

## **BIOLOGY TEACHING WITH AUTHORING TOOLS ON THE INTERNET**

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The information society, in which we operate, is characterized by being influenced and shaped by information and communication technologies (ICT) and their advances. In this context, teachers are challenged to encourage students' curiosity, seeking teaching innovation in the face of new technologies (Lévy, 1999). In this same scenario, students must develop skills for solving problems and interconnect them with the application to everyday life using ICT.

ICTs can be used as mediating tools for teaching, helping teachers and students in the teaching-learning process. However, the constant use of mobile devices such as tablets and smartphones in the school environment is noticeable (Mallmann; Jacques, 2015), not as an ally of the teacher, but, in many cases, as a “competitor” of students' attention.

To keep students' attention and motivation, it is essential to bring the contents covered in the disciplines closer to the daily lives of students, characterized by the constant use of digital technologies. Thus, the professor, with the support of the internet, can convert the use of these devices into potential allies in Biology teaching, making it more attractive and current.

The internet offers various educational support materials: games, educational software, learning objects, blogs and virtual libraries, among many other means designed for application in teaching and learning. These resources are made available, in large part, free of charge and with the possibility of collective editing and creation, in a perspective in which the materials found partially meet or even meet the demands of teachers. The teacher has the possibility to develop his own teaching material, and can fill this gap with material considered appropriate by him, according to customization, to meet the specificities and socio-educational context of the school and the student.

As mentioned by Soares and Góes Brennand (2017), the teacher, when developing their own teaching materials, can create interactive media, making use of the collaboration of other teachers and in an iterative way, with the involvement of the student, making the learning constructivist, that is, the student effectively participating in the construction of their knowledge.

The objective of this work is to verify the performance of 1st year high school students after applying the use of author tools in Cytology classes, in Biology. To achieve this goal, the authors used tools produced by the professors and stored in a blog dedicated to this purpose;

they can improve student learning, seeking better quality of classes and making them more dynamic.

As the main result found, there are indications that authoring tools on the internet can enhance the teaching of Biology, making classes more interesting and interactive. Teaching aided by authoring tools makes the contents to be learned in a collaborative way, in addition to including the experiences and experiences of students and improving their academic performance.

**Scope of knowledge**

Despite following a standard curricular structure for the country, municipal, state and private schools, together with the board of directors and higher education, adapt the themes studied, according to the reality of the region and its particularities. The contents of Cytology in the 1st year of high school throughout the school year, according to the MEC, are presented in Table 1.

Table 1: Syllabus treated in Cytology in the 1st year of High School in Brazil

Contents	Topics (detailed content)
optical instruments	Structure of different living beings, cell organization.
Different cell types	Organization and functioning of different types of cells.
single origin	Common characteristics among living things.
cell interior	Golgiense complex, lysosomes, ribosomes, mitochondria, centrioles, chloroplast, smooth and rough endoplasmic reticulum, caryotheca, nucleoplasm, chromatin and nucleolus.
Basic vital functions and their related processes	Cell membrane. Energy acquisition processes by living systems – photosynthesis, cellular respiration. Cell reproduction and cancer. Hereditary material in cells of different types of organism. Cell cycle and its processes.

Source: Brazil, PCN+ (2005).

The Common Basic Content (CBC) of Biology adopted by the Secretary of State for Education of Minas Gerais is very similar to the contents of the National Curriculum Parameters, as shown in Table 2.

Table 2: Cytology syllabus in the 1st year of high school in Minas Gerais

Contents	Topics (detailed content)
cell wraps	Cell theory. Cell wraps. Plasma membrane. Wraps outside the plasma membrane. Exchange processes between the cell and the external environment. Concentration of a solution.
cytoplasmic organelles	Golgi complex, lysosomes, ribosomes, mitochondria. Centrioles, chloroplast, smooth and rough endoplasmic reticulum.

Cell core	Karyotheca, nucleoplasm and chromatin, nucleolus.
cell division	Cell cycle, interphase, mitosis and meiosis in animal and plant cells, prophase, metaphase, anaphase, telophase and cytokinesis, mitosis in plant cells, meiosis, meiosis I, meiosis II.
energy metabolism	Photosynthesis, respiration, fermentation, chemosynthesis.

