Students' perceptions about a multimedia learning laboratory: an experience in teaching biology classes

Bruna Paula da Cruz – UENF, IFFluminense – brunapaulacruz@gmail.com
Alexandre Horácio Couto Bittencourt – UENF – bittencourt.alex@gmail.com
Michelle Maria Freitas Neto – IFFluminense – michelleneto@gmail.com
Nilson Sérgio Peres Stahl – UENF – nilson8080@gmail.com
Fernando José Luna – UENF – fernandojoseluna@gmail.com

Abstract: This research aimed to assess students' perceptions regarding a multimedia learning laboratory, after experiencing biology classes that used a different teaching approach. The survey involved 159 students between 15 and 17 years old. The methodology combined quantitative and qualitative approaches and obtained results by using a questionnaire and by conducting interviews, respectively. Results indicate that students have good perceptions about the laboratory. They consider it as relevant, authentic, challenging, and useful, with fun and easy-to-use resources. They also point out that it provides opportunities for reflection about their own learning. Results further indicate that boys and girls have similar perceptions about the laboratory, and that students from different years of secondary education do not follow a pattern in their preferences. **Keywords:** Multimedia learning laboratory; Information and Communication Technology; Multidisciplinarity; Teaching of biology.

Percepções dos estudantes sobre um laboratório de aprendizagem multimídia: uma experiência no ensino de biologia

Resumo: Essa pesquisa teve o objetivo de avaliar as percepções de estudantes sobre um laboratório de aprendizagem multimídia, após terem vivenciado uma aula de biologia que utilizou uma abordagem de ensino diferente. A pesquisa envolveu 159 alunos entre 15 e 17 anos de idade. A metodologia combinou abordagens quantitativas e qualitativas por meio da aplicação de um questionário e entrevistas. Os resultados indicaram que os alunos têm boas percepções sobre o laboratório. Eles o consideraram relevante, autêntico, desafiador e útil, com recursos divertidos e fáceis de usar. Apontaram que o laboratório proporcionou oportunidades de reflexão sobre sua própria aprendizagem. Os resultados também sugeriram que meninos e meninas têm percepções semelhantes sobre o laboratório e que alunos de diferentes anos do ensino médio não seguem um padrão em suas preferências. **Palavras-Chave:** Laboratório de aprendizagem multimídia; Tecnologias da Informação e Comunicação; Multidisciplinaridade; Ensino de Biologia.

1. Introduction

We live in a time when plenty of opportunities are available to reflect upon the Brazilian basic educational system. According to Ferreti et al. (2013), access to school is no longer a problem, because 95% of each generation can access an educational institution. For these authors, the main problem of our educational system is the high rate of school repetition. They explained that the untimely school dropout is also no longer a problem, because the students only permanently give up after experiencing multiple failures. Therefore, we must think about what we can do to make the learning process more meaningful for our students, and what kind of didactic strategies we can use to motivate them.

In this context, discussions about the uses of Information and Communication Technology (ICT) in education have become more relevant. According to Peixoto and Araújo (2012), many researchers who support studies on the constructivist approach of learning believe that ICT represents valuable resources to improve the quality of teaching and to develop the autonomy and reflective thinking of the students. For Bransford et al. (2000), the new technologies can help students and teachers develop the competencies and skills needed for the 21st century education. These authors indicate that the technologies' interactivity facilitates the creation of environments, in which students can "learn by doing", receive feedback regarding their activities, continuously improve their knowledge, and understand their difficulties. These authors emphasize that ICT can also enhance the connection between schools and communities as well as help students solve real problems.

Several researchers have evaluated the ways by which ICT can be applied in the field of education. These include, Braten and Stromso (2006), Chuang and Tsai (2005), González-Gómez et al. (2012), Hung et al. (2010), Jesus et al. (2014), Kao et al. (2011), Kerr et al. (2006), Lee and Tsai (2011), Maor and Fraser (2005), and Won et al. (2015). These authors investigated the perceptions of students and teachers regarding multimedia programs, interactive games, internet-based learning environments, and social media technologies, among others. They also evaluated new instruments especially questionnaires in assessing the users' opinions about the learning processes mediated by technology.

