The instrumentation for teaching physics at initial teacher training: Assuming authorship in the physics teaching-learning process

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Abstract. This work investigates a didactic sequence developed in the Instrumentation for Teaching Physics (B) course, the didactic-methodological strategies adopted and its innovative character towards critical and reflexive formation. The context of the research focuses on this evening course offered in the second semester of 2016, part of the Teaching degree in Physics at the Federal University of Santa Maria (UFSM). The course's main objective is to understand the importance of the laboratory for the development of Physics and for the teaching of Physics, as well as to elaborate and defend in the classroom, structured and unstructured teaching scripts for high school that integrate theory and practice in Mechanics and Thermodynamics. From this objective, we developed a work dynamic that allowed a study that spoke to the physical contents involved, the selection and construction of the experimental activity and sharing of the work during two meetings a week. Features such as MOODLE, WhatsApp, and shared documents in Google Drive were used in the course of activities. Based on the results obtained, it is accepted that the didactic sequence adopted in the discipline promoted the understanding of academics about the importance of planning and use of the experimentation in their future activities as teachers.

1. Introduction
The Instrumentation for Teaching Physics B (InspB) course is part of a four-course set (Instrumentation for Teaching Physics A, B, C and D) that has as its educational objectives to work with the available teaching resources and to put them to good use in the didactic planning along with the students in their training. The main objective of the InspB course is to understand the importance of the laboratory for the development of Physics and for teaching Physics, as well as to elaborate and defend, in class, structured and unstructured teaching scripts for high school that integrate theory and experiments in Mechanics and Thermodynamics.

The course should enable the academics to have contact with the content of Physics for Basic Education, to become familiar with and test different teaching methodologies in order to develop experimental day-to-day activities in the school, whether in the classroom or outside. In this way, the course offers great potential for the planning and development of experimental activities in different contexts and with a diversity of materials.
The students’ interaction with the experimental materials may occur in two ways. It may be only visual, where the teacher leads the experience in the class, designated as demonstration; or through manipulation, where the students work, in small groups, directly with the experiment [1]. In addition, the planning and leading of lab classes may vary greatly, whether it be with structured guides or even through the investigation of a lab problem with the objective of resolving an experimental problem [1].

In this perspective, there are different possibilities for developing experimental activities: with open or closed scripts, as a demonstration of a specific phenomenon led by the teacher and/or developed by the students, carried out in labs that are specific for these activities or even in the classroom, with more sophisticated kits acquired by the school or with alternative/low-cost materials and/or also using computer simulations.

The experimental activities have their didactic contributions to the development of abilities in Physics outlined in the Complementary Orientations for the National Curricular Parameters (PCN+). It provides guidance to the experimental activities so that their use may guarantee the construction of knowledge by the student while developing his or her curiosity and habit of inquiry.

That fact that experimental activities have been a part of school curricula for almost 200 years and have permitted a wide variation in the possible developments does not guarantee that teachers will be familiar with this type of activity. This is because the performance of these activities has been characterized more by the division of tasks among students than by the exchange of significant ideas around the phenomenon being studied [1].

There is a need to take certain precautions in the development of such activities. When they are not planned adequately, there is a great risk that these activities are undertaken in a mechanical manner, in which they do not stimulate the students to reflect sufficiently about the theoretical constructions that support the experiments [3]. Thus, theory and practice are not associated in such a way as to allow the students to relate them to reality.

There is no single way of organizing work in the laboratory. One may make use of demonstrations or guided practical-experimental activities, either by the teacher or indirectly with a script [4]. In order for the work to be effective, however, the teacher needs to establish, in a clear fashion, the objects behind the realization of the proposed activities. Despite the existence of a vast literature around the experimental activities, in which “there is a significant variety of possibilities and tendencies” [5], the materials that are available to teachers often times have orientations that are associated with a traditional approach to teaching, with closed demonstrations and with laboratories that seek to verify and confirm previously defined theories.

In this sense, the enrichment of experimental activities becomes a necessity, achieved through the adoption of a more flexible stance and the introduction of elements and methods that allow for a deeper reflection around the phenomena being studied. It is an attempt to produce practices that may provide an effective contribution so that the learning process around the concepts in question may be as significant as possible [5]. The enrichment of experimental activities may even be realized with the production of the materials to be used in the activity, for it will contribute to the development of experimental abilities of the academics [6, 7].