Source: Minas Gerais State Department of Education (2005).

Based on the analysis and comparison of the menus, it can be noted that the contents are similar, with only the level of depth in some subjects varying to the detriment of others. Thus, it can be said that the contents covered in the State of Minas Gerais are divided according to the needs and reality of the target audience, and the themes follow the national guidelines and the textbooks themselves. This work, therefore, will adopt as reference the contents used in Minas Gerais.

In compliance with the curriculum, it is clear that the Biology textbooks used in public schools address the issues demonstrating the theory and with the proposition of some practices. However, despite covering all contents, they are poorly contextualized with technology and its main tools, making teaching theoretical and alien to the students' reality.

Making a comparison between works often adopted as the main bibliography of schools according to the Guide PNLD 2018 (FNDE, 2018), it is possible to observe that the book *Biologia*, by César da Silva Junior, Sezar Sasson and Nelson Caldini Júnior, has sections of activities to develop the skills required in Enem related to Cytology. The program is considered complete, dosed in the right measure, with language adequate to the level of the students, avoiding excessive technical terms. The book *Biology – single volume*, by the same authors, offers fluent and easy-to-understand didactic text, establishing direct communication with the student, with complementary readings and exercises that lead them to “think biologically”. The book *Biology in Context*, by José Mariano Amabis and Gilberto Rodrigues Martho, brings an interdisciplinary approach, relating aspects of scientific knowledge and practices of argumentative rationality and seeking approximations of Cytology with other fields of science and other areas of knowledge, relating them to everyday life.

### **Biology teaching**

Biology is the science that studies life in all its forms. For the study of life, the cell, the forming unit of living beings, must be based on (Alberts et al., 2006). Thus, knowledge and understanding of the cell, which is the object of study of Cytology, one of the areas of Biological Sciences, is essential for students in the 1st year of high school.

Despite the importance that Biology has in the students' curriculum, they have difficulties in understanding its contents. According to Silva Dias, Núñez and Oliveira Ramos (2010), the complexity of the terms used and the difficulty of applying such knowledge in everyday life are some of the obstacles pointed out by professors and students for teaching and learning the contents of Cytology.

Júnior and Princival (2014) point out that the teaching of Cytology generally practiced is characterized by the transmission of content, lacking intertextuality, interdisciplinarity and

the relationship of problems with everyday situations, leading the student to lack motivation for learning. Krasilchik (2004) reports that students perform learning by memorizing the processes involved and demonstrations with two-dimensional drawings.

To provide students with motivation, Tarouco, Silva and Grando (2011) report that the teaching-learning process must be conducted in the search for understanding the processes through playful strategies. Thus, the union of teaching and learning with the technological tools available in cyberspace, encompassing the characteristics of the information society in which we live, can make learning more fruitful.

### **ICT in Biology teaching**

Medeiros (2009) mentions that “the most interesting aspect of the insertion of ICT in education, from a pedagogical point of view, is the opportunity to face educational issues from a point of view more centered on the process of teaching and learning”. In this perspective, the school can be a social space for learning, combining ICT with a pleasurable learning, covering all senses, with the use of sound, image, movement, animations (Barro; Veras; Queiroz, 2016), making the students have greater satisfaction and effectiveness in the teaching-learning process.

The experience of participatory processes and teaching sharing in a dynamic process can be obtained with the use of innovative technologies in the classroom. However, this reality is not present in most schools (Silva, 2003), since there are times when there is no computer or internet connection. In this case, a possible solution would be the use of mobile devices to eliminate the lack of equipment, enabling the development of active learning, open to suggestions and criticism from students.

Biology classes tend to become more fruitful, dynamic and motivating when authoring tools and new technologies are used, in order to make them allied to the teaching-learning process (Soares; Góes Brennand, 2017). These technologies bring several benefits both in the use of devices that are constantly used by students and in classes and explanations of the processes involved in Cytology.