Technology can also help teachers motivate their students in the process of learning biology, a subject in which they show a lack of interest according to Nascimento and Garcia (2014). Therefore, we have to examine the current practices of biology teaching in Brazil, which could be the reasons why it is considered a non-contextualized and boring subject. The meaningful learning of biology presupposes the students' active participation, their interaction, and collaboration.

According to Chronaki (2004), the learning strategies supported by computer-based learning environments can be described as active, reflective, mindful, self-organizing, and socially oriented. These environments provide fast access to information, and a wide range of opportunities to increase students' engagement in more complex and challenging activities. Considering this educational potential, an innovative multimedia learning laboratory, known as Tecnoteca, was established by the Fluminense Federal Institute of Education, Science, and Technology located at the Itaperuna City, Brazil. The purpose of this laboratory is to facilitate the interactive and dynamic learning process mediated by the use of ICT. Therefore, the objective of this research is to evaluate the secondary education students' perceptions regarding the Tecnoteca as a multimedia learning laboratory after experiencing biology classes taught in a different way.

2. Methodology

This paper is a quantitative and qualitative research that combines the results of a questionnaire with the ones obtained via focused interviews.

2.1. Participants

The survey involved 159 students from the Fluminense Federal Institute of Education, Science, and Technology. They were enrolled in the first, second, or third year of secondary education, and were between 15 and 17 years old. Among the participants, 38% were in the first year, 23% were in the second year, and 39% were in the third year of secondary education. Of the total, 62% were girls and 38% were boys.

2.2. Research location: The multimedia learning laboratory

Tecnoteca is an innovative laboratory that holds many types of special classes designed to motivate the students. This educational environment is also a conducive place for digital inclusion as it provides opportunities for students from different economic backgrounds to become familiar with the new technologies.

The laboratory differs from a traditional classroom in several aspects. First, it is divided into two areas. The first area has four round tables that aim to stimulate the work group and facilitate discussions among students and teachers. The second area includes chairs set in lines and one 3D digital television equipped with 3D Blu-Ray, an Apple-TV®, and a home theater device. These technological resources provide an area where video, documentary, and movie presentations can be made.

The lack of a traditional whiteboard in the laboratory is another interesting educational strategy. This characteristic aims to encourage teachers to use other resources available within this environment, such as the interactive digital whiteboard. The laboratory has 32 tablet PCs, 12 iPads®, six smartphones, a table scanner, a multimedia projector, and a MacBook®. The laboratory is designed with a set of ludic characteristics that comprise an entertaining learning environment, such as specific blue lighting, transparent chairs instead of traditional desks, and stickers in the windows and doors referring to technology. A presentation about the laboratory can be found through this video link: https://www.youtube.com/watch?v=yKX53C9gAXY&app=desktop.

2.3. Questionnaire design

The questionnaire applied in this research was adapted from Maor and Fraser (2005). The authors developed and validated the Constructivist Multimedia Learning Environment Survey (CMLES). This instrument was initially developed to assess the students' perceptions regarding the use of online multimedia programs in science teaching. The CMLES has two forms: actual and preferred. The actual form evaluates the students' perceptions about the learning environment where they are at the moment, and the preferred form collects opinions about the environment that they consider as an ideal one. Chuang and Tsai (2005) have adapted the preferred form of this instrument to evaluate the preferences of students between 12 and 18 years regarding internet-based learning environments.

The questionnaire consists of 30 multiple choice questions divided into six blocks, comprising five questions each. The blocks correspond to six different factors or scales, namely, Negotiation, Inquiry Learning, Reflective Thinking, Relevance, Complexity, and Challenge, all of which measure the students' perceptions about the concerned learning environment. In this research, we used the actual form of the questionnaire, and each factor was assessed as described below.

1) Negotiation: The students' perception about the degree of opportunities they have in the laboratory to discuss their issues, questions, and solutions. Sample item: *In the multimedia learning laboratory, I ask other students to explain their ideas.*

2) Inquiry Learning: The students' perception about the degree of encouragement they receive in the laboratory to become more involved in their research. Sample item: *In the multimedia learning laboratory, I carry out investigations to test my own ideas.*

3) Reflective Thinking: The students' perception about the opportunities given to them to reflect upon their own learning in the laboratory. Sample item: *In the multimedia learning laboratory, I get to think deeply about my own ideas.*