In developing this course, we thought of using a Didactic Sequence (DS) that would allow the academics to reflect on the potential behind this activity and that could, at the same time, construct/systematize knowledge in an attempt to overcome the obstacles around dichotomized teaching in which theory, practice, teaching and research do not relate to one another. Additionally, by strengthening these relations, we attempt to contribute toward the preparation of future Physics teachers in the sense that they be able to act with autonomy and creativity, assuming the role of authorship in the planning/production of their work and in their permanent education.

2. Objectives and method
The main objective of this work resides in highlighting contributions toward teacher development that foment the use of experimental activities in teaching Physics, based on an educational process that is
reflexive and that leads the future teacher to assume the role of authorship in his or her practice, as well as a more critical stance in regard to the use of this type activity.

To reach this objective, we will present the didactic sequence developed for the course Instrumentation for Teaching Physics B, as well as the didactic-methodological strategies adopted and its innovative character toward the following specific objectives:

- To investigate a didactic sequence for the discipline Instrumentation for Teaching Physics B;
- To provide a contribution that allows the academics to elaborate pedagogical activities that relate theory to practice.

The data used for the analysis were from the activities developed throughout the discipline and from two diagnostic questionnaires applied by the teacher, one in the beginning and the other at the end of the discipline, and from a teacher evaluation conducted by the educational institution.

We analyzed the qualitative data using the content analysis method [8]. For this, we listed two dimensions. The first dimension conceives the academics’ conception of and experience around the use of experimental activities, contemplating the difficulties and knowledge considered necessary for the development of experimental activities. The second dimension contemplates the activities undertaken throughout the course with a focus on the desired training. Moreover, to contribute to the future development of the course, we completed a self-evaluation of the discipline that will be presented along with the analysis, in item 04 below.

2.1. The Experience

The Instrumentation for Teaching Physics B course was offered in the second semester of 2016, in the Physics Teaching undergraduate degree program – Evening, at the Federal University of Santa Maria (FUSM). It is offered to academics in their fifth semester and has a workload of 60 hours in class, divided into two weekly meetings. The course seeks to help the academics to comprehend the importance of the laboratory for the development of Physics and for teaching Physics, as well as to elaborate and defend, in the classroom, structured and unstructured teaching scripts for high school that integrate theory and experiments in Mechanics and Thermodynamics.

The activities were developed with six academics, divided into two groups, with three members each in two sessions a week. The first session was used to systematize knowledge, between dialogues around knowledge of the content specific to Physics and pedagogical knowledge for the construction of a didactic sequence – DS (development of an experimental activity or demonstration) to be related to the content in question. The second session was used to share the experimental activity that had been constructed.

The DS proposed for the studies was delimited by taking into account that tasks and activities acquire greater value when systematized in an order or didactic sequence [9]. According to the authors, for this to occur, there are three elements that must be considered for a reflexive educational practice: planning, application and evaluation.

However, through the activities that were developed, and beyond the aforementioned objective, we sought to provide a critical education to guide each one of the academics to assume a role of authorship in the planning and in the development of their practices. This was accomplished through the sharing of knowledge and practice, through dialogue, research and the search for a process of continuing education. The course’s program was divided into two units. The first unit, titled Laboratory Scripts, contemplated the following topics: The laboratory in Physics; The laboratory in Physics teaching; Structured scripts; Unstructured scripts; and Theory-experiment integration. The second unit, titled Elaboration of Scripts, contemplated the development of activities in the following topics: Kinematics; Newton’s laws; Principles of conservation; Fluids; Oscillations; Waves; Thermometry; Calorimetry; and Thermodynamics.

The development of each topic contemplated the Content Knowledge, related to the physical concepts involved in each activity, and the Pedagogical Knowledge, related to the planning and development of activities and to the teaching-learning process of the physical concepts in question. This relation allowed for the integration of various contents previously developed in other courses.
The didactic procedures began with the application of a diagnostic questionnaire that sought to grasp the conceptions and experiences of the academics around the use of experimental activities. All questions related to the diagnostic questionnaire were discussed in the discipline’s second session, a few of which were problematized.

After a period of readings and dialogues around experimental activities and the elaboration of scripts that could contribute toward the development of critical thinking and of the investigative “spirit” of the academics, in the first unit, the group was separated in two in order to begin the stage related to the second unit of curricular content of the discipline.

The groups were assigned the task of creating a DS for each topic or, in an attempt at defragmenting contents, think of an interdisciplinary didactic sequence. We elaborated a work dynamic that would allow for study and dialogue in the groups around the physical contents involved in each topic, the selection and construction of experimental activities or demonstrations and sharing in the larger group.

