# The Use of Digital Technologies as A Teaching Resource For Science Learning For Students of The Last Year of Fundamental Education of Public Schools in Brazil

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**Abstract**

The technological transformations in the last decades have asked the teachers a new look at how to teach and why to teach, since it is necessary that the knowledge be transformed to connect with the daily life of the students. So the school must also adapt to this new reality. This work aimed to verify the insertion of digital technologies in the daily life of the students of public schools of the state school system in Brazil. Four schools were chosen for the research, two of which were located in Divinópolis MG, a city in the interior of Minas Gerais, and two located in the outskirts of Greater São Paulo. In the research the students answered a questionnaire with six objective and discursive questions. From the analysis of the answers given it was concluded that more than seventy percent of the students surveyed use the smartphone as the main tool associated with digital technologies. Other options like tablets or desktop computers were little chosen. When we asked about the use of digital technologies by the teacher during science classes, there were very different answers. At school A, 30 students stated that the science teacher does not use digital technologies in their classrooms. In school B, in the same city the result was the opposite, because all 36 students said the teachers' daily use of technologies. At school C, 22 students said that they did not use technologies in their classes while at school D, only 17 students made this statement. It is noticed that many schools prohibit the use of smartphones in the period of classes, however, another approach using this device as a teaching tool would certainly be more interesting for teaching learning between students and teachers, after all this device is a constant component in the daily lives of the students, and may arouse in them an interest in scientific concepts.

**Keywords:** Digital technologies; Teaching; Science; Traditional teaching methodology

## Introduction

Technologies, especially digital ones, invade people's daily lives and can provide new perspectives, broadening their vision on various topics, including education.

It is important to emphasise the presence of digital technologies in the school environment, since these aim to support a new teaching pattern, in other words, technologies must support students in their learning, constituting an important educational resource.

According to Alda (2012), education and the educational system have experience numerous changes, adapting to the advancement of technology that popularized access to information by changing our way of learning and even our habits.

The idea of the use of digital technologies in the classroom, seeks to arouse the interest of the student and through this interest expand their learning. As argued by Moreira (2005), in order for the student to achieve meaningful learning, he should initially want to learn and the initiative of this interest must begin with the practice of the teacher in the classroom.

According to Alda (2012): "The student developing the habit of research and interest in information will naturally develop the need for learning, becoming a questioner and critical in relation to the reality that surrounds him. It is the school's function to train a critical subject. "

According to the National Curricular Guidelines, Brasil (2014), constant scientific and technological development imposes on the school a new positioning of experience and coexistence with its students.

The Ministry of Education, Brasil (2014), through the National Curricular Guidelines, cites that: "The appropriation of scientific knowledge is effective through experimental practices, with contextualizations that connect knowledge with the life".

Often the link between scientific concepts and everyday aspects of students is linked to the teaching practice of the teacher.

The use of digital technologies that allow a differentiated class, through the use of experimental contributions or computational simulations, can provide the student with a different view of scientific concepts, facilitating understanding and learning.

According to Alda (2012), for a long time the teacher was considered as the only provider of knowledge where the students were in the classroom just to learn, however in the contemporary world one has the idea that knowledge is built together and mutualy so, the use of digital technologies can improve the relationship between students and teachers by developing this exchange of knowledge.

The use of digital technologies in the school environment has promoted changes contributing to access to information, given the ease of access to the web mainly by the use of smartphones. It is observed that even today many teachers or educational institutions prefer to prohibit the use of these digital technologies in the classroom instead of exploiting them in favor of students' learning. As these digital technologies are immersed in the students' daily life, it can be assumed that their use in school can contribute to the meaningful learning of the concepts worked.

According to Pinheiro and Rodrigues (2012), the smartphone is a powerful pedagogical tool, because it concentrates several media, contributing to the development of communicative skills to the students. The teacher should have the function of directing and coordinating the use of these digital technologies in the classroom, since many students do not have the maturity to discern when it is appropriate to use these tools. Ideally, activity using these technological resources should always be included in lesson planning.

An important factor to consider is the preparation of the teacher during his or her basic academic training or participation in continuing education courses, on how to use and explore

in the best possible way, with teaching, resources related to digital technologies, after all, how will teachers use these tools with their students if they do not dominate the handling.