4) Relevance: The students' perception about the authenticity of the laboratory in terms of teaching and learning and how successful it is in representing real-life

situations. Sample item: *Working in the multimedia learning laboratory, I realize that it shows how complex real-life environments are.*

5) Complexity: The students' perception about how many easy-to-use resources the laboratory has. Sample item: *Working in the multimedia learning laboratory, I find that it has features that are fun to use.*

6) Challenge: The students' perception about how challenging the laboratory is, but how useful it is in solving several problems at the same time. Sample item: *Working in the multimedia learning laboratory, I find that it helps me to generate new ideas.*

Each item in the questionnaire is characterized by an affirmative and a five-point Likert scale for all responses. The questionnaire did not ask for each participant's name, but only required them to indicate their gender, age, and year of secondary school. The questionnaire was pretested with a 20-student group who participated in this survey.

2.4. Questionnaire application

First, the students were invited to participate in an interactive biology class held at the Tecnoteca. Then, they were divided in groups of 20 students each to attend the class in different times. During each class, the participants used many multimedia resources, such as the digital television, the interactive digital whiteboard, tablet PCs, and iPads®. The content of the class was "Ecology in an uncomplicated way", and the topics discussed were as follows: what is ecology, the importance of studying ecology in the present day, and the ecological relationships between the living creatures, among others. The class started with the exhibition of the third episode of "Africa: Eye to eye with the unknown, the world's wildest continent". This documentary was produced by the British Broadcasting Corporation® in 2012, and its initial minutes illustrated the main class content.

After the documentary exhibition, the students were asked to sit around the round tables where they could find the tablet PCs and iPads®. Then, we proceeded with a presentation about the class content, followed by a dynamic interaction with the students. The students were asked to conduct basic investigations through the Internet and to ask fellow students about questions and issues they may have about the topic. At the end of this activity, we invited them to answer the online questionnaire using the tablet PCs and iPads®. The students were advised that their participation in the survey was optional. One noteworthy observation was that they only spent about 10 minutes to answer the questionnaire. Figure 1 illustrates some moments during these classes, the two areas of the multimedia learning laboratory, and some of the provided resources.

Figure 1 a, b - Classes at the multimedia learning laboratory. Source: Authors' archive.

2.5.Statistical analysis

The results of the questionnaire were subjected to Principal Component Analysis (PCA) and Cronbach's alpha analysis using the IBM SPSS Statistics® software, version 20, as performed by Maor and Fraser (2005) and Chuang and Tsai (2005). The same

software was used to perform the Student's t-test in order to compare the answers by gender (boys and girls), and by year level (first, second, and third year of secondary education).

3. Results and discussion

The PCA with varimax rotation was used to verify the questionnaire structure containing six factors; each factor had five questions for a total of 30 questions. The six factors were retained in the PCA, and accounted for 66.813% of the total variance (Table 1). The questions' factor loadings were at least 0.400 for their own factor, and less than 0.400 for the other factors, with the exception of questions 1, 29, and 30 from the Relevance factor, and question 20 from the Complexity factor. Therefore, the PCA confirmed the initial structure of the questionnaire.

Table 1 - Rotated factor loadings and Cronbach's alpha values for the factors of the questionnaire.

Item	Factor 1 Negotiation	Factor 2 Inquiry Learning	Factor 3 Reflective Thinking	Factor 4 Relevance	Factor 5 Complexity	Factor 6 Challenge
Factor 1: α = 0.857						
1	0.540			0.404		
2	0.630					
3	0.736					
4	0.825					
5	0.749					
Factor 2: α = 0.832						
6		0.414				
7		0.749				
8		0.684				
9		0.679				
10		0.424				
Factor 3: α = 0.917						
11			0.764			
12			0.846			
13			0.791			
14			0.788			
15			0.819			
Factor 4: α = 0.834						
16				0.611		
17				0.660		
18				0.564		
19				0.598		
20				0.591	0.515	
Factor 5: α = 0.816						
21					0.657	
22					0.819	
23					0.723	
24					0.835	
25					0.422	
Factor 6: α = 0.794						
26						0.606
27						0.681
28						0.640
29				0.450		0.617
30				0.433		0.590
Total α = 0.938						
Total variance explained = 66.813%						

*Loadings less than 0.400 were omitted. Source: Elaborated by the authors.