For the interaction between academics and professor outside of the classroom, we used a Virtual Teaching and Learning Environmental (VTLE) called Moodle, which provides tools for interaction. We shared documents on Google Drive and used the tool for the collaborative production of the proposed activities. The platform was used to elucidate doubts in forums or dialogues, to share activities during and after their construction, and to share knowledge and practices around the topics being studied. Due to a suggestion by one of the groups, we also interacted via WhatsApp.

The second weekly meeting would have time set aside for presentations of the experimental activities and the first written version of the DS developed by each group. After sharing, those present would reflect on the proposal presented and suggest possible adaptations and changes that could improve the quality of the activity. Once this was done, each group would adjust its written proposal and send it to the teacher/professor, who would evaluate the proposal and provide feedback and new suggestions for the final version.

In addition to the evaluation of each group’s DS, their participation and interaction in the in-class discussions, the academics also filled out questionnaires evaluating the course, the professor and themselves in a self-evaluation.

3. Presentation and data analysis
This section presents the research results. The results and analysis of the academics’ conceptions are presented first, followed by the activities undertaken throughout the course.

3.1. The academics’ conceptions and experiences regarding the use of experimental activities
A diagnostic questionnaire was applied with the objective of construing the academics’ conceptions and experiences around the use of experimental activities, as well as the difficulties and knowledge necessary for the development of experimental practices.

Among the academics, 83.3% had no experience with experimental activities in their high school Physics class; 66.7% had experience in other classes at the basic education level, mainly in Biology and Chemistry; and 33.3% never participated in any experimental activity throughout this period, even though 83.3% claim to have studied in schools that had a computer lab.

At the time of filling out the questionnaire, all academics agreed that experimental activities make the class more attractive and dynamic; they allow the student to have more interaction with the object of study and verify the relations between theory and practice, results which are in line with recent research [3, 5].

Only 16.7% affirm that this type of activity takes too much classroom time and 33.3% agree that the students become more agitated with this type of activity. Moreover, only 33.3% agree that what is gained from this type of activity does not compensate the time required for planning them. All agree that the experimental activities minimize learning and teaching difficulties in Physics in a significant and consistent manner.

Questioned about the difficulties found in practicing experimental activities, the academics expressed the opinions organized in Table 01.
Table 01. The academics’ assertions regarding the difficulties in using experimental activities

| Academic | Difficulties |
|----------|--------------|
| ED1      | Having adequate equipment available for the activities (whether bought or hand-made). But, personally, knowing whether the experiment is adequate and if it will actually be beneficial and well executed to the benefit of the students. |
| ED2      | Class time should be enough to assemble the experimental apparatus and to accomplish the activity. A lack of materials makes things difficult. Unprepared teachers and a lack of interest by the students also prevent the development of experimental activities. |
| ED3      | How open students are to its applicability; The availability of equipment; The time most teachers have available to plan their classes. |
| ED4      | A lack of equipment. |
| ED5      | The difficulties are the lack of material to do the activity, the lack of structure or of space to accomplish the experiment and sometimes unpreparedness of the professional. |
| ED6      | Just like the theoretical lesson the first experimental activities with a class may not provide the expected results due to the teacher’s inexperience. Another difficulty is the issue of concepts that require materials that are unavailable for study in an experimental activity. |

The assertions presented in Table 01 refer to two main difficulties that the academics they think are present in accomplishing experimental activities in school: the lack of adequate supplies and of teacher training. The lack of supplies for teaching Physics is a constraint for teachers, but may be lessened with the use of alternative and low cost materials [5,7], allowing the students access to these materials.

In regard to the knowledge necessary for the Physics teacher to possess in order to plan and develop experimental activities, the students considered the following:
Table 02. Academics’ conceptions around knowledge required for the Physics teacher

| Academic | Knowledge required for the Physics teacher |
|----------|------------------------------------------|
| ED1      | The teacher needs to have adequate knowledge about the subject that will be taught in the experiment. He or she needs to know if the group for which the experiment is intended is adequate. And to know exactly how to conduct the activity so that the objective is not lost along the way. |
| ED2      | Mastery of the content covered in the experiment is essential. Knowledge about the materials used as well. The teacher must decide together with the students the subjects of the experiments. |
| ED3      | Diversified knowledge that goes beyond simply knowing Physics, but also knowing how to “mix” the sciences while respecting the laws of Physics. |
| ED4      | Master the subject and test the experiment before class. |
| ED5      | First of all, theoretical knowledge around the subject and, after the teacher has already performed the activity, in order to know if there are enough necessary supplies, if it is not too complicated for the students, if the activity will indeed resolve the doubts students may have around the theoretical content. |
| ED6      | Knowledge about the subject that will be studied and the apparatus that will be handled is necessary for the development of the activity. |