Second Vivian and Pauly (2012): Teaching through the use of new media seems to be a challenge that creates new paradigms in relation to education and transcends our expectations, motivating the teacher to go ever further.

This work aimed to analyse the conception of a sample of 130 students from public schools in two Brazilian states on the use and learning of science concepts using resources related to digital technologies. Through the answers given by the students, we also sought to verify if the use of these resources by teachers of science occurs during classes and also discuss the use or prohibition of technological devices such as smartphones in schools.

**Significant Learning and Mechanical Learning**

In surveys that portray how people learn, Ausubel et al., (1978), defend a cognitive view of learning and show two psychologically distinct ways of learning, termed meaningful learning or mechanical learning.

Meaningful learning is the process by which a new concept relates in a non-arbitrary and substantive way to the learner's cognitive structure Moreira (2005). Because it is an interaction, the previous concepts are transformed, becoming more elaborate, and the new concepts acquire meanings. In this way, prior knowledge helps in the incorporation and understanding of new knowledge, when they are based on relevant concepts, the so-called subsunction concepts.

Moreira (2005), state that in order to learn meaningfully, the learner has to express a willingness to relate the meanings he draws from potentially meaningful educational materials to his non-literal and non-arbitrary cognitive structure.

Students are not always able to develop meaningful learning, most of which is tied to the mechanical learning given by the temporary memorization of a taught content. Figure 01 shows a schema where knowledge is between mechanical and meaningful learning, and it can be constructed from the junction of the two modes of learning.

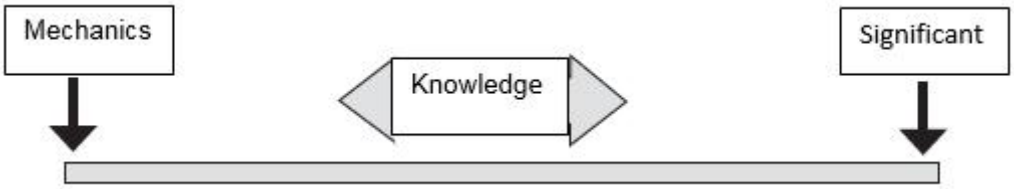


Figure 01: Interval between mechanical and meaningful learning

Second Braathen (2012): Mechanical learning occurs with the incorporation of new knowledge in an arbitrary way, that is, the student needs to learn without understanding what is involved or understand the meaning of why. This learning also happens in a literal way, the learner learns exactly how it was spoken or written, with no room for self-interpretation. Learning happens as a product of the absence of prior knowledge related and relevant to the new knowledge to be learned.

In the daily routine of school it is realized that it is perfectly possible to occur mechanical learning and meaningful learning in the same study session or in the same classroom. This justifies how important it is for the teacher to work several teaching methodologies, using various educational resources, so that he will be able to develop different learning with the students.

**Digital Technologies and Teaching Science Learning**

As can be seen, digital technologies are increasingly inserted in the daily lives of students and teachers. The blackboard, chalk and notebook are no longer the only available materials that can be used as teaching methods today.

Despite the availability of new technologies for teaching, there are still major difficulties in introducing these new teaching methods, mainly involving digital technologies.

Information and Communication Technology can be explained as an agglomeration of technological resources, used in a globalized way, and that have a common goal. These technologies can be used in a variety of ways, such as in industry, in commerce, in the investment sector and even in education, with application in the teaching and learning process, for example in online education.

It is important to emphasize that it was with the spread of the internet that these Information and Communication Technologies expanded, leveraging the use of tools such as the smartphone in several areas, including education.

Second Junquer e Cortez (2010): Young people today have found in the use of smartphones an area of independence of the adult world, which accelerates a supposed majority, regardless of their social class and the variety of models of this support, since all social classes carry cell phones, from the simplest the most sophisticated and technologically advanced. The justified purpose for its great use is that the contact between parents and children requires more care, attention and closeness in daily life. And most young people say that they can not stop using this technology communication tool, since their use is the best way to have and keep friends with whom they establish relationships that are characterized by the exchange of advice, ideas and information of the moment they are living. They also use as artifice for the activities of each age group, since they guard against any interference from adults.

