ACTIO: Docência em Ciências
ISSN: 2525-8923

http://periodicos.utfpr.edu.br/actio

Student engagement and contemporary themes approach: structural, curricular and methodological challenges

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ABSTRACT

The demands of integration among areas of knowledge and the linking of school contents with the experiential elements of the subjects can be understood within the scope of the contemporary themes approach in Basic Education. This perspective can aggregate the problem-posing of relations between Science, Technology, Society and Environment (STSE), the positioning and the proposition of alternatives, towards controversial issues. Regarding this educational conception, in this experience report, some analysis are presented concerning the development of an educational proposal within the scope of the Pedagogical Residence of Physics, with students from the third year of a public institution in Curitiba, Paraná, from February to September 2019. These actions were undertaken considering the assumptions of approach of STSE relations and engagement, with theme related to the Production, Distribution and Use of Electric Energy. In reference to this process, the objective is to point out structural, curricular and methodological challenges. Among the developed educational activities, reading processes, discussions, experimental activities and model making stand out. The analysis focused on reports elaborated by residents, materials produced by students in Basic Education (written activities delivered on paper and in Google Classroom; models) and questionnaire. The written materials were analyzed considering elements of Content Analysis. In the data analysis process, aspects of student involvement and correlations with structural, curricular and methodological challenges were highlighted. It was evidenced student engagement in the activities, with recognition, problem-posing and proposition of alternatives to contemporary problematic situations. However, difficulties concerning student participation and the use of mathematical elements were identified. In terms of challenges, there was a need for adaptations and articulations, considering the characteristics of the institutions and the subjects involved; these comprised structural perspective, curricular organization and methodological approach, concerning the break with aspects of traditional teaching. It should be noted that the development of this proposal made it possible for residents to articulate theory and practice, with action and reflection towards the educational practice itself.

KEYWORDS: Physics teaching. Teacher Education. Electric energy.

INTRODUCTION

Recent changes in scientific, technological, social and environmental panorama evidence the urgency of new ways of teaching, with integration among fields of knowledge, associated with the subjects' living contexts. In this sense, according to National Common Curricular Base (BNCC), “the social, historical and cultural contextualization of science and technology is fundamental for them to be understood as human and social enterprises” (BRASIL, 2018, p. 549, translation by the paper authors).

In articulation with these demands, studies of the relations between Science, Technology, Society and Environment (STSE), with problem-posing concerning elements from these domains, are placed. Within this scope, the public participation in issues relevant to such dimensions, involving the engagement perspective, is highlighted.

Regarding the approach of these aspects in the educational domain, problem-posing concerning contemporary themes stands out, in an integrating perspective, linked to the contexts of students and teachers. In this paper, this educational concept is articulated with structural, curricular and methodological aspects relevant to Basic Education.

In this direction, in this experience report, considerations are presented on an educational proposal developed in a public institution in the city of Curitiba, Paraná, with students from the third year of high school, between the months of February and September 2019, in the context of the Pedagogical Residency Program in Physics. This work was carried out with the support of Coordination of Superior Level Staff Improvement - Brazil (CAPES) - Financing Code 001.

Regarding the analytical design, in a formative perspective, analyses of student engagement are highlighted, comprising articulations between Physics content and contextual aspects, within the scope of this educational proposal. The objective is to point out structural, curricular and methodological challenges associated with the experienced process.

ENGAGEMENT AND STSE EDUCATION

The concept of engagement refers to the relationship that students establish with activities proposed in specific contexts. “Engaging students is an important objective to be pursued, as numerous studies point out the close relationship between engagement, school performance and students' social and cognitive development” (FARIA, 2008, p. 2, translation by the paper authors).

Faria points out that student engagement is associated with the undertaken actions and that some elements of context - such as the relationship between classmates, the infrastructure of the classroom and the characteristics of educational activity - interfere in the way students act in this conjuncture. Identifying and understanding the factors that promote or inhibit student engagement in the proposed activities can provide important information so that teachers can act and reflect on the conditions of educational practice.