It is clear from the academics’ assertions that the necessary knowledge that the Physics teacher must have regards content and technical/instrumental knowledge. Only one of the assertions (ED3) refers to the idea that the teacher should favor interdisciplinarity when (s)he mentions “diversified knowledge” and “knowing how to mix the sciences”. It is important that the teacher know how to promote interdisciplinary actions in the sense of promoting competencies [2, 5].

Moreover, the teacher also needs to have pedagogical knowledge; that is, beyond simply knowing the content, one should also know how to teach it. This points to the importance of teacher training courses that guide the practice of the teacher. In this sense, one should study the different didactic-pedagogical strategies that best fit the process of constructing knowledge and that foster the development of critical thinking skills and an investigative spirit in the students.

3.2. Activities carried out throughout the course focusing on the desired training

As was mentioned above, each group constructed one DS a week, which contemplated each one of the topics of the second unit. The work dynamic allowed for study and dialogue in each group around the physical contents involved in each topic, the selection and construction of the experimental activities or demonstrations and, afterwards, it was shared with all the other academics.

During the first sessions of the week, the group would meet in the classroom to discuss one of the topics of the second unit and think up an experimental artifact to include in the DS. Each academic would come to class already having some ideas and alternative materials for building the experimental artifacts, having in mind that one of the objectives of the discipline was to build low-cost experimental artifacts using alternative materials. In this manner, one of the difficulties pointed out in the questionnaire, regarding the lack of appropriate resources in the schools, could be attended to. In these sessions, the teacher fomented dialogue and gave feedback to draw attention to relevant points.

As a way of encouraging the development of the role of authorship, the teacher invited the academics to publish their “scripts” in a public space. In addition to contributing to their critical and creative
training, such an initiative contributed to Physics teaching and to the continuing education of other teachers through the sharing of this knowledge and these practices.

At all times, we sought to form critical thinking skills in theory related to the academics’ pedagogical work, in a spiral of observation, action, and reflection. This serves the purpose of rethinking practices and seeking new paths, as defended by the authors of research-action. In this perspective, the study sought to integrate theory production and teaching practices in a single process [10].

As a form of self-evaluation of the entire process developed here, of the teacher educator, as well as of the project’s contributions to the teacher’s professional development and to the academics’ training, we used the data provided by the course evaluation questionnaire, given at the end of the discipline, and by the teacher evaluation [10].

According to the assertions presented in the first question regarding the evaluation of the discipline, the answers presented in Table 03 were obtained.

**Table 03.** The academics’ answers to the questionnaire regarding the objectives of the discipline

| Academic | Were the objectives of the discipline achieved? |
|----------|-----------------------------------------------|
| ED1      | Yes. All of the activities performed related theory and practice in a creative and interactive manner. All models were built with used or low-cost materials, which allows them to be built at any school and by teachers and students. They served the observations of theory as practice very well! |
| ED2      | The activities (demonstrations, experiments) used during the course showed the importance of this type of activity in the classroom. The main characteristic is that it brings an understanding to concepts that were not understood with theory alone. In regard to the scripts, we noticed the importance of their structure. The structure is reflected in the results obtained with the students. |
| ED3      | Yes, after all the experiences, I believe we are capable of elaborating an experimental activity, even if it improvised, to reach a better understanding by the students. |
| ED4      | Yes. I believe the objective of the course was achieved as the activities were being carried out. The elaboration of scripts helps with the organization of the content that must be given in the classroom. |
| ED5      | Yes. The course in addition to achieving the objectives, stimulated group sharing, collective participation and the development of activities that involve the daily life of the students. |
| ED6      | Yes. With guidance from the teacher and debating with colleagues, I was able to elaborate several scripts. |

According to the responses presented in Table 03, all the academics claim that the objectives of the course were met and emphasized the importance of previously prepared scripts, because, in addition to integrating content with practice, it improves the students’ understanding of the concepts being studied. We verified that the scripts serve as a guide when they allow for the systematization of a task or a pedagogical activity such as a didactic sequence. They gain a greater value and allow for learning [9].