### **Blog authoring tools in teaching Cytology in Biology**

Authoring tools are seen by teachers as a positive factor in teaching practice, so that, according to Silva (2001), students "are able to work collaboratively, the teacher starts to teach the content better and, thus, they are more motivated to teach". Teachers and students can create digital teaching resources, without the need for specific computer skills, favoring collective and collaborative production, expanding the interaction between students and teachers (Lima, 2009). In this moment of content elaboration, the authors start to have greater participation in the classes, being able to enrich and fix the subjects covered in the classroom.

Authoring tools on the internet provide the exercise of creativity in proposing activities that are closer to the student's routine, enabling the creation of multimedia and hypermedia resources with high pedagogical and educational potential. In this context, Medeiros (2009) states that “school work thus begins to reflect the communicational complexity and critical spirit necessary for training”.

Barro, Veras and Queiroz (2016) suggest that the developed content can be stored in a virtual environment, composing an educational repository in which all created resources are easily accessed, enabling interaction, through the comments section, in addition to suggestions, opinions and raising extra-class issues. In addition, the blog can follow the lines of authoring tools, with the possibility of being prepared and managed both by the responsible teacher and collectively by the students.

The blogs are virtual environments similar operation to a site on the Internet, "usually free, easy creation and maintenance, not requiring technical expertise for its implementation" (Lima, 2011). They offer features and support for various multimedia content, such as sound, image, video, animation and text, among others. In the educational environment, they can be used as repositories of learning objects, organized according to the needs and preferences of teachers and students.

The creation of a blog to house educational objects developed by the teacher or together with the students is a simple, intuitive procedure and an authoring process on the internet (Medeiros, 2009). The creation tools are, for the most part, free and with high quality to handle.

Rios and Mendes (2014) report that this environment can be used as an educational blog: research tool and source of materials, such as photos, videos, texts, etc.; or even as a pedagogical strategy, interpreted as a communication channel between professor and students for debates on subjects covered in the classroom or outside the classroom.

This work aims to evaluate the application of authoring tools in the classroom through a case study, so that students develop skills and abilities to improve the learning of the contents of Cytology in Biology. The blog may primarily be used for research purposes by students, but the main objective is to use it as an educational repository for storing authorship tools specific to the needs of students.

### **Survey Details**

The work fits into the qualitative research model using quantitative data, case study, using two questionnaires for data collection and observation of the proposed teaching activities, with the participation of 60 students aged between 14 and 16 years of two classes of 30 students each in the 1st year of high school at a public school. The first group had contact with authoring tools; was called a participant. The second had no contact, was called control. Subsequently, the learning outcomes in the participating class were analyzed and compared with the control class.

All students use the internet for school purposes and for entertainment such as games and social media. In addition, 80% of students remain connected between four and eight hours a day; the remaining 20%, between 1 and 3 hours. The device used by 80% of students is the cell phone; 20% use computer and tablet .

To achieve the proposed objective, this work was divided into five sequential steps, called Scope of knowledge, Demonstration and training, Pre-assessment and application,

Comparative assessment and Analysis of results. Figure 1 is a flowchart in which these steps are arranged.

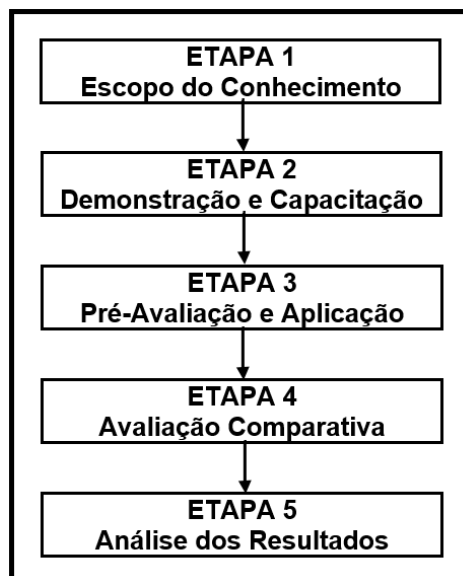


Figure 1: Work methodology flowchart

In the first stage, Scope of knowledge, the syllabus addressed in Cytology was listed and reported on how this content is taught today, considering at least three books used as reference in public schools.