The use of different digital technologies such as simulations, PowerPoint presentations, educational games, YouTube videos and the applications themselves, when properly used, allow students to have contact with other forms of language, and also provide a teaching to these new generations, who from the outset present intimacy and mastery over these new digital technological resources.

**Methodological Procedures**

The research with the schools was carried out from the application of a questionnaire with six questions, being objective and discursive. The questions dealt with the use of digital technologies in the daily routine of the classroom and in the daily life of students and teachers. Students were asked if during their student life they had attended

science classes taught using digital technological resources. Four state public schools participated in the study, two of which were located in the city of Divinópolis, in the state of Minas Gerais, and were named A (32 students surveyed) and B (36 students surveyed) and two schools located in the outskirts of Greater São Paulo, called C (31 students surveyed) and D (31 students surveyed).

A total of 130 students were studied, with an average age between 13 and 14 years old, all of them attending the last year of Elementary School. A study of the data was carried out based on the techniques of content analysis of Bardin (1994), by categorization of responses and grouping by similarities. The data were represented in discussions involving tables and graphs.

**Results and Discussions**

In this section we will analyse the answers given to the research questionnaire applied to the students.

Question number one asked the students about which computer equipment they used most in their daily lives. Table 01 gives an outline of the answers given to this question.

Table 01: Quantitative responses to the first question

| Schools | Smartphone | Notebook | Desktop computer | Smartphone and Notebook | Others | Does not have |
|---|---|---|---|---|---|---|
| A | 20 | 0 | 4 | 2 | 6 | 0 |
| B | 30 | 1 | 3 | 0 | 2 | 0 |
| C | 21 | 5 | 2 | 1 | 2 | 0 |
| D | 22 | 5 | 2 | 1 | 0 | 1 |

It was noticed that the smartphone option was the most chosen by the students, which was already expected, after all, today students are very connected and even dependent on this device. Everything from general research to participation in groups and social networks can be done using this device.

The touch-screen interaction platform and the easy handling due to the small size and weight are elements that contribute a lot to the choice of this device as the main tool of access to the web at the present time. From the data it was observed that the smartphone practically replaces the functions of notebooks and desktop computers. Another factor noted was the easy access to these handsets. It was found that among 130 students surveyed only one said that they did not have access. In the other column of Table 01, few students reported using computers in other settings, such as at school, in the library, and even in the lan houses, for example.

The question 02 presented nine options related to students' frequent or non-use of digital technologies to perform day-to-day tasks. Students were asked to rate the options between "I do not use"; "Little use"; "I quite use ". The Table 02 presents the nine items available for students' choice of use or not.

Table 02: Items in question 02 for classifying students as to their use or not

| Options for answers to question 02 |
|---|
| 1 I use the computer only to process texts |
| 2 Social network, Facebook, Instagram, Games, Twitter |
| 3 Educational software / CD-ROM |
| 4 School works with computer |
| 5 Video lessons on YouTube |
| 6 Virtual libraries |
| 7 Educational apps for smartphone |
| 8 Virtual simulations of images and animations related to Sciences |
| 9 School Informatics Laboratory |

Figures 02, 03, 04 and 05 respectively illustrate the graphs representing the answers given to question 02, by school. The vertical columns in the graphs represent the students' choice of the items shown in Table 02.