Table 04 presents the academics’ responses when questioned if the activities developed in the course contributed toward an adequate training in the use of experimental activities.
Table 04. Responses about the contributions of the course toward adequate training

| Academic | Did the activities developed in the course contribute toward an adequate training in the use of experimental activities? |
|----------|----------------------------------------------------------------------------------------------------------------------|
| ED1      | Yes. In my case, since my knowledge around the theoretical part of Physics is still very limited, I had to begin my observations practically from nothing, but I was able to notice how much this type of activity allows for the “absorption” of information to be given in a more easy-going and interesting manner than the old lecture class. |
|          | In my view the main contribution was in the sequence of the activity. I was able to see during the activities how much this is reflected in the results obtained, because the moment and manner in which it is introduced may or may not attract a greater interest of the students. Another reason that justifies the importance of the sequence is that it is reflected in the elaborated scripts. And these scripts may serve as a basis for later consultations for the class. |
| ED3      | Yes, because in addition to elaborating the EA, there is also the elaboration of the scripts and the conceptual development to be applied in the classroom. |
| ED4      | Yes, it does. After taking the course, the student notices that accomplishing the experimental activities makes learning easier and, at the same time, prepares him or her for the class. |
| ED5      | Yes. Despite the difficulties faced by the group, we were able to, with time, develop the activities in the classroom, breaking the barrier of “not having time to do” and the incentive to search for low-cost materials gave us a new perspective so we wouldn’t remain “hostage” to a lab to be able to carry out experiments. |
| ED6      | Yes. Debating the results and reviewing alternative conceptions. |

According to the responses shown in Table 04, everyone agreed that the Instrumentation course contributes toward an adequate training. The academics’ main conclusions about the use of didactic sequence in the classroom include: breaks with traditional teaching, increases student interest in the content being studied and facilitates learning. In analyzing ED5’s assertion, we can also conclude that the time allotted by the course for planning the didactic sequence during class time collaborated with the academics’ learning, given that, often times, they are overloaded with activities and are unable to develop tasks outside of the classroom.

Table 05 brings the academics’ assertions concerning how secure they feel when using this type of activity to teach Physics.
Table 05. Security in the use of experimental activities

| Academic | Do you feel comfortable using these activities to teach Physics? Justify your response. |
|----------|--------------------------------------------------------------------------------------------|
| ED1      | Yes and No. Yes, because I could replicate the activities proposed in the course and No, because I still need a stronger theoretical grounding that would allow me greater mastery and a greater vision of how to explain the content, intertwining it with the activities. |
| ED2      | Since the activities used in this course were mainly demonstrations, I would use them comfortably. If I notice there is good progress by the students, I can add collection of measurements and calculations to it. Otherwise, I can finish with only the demonstration which is usually faster than the experimental activities and continue with the class. |
| ED3      | Partially, I still need to ripen my knowledge in Physics so that I can apply it in the best way possible when elaborating an EA. |
| ED4      | Yes. The activities were carried out with low-cost material, making it easier. |
| ED5      | Yes. All the elaborated activities are easily assembled and handled, they can be done in small groups. |
| ED6      | Yes. The theoretical support helps me in elaborating the activities. |

Not all the academics demonstrated a feeling of total security in using didactic sequences in the classroom, as the assertions in Table 06 show. The academics ED1 and ED3 point to the little knowledge they possess of the theoretical content in Physics as the reason behind their insecurity. Despite the fact that most of the academics have already completes a majority of the basic courses in Physics, they still show fragilities in the conceptual understanding of the contents. The insecurity that the academics feel regarding the content studied is directly related to their initial education in the teaching degree, since in the first semesters there is great emphasis in technical knowledge of Physics and in problem solving [6]. With this, learning occurs in a mechanical fashion and, when they take the teaching courses, the academics have difficulties and insecurity in transferring this knowledge didactically in the context of basic education, given that they need to lead the students to reflect and think critically.
3.3. Course evaluation

In regard to the difficulties encountered in the development of the activities proposed in the course, the academics made the following affirmations:

Table 06. Answers regarding the difficulties encountered in the development of the activities

| Academic | Which difficulties did you encounter in the development of the activities proposed in the course? |
|----------|--------------------------------------------------------------------------------------------------|
| ED1      | Yes. Constructing models that were visual and very interactive!                                    |
| ED2      | As for the moments of sharing, I didn’t have any difficulties, because the group is small and we only looked at the basic content we already knew. I had more difficulty elaborating the scripts, the moment in which we put on paper what was done in practice. |
| ED3      | Yes, those activities that involve content that I haven’t mastered were the most difficult.         |
| ED4      | Yes. I had personal difficulties.                                                                  |
| ED5      | Yes, in the activities in Thermodynamics, not due to the activity itself, but because of the difficulty I have with the content. |
| ED6      | None.                                                                                              |