The Cronbach's coefficient values ranged between 0.794 and 0.917 (Table 1). Such results indicated that the factors have internal consistency and are reliable in measuring the students' perceptions about the Tecnoteca. According to Spector (1992), the Cronbach's coefficient must be at least 0.700 to demonstrate the internal consistency of a scale.

Figure 2 shows the average values of students' perceptions of the six factors included in the questionnaire. As can be seen, the values ranged from 3.518 for the Negotiation factor to 4.538 for the Complexity factor. The highest ones were 4.538 for Complexity, 4.330 for Relevance, and 3.952 for Challenge. Such values indicated that most of the students concurred with the statements of the questionnaire. Chuang and Tsai (2005) found very similar values when analyzing internet-based learning environments, which ranged from 3.96 for Student Negotiation to 4.21 for Relevance. Their highest values were 4.21 for Relevance, 4.19 for Ease of use or Complexity, and 4.13 for Reflective Thinking.

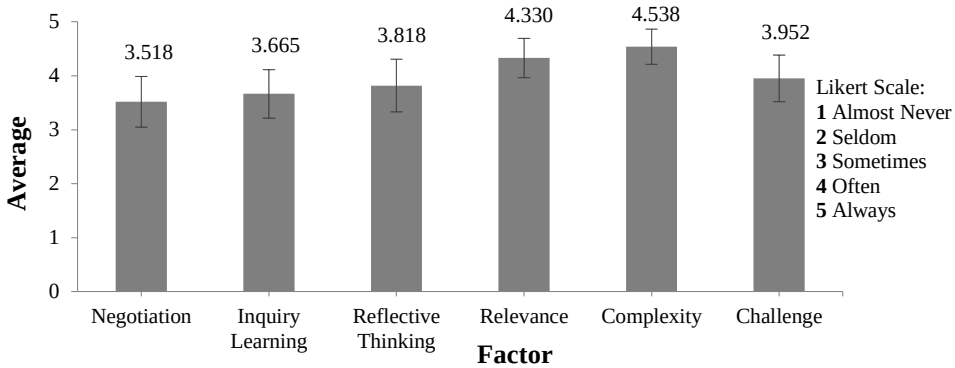

Figure 2 - Average values of students' answers for the factors of the questionnaire. Source: Elaborated by the authors.

In Table 2, we present the results of the Student's t-test comparing the averages of the answers from boys and girls. The test was significant only for the Relevance factor, in which the average from girls was statistically higher than that from boys, indicating that girls were more concerned with authentic learning environments representing real-life situations.

Table 2 - Gender comparisons on the factors of the questionnaire.

Factor	Gender	Average	Standard Deviation	*t* value
Negotiation	**Male**	3.470	1.009	0.616 (n.s.)
	Female	3.547	0.898	
Inquiry Learning	**Male**	3.697	0.954	0.733 (n.s.)
	Female	3.646	0.863	
Reflective Thinking	**Male**	3.680	1.001	0.169 (n.s.)
	Female	3.901	0.963	
Relevance	**Male**	4.170	0.815	0.031
	Female	4.426	0.654	
Complexity	**Male**	4.403	0.813	0.067 (n.s.)
	Female	4.620	0.516	
Challenge	**Male**	3.833	0.891	0.179 (n.s.)
	Female	4.024	0.849	

*n.s.: not significant. Source: Elaborated by the authors.

Many researchers, such as Chuang and Tsai (2005), Goldstein and Puntambekar (2004), González-Gómez et al. (2012), and Ong and Lai (2006), have been evaluating

the gender differences in the learning process mediated by technology. Some of them concluded that boys have more computer skills and are more willing to use and learn about these devices. Others indicated that boys present more positive attitudes and are more easily adaptable to computer-related learning environments compared with girls. Other ones pointed out that girls are more concerned with many aspects of e-learning than male students. They also indicated that girls usually face the technology for its social role, whereas boys are more interested in the machinery itself. Meanwhile, other authors demonstrated that students from both genders have similar preferences for internet-based learning environments. Our research showed that boys and girls have similar perceptions about most of the factors evaluating the multimedia learning environment, with the exception of the Relevance factor.

The data described in Table 3 show that students from different years of secondary education did not follow a pattern in their opinions. Only for the Challenge factor, no significant differences were found between the students' answers. For the other factors, at least one test was significant. One important result was that a statistical difference can be found between the responses in the Reflective Thinking and Relevance factors of students in the first and last year of secondary education. This finding can be attributed to the differences in age and maturity between the two groups of students.