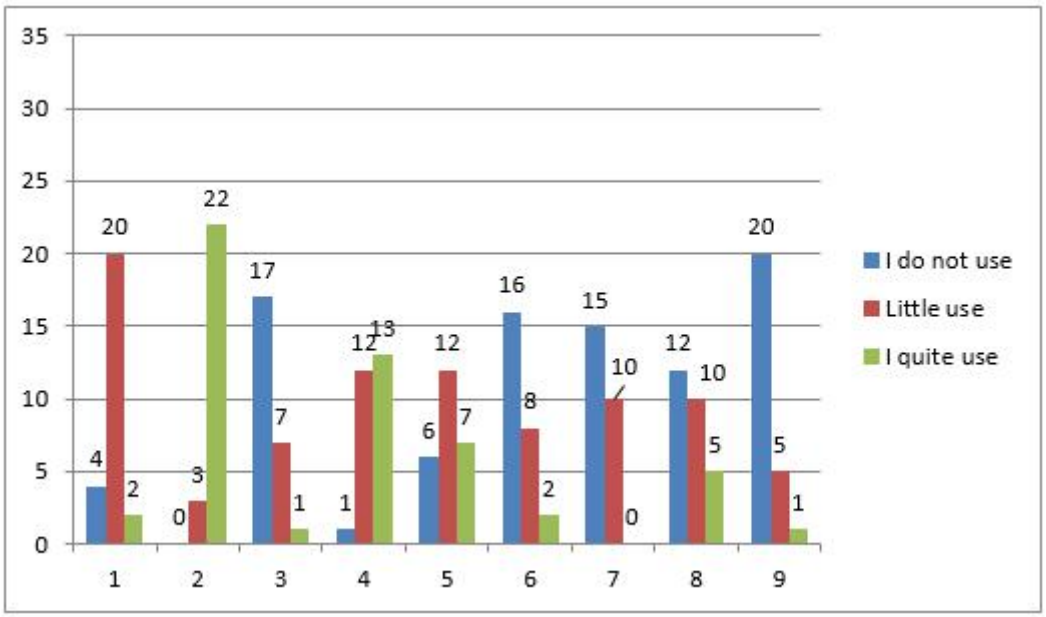


Figure 02: Graph with the answers from school A

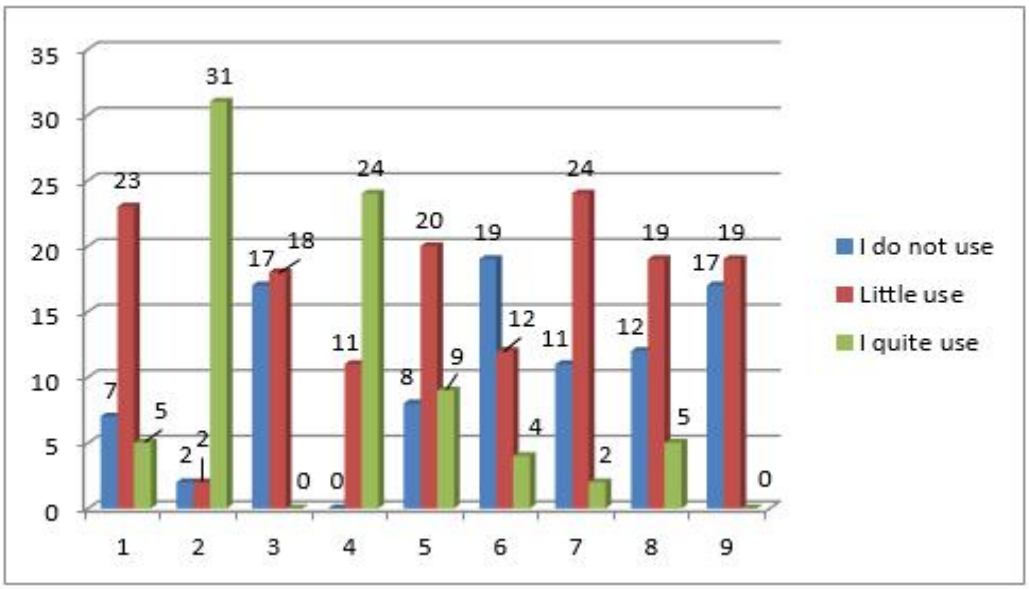


Figure 03: Graph with the answers from school B

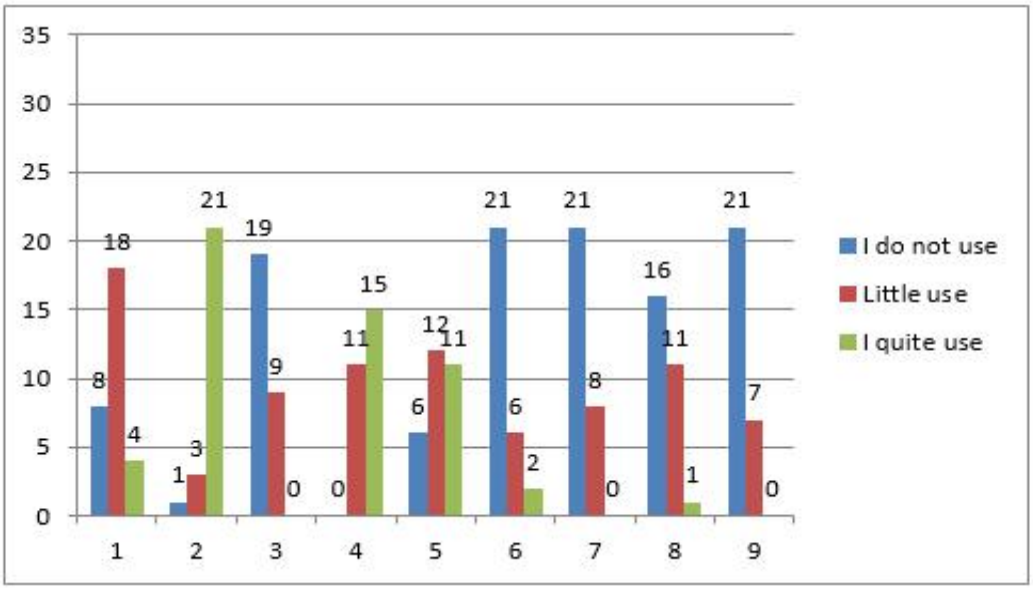


Figure 04: Graph with the answers of the school C

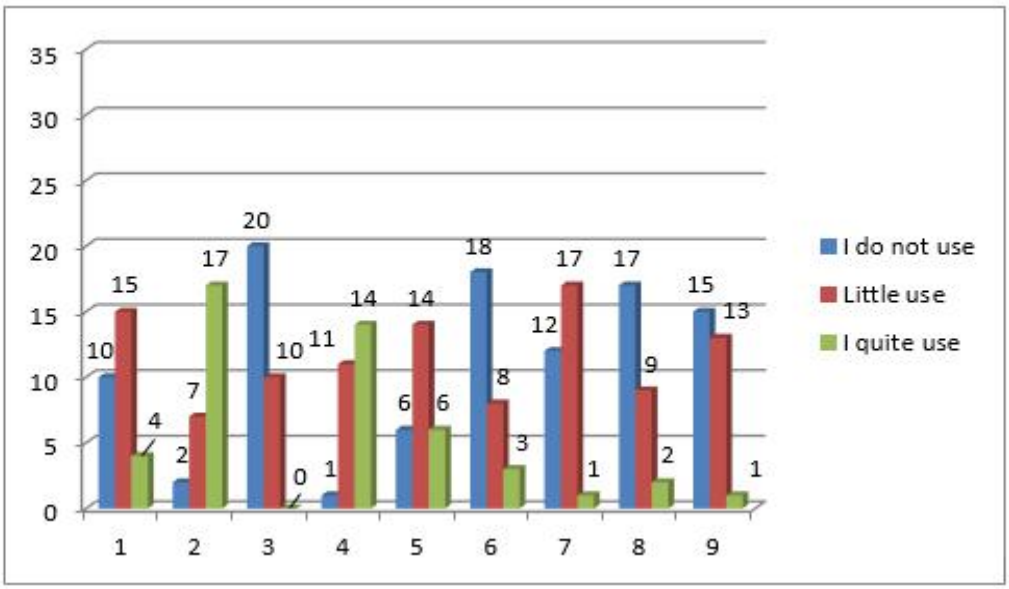


Figure 05: Graph with the answers of the school D

It was observed that the four graphs presented in the previous Figures presented values in the ordinates, where the number of alternatives chosen did not coincide with the total number of students studied per school. This can be justified by the questionnaire model used, where the proposed question is multiple choice, allowing students not to answer it or even choose more than one item among the response options. It was observed that the graphs of Figures 02, 03, 04 and 05 presented in their ordinates values greater or less than the number of students per school, participants of the research.

In relation to the term "quite use", the graphs of the four schools, represented in Figures 02, 03, 04 and 05, showed the predominance of items 2, 4 and 5 (Table 02) that refer to social networks, computer on school assignments and video lessons on YouTube. There was more emphasis on item 2, which includes the use of social networks and Facebook, which is the most chosen in the four schools. It was noticed that even in different schools, located in different regions of Brazil, there was a predominance of this choice since the vast majority of students have smartphones, which facilitates access to social networks and Facebook. Young people today have the habit of relating via social networks, dealing with issues related to friendships, work and school, for example.

The term "no use" presented a greater differentiation in the students' choices, not presenting patterns of answers. Even so, in the four schools surveyed, there was a predominance of items 6 and 9 dealing with "virtual libraries" and "computer labs in schools". It can be seen that state public schools do not normally offer their students access to the web in school libraries, let alone computer labs. This is a problem since our students have their everyday connected to a world connected to the web and school, most of the time, because of economic factors can not offer this support. With this, students form an image of the school as outdated and often do not give it the deserved value.

Schools A, C and D cited item 8 dealing with simulations related to science content, such as "no use". One can link these responses to the lack of contact and even knowledge of the existence of these computational simulations that can aid learning. This use and even the

dissemination of this resource should begin with the teacher in the classroom, where the students would be better able to access them and use them as a facilitator of teaching.

In question 03 students were asked to choose three items from the nine available that represent good resources to facilitate the learning of Sciences. Table 03 represents the nine items of this question.

Table 03: Items in question 03 for student choice

| Options for answers to question 03 |
|---|
| 1 Lectures on technological advances in the area of exact sciences |
| 2 Movies related to Science and Technology |
| 3 Science books |
| 4 Experiments that illustrate science in everyday life |
| 5 Educational Games directed to Science |
| 6 Video lesson on YouTube |
| 7 Desktop computer |
| 8 Smartphone and tablet apps |
| 9 Use of models and lego-type toys |

In this question students were asked to choose three items among those available in Table 03, but many students chose more than three options, generating repetitions and consequently a greater number of chosen items when compared to the number of students surveyed by school. At school A, for example, 32 students participated in the research, but the sum of items chosen by students was 42.

At school A the most chosen by the students were: Item 1 (18 students), item 2 (16 students) and the least chosen items were 7 and 8, with only four students each.

At school B the most chosen were item 2 (16 students) and item 4 (19 students). The least chosen item was 3 with only four students.

At school C the most chosen were item 2 (18 students) and item 4 (19 students) and the item less chosen was the 7 with only two students.

At school D the most chosen were item 2 (17 students), item 4 (15 students) and the least chosen were items 5 and 7 with only five students each.

It was observed that even though they were different schools, the students chose a common item that dealt with "Movies related to Science and Technology". This illustrates students' preference for new teaching methodologies, in this case, using movies. Regarding the less chosen items, item 7, "desktop computer" was quoted in schools A, C and D. This choice is justified due to the replacement of this item by compact devices such as tablets and smartphones.

In question 04, students were asked if their teachers used resources linked to digital technologies during their science classes.

At school A, almost all students said that the teacher does not use technological resources during science classes, and 31 students answered "no" and only one did not answer.

At school B, a different reality occurred because all 36 students surveyed stated that the science teacher uses technological resources in their classes. The justification of most of these students was related to the teacher's use of the multimedia projector during Science classes.

At school C, 22 students answered that the teacher does not use technological resources during their classes. Six students answered that "yes" justifying that he quotes technological resources during his explanations. Three students did not answer.

At school D, 15 students answered "no" and nine students answered "yes", with seven students did not answer.

It is noticed that the teacher of the school B can mix expositive classes with the use of the multimedia projector, illustrating the themes of science classes with photos on slides and related videos. These differentiated classes have greater potential to contribute to the attention and learning of science concepts with students.

Question 05 asked for students' opinions on the use of mobile digital technologies such as tablets and smartphones in teaching and whether this feature could facilitate the learning of science content.

At school A, 27 students agreed with the idea that mobile devices can improve and facilitate teaching and justified:

"- With the smartphone teaching can be more dynamic and comprehensive, as we can consult and ask questions about some unknown concept."

"- With the smartphone we can use the virtual books, not having to load them."

"- With the smartphone we can watch video lessons at home, complementing the teacher's explanation."

One student did not agree with the use of these mobile technologies in school and answered "no".

Four students from school A did not answer this question.

In school B, only one student did not respond and 35 students answered "yes", being favorable to the use of mobile devices in science teaching and justified:

"- With the smartphone, I access the internet more easily."

"- Digital technologies support students' interest in learning."

At school C, 28 students answered "yes", agreeing to the use of mobile digital technologies and only three students did not respond.

At school D, 27 students answered "yes", agreeing to use these devices for teaching, one answered "no", disagreeing with the use and three students did not answered.

It was noticed by the analysis of the answers that the majority of the students agreed with the use of these technological resources jointly to the teaching of the concepts of Sciences and consider it as a tool that complements well the expositive classes.

In question 06, students were asked if they had Astronomy classes in Elementary School and if during these classes, teachers used digital technologies, such as simulations, videos and smartphone applications to exemplify and assist in the teaching of such content.

At school A, 27 students answered "no", most of whom justified that they had not studied Astronomy or did not remember. Only five students answered "yes" to this question.

In school B there were very varied answers and these are represented in Table 04. It is clear that in this school the students had little contact with the content of Astronomy and the teachers, by the students' reports, did not use digital technologies in teaching.

At school C the answers were more homogeneous and 14 students answered "no" and 14 students answered "yes". Only three students did not answer this question.

Table 04: Representation of the answers given by the students of the school B

| Answers Given | Quantitative of students who answered |
|---|---|
| No | 19 |
| Do not remember | 5 |
| Others ("Never used anything", "no textbook") | 4 |
| Yes | 8 |

At school D, 27 students answered "no", one answered "yes" and three did not answer the question.

It was observed that in the four schools most of the students surveyed answered "no", indicating that they did not study Astronomy properly in Elementary School or that their teacher did not work this content using digital technologies linked to education.

**Conclusions**

Most of the 130 students surveyed reported having access to digital technologies, as seen in item 2 presented in Table 02 that dealt with the use and access to social networks and Facebook, but it is noticed that there is still resistance in the schools to use resources linked to digital technologies for teaching. It was observed in the graphs of question 02, represented in Figures 02, 03, 04 and 05 that most schools do not use or have a computer lab. This shows a lag in the education system where many schools fail to provide minimal support to students for use and access to the web. The possibility of offering wi-fi networks for remote access in schools would be a way to use the smartphone as an instrument of consultation, but this reality is still distant for most Brazilian public schools. In another research question, the students' report showed that most of their teachers do not use digital technologies in their classrooms. The use of these technologies could lead the students to give greater real meaning to the concepts taught in the daily school life and, in addition, there would be greater chances of these concepts if they interconnect to the daily life, favoring with this a significant learning.

Constantino (2003) said that for science teaching to really lead the student to meaningful learning needs to have its contents connected to the students' daily life, because the new concepts will have greater meaning and consequently students will learn more easily. One way to connect school concepts with students' daily lives may be through the use of digital technologies.

Second Braathen (2012): "... even in traditional lectures, many changes of concept involving meaningful learning can happen if the teacher uses more dynamic methodologies, for example, using other technologies. So, even in classes with many students, problems of lack of prior knowledge can often be solved or attenuated by creating an interactive and

dynamic environment, with effective involvement of students in the process, as well as with work in pairs and in small groups, among other methodologies. "

It is expected that education professionals in general are prepared, mainly for their basic academic training, to handle and use digital technologies in their classes, this is because smartphones are a reality in schools and it is perceived in everyday school that the simple prohibition does not is an ideal way to deal with this device.

Many young people consider the smartphone as an integral part of their daily life, since it is a tool that facilitates basic tasks, which is why they tend to use it as an educational resource.

Second Soares (2003): Universities need to insert mobile technologies in the formation of the professional future of education, so that later, already inserted in the job market, acting as a teacher, they have the skills to insert these resources into their classes. It is also necessary to rethink the curriculum in the basic school, taking into account the possibilities of the use of cell phones, which when used in a pedagogical way, provide a collaborative learning process for students.

In the four schools, the question that asked students if they had studied Astronomy in Elementary School and if the teacher had used some resource tied to digital technologies, had a high index of "no" answers.

This was a worrying fact since the contents of Astronomy second the National Curriculum Parameters, Brasil (2002), should be worked on in Elementary School. Another problem is noticed, since many times the teacher in his academic formation, who accredited him to teach Sciences, did not offer the study of the basic concepts of Astronomy and therefore he does not work these concepts with his students.

It is noticed that the education departments do not support the teachers, promoting, for example, continuing education courses with Astronomy subjects or about the use of digital technologies in the classroom, which, as contacted in the research, there are lags.

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