In Table 06, the fragility of the initial academic education of the teaching degree becomes evident. Once more, the academics report difficulties related to theoretical content that they did not learn well during the basic courses offered by the degree program. This situation leads us to reflect on the educational proposal in the Physics Teaching degree and, mostly, to discuss what type of teacher we want to prepare, based on the manner in which our initial courses are given. There is a need to review the technical knowledge in Physics being taught in the teaching program in order to search for a new restructuring that attends to the real interests of basic education [6].

The main contributions of the course, according to the academics, were: new perspectives on Physics, opportunities to elaborate and apply a practical activity, time to elaborate and reflect on the activities, and planning and discussion of the activities among peers. The use of experimentation in Physics teaching may or may not favor concept comprehension, because it will depend on teacher planning, on different foci [5] and on the relation created between theory and practice. The planning of activities in a team setting provided greater security to the academics who showed insecurity in relation to theoretical knowledge in Physics. This was reflected in ED1’s self-evaluation:

*I think I participated a lot, but my knowledge is still very limited. There were a few moments in which I felt somewhat lost in the activities. But, with the help that I received from my excellent group, I was always able to catch up and show, at least partially, the progression of what was being worked on.*

The academics shared the opinion that the course could be improved in the following aspects: by reviewing the content that would be used, improving the infrastructure and giving more flexible deadlines for assignments. According to them, aspects that could improve the course include a good internet connection for virtual communication and classes in a space with stands and shelves. Concerning the amount of time provided for developing activities, there was a disagreement between
two academics. While one argued that flexibility of deadlines for the development of activities was an essential factor for the course to progress satisfactorily, the other defended that timelines needs to be lengthened.

According to the Teacher Evaluation report, among the points that were listed, it is worth noting that the students affirmed, in their totality, that the teacher who administered the course: presented and accomplished what was set out in the program; demonstrated mastery of the content, addressing it in a clear and objective manner; established relations between the content of the course and the content of other subjects, and contributed to their professional development; was available for the elucidation of doubts regarding the course and the content given; used methodology (teaching techniques) that are adequate for learning; used the available didactic resources to favor learning; stimulated the use of complementary materials (books, websites, online newspapers, audios, videos, among others); elaborated evaluations that were compatible with the contents administered in class; discussed the questions in the evaluations and explained the grade given (feedback); heard criticisms, opinions and suggestions relating to the classes, demonstrating openness to dialogue; presented a posture of mutual respect; preserved the image of the institution, of colleagues and of the academics.

Based on these assertions, one can conclude that the objectives of the course were met. The traditional education model, based on the presentation of content and student passivity, was broken using a critical and reflexive approach that creates close ties to the context of the real and social life of teachers and students. Thus, it contributed to a more critical and creative teacher education.

We highlight that this discipline is usually held with few students and this justifies the small sample (only six students) in this article. However, this experience will be repeated and reviewed by authors, every new semester, paying attention to the results of the present analysis and in the subsequents.

4. Final Considerations

It is important to reflect on the teaching-learning process in Physics, one which goes beyond a mere content-oriented process, but that draws attention to the abilities that can be developed in the direction of the preparation that is currently to be expected from our students.

Thus, the criteria that guide pedagogical action are modified so as not to take “what to teach” as a first reference, but rather re-centers itself around “why teach”, making explicit the need to assign meaning to knowledge at the moment it is learned. When one takes “why” teach Physics as a reference, one can assume that the student is being prepared to deal with real situations, energy crises, environmental problems, device manuals, conceptions of the universe, medical exams, newspaper articles, and so forth [2].

In fact, the very scope of Physics prevents this science from covering all its content in basic education. The Physics teacher needs to know how to select the content that is most pertinent for the students’ education. This requires, beyond a mastery of content specific to Physics, a mastery of pedagogical content that leads him or her to establish the criteria that could demark the selection of the content in question, how it should be addressed, for what reason it should be addressed and at what moment. It was in this perspective that the InspB course was planned and developed, based on the principle that the student is a subject of knowledge, that is, that he or she should assume authorship in the process of constructing knowledge itself.

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