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Students Conceptions from a Countryside Area of a Continental Nation about Sciences Practical Classes: A Brazilian Case Study

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Abstract

Quality education is one of UNESCO's goals for sustainable development, including in the science area. In order to achieve this goal, experimental activities are needed to produce dynamic, interactive, and more effective teaching. Brazil is a continental country with problems in assures education for all. In this work, with the aim of identifying student conceptions about the importance of practical classes, we performed a literature review and developed a research questionnaire for using with elementary school students from the municipal and state public schools in a Brazilian small town in the mountain region, located in the north-central region of the state of Bahia. The questionnaire contains subjective, semi-subjective and objective questions divided into categories: Profile (gender, age, grade) and Practical Classes (concept, importance, achievement). The questionnaire was applied to all elementary and high schools of the municipal and state public network located in this small town, together with the Free and Informed Consent Term (FICT), for the personal consent of students over 18 years of age, and in the case of underage students, the consent of parents and/or guardians. The results with the students from the final grades, respectively 9th year of 2 elementary schools in the urban area and 5 in the rural area, which made up all the elementary schools of this city at the time of the research, and students of the 3rd year of a high school revealed that they do miss practical class and know what is necessary to have those, despite their knowledge about of "*what is a practical class*" is not linked directly to disciplines such as biology. This work may contribute to stimulate the investment in laboratories at elementary schools not only in this small city, from a Northwestern state, one of the poorest countryside areas of Brazil, but also in other cities in developing countries.

Thus, this may help them to improve their scientific ability to develop themselves thus improving the quality of life of their own citizens.

Keywords

Experimental Classes, Student Conceptions, Basic Education, Science Teaching

1. Introduction

Science and Technology were recognized as essential for economic, cultural, and social development. Thus, the teaching of science research witnessed countless movements for teaching transformation in an attempt to promote educational reforms (Zhang & Feng, 2022).

There are several investigations being developed in the area of Science teaching in Brazil. Their main focus is mostly to study the teaching and learning processes in classrooms as well as to help the science teacher work.

It is noteworthy that hands-on, experimental, or inquiry-based education can facilitate the development of students' scientific creativity, leading to project development (Sidek et al., 2022). But unfortunately, creative education is in decline in Rio de Janeiro, an important cultural center in Brazil (Jesus et al., 2019) and is unknown in countryside (*vide infra*). The Brazilian public school's efficiency reproduces the income inequalities among cities (Agasisti et al., 2022).

Socioeconomic determinants also markedly influence education standards in distinct parts of this large nation. The share of adults aged 25 - 64 with below upper secondary attainment is 30% in Brasília, the Federal District, and reaches 67% in Alagoas (OECD, 2022). Therefore, studies focusing on the mostly unknown education properties in countryside schools are required.

Brazilian GDP expenditure on education in 2018 was above the OEDC average (OECD, 2022)[1] and European Union average, but the Programme for International Student Assessment (PISA) accomplishments were astonishingly low as the Brazilian mean scores in reading, mathematics and science were significantly lower than the ones observed in OECD average.

Despite interesting proposals, innovative teaching approaches still do not effectively reach most Brazilian schools. The teaching of science is still based on contents devoid of meaning, requiring excessive memorization, and that does not allow the students to recognize science as an instrument for analysis and understanding of the social reality in which it is inserted (Prestes & Silva, 2018).

Students who are led to memorize facts, information, and technical terms might understand science as secure, and immutable, which will limit their learning in later stages of their academic life as well as compromise their social performance as citizens (Bizzo, 2010). According to literature, modern science

[1]Comparing the cumulative spending per student at ages 6 - 15, Brazil is below OECD average (PISA, 2018).

includes experimentation as a relevant step in its planning and execution. Meanwhile, most Natural Sciences also have the experimental profile as their essential characteristic. Even though not used in all science areas, the understanding of experimentation is essential to science knowledge at schools to contribute to the future of society (Kolb, 2014; Bizzo, 2010). This study aimed to identify the conceptions of elementary school students in a small town in the Brazilian hinterland about practical classes.