Engagement also refers to public participation on issues involving the STSE relations, permeating the perception of belonging to cultural spaces and groupings. Conrado (2017, p. 83, translation by the paper authors) points out that:

> The engagement and the affective/emotional approach help in the perception that the student is directly responsible and, therefore, necessary to promote changes in order to solve or mitigate the current socio-environmental problems, whether those that affect him directly or indirectly.

According to Nascimento and von Linsingen (2006), studies on the relations among Science, Technology and Society (CTS) were established in connection with the feeling that scientific and technological development was not associated with social well-being. "In general, it emerges as a movement that began to question the real role of science and technology within society" (QUINATO, 2013, p. 22, translation by the paper authors).

According to Hofstein, Aikenhead and Riquards (1988), studies involving these perspectives, in educational domain, include links between scientific, technological, social and environmental aspects and students' experiences. In this sense, with regard to teaching approaches linked to the most diverse contemporary problematic events, Quinato (2003, p. 27, translation by the paper authors) expresses that "[...] STSE education must be articulated around themes involving science and technology and that are potentially problematic from a social point of view ".

Concerning this conjuncture, the problem-posing perspective of themes in this interface is highlighted. In this understanding, the formation of subjects and their reality, in a dialogical and collaborative process, is highlighted (FREIRE, 2008). In this panorama, the concept of problem-posing also refers to confrontation with everyday situations, including the destabilization of previous knowledge on events and the perception of a gap by the student (NASCIMENTO; VON LINSINGEN, 2006). The living context of the subjects constitutes the starting point for educational actions, implying reflection and action on reality.

In the relation between problem-posing and communication, Nascimento and von Linsingen (2006, p. 104, translation by the paper authors) emphasize "[...] a movement of interaction between educator and student that is constituted as a dialogue whose content is not random". In this way, Santos (2008) highlights the demand for an association between science content and scientific, technological and social elements, articulating everyday experiences, and expresses a goal linked to:

> Promote the scientific and technological education of citizens, helping the student to build the knowledge, skills and values necessary to make responsible decisions on science and technology issues in society and act on the solution of such questions. (SANTOS, 2008, p. 112, translation by the paper authors).

Santos (2007, p. 3) asserts that National Curriculum Parameters (PCN) make indirect reference to STS approach, in line with National Education Guidelines and Bases Law (LDB), which emphasizes the purpose of Basic Education associated with the common formation indispensable for the exercise of citizenship (BRASIL, 1996).

However, the continuity of traditional perspective of science teaching in many educational spaces is pointed out, which favors the emphasis on approaching contents disjointed from the experiential reality. Thus, the reason for this persistence of traditional approaches is questioned. Roehrig, Assis and Czelusniaki (2011) point out that many teachers do not really know the STS approach, implying that its assumptions are not incorporated. In this way, decontextualized science is presented, neglecting the positioning of students. These are induced to not understand the meaning and importance of the approached issues, prioritizing only the memorization of information.

In this scenario, the developed proposal comprises fundamentals of STS(E) Education and conceptions of engagement, in perspective of problem-posing, dialogue and propositions of alternatives, within the scope of studies on the incorporation of these assumptions in regular education.

METODOLOGY

In the context of the Pedagogical Residency Program in Physics, an educational proposal with an approach to contemporary themes was developed, in order to enable processes of problem-posing and positioning of students. The actions pertinent to this proposal were developed in a public institution in Curitiba, with students from the third year of high school, between February and September 2019.

In order to delimit the theme, observations concerning the school structure and educational activities were made in the second semester of 2018. In addition to it, discussions with second year students and the school Physics teacher about the needs of the institution and students were carried out. The theme "Electric Energy: Production, Distribution and Use" was selected, considering the content proposed by the institution for the referred year and its potential with regard to the assumptions of STSE relations approach. In the course of the actions, some adaptations were made, due to unforeseen circumstances, in order to enable the development of the proposal.

