does not happen. These intense social relationships, therefore, signaled to the teacher a new perception in relation to their practice enabling a greater involvement in the particularities of these collective relationships with the possibility of transforming and getting to know their students better in their pedagogical needs.

THE COLLECTIVE SYSTEMATIZATION OF KNOWLEDGE AS A METHODOLOGICAL POSSIBILITY

As signs in the discussions of student practices the possibility and need for a new methodology in the teaching-learning process in Physics emerged due to the current demands of High School. This implies teacher training in relation to their practice in the classroom in order to enable students to become co-authors of the teaching-learning process as proposed by the perspective of Collective Systematization of Knowledge by Martins (2009).

In this line of reasoning and relating relevant points during the process student Sofia takes a stand showing herself in favor of the methodological alternative experienced highlighting new ways of understanding among students of a particular content of study.

Regarding the integrated panel activity carried out, it showed us how important each one of us is for everyone's learning. Only one had certain knowledge that can be summarized in a few words and everyone could learn it quickly and easily because as each one knew its content well was able to transmit it well. I thought everyone's participation was positive, there were interactions with the material and with people as it is important to interact after all we are not alone in the world. A longer lasting learning will not be forgotten so quickly (student Sofia).

Student Kátia considers changes in her study practice as transformations in her learning process, as follows:

What was most valuable were group conversations. On them I had new ideas of how to study and other people's point of view on the same subject. For example, what was important to one person about acoustics was not to another. The quality of understanding was superior (student Kátia).

And finally other students participating in this research expressed themselves:

[...] the Collective Systematization of Knowledge makes it easier to see where there was more difficulty in understanding and it ends up that you learn much more from what others have to tell you about the subject, which alone would end up not giving importance. This practice will depend a lot on the students and no one will be able to fail to do their part, but "it is a good idea to differentiate this monotonous teaching method that we have today" (student Alexandre).

[...] it was able to feel that time passed by easily unlike those "long" classes where the teacher starts talking and it seems that the class will never end (student Simone).

[...] in addition to making classes more dynamic and contributing to the fixation of content it also awakens greater interest in the student and possibly increases their academic performance. I sincerely believe that not only in Physics, but also in other subjects the way in which the content is being worked needs to be changed (student Germano).

The perceptions of possibilities for transforming practices both in the study of students and in the pedagogical study of the High School Physics teacher were evidenced by the experience of students in the research-teaching modality with the Collective Systematization of Knowledge constituting the following indicators:

- a) collective issue: valuing discussion groups in the classroom;
- b) autonomy: students prefer to study autonomously;
- c) contextualization: students relate the study content with the social reality where they are inserted and the reality of the school;
- d) formation of a web of solidarity: learning in relation to students' study practices provides contributions to teaching practices and intertwines social relations between participants in the teaching-learning process; and
- e) protagonism of students: students show that it is not just about reading and synthesizing but going beyond. They are problematizers and have a significant capacity for argumentation inserting new elements and concepts that have not been experienced by other generations revealing that it is not just about reading and synthesizing but going beyond.

Thus, it is clear that in the teaching practice in the classroom from the perspective of the Collective Systematization of Knowledge students recognize themselves in the process in a new way of working with teaching which makes it possible to understand the contents bringing students to the reflection -criticism.

FINAL CONSIDERATIONS

Deconstructions and reconstructions of the study practices of high school physics students, both individual and collective, and of the pedagogical practices of their teachers in the view of the students.

The students in this research experienced the teaching process with a focus on the process of doing (Collective Systematization of Knowledge) and not on listening to how they should do it. They were able to analyze and understand the Moments of this teaching approach signaling possible changes in attitudes towards the pedagogical practices of their teachers with clues for a new role in the teaching-learning process, including a new pedagogical structure for the classroom, bringing questions and insights about contents with the active student in the process. Also signaling the possibility of students leaving the situation of being passive in the educational process providing possible paths for transformations in their study practices.

The process presented comparisons between concepts, clarifications, interpretations and practical examples around the content of Physics, but having as its main focus the experience of the study practices of students participating in the research before it through the Collective Systematization of Knowledge.

Thus, we did not seek a model that would be adopted by High School Physics teachers, but to bring to the reflection the procedures and results used in this practice and not in any practice with the Collective Systematization of Knowledge methodology proving possible for teaching of Physics in High School favoring the reflective critical appropriation of contents with the formation of webs of solidarity that will give a new format to social relations in the classroom providing more

autonomy to students highlighting individualities and enriching the collective in the process teaching and learning.

Then, there is the possibility and the need to break with the transmission-assimilation teaching approach axis, inserting students and teachers in the critical-reflective perspective, understanding knowledge in a new way of working teaching, not only reproducing the content but relating it to the daily life of the participants in the process through the Collective Systematization of Knowledge envisioning different ways of perceiving a certain topic in the teaching of Physics in High School. This is the challenge...

Ensino de física no ensino médio pela sistematização coletiva do conhecimento

RESUMO

Este artigo aborda uma pesquisa-ensino voltada às práticas pedagógicas dos professores e às práticas de estudo de estudantes de Física do Ensino Médio, tendo como eixo epistemológico a concepção de teoria como expressão da prática. Tem como objetivo trazer para reflexão a Sistematização Coletiva do Conhecimento como alternativa de ensino e de estudo nesta área do conhecimento. Os dados foram produzidos por meio das falas e textos elaborados pelos estudantes, na vivência de quatro momentos do processo metodológico Sistematização Coletiva do Conhecimento, tendo como base referenciais teóricos pré-estabelecidos, com os participantes da pesquisa descrevendo, analisando, problematizando, discutindo, explicando e compreendendo tanto suas práticas de estudo quanto as práticas pedagógicas dos professores de Física do Ensino Médio. O estudo mostra que a desconstrução e reconstrução do ensino pautado na transmissão-assimilação tanto na prática do professor como nas práticas de estudo dos estudantes pode ser modificado se realizada a Sistematização Coletiva do Conhecimento, favorecendo a apropriação crítico-reflexiva dos conteúdos inerentes à Física.

PALAVRAS-CHAVE: Ensino de Física. Ensino Médio. Indicadores para as Práticas Pedagógicas.

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