The second stage, Demonstration and training for the use of the blog's teaching resources, consisted of exposing the blog and the resources authored by the teacher and training students for their proper use. For this, an expository class was held in the classroom and then in the computer lab or on the students' mobile devices.

In the third stage, Pre-assessment and application, a questionnaire was applied in which students answered questions related to learning with the use of the blog. Then, the students made use of the blog and its resources in the Cytology class, reporting their experiences with the methodology.

In the fourth stage, Comparative Evaluation, which tools are more appropriate for the teaching-learning process were evaluated, according to the opinions of students concerning the level of difficulty in handling and using the blog tools.

In the fifth step, Analysis of the results, the learning of students was analyzed after the application of content assessment with open and multiple choice questions. Soon after, the same theoretical test was applied to the group participating in the project and to the other, not participating, in order to compare the performance of the groups. The evaluation was also made through the opinions about the resources used in the teaching methodology.

**Demonstration and training for the use of the blog's teaching resources**

Students were introduced to the discipline of Biology and the content of Cytology; then they were introduced to the blog . A case study was carried out in which the learning and interest of the class in the subject were analyzed and compared before and after the application of the project. To create the blog , we used the tool Blogger , the Google with a view to allowing the free creation.

Authoring tools on the internet were used free of charge and with a free license, both for the blog and for the tools that make up its sections. The blog structure is divided into six sections: Homepage, WebQuest, HQs (comics), Animated Tips, Quizzes and The Teacher.

On the Home page there is a manual for training in the use of the blog and crosswords. The manual inserted in the virtual environment was intended to assist in the training class and follow up on the blog . The crossword was designed to address the characteristics of cells. The JClozeo application, from the free HotPotatoes software , was used for its elaboration .

The webquest is an interesting way to develop guided activities. This instrument allows the student to develop a research guided by the teacher, available on the internet at any time of access. The WebQuestFacil site was used to create the webquest, as it is a site that provides free and accessible creation tools for any registered audience.

Comics have always been part of students' daily lives, with traditional printed magazines or even those available on the internet. In the HQs section, the students learned about a comic book produced by the professor on Cytology. After reading the comic, the students performed the activities of the subsections: To reflect and In action authoring on the web , where they made reflections and created their own comics (printed and online ). As stated in the blog , free sites were suggested for the production and the comments space was used to post the various works and share with colleagues and the teacher.

In the Animated Tips section, students watched animations produced by the professor about Cytology. The animations were produced with avatars that teach the content being treated in class and on the blog . To create these animated avatars, the Voki website was used .

The tests in the section of the same name are designed to assess student learning. Two tests were made available, applied before and after the experience of using the blog . These tests were prepared with the Google Forms tool. The tests were applied through a link made available in the blog's virtual environment . Each test has ten required multiple-choice questions with one correct answer. After completing all the questions and submitting, the student received the grade obtained, with a result between 0 and 10, as well as access to their mistakes and successes and the respective feedback. Other attempts were also allowed to answer the test, with different versions for each attempt performed, but, for the purposes of this research, only the first recorded result was used.

Finally, students learned more about the author-teacher in the The Teacher tab, where there is a space for comments for students to issue opinions, formulate suggestions and criticisms regarding the use of the blog and its tools, in order to improve the virtual environment for future classes.

In order to assess the students, three tests were applied at different times; the participating class performed a preliminary test, before using the blog materials and contacting

the content. The last two tests were applied, one in each class, to compare students' academic performance learning, being carried out at the end of the discipline.

**Pre-assessment and application**

The activities related to the pre-assessment aimed to find out how students use the internet, the device used for this and the connection time. When students were asked if any teacher had ever used the internet or any technological resource in class throughout the grades, 87% answered that they had already had this type of application; 50% of this audience reported that such methodology was carried out in Science/Biology. With this, an online test was applied for prior assessment of the class's knowledge in Cytology, in Biology.

This test allowed us to observe that 30% of the students had grades below 4.0 points; 30% obtained grades between 4.0 and 6.0; 30% of them with grades between 6.0 and 8.0 and 10% with grades from 8.0 to 10.0. Thus, it could be seen that 60% of the class have grades below the average of approval (6.0).

**Comparative Evaluation**

Students experimented with available resources according to the teacher's authorship. A different resource was used in each class: crosswords, webquest , comic books, animated avatars and their animated tips and online tests . When they were asked which blog content they considered most interesting to be used in the classroom, the result was diversified, as shown in the graph in Figure 2.

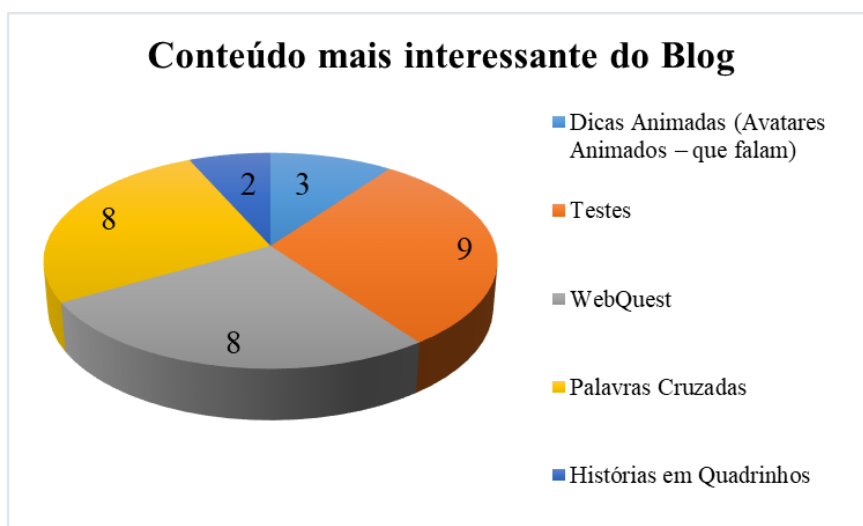


Figure 2: Most interesting content graph on the blog

According to the students' opinions, the Test was the favorite resource, with 30%, followed by the webquest and crosswords, with 26.7% of the preference. Tips from animated avatars (10%) were followed by comics (6.6%). The graph shows students' preference for



interactive and immediate feedback materials , such as tests, crosswords, and even the webquest.

At the end of the bimester, a final written test of ten multiple-choice questions, with a value of 10.0 points, was applied in order to assess the learning of students both in the class participating in the project and in the one that did not participate.

### Analysis of results

Asked about the use of authoring tools on the internet in biology classes, the students were quite optimistic and interested in the application of such methodology. Initially, students were asked if the teacher should create exclusive materials on the internet to be used in the classroom, according to the profiles of each student; 77% of students think this is a great idea and 23% think it is a good idea. None of the students considered the option a bad one.

The evaluation of students, after contacting the authoring tools, when asked again about the teacher creating exclusive materials on the internet to be used in the classroom, according to the profiles of each student, 87% responded as a great idea; 13% as a good idea. It is noteworthy that the development of activities reinforced and increased students' interest in authoring tools on the Internet and that no student responded that the methodology would be a bad idea.

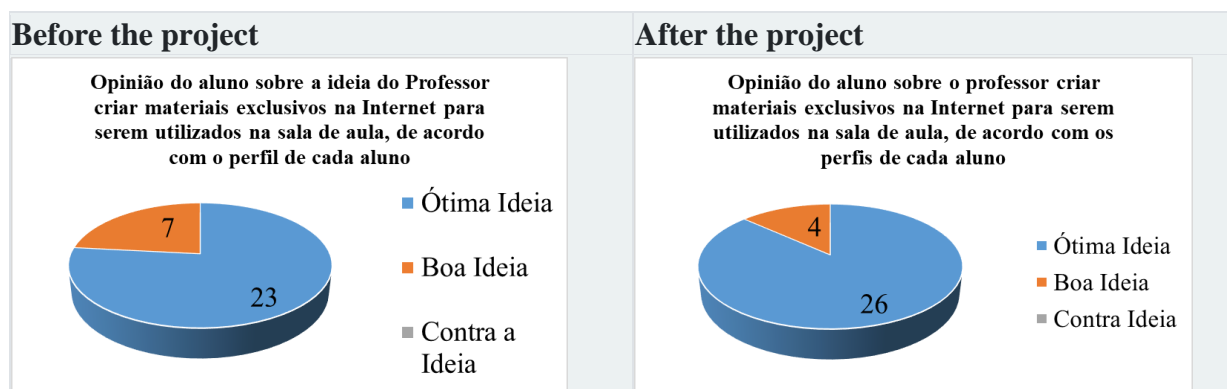


Figure 3: Comparative graphs between student opinions about teacher-created materials

After applying the authoring tools during Biology classes, a test was applied again to verify the students' learning; following the molds of the first application, the virtual blog environment was used , with a test of ten mandatory multiple-choice questions with a correct answer. Immediately after completion, the student received the grade obtained, with a result between 0 and 10, in addition to the feedback about hits and misses. The other attempts released for answering the test had different versions, but only the first attempt was registered for this analysis. The test allowed us to observe that 20% of the students had grades below 4.0; 20% obtained grades between 4.0 and 6.0; 50% with grades between 6.0 and 8.0 and 10% with grades from 8.0 to 10.0. Thus, it can be observed that 60% of the class achieved grades above the average (6.0) of approval.

The use of the blog with materials created by the teacher in Biology activities is considered by 34% of students as very important, for 63% it is important and for 3% it is not very important, as shown in Figure 4.

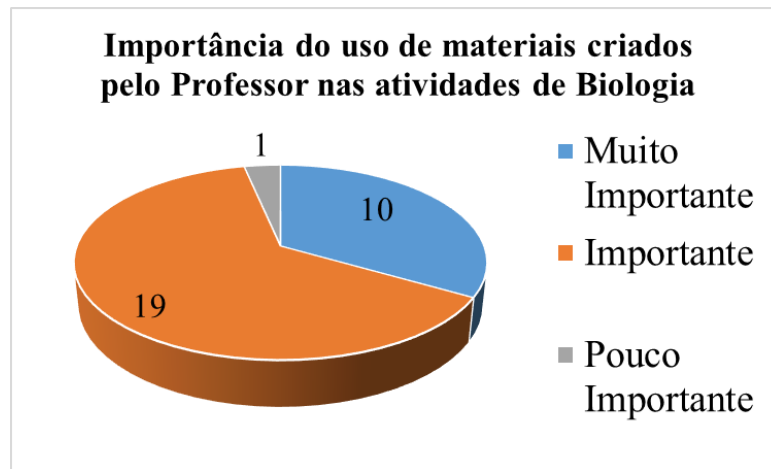


Figure 4: Importance of copyrighted materials in Biology

It is also verified that 90% saw the materials as attractive, 7% as easy and 3% as difficult, as can be seen in Figure 5. All participating students said that the use of authoring tools by the teacher on the internet helps in the process teaching-learning process, positively influencing this process. In addition, if given the opportunity, all students would also like to continue using a blog like the research one, with resources produced by the teacher for each Biology content.