Regarding the proposal, theoretical and practical classes were conciliated, including actions concerning reading, discussion, debate, experimental activity, model making and student presentation. The social, economic and environmental impacts related to electric energy were addressed. Educational activities covered three topics: (i) production of electric energy - types of plants and their operation; (ii) distribution of electric energy - electric grid and voltage transformations; and (iii) use of electric energy - electrical circuits and equipment. The actions linked to the educational proposal are presented in Table 1.

Table 1 – Activities of the educational proposal

Week	Activities
1	Presentation of the assumptions and characteristics of the educational proposal. Discussion on types of electric power plants.
2	Discussion on historical aspects related to electric power plants.
3	Development of experimental activity with an electroscope to approach electric charging processes.

Week	Activities
	Written evaluation on electric power plants.
4	Expository approach on electric charge, charge quantization and electric charging processes. Problem-solving activities on electric charge, charge quantization and electric charging processes.
5	Expository approach on electric force. Problem-solving activities on electric force.
8	Expository approach on electric field.
9	Organization of model making activities on residential electrical circuits and power plants. Reading and discussion of text on cell phone use.
10	Debate on cell phone use.
11	Problem-solving activities on electric field.
12	Expository approach on electric potential and equipotential surfaces.
13	Problem-solving activities on electric potential.
14	Review on electric potential.
15	Model making activity on residential electrical circuits.
19	Expository approach on association of resistors in series and in parallel.
20	Expository approach on mixed resistors circuits. Problem-solving activities on mixed resistors circuits.
21	Development of experimental activity on paper resistors.
22	Development of experimental activity with protoboard on mixed resistors circuits.
23	Analysis of electricity bill.
24	Model making activity on electric power plants.
25	Project evaluation by students.

Source: Authors (2019).

In some weeks, evaluations and other specific actions of the institution were emphasized and are not presented in Table 1.

On weeks 1 and 2, discussions on types of electric power plants were held, in which students were encouraged, based on questions, to discuss environmental and social issues related to each modality, such as pollution, cost, profitability and space for installation. On weeks 3, 4, 5 and 8 basic concepts of electricity were worked on, such as quantization of charge, which is fundamental for students to understand electric current and electric field.

On week 9 there was a brief pause in the content approach to reorganize the proposal with the students. When analyzing the activities already carried out, it became evident that they were, in part, distancing themselves from the objective of approaching STSE relations, making it necessary to regain focus.

Still on weeks 9 and 10, students received a text about the excessive use of cell phone causing addiction and dependence. The reading was carried out in the classroom and, in the next class, the students debated on the burdens and bonuses of cell phone use. At that time, the use of text linked to the proposal in a reading class (held during the Physics course) was negotiated. Between weeks 11 and 14, concepts that explain the operation of electrical equipment and circuits were approached.

On Week 23, the electricity bill was analyzed. The students received a model bill and identified some information requested by the residents. Part of the activity was carried out in the classroom and part of it the students developed in their homes. Below, some analyses proposed in the classroom are presented.

1) Observe the model bill and identify:

a) reference month and period:

b) total electricity consumption:

c) total cost:

d) kWh value:

e) state tax:

f) public lighting services fee:

g) tax rate:

Some questions developed for study, related to the electricity consumption in students' homes, are explained below. The students brought the results in the next class, in which a discussion involving groups of students on the electricity consumption was held.

1) check your home's electricity bill (last month) and identify:

a) total cost (R $):

b) total electricity consumption (kWh):

c) kWh value (R $):

d) taxes:

e) tax rate:

2) build a bar graph with the consumption of the last 12 months of your residence. Indicate the month with the highest consumption;

3) build a bar graph with the consumption cost of the last 12 months of your residence. Indicate the month with the highest consumption cost.

4) investigate the shower’s electric power and the average time of shower use of your residence. After a month (30 days), what will be the total consumption in kWh and the total cost of it in the bill?

5) choose another electronic device in your residence and calculate the daily cost of its use;

6) what is the purpose of the Procel Energy Saving Label? Identify, in your home, what equipment has the Procel Energy Saving Label.

On week 24, the model making activity on electric power plants was held. The students were able to choose between wind and hydroelectric power plant.

The production of a thermoelectric power plant model was not possible due to the lack of specific material in the laboratory. In addition to the challenge of producing electricity by power plants, this apparatus should also provide enough electricity to power the circuit of the previous model. To help students, prototypes of each type of plant were built and presented, explaining the main elements of its operation.

On week 25, an evaluative activity was carried out with the students, in which they answered a questionnaire, involving STSE relations they established (or not) and their perceptions on the educational proposal. There was also a conversation with the students on the process as a whole, in which they expressed what they found interesting, what they thought could be improved and how the actions undertaken were related to their personal goals. Questions from this questionnaire are represented below.

1) STSE approach is based on the relations between Science, Technology, Society and Environment. Do you consider that STSE approach in Physics classes helped to understand the theme? Explain.

2) which part of the content approached this year was the easiest for you to understand? And which one was the most difficult? Would you make any change or mention any example to improve the explanation of this content?

3) one of the principles of STSE approach is the establishment of relations between the scientific content and the technologies present in everyday life, such as cell phones, highlighting the scientific concepts that explain their functioning and the social and environmental impacts. With that in mind, do you feel more motivated to study Physics due to STSE approach? Why?

4) can you associate the study of Physics with your daily life or society, based on the Physics classes you attended to this year?

For inferences on student engagement and correlations with structural, curricular and methodological challenges, observations were made throughout the educational activities, especially those concerning the organization of students, discussions among themselves and with residents and their interest in these actions. These observations enabled the composition of reports, which, together with works made by the students (written materials delivered on paper and in the Google Classroom; models) and questionnaire, constitute the set of data considered in this paper. The written materials were analyzed considering elements of Content Analysis (BARDIN, 2009).

RESULTS AND DISCUSSIONS

The analytical procedures comprise two moments: inferences on student engagement in terms of involvement in educational activities and in problem-posing and proposition of alternatives within the scope of contemporary themes in the STSE interface; correlations of these evidences associated with student engagement with structural, curricular and methodological challenges. For the purpose of presentation of analytical examples, Basic Education students are identified by the letter A, followed by a number (example: A1).

With regard to the first moment of analysis, in the developed activities, the engagement of most students was evident, particularly in discussions and model making. They elaborated the proposed activities, however, adding different intensities in terms of involvement. In some cases, motivation was associated with the grade pertinent to the evaluation in the activity. At the beginning of the project there were late deliveries, mainly in the activities at Google Classroom.

In discussions and written activities, on paper and in the Google Classroom, students expressed relations involving scientific concepts on which the technologies approached are based. In addition, they manifested recognition, problem-posing and proposition of alternatives concerning the environmental and social impacts pertinent to its production and use.

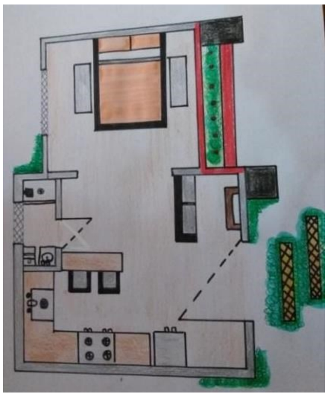
In this sense, the students highlighted the difficulty of concentrating on something due to the indiscriminate use of cell phones, proposing some solutions, such as: limitation of time for using the equipment; to leave the device in another location while talking to important people (family and friends); do not take the equipment to classroom or turn it off to avoid distracting attention.

In discussions on electricity consumption, students from two classes reported that they had used, at some point in their lives, measures commonly practiced by the general population, such as: turning off the light in the room where they were not; turn off electronic devices when sleeping or leaving home. However, most of the students considered themselves unable to reduce or change consumption habits, failing to give up any electronic equipment they use or decrease the time of use - especially in relation to cell phones and shower. The recognition of everyday actions of electricity consumption made it possible for a group of students to perceive the relationship between individual and collective attitudes and social and environmental impacts.

In one class, the possibility of using solar panels was mentioned, putting Curitiba's climate as an obstacle for its implementation - generally cloudy -, showing a certain lack of knowledge about the operation of this type of plant. The consumption of electronic equipment and the generation of jobs linked to the installation of power plants were mentioned as economic impacts. Some students expressed that they use the social tariff of Paraná Energy Company (COPEL) - responsible for supplying electricity to Curitiba region - and several colleagues mentioned they did not know about this program. With the information about this COPEL program, these students defended the measure relating better quality of life to access to electricity, being, in their words, "impossible for a person to live without electricity".

Within the scope of these problem-posing processes and propositions involving electric energy, Figures 1 and 2 show examples of floor plan and residential circuit model made by students. The students mentioned, at that moment, some environmental impacts related to the types of plants: hydroelectric, wind and solar, associating discussions held in the first semester.

Figure 1 – Floor plan made by students



Source: Authors (2019).

Figure 2 – Residential model made by students

Source: Authors (2019).

When carrying out the construction of the power plants models, the students faced several difficulties, such as the adjustment of materials and the lack of some resources, which made the construction of the thermoelectric plant unfeasible. Obstacles associated with mastering the concepts related to the energy transformations involved in each type of plant can be highlighted.

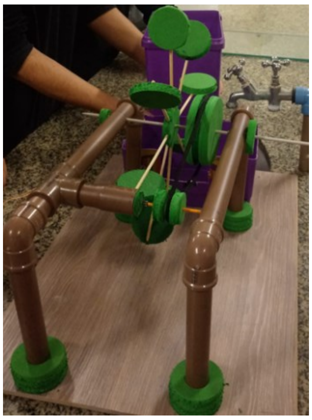
Figures 3 and 4, below, illustrate models of power plants. Figure 3 shows a model of a hydroelectric power plant that is aesthetically beautiful, but not functional, since the blades are large, slowing down their movement, and did not provide enough speed for the process. Although the device does not generate enough electricity to turn on the LED lamps of the residential circuit model, it was possible to verify the electric voltage and the principle of operation of the plant.

The students used a rope as a transmission line between the wheels coupled to the axles of the blades and the generator. The students' first observation was that as the rope absorbed water, it became heavier and defaulted the movement between the wheels. Later, they realized that if the diameter of the wheel, which was attached to the rear axle of the generator, were reduced, the angular frequency would increase and thus amplify the potential difference.

Regarding the turbine built for the engine, the students initially delivered the prototype with the huge blades in Figure 3. The moment it was tested, they realized that the geometrical configuration, size and material (EVA) of the blades, which absorbed water and became heavier, were making it difficult for the engine to rotate.

When this problem was perceived, the students chose to build new blades. For that, the students decided to build a turbine using a metallic material, making it more compact. The observation made by the students was that because the second turbine was lighter and did not absorb water, this one presented greater efficiency for the generation of electric energy, with a record of higher electric potential difference.

Figure 3 – Hydroelectric power plant made by students



Source: Authors (2019).

Figure 4 shows a wind farm model. For the construction of this plant, the students attached propellers to an engine and used a fan to make its rotation possible. Initially, the prototype reached a maximum of 0.5 V and did not allow the residential circuit to function.

As a solution, the students proposed to associate it, in series, with another prototype, which also had not generated enough electric energy. By associating the two prototypes in series, it was then possible to turn on the LED lamps of the residential model (Figure 5), providing 5 V of electric voltage.

Figure 4 – Wind farm model made by students

Source: Authors (2019).

Figure 5 – Residential circuit model made by students in operation

Source: Authors (2019).

However, it was also observed that students have great difficulty with mathematics linked to Physics concepts. At several moments they demonstrated mastery over Physics concepts, without being able to associate them numerically. As an example, calculations associated with the necessary electric resistance in the circuit they built can be mentioned.

Concerning the second analytical moment, several challenges related to the experienced process and that impact student engagement in educational activities and contemporary themes involving STSE relations are highlighted. In structural terms, it is worth mentioning that the Basic Education institution has a good infrastructure for carrying out its activities; smart television, blackboard, classroom and science laboratory were the resources/spaces most used by the residents. The residents also counted on the assistance of a laboratory technician throughout some stages of the project. These conditions made possible by the Basic Education institution were essential for carrying out educational activities.

However, the organization of some school procedures triggered limitations for the activities. The institution has two weeks of the two-month period with two classes (of five) per day that are destined, exclusively, for the application of tests. Many classes are aimed at taking tests, recovering grades and reviewing content. The school has a reading project that uses one class per week. Mention is also made of the various interruptions to classes, with activities not relevant to the proposal and to Physics classes. Thus, there was a significant reduction in the number of classes and time available for Physics teaching.

In a broader sphere, some difficulties concerning the articulation of assumptions of BNCC and State Curricular Guidelines (DCE) were noticed. BNCC was approved in December 2018, with demand for implantation throughout the country within two years after its approval. Therefore, in what concerns the curricular organization, the Basic Education institution is experiencing a transition moment, in which the proposals presented by the DCE are still adopted as guidelines for the school curriculum. It is worth mentioning that discussions are taking place in all state schools, with the aim of formulating a new guiding document for the curriculum of Paraná's Basic Education institutions, considering the demands presented by BNCC, called “Paraná Curriculum Reference: Principles, Rights and Guidelines ”.

The need for student mobility between classes and schools is pointed out. These factors associated with the perceptions of managers, teachers and students provided challenges in terms of curricular and methodological reformulation of high school.

Regarding the students’ perceptions, the answers in the questionnaire, in an evaluative activity of the educational proposal carried out on week 25, are highlighted. In question 1, on the understanding of contents related to electric energy with a thematic approach, most students stated that the activities carried out helped in this regard, with mention of different parts of the processes of production, distribution and use of electric energy and their social and environmental impacts.

Similar expressions were identified in question 4, on the relations between Physics content and daily life/society. It can be inferred that students were very receptive to the insertion of contemporary themes in Physics classes.

Within this scope, it is worth highlighting the implications of students' perceptions on the goals of Physics teaching for addressing these themes and engagement, which provide understandings about curricular and methodological aspects. Inferences pertinent to these analyses were triggered, particularly, in answers to questions 1 and 2. In relation to question 2, about easy and difficult aspects of the educational proposal, several students highlighted the difficulty with the “practical” part, particularly in the construction of the power plant model, considering the “theoretical” part easier.

Regarding the purpose of Physics teaching in high school, it can be emphasized the existence of perceptions associated with training for exams, phenomena understanding and “how things work”, largely highlighted by students, and action in society. In Table 2, below, some expressions by students on these aspects are presented.

Table 2 – Students’ perceptions on Physics teaching

Item	Expression	Perception
1	A1: It helped to understand the theme, but it took the focus away from the content itself because we were too busy with the program's activities that involved more science and society (Answer Question 1).	Emphasis on content-based Physics teaching opposed to thematic perspective.
2	A1: The easiest part of the content is about power plants and there was not a most complicated part in my opinion, because it was balanced and everything on the same basis. I prefer the content being explained in a more traditional way. Not taking different classes is not my suggestion, but I also do not consider it ideal to abandon almost completely the methodical methodology (Answer Question 2).	
3	A2: The plant part was the easiest. Electric field was the most difficult part. I would like more exercises to practice the formulas for university admission exams and ENEM [National High School Exam] (Answer Question 2).	Emphasis on Physics teaching for admission exams training.
4	A3: Power plants were the easiest part, electric field was the most difficult part. More exercises for university admission exams training, less models being aware that we are in the 3rd year (Answer Question 2).	
5	A4: Not entirely, in my opinion, it was more focused on the	

Item	Expression	Perception
	issue of society and the environment than on the calculations themselves, I would like more issues for university admission exams training (Answer Question 1).	
6	A5: Yes. When we do not study the physics of electric energy, it is difficult to understand how everything works. Therefore, it is important to understand so that we can apply it in our daily lives without much difficulty (Answer Question 1).	Emphasis on Physics teaching associated with the understanding of phenomena and technology and for action in daily life.
7	A6: Yes, because it presents the theme in a more correlated way with daily life and sustainability (something extremely necessary for the well-being of the planet) and facilitates long-term learning (Answer Question 1).	

Source: Authors (2019).

Regarding the learning, it was mainly identified understandings associated with the resolution of exercises and connections with contexts. In question 2, most of the suggestions for educational actions involved "more practical classes" and there were statements about "more exercises". In Table 3, below, examples of expressions underlying these conceptions are highlighted.

Table 3 –Students' perceptions on Physics learning

Item	Expressão	Percepção
1	A7: The easiest was the 2nd period of two months (resistance, current intensity) and none was difficult, the only change I would do is to have more content exams and more exercises to fix the content (Answer to question 2).	Physics learning associated with exercises.
2	A8: I believe that the operation of the plants was the easiest content to understand and the most difficult was electromagnetism. I would approach it more in concrete facts, not only in debates (Answer Question 2).	Physics learning associated with relations concerning contexts.
3	A9: The subject of most comprehension studied this year was about the means of generating electric energy, such as wind and hydroelectric plants. The most difficult topic to be studied was electromagnetism. Experiments and the laboratory activities improve the explanations of the lessons (Answer Question 2).	
4	A10: The electrical part was the easiest and the resistor theory part was the most difficult. I think that to improve we would have to have more practical classes (Answer to Question 2).	
5	A11: Everything was well understood and comprehended, mainly due to the examples mentioned and their practical applications in society (Answer Question 2).	
6	A12: Yes, associating what for many is abstract, giving examples of how it is used in everyday life or using everyday things facilitate understanding (Answer Question 2).	
7	A13: Yes, both because of the work done and the classes, it became more understandable the needs we have for energy, its uses and the impacts it generates on the environment, in addition to understanding more easily the ways to obtain it (Answer Question 1).	
8	A13: All the content was easily understood, especially its	

Item	Expressão	Percepção
	practical applications in our environment (calculations are difficult to do) (Question 2 answer).	

Source: Authors (2019).

The learning conception associated with exercises aimed at university admission exams constitutes a challenge to engagement in activities in STSE relations approach. Some students expressed positive perceptions regarding the developed activities; however, they highlighted aversion to Physics course. At this point, it is worth questioning whether they have indeed aversion towards Physics or to the understanding of Physics course as processes of repetitive problem-solving.

On the other hand, the remarkable interest on how things work can enable educational activities for problem-posing and proposition of alternatives in STSE interface. Some students pointed out criticism towards the activity involving the use of cell phones, expressing the need to deepen the functioning of the apparatus. This more complex approach of the equipment was made impossible, among other reasons, by the reduction of Physics classes in the process. However, these notes of the students can be incorporated in the reformulation of the educational proposal.

In this sense, the expressions of students A14 and A15 stand out regarding the need to expand discursive interactions and the motivation linked to integration between areas of knowledge.

> A14: The easiest content for me was electric potential and the most difficult was the mixed resistor circuit. I would create more dialogues on the subject with students (Answer to Question 2).
>
> A15: Yes, because in this way, in addition to acquiring a broader knowledge, one can have contact with content from exact sciences by studying a content normally seen as from human sciences. For example, the study of social impacts (Answer to Question 3).

It can be highlighted some possibilities regarding students' perceptions on the objectives of Physics teaching in Basic Education associated with the understanding, problem-posing and action on reality, despite the challenges presented by the dominance of traditional perspective with the disconnection of contextual elements which impact the subjects' experience aspects.

CONCLUSIONS

The educational activities enabled formative elements, despite some limitations in terms of student participation. In discussions with the students, it became evident that most of them prefer this proposal approach to the traditional one. Some explained that, with the actions involving models, texts and investigative activities, they managed to better understand the contents. The relationship between the methodology used throughout the proposal and the evaluation of the National High School Exam (ENEM) was also mentioned.

Other reports pointed to the students' difficulties concerning the contents and their anxieties linked to university admission exams. There was a suggestion for an extra Physics class per week to work on exercises for these exams and to address doubts.

The identification of problematic situations and propositions relevant to these provided students and teachers with formative possibilities. In this context, structural, curricular and methodological challenges pervaded Basic Education planning instances, notably national, state and institutional documents. The change in the order of content necessary to articulate the theme triggered negotiation processes and, in some points, there was a need to adapt the proposal.

The reduction of the number of Physics classes due to specific activities of the school institution also represented an obstacle to the development of actions. In this sense, there is a need to expand negotiations on characteristics and conditions for carrying out school activities.

In this scenario of challenges, it is inferred the existence of a school culture in Physics associated with university admission exams and ENEM, attributing a primordial character to problem-solving actions concerning these tests. It is also worth noting the favoring of the proposal's development due to resources/spaces at the school institution. The existence of a science laboratory, with a technician at the disposal of teachers and students, is a factor that increases the feasibility of breaking with the traditional teaching model.

Engajamento de estudantes e abordagem de temas contemporâneos: desafios estruturais, curriculares e metodológicos

RESUMO

As demandas de integração entre áreas de conhecimento e de vinculação de conteúdos escolares com elementos vivenciais dos sujeitos podem ser compreendidas no escopo de abordagem de temas contemporâneos na Educação Básica. Essa perspectiva pode agregar problematização de relações entre Ciência, Tecnologia, Sociedade e Ambiente (CTSA), o posicionamento e a proposição de alternativas, direcionados a questões controversas. Nessa vertente educativa, apresentam-se, neste relato de experiência, análises concernentes ao desenvolvimento de proposta educacional no âmbito do Programa de Residência Pedagógica de Física, com alunos do terceiro ano de uma instituição pública de Curitiba, Paraná, entre os meses de fevereiro e setembro de 2019. Essas ações foram empreendidas considerando pressupostos de abordagem de relações entre CTSA e engajamento, com tema vinculado à Produção, Distribuição e Uso de Energia Elétrica. Em referência a esse processo, objetiva-se apontar desafios estruturais, curriculares e metodológicos. Entre as atividades educacionais desenvolvidas, destacam-se processos de leitura, discussão, experimentação e elaboração de maquetes. As análises incidiram sobre relatórios elaborados pelos residentes, materiais produzidos pelos alunos da Educação Básica (atividades escritas, entregues em papel e no Google Classroom; maquetes) e questionário. Os materiais escritos foram analisados considerando elementos de Análise de Conteúdo. No processo de análise de dados, foram destacados aspectos de engajamento dos estudantes e correlações com desafios estruturais, curriculares e metodológicos. Evidenciou-se engajamento dos estudantes nas atividades, com reconhecimento, problematização e proposição de alternativas a situações problemáticas contemporâneas. Contudo, identificaram-se dificuldades concernentes à participação de estudantes e utilização de elementos de matemática. Em termos de desafios, houve necessidade de adaptações e articulações, considerando características das instituições e sujeitos envolvidos; estes compreenderam vertente estrutural, organização curricular e abordagem metodológica, concernentes à ruptura com aspectos de ensino tradicional. Salienta-se que o desenvolvimento da referida proposta viabilizou aos residentes a articulação entre teoria e prática, com ação e reflexão direcionadas à própria prática educacional.

PALAVRAS-CHAVE: Ensino de Física. Formação docente. Energia elétrica.

ACKNOWLEDGEMENTS

The authors thank Coordination of Superior Level Staff Improvement (CAPES) for the financial support.

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Received: 17 sep. 2019
Approved: 06 dec. 2019
DOI: 10.3895/actio.v5n1.10713
How to cite:
SILVA, J.C.; NOGUEIRA, C. S.; SUTIL, N.; HIGASHI, E. M. Student engagement and contemporary themes approach: structural, curricular and methodological challenges. **ACTIO**, Curitiba, v. 5, n. 1, p. 1-19, jan./apr. 2020. Available at: <https://periodicos.utfpr.edu.br/actio>. Access at: XXX
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