Table 3 - School year comparisons on the factors of the questionnaire.

Factor	School year	Average	Standard Deviation	*t* value
Negotiation	**1st**	3.527	0.721	**1st - 2nd** = 0.018
	2nd	3.928	0.897	**1st - 3rd** = 0.129 (n.s.)
	3rd	3.276	1.068	**2nd - 3rd** = 0.003
Inquiry Learning	**1st**	3.573	0.771	**1st - 2nd** = 0.001
	2nd	4.072	0.618	**1st - 3rd** = 0.753 (n.s.)
	3rd	3.521	1.067	**2nd - 3rd** = 0.002
Reflective Thinking	**1st**	3.993	0.912	**1st - 2nd** = 0.773 (n.s.)
	2nd	3.939	0.862	**1st - 3rd** = 0.023
	3rd	3.581	1.069	**2nd - 3rd** = 0.090 (n.s.)
Relevance	**1st**	4.467	0.586	**1st - 2nd** = 0.643 (n.s.)
	2nd	4.411	0.530	**1st - 3rd** = 0.023
	3rd	4.152	0.898	**2nd - 3rd** = 0.075 (n.s.)
Complexity	**1st**	4.583	0.538	**1st - 2nd** = 0.100 (n.s.)
	2nd	4.756	0.400	**1st - 3rd** = 0.089 (n.s.)
	3rd	4.371	0.809	**2nd - 3rd** = 0.002
Challenge	**1st**	4.123	0.829	**1st - 2nd** = 0.097 (n.s.)
	2nd	3.839	0.760	**1st - 3rd** = 0.096 (n.s.)
	3rd	3.854	0.944	**2nd - 3rd** = 0.935 (n.s.)

*n.s.: not significant. Source: Elaborated by the authors.

Students' abilities to reflect upon their own learning (Reflective Thinking) and to choose their learning strategies, such as the preference for authentic environments that reflect real-life situations (Relevance), are connected to their ability to self-regulate their learning process. This process involves their active, constructive, and autonomous participation in their own learning. The self-regulation of learning refers to the degree by which students work at the metacognitive (knowledge and control of their own cognition), motivational (engagement in a specific task), and behavioral levels (choice of strategies, methods, and actions) to improve their own learning. This process is influenced by different factors, such as the students' psychological development, their

family and school experiences, gender, age, and school environment, among other factors (Hargis, 2001; Mateos, 2001; Silva, 2004; Silva et al., 2004; Zimmerman and Martinez-Pons, 1990).

Therefore, teachers should support educational strategies that help students self-regulate their learning. The experience with our multimedia learning laboratory showed that it is a favorable place to encourage the students' active and autonomous participation in their own learning. The laboratory is also a suitable place to stimulate the collaborative work among the groups of students. As argued by Chronaki (2004, p. 560), the learner is no more a "[…] passive recipient of information (or the consumer of prescriptive guidelines) but has the potential actively to interact with information technology tools and peers and to construct meaning via exploration, discovery, trial and error and social engagement".

3.1. Qualitative data: focused interviews with some students

During the biology classes, some students were interviewed regarding the multimedia learning laboratory, and the learning process that was happening in it. All students highlighted the motivational aspects of applying technology in education, and emphasized the interest and attraction that the laboratory aroused.

> […] In my own opinion, this laboratory presents a way of familiarization with the technology in education. We are immerse in the new technologies and we master it. So, if it is convenient, why can't we use technology in education? Wouldn't it make our learning more effective? The answer is simple: Yes. In addition to being useful and convenient, I can see that we are feeling attracted to this place. Basically, we are more comfortable in it (Pupil 1).

> […] This environment is a major innovation in the teaching method, a model for our country, because by using advanced technologies the students can discover new intellectual worlds. It also combines the teachers' skills with new technologies, which makes the classes more dynamic and fun for both learners and teachers (Pupil 2).