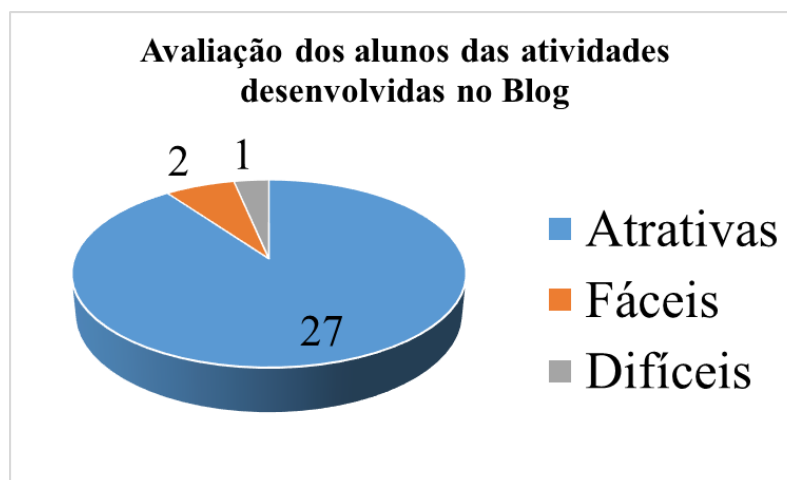


Figure 5: Assessment of student activities

When the averages of the students' grades in the Cytology test are compared, there is an increase of 19.27% in class performance: from 4.67 points, it jumped to 5.57 points after classes with the resources of the teaching methodology with the authoring tools on the internet.

Later, after a month, at the end of the term, a final written test was applied to the group of control students, who had lectures and lectures, and to the group that made use of authoring tools on the internet. It was observed that students in the second class had an average of 6.96,

while the average of the control class was 5.93 points. The 17.4% higher result indicates the effectiveness of the methodology and an important aspect in education: the retention of knowledge over time. This indication of the permanence of information in memory is an indicator of real learning, with the potential to apply the learned content to other contexts and to learn new content.

It is noteworthy that, given so many positive results regarding the use of authoring tools on the internet in Biology classes, the students' opinions were also quite positive, as can be seen in their comments in the last application class:

Very creative, you could pass it on to other colleagues in your profession. Congratulations!

The idea of creating blogs with disciplinary content was very valid. Thus, students are more willing to deepen their knowledge, as the activities provided by the blog were well designed.

I really liked the tools created, as they, together with the blog, provide a means of facilitating a long learning process.

It is very valid for the fixation of the subject, as students with difficulty to learn only with the teacher's oral part have internet support in a more relaxed and interactive way. And overall not losing the focus that is learning.

Excellent learning format.

Very creative, they led the students to be more interested in the subject.

It is observed that the students enjoyed the classes using authoring tools on the teacher's internet and that they made the teaching-learning process effective, engaging and effective.

## **Conclusions**

The objective of this work was to verify the performance of students after using authoring tools in Cytology in Biology classes, focusing on 1st year high school students. It is concluded that the teachers' authoring tools contribute to the improvement in student performance, encourage the production of specific materials for the reality of the class and seek a collective and collaborative teaching-learning process.

This work demonstrates that it is possible to develop quality teaching materials on the Internet with free tools, meeting most of the realities of public schools. For this to happen, it is necessary the commitment of teachers and the union of the school community in projects like this. When the school supports initiatives in this sense, it recovers its role as an agent of transformation and expands the range of pedagogical and educational resources. It is important to remember that, despite the work covering only one class, the students expressed interest in continuing to work with the methodology, thus demonstrating the importance of pedagogical and technological updating in the school environment.

Knowing that this work does not intend to exhaust the subject, further research is needed that seeks to develop new teaching tools, their application in other classes, grades and schools,

including covering other subjects. Students will only have quality academic and citizen training when Education improves and is updated in light of the benefits of new technologies.

Through the evaluations and responses of the students participating in the research, it was possible to observe that there are indications that the authoring tools on the internet can enhance the teaching of Biology, making the classes more interesting and interactive. It is also noteworthy that the teaching exercised through authoring tools makes the contents to be learned collectively, collaboratively, in addition to including experiences and experiences of students.

The main challenge in a class that seeks to use technological and computer resources is precisely the lack of such equipment in public schools. The solution proposed for this work was the use of the computer lab, together with the students' mobile devices, when a computer had a problem or even when the internet connection was failing. With that, a very very positive point was revealed: the integration of technologies in Biology classes.

In addition, through feedback from the students themselves, it was possible to notice the great interest and the very positive attitude shown with this class methodology, in which the participation of all was of fundamental importance. The author's tools by the teacher contributed so that the specific needs and difficulties of that class were reduced, providing improvements in academic achievement.

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