2. Literature Review

Currently, science teaching aims at the application of the theory with practice, and although the National Common Curriculum Base recommends that students are encouraged to work on instigating enticing questions, delineate problems, propose hypotheses, plan and cooperatively carry out investigations, including field activities or experiments as well as sharing the results of these investigations. The prior knowledge brought by the students influences the teaching-learning process, so it is important that the teacher knows what the students know about any subject, so that teachers can propose activities that favor meaningful learning (de Freitas Zompero et al., 2019).

Experimentation attracts the interest of students at different levels of cognition and should stimulate the development of criticality on practices results (Woithe et al., 2022). Nevertheless, experimental procedure and hands-on activities are scarcely observed in Brazilian schools, particularly in the Northeastern countryside.

According to the literature, many students are unable to establish relationships between the materials they manipulate in the real world and the data obtained, performing experiments without data contextualization (Hodson, 1994). The biggest issue is that the practical class is not only "doing things" by carrying out experiments, but also formulating questions and elaborating hypotheses. It is not just an opportunity to apply what was previously learned in the theoretical class but also to be in direct contact with the object of study, promoting observations and thinking about applicability (Kolb, 2014).

Practical classes can help in the process of interaction and development of scientific concepts, as well as allow students to learn how to objectively approach their world and how to develop solutions to solve complex problems (Bemiss, 2018). In the last decade, the focus of science teaching has turned to knowledge and understanding of science at the expense of investigative and illustrative processes (Contant et al., 2018). The sciences addressed in the classroom must allow the involvement of students with characteristics of the scientific community, such as investigation, discursive interactions, and the socialization of ideas among teacher and students (Kolb, 2014; Williams, 2011).

It is important that teaching sciences be based on the reality problematization and observation of everyday life, through the exchange of ideas among students whereas they elaborate collective explanations, identify their own vocational po-

tential, and get in contact with scientific tools (Kolb, 2014).

According to studies by Lannes et al. (2002), there is a great demand for a new school program with new content, due to the great dissatisfaction of students with it. School has an important role in the future life and career of these students as individuals and citizens and should not be ignored. Thus, science classes should offer the possibility of experimentation, and provide problem-solving activities so that students can feel challenged to look for solutions, raise and test their own hypotheses, discuss their ideas with their peers and teachers, and also write their impressions in reports about their lived experience (Markowitz, 2004; Oliveira, 2013).

Practical classes have generally positively impacted the teaching-learning process (Kolb, 2014; Woithe et al., 2022). In this sense, our group takes part in the National Network of Education and Science (http://www.educacaoeciencia.net.br/) created by Prof. Dr. Leopoldo de Meis from the Institute of Medical Biochemistry[2] at the Federal University of Rio de Janeiro. In this network that integrates 37 groups, 23 HEIs in 15 Brazilian states, the discussion, planning, and execution of experiments by students are recommended, which can stimulate learning, streamlining science teaching (Deccache-Maia et al., 2012). It is important to note that these activities must be properly oriented and planned to be successful (Xavier, 2021).

During the last decades, research on students' conceptions has brought important advances in the investigations of science didactics (Abrahams, 2011; Moeed & Anderson, 2018; Oliveira & Obara, 2018). Nevertheless, practical activities in science teaching are not invariably successful (Hodson, 1991; Osborne, 1993; Millar, 1998; Abrahams & Millar, 2008), therefore the perceptions and effectiveness must be monitored to allow a *bona fide* planning. Thus, in this work, we analyzed the conceptions of elementary school students about practical classes, in a Brazilian small city in a Northeast state, one of the poorest Brazilian countryside areas. Our purpose is to contribute not only to stimulate the investment in laboratories at elementary schools in this small city, but also in others from developing countries to improve science teaching worldwide.

3. Material and Methods

In order to carry out the research, the project was submitted to the Ethics Committee for Research on Human Beings, in accordance with Resolution 404/2008 of the National Health Counci—Ministry of Health and approved under the opinion (CEP/FIOCRUZ) of n˚.77680—CAAE: 04008212.3.0000.5248. Authorizations from parents or guardians, teachers and schools were obtained through the Free and Informed Consent Term properly signed.

In order to collect and analyze the students' conceptions about the practical classes, a literature review was carried out and a research questionnaire was prepared for students of elementary education of the state and municipal public

[2]That nowadays carry his name in respectful tribute.

education network in a small city in the countryside region, located in the mid-north region of the state of Bahia. This small city has over 26,000 inhabitants (IBGE, 2010) and low development rates in Basic Education—elementary and high school (IDEB). It is like other municipalities in the drought polygon in Brazil northeastern, which suffer from harsh dry weather, causing remarkable socioeconomic problems.

The primary data collection tool is a questionnaire quantitative research contained subjective, semi-subjective, and objective questions, aimed at collecting the student's conceptions regarding the importance of practical classes. The questionnaire was applied together with the Free and Informed Consent Term (ICF), for personal consent of students over 18 years-old and in the case of underage students, parental and/or guardian consents were signed. They were applied throughout the city, reaching all schools in the municipal and state public elementary and high schools. Thus, the study involved students from the final grades, respectively 9th grade at 2 elementary schools from the urban area and 5 from rural area—which formed all elementary schools of this city at the time of the research—and 3rd grade students from one secondary school. A total of 283 (100%) students enrolled in the 9th year, 168 (59.4%) met the inclusion criteria (signing the informed consent and answering the questionnaire). On the other hand, of the 130 (100%) students in the 3rd year that desired to participate, only 50 (38.5%) were included in the study since those who did not meet the inclusion criteria were excluded.

All students' names were coded not only for discretion and to keep the identification of each interviewee confidential but also to facilitate the analysis of the questionnaires, and the transcription of the open answers. The identification of the location of the high school students also does not appear because they were all from the urban area. Each questionnaire received a label with the respective identification. Statistical analyzes were performed based on the responses received from members, in order to obtain information on the distribution of each question among the sample. For data analysis, the questions were divided into the following categories: Profile (gender, age, grade) and Practical Classes (concept, importance, achievement). Data collected in the quantitative approach, via questionnaires structured, were tabulated in spreadsheets and treated to enable comparisons, inferences and correlations.

4. Results and Discussion

In this study 218 students participated by answering the questionnaire, including 9th grade students (168 = 59.4%) from across the city, including rural areas, municipal and state schools, and 3rd-year students (50 = 38.5%). Most of these students were female and aged between 13 and 25 years (62%). According to the Brazilian National Institute of Educational Studies and Research Anísio Teixeira (INEP), these elementary school students presented the age range expected for the respective grades.

Our analysis revealed that these students' preferences in the curriculum are Arts, Geography, Science, and Physical Education in elementary school, with no significant differences in these preferences among the students from urban and rural areas (Figure 1). The 3rd year high school students preferred Physical Education, Arts, and Portuguese Language. It is worth mentioning that the natural sciences are not among these students' top three and that the preference of high school students for the Portuguese language is not very common (Pereira, 2019).

Herein we observed that 49% of the students that participated in our survey liked school "*very much*" (Figure 2). Despite enjoying the school, the students emphasized the lack of laboratory and practical classes (Table 1).

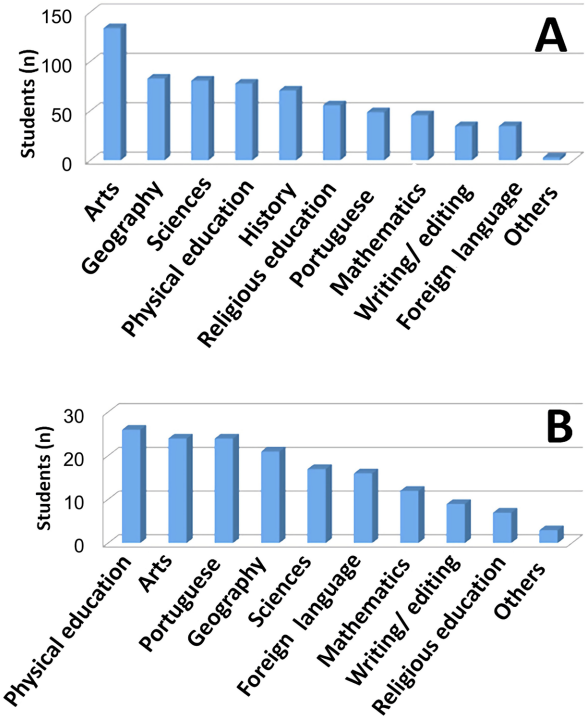

Figure 1. Student preferences in the curriculum. (A) students from the 9th grade of Elementary School; and (B) from the 3rd grade of High School of a small city in the countryside region of the Brazilian state of Bahia.

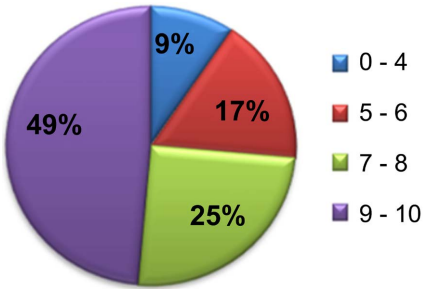

Figure 2. Total responses from 218 students (9th grade of elementary schools and 3rd grade from high school) from a small city in the countryside region of the Brazilian state of Bahia, to the question: "how much do you like your school?" from 0 to 10 (0 = dislike, 10 = like very much).

Table 1. Comparison of some Justification from the 9th-grade students of elementary schools and 3rd from secondary school from a small city in the countryside region of the Brazilian state of Bahia about enjoying school.

Student	Grade	Commentary
A(9)r	10	"there I learn new things every day"
A(43)r	10	"the studies here are better than many schools in the big city"
A(148)u	10	"the school that will give a better future and will also help to be someone"
A(29)r	10	"because it is where I study and where I learn things, because I have to like it"
A(67)r	10	"despite all the difficulties, it is a great school"
AM(201)	10	"because besides studying we have the opportunity to improve every day";
A(36)r	9	"I'm learning a lot, despite everything, I like being here";
A(58)r	9	"lack of organization, more learning, reinforcement at school, lecture, more things etc."
A(135)u	9	"we do not have practical classes"
A(139)u	9	"we do not have any laboratory"
AM(183)	9	"there is a lack of practical chemistry and physical education classes"
AM(180)	8	"socializing here is good, but more order just needs to be imposed"
A(126)u	8	"because not all teachings are attended due to lack of practical classes"
AM(213)	8	"there is always a vacant class or some teachers do not know how to explain"
AM(188)	7	"the infrastructure has no space for practical and sports classes"
A(115)u	7	"because there is no laboratory, among others, but it has its advantages"
A(168)u	7	"our school lacks some teachers and as we are going to high school next year, this is difficult"
AM(174)	7	"teaching and meals have to be improved"
A(1)r	3	"we do not participate in physics classes and there is still a lot to improve"
A(20)r	0	"there is no bench for the students to sit and shadows in the school yard"
A(25)r	0	"because there is nothing to do at half-time, there is no sports court"
A(73)r	0	"not enough material to be good"
A(121)u	0	"we don't have many things to practice, with the laboratory we would have a lot to learn"
A(146)u	0	"there is no library, no laboratory and the rooms are small"
A(168)u	0	"because there is no adequate infrastructure for classes"
AM(185)u	0	"there are many things wrong that I do not approve"

Among the 218 students, 25% also quantified their liking for the school, attributing grades from 7 to 8, but they alleged issues regarding school infrastructure meals, and lack of teachers/vacant classes. Of the 9% of students from urban and rural areas who said they did not like the school (Figure 2), the reason was once again due to the infrastructure issues (Table 1).

Understanding students' desires and the factors that underlie them, what they expect from a class and/or how they would like it to be are essential for planning the teaching and learning process. When asking students what is a practical class, we observed that they do not precisely know its meaning (Table 2).

It is interesting that several students attributed the concept of experimental

Table 2. Concept about practical classes from the 9th-grade students at elementary schools and 3rd grade from high school from a small city in the countryside region of the Brazilian state of Bahia.

Student	Commentary
A(1)r	"it is a class where the student reinforces and complements some subject, experiences and makes crafts"
A(6)r	"class that helps the student to develop and see new subjects"
A(7)r	"experimental class is making crafts"
A(8)r	"these are extraordinary classes, such as music, poetry, theater, dance, that is, outside the traditional way"
A(11)r	"that have good things to do, play sports, tutoring"
A(20)r	"it's something I don't understand"
A(13)r	"I don't know"
A(28)r	"a class where we do different things like the Physical Education class"
A(62)r	"these are classes in which the teacher works with arts and other things"
A(81)u	"I don't know, my school has no practical classes"
A(157)u	"it is a class that practices, such as Physical Education class that has theoretical and practical classes"
A(162)u	"in my opinion, I think learning to play ball and have fun"
AM(184)	"playing, doing something different, outside the classroom"
A(83)u	"it's a class that students take with the teacher only in practice"
A(147)u	"it's a well-explained class that the teachers teach the students"
A(161)u	"practical class is the time in the discipline where you leave theory and go to practice"
AM(185)	"a class unlike any other, that we have every day, that is, a class just for practice"
AM(174)	"learn and reflect more with the given subject"
AM(188)	"learn, reflect, discover new things and learn about the topic"
AM(201)	"it is important because it draws students' attention, making them reflect and think"

practical science/biology class to the practices they carry out in Arts and Physical Education classes. This fact occurred mostly within the conceptions of students in the rural area, while in the urban area some students also declared that the experimental practical class is the computer class: student A(130)u "informatics with computers and others"; AM(214) "It is the classroom that people go to the computer room, where most of the time the classroom teacher uses Datashow"; AM(215) "It's a classroom that distracts us, like a computer room". Of the total number of students, only the student A(135)u in the 9th grade of elementary school from the urban area, cited *reflection on* defining the practical class: "a class in which the student has fun, but learns, with reflection". Reflections are essential for the student to develop critical behavior and build knowledge. Experimental activities commonly combine action and reflection, where discussion and dialogue play a key role (Rosito, 2003; Delizoicov, Angotti, & Pernambuco, 2018).

Among the 218 students, 87% wrote their perception about the practical classes (11% wrote "*I don't know*" and 2% did not answer), and of these, only 3% of the students, all from the urban area, associated the classes of experimentation in laboratory (**Table 3**). Secondary school students classified the practical class as everything that happens outside the classroom.

Only two 9th grade students, 1% of the total of those who participated in the study, said that the practical class should involve more reflection than practice, thus reinforcing that the vast majority are not aware of what effective experimental practical class should be like (**Figure 3**).

As shown in **Figure 3**, the majority (57%) of the students think that during the practical class, practice and reflection should occur at the same proportion. When we asked about the importance of practical classes for students, only three students cited reflection in their answers: "learn and reflect more on a given subject" AM (174); "learn, reflect, discover new things and learn about the topic" AM(188); "it is important because it draws students' attention, making them reflect and think" AM(201).

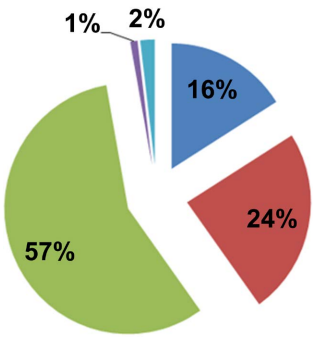

Figure 3. Answers of students (9th and 3rd grades) from a small city in the countryside region of the Brazilian state of Bahia, to the question: "*The practical classes should involve: only practice*; *more practice than reflection*; *practice and reflection or less practice and more reflection*?". Answer colors are: only practice (blue); more practice than reflection (red); practice and reflection (green) or less practice and more reflection (purple) and others (cyan).

Table 3. Perceptions of science/biology practical classes from the 9th-grade students of elementary schools and 3rd from secondary school of a small city in the countryside region of the Brazilian state of Bahia.

Student	Commentary
A(113)u	"it's a class with everything, teachers, laboratories etc...machines, experiments"
A(123)u	"it is in the laboratory"
A(138)u	"a practical class is one in which we leave the classroom and go to the laboratory to study and advance further in the process"
A(140)u	"these are classes where we study in the laboratory, it is a type of class where we practice not only writing in the notebook, but also making our idea happen"
A(152)u	"It is a well-explained class that students understand. With science labs, which are essential to have at school so that we can learn a little more"
AM(170)	"a class outside the classroom, where we can perform other ways of learning more" AM(170)
AM(172)	"a practical class for me would be a different class outside the classroom, for example, going to the court in Physical Education class, going to the laboratory and outdoors"
AM(186)	"activities developed outside the classroom in which the student puts into practice everything he has learned"
AM(192)	"practical class is cool because the contact with nature is direct"
AM(195)	"it is a class where we learn outside the classroom, facilitating subjects where work requires greater competence in practice"

Many times, for not using laboratories in practical, hands-on activities (Santana et al., 2019), students are not challenged to explore, develop and evaluate their own ideas (Lee et al., 2020). Science curricula do not provide opportunities to address questions about the nature and purposes of science and scientific inquiry. The importance of practical classes linked to student performance, to the issue of improving learning was what most appeared in the students' responses (51%) (**Table 4**).

Some students attributed the importance of practical classes to the question of incentive, of arousing interest on them for a better learning, which makes us agree with Giordan (1999), according to which experimentation stimulates interest among students of different levels of education and who in their testimonies, they usually attribute a motivating and playful character to experimentation (**Table 4**).

Creativity is considered valuable in science teaching by preservice teachers (Holzapfel et al., 2022), and practical activities such as hands-on/laboratory experiments and inquire-based education can facilitate the development of student's scientific creativity, possibly leading to project development (Sidek et al., 2022).

Table 4. The importance of practical classes according to the perceptions of students from the 9th grade elementary schools and 3rd grade from a secondary school of a small city in the countryside region of the Brazilian state of Bahia.

Student	Commentary
A(29)r	"so that they understand better and learn more"
A(31)r	"learns better more easily"
A(48)r	"improves teaching and understanding"
A(51)r	"the development of learning and knowledge"
A(71)r	"they bring teachings, experiences that we do not know and more learning"
A(78)u	"to learn more, learn about the subjects of discipline and make discoveries"
AM(170)	"help in learning, in student interactivity"
AM(200)	"help to develop the student's mentality"
A(118)u	"because students are more interested in the class and have a better performance"
A(155)u	"to be distracted and at the same time reflect to participate more in classes"
A(161)u	"involves the student to become more interested in the subject"
AM(169)	"it is a different and more attractive class"
AM(175)	"having more participation, motivation in the hours of these classes"
AM(182)	"awaken more the student's desire to learn and curiosity that would benefit"
AM(185)	"we started to like the subject more, in addition to understanding about the subject and how it works"
AM(193)	"contact, development of interest in scientific methods"
AM(215)	"it is important because the student is more willing to study and is able to learn better"

Some authors such as Hoernig and Pereira (2004) stated that, when observing the object of their study, the student understands the subject better, since what is being observed can be manipulated, allowing that, from concrete observation, the concept can be built and not only imagine it. Other authors such as Bizzo (2009) discuss that science education should provide students with the opportunity to develop skills that arouse disquiet upon the challenge by the unknown, seeking logical and reasonable explanations.

Practical classes providing basic concepts whereas enable students to engage in scientific investigations to solve problems, can increase students' interest in science learning inducing academic self-efficacy in science learning (Inkinen et al., 2020; Lee et al., 2020). Unfortunately, many schools have prioritized test approval preparation via massive memorization training, rather than using laboratory activities as a strategy for science knowledge application and understanding (Mortimer & Araújo, 2014). Therefore, education policymakers must be involved to improve science teaching. The lack of adequate infrastructure for carrying out experiments is an overwhelming barrier in science teaching (Valadares, 2001). Enabling experiments that are financially and operationally access-

ible of Brazilian schools is a pressing demand, since the huge cost of specific materials/equipment for carrying out the experiments outweighs the interest of the teachers and/or managers in practical classes' implementation.

When we asked the question "*Have you ever participated in any practical class*?", 54% of elementary school students answered *no*, unlike in high school, in which 82% of students answered *yes*. Among the Elementary school students (9th grade), 46% said they had participated in practical classes in the disciplines of Physical Education, Arts and Informatics, exactly the disciplines that appeared in the answers to the question "*In your opinion*, *what is a practical class*?".

The 3rd grade secondary school students, who answered ***yes***, said they had participated in practical classes in the discipline of Physical Education and to a lesser extent in the disciplines of Chemistry, Geography, Biology, Physics, Mathematics, Sociology, History and Portuguese Language (Figure 4).

Among the conclusion activities of the practical classes, 12% of the students said they had produced reports, 20% presented seminars and 57% of the students said they had not done any type of conclusion activity.

Interestingly, they analyzed the relationship between the practical classes and their own behavior, mentioning attention and politeness, in addition to calm, patience, dedication and willpower. The students pointed out the greatest difficulty to work with practical classes/experimentation including the lack of materials/resources and space/laboratory (Figure 5).

When we asked students to answer with one word what is essential for practical classes, the four most frequent answers were: "laboratory, experienced teacher, available material and equipment". Unfortunately, only one student cited the word "*safety*" (Figure 6) which inferred that they lack biosafety issues involving practical class. We know how important biosecurity is, whether in the school environment, general or specific laboratory. Unfortunately, the absence of content

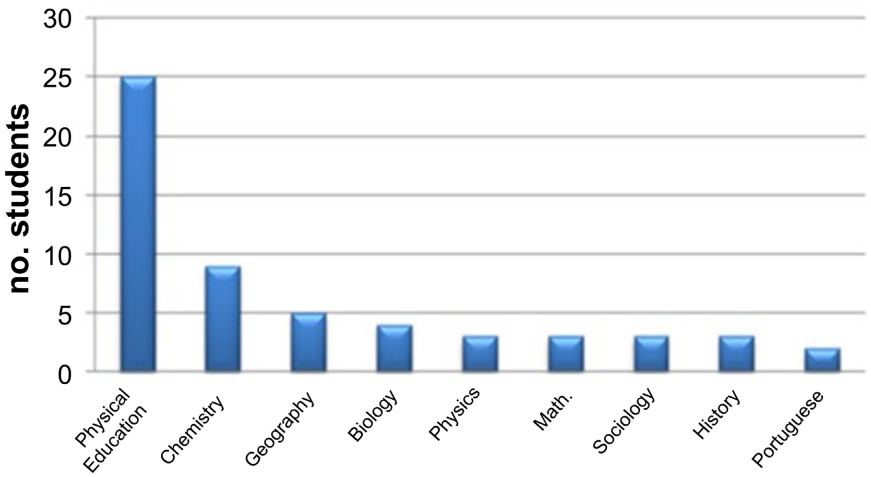

Figure 4. Response of secondary school students (3rd grade) from a small city in the countryside region of the Brazilian state of Bahia, to the question: "*Have you ever participated in any practical class*, *in which discipline*?"

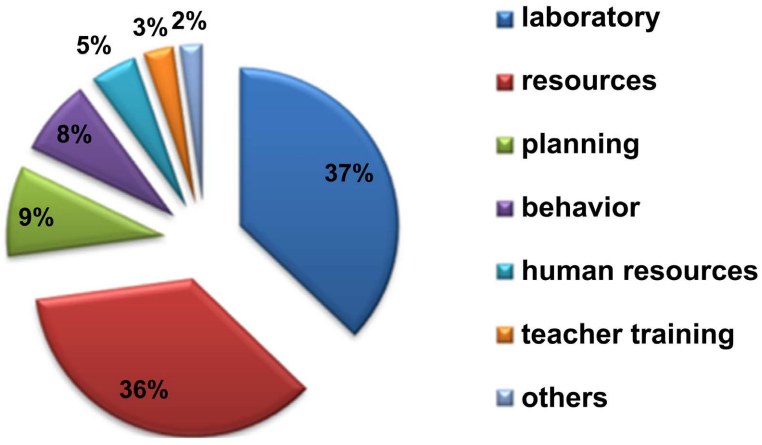

Figure 5. Answers of students (9th and 3rd grade) from schools of a small city in the countryside region of the Brazilian state of Bahia, to the question: "*What is missing to allow working with practical/experimentation classes in your school*?" Note that laboratory and resources were the most frequent answers.

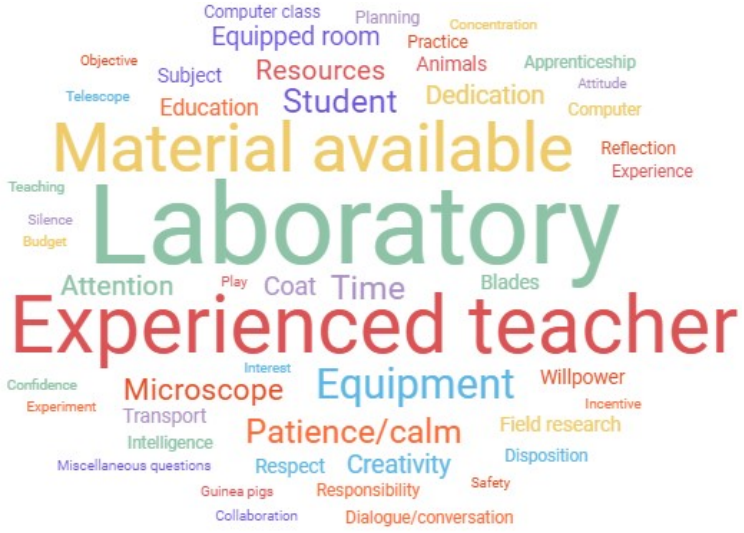

Figure 6. Word cloud cited by students (9th and 3rd grade) from schools of a small city in the countryside region of the Brazilian state of Bahia regarding the question: "*In your opinion, in order to carry out a practical class, it is essential to have mainly.*"

related to biosafety in biology, chemistry and physics textbooks used in high schools, in addition to the absence of this theme in the curriculum of Basic Education Sciences are pointed in studies carried out by some authors (Costa et al., 2006; Carvalho, 2008).

In summary, the analysis revealed that the students' preferences in the curriculum are Arts, Geography, Science and Physical Education in elementary school. A total of almost 50% of the students liked the school "very much". Although they liked the school, the students highlighted the lack of laboratory and practical classes (although we noticed that they do not know exactly what it means). Only 1% of the students who participated in the study stated that the practical class should involve more reflection than practice, thus reinforcing that

the vast majority are not aware of how an effective practical experimental class should be. Some students attributed the importance of practical classes to the question of incentive.

Interestingly, it is clear the student's perception about the need for a trained teacher for leading practical classes. Thus, the continuing training of the teacher is necessary as it is not enough to have resources, such as the laboratory. The teacher properly qualified to teach experimental science practical classes can make the difference and the students know and feel that.

5. Conclusion

Students from a small city in the countryside region of the Brazilian state of Bahia, unfortunately, do not participate in practical classes nor do they even know what the extension of an experimental practical class is within all disciplines. They related mostly the practical classes to Physical Education and Arts classes, which justify the urgent need for practical classes in school implementation as an intervention for improving science teaching.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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