In the interviews, the students highlighted the Complexity, Relevance, and Reflective Thinking factors. Specifically, they pointed out their ability to use the technological resources available at the multimedia learning environment (Complexity - Ease of use), the authentic atmosphere of this place, and its potential to represent real-life situations (Relevance). They also emphasized that, at the multimedia learning laboratory, they could reflect about their own learning process and strategies (Reflective Thinking). These speeches corroborated the quantitative data, which showed that the Complexity and Relevance factors reached the highest averages, followed by Challenge and Reflective Thinking factors. Chuang and Tsai (2005) also obtained qualitative results that corroborated the quantitative ones, as most of the students demonstrated in the interviews that they preferred relevant and easy-to-use internet-based learning environments. These authors also found that some students emphasized the Reflective Thinking factor in the interviews.

> […] Technology is becoming an increasingly powerful tool to improve education. So, our laboratory is showing to everyone that it is possible to have a nice and different type of school while maintaining the quality of education. As a student, I am honored to be part of the early years of this project, as it has a lot of potential to innovate - and

> it has innovated - the current teaching methodologies, in addition to making the classroom a more dynamic, interactive, and attractive environment for both students and educators (Pupil 3).
>
> […] This biology class that I attended at our laboratory was really nice, because it allowed my teacher to address some contents in a more attractive way than in a common classroom. What made the lesson more interesting and pleasant was the fact that it broke up our routine (Pupil 4).

4. Final considerations

This research showed that the students have good perceptions about the laboratory. They highlighted that this environment has fun and easy-to-use resources (Complexity), is relevant and authentic (Relevance), challenging and useful (Challenge), and contributes to the reflection about their own learning (Reflective Thinking). In the interviews, they also emphasized the interest and attraction that the laboratory arouses, confirming the technology's potential to motivate them. This research also found that boys and girls have similar perceptions about the laboratory, and that students from different years of secondary education do not follow a pattern in their preferences.

This paper presents a preliminary study evaluating the educational contributions of a multimedia learning environment for secondary students, and the learning strategies that can be used to motivate them. Future works may evaluate the teachers' opinions about these environments to understand their expectations and concerns. Finally, we understand that it is important to promote reflections in our schools regarding the most effective learning strategies. We need to think about how can we attract our students' attention and develop their critical thinking. As taught by Freire (1987), this is the only way to promote emancipatory education in our schools.

5. References

BRANSFORD, J. D; BROWN, A. L.; COCKING, R. R. **How People Learn:** brain, mind, experience, and school. Expanded Edition. Washington: National Academy Press, 2000.

BRATEN, I.; STROMSO, H. I. Epistemological beliefs, interest, and gender as predictors of Internet-based learning activities. **Computers in Human Behavior**, v. 22, p. 1027-1042, 2006.

CHRONAKI, A. Computers in classrooms: learners and teachers in new roles. In: MOON, B. et al. (Eds.). **Routledge International Companion to Education**. London: Taylor & Francis e-Library, 2004.

CHUANG, S. C; TSAI, C.C. Preferences toward the constructivist internet-based learning environments among high school students in Taiwan. **Computers in Human Behavior**, v. 21, p. 255-272, 2005.

FERRETTI, C. J.; ZIBAS, D. M. L.; MADEIRA, F. R.; FRANCO, M. L. P. B. Um debate multidisciplinar. In: FERRETTI, C. J. et al. (Orgs.). **Novas tecnologias, trabalho e educação***:* um debate multidisciplinar. 16. ed. Petrópolis: Vozes, 2013. p. 7-18.

FREIRE, P. **Pedagogia do Oprimido**. 17. ed. Rio de Janeiro: Paz e Terra, 1987.

GOLDSTEIN, J.; PUNTAMBEKAR, S. The brink of change: gender in technology-rich collaborative learning environments. **Journal of Science Education and Technology**, v. 13, n. 4, p. 505-522, 2004.

GONZÁLEZ-GÓMEZ, F.; GUARDIOLA, J.; RODRÍGUEZ, O. M.; ALONSO, M. A. M. Gender differences in e-learning satisfaction. **Computers & Education**, v. 58, p. 283-290, 2012.
HARGIS, J. Can students learn science using the internet? **Journal of research on computing in education**, v. 33, n. 4, p. 475-487, 2001.
HUNG, M. L.; CHOU, C.; CHEN, C. H.; OWN, Z. Y. Learner readiness for online learning: Scale development and student perceptions. **Computers & Education**, v. 55, p. 1080-1090, 2010.
JESUS, A.; GOMES, M. J.; CUNHA, A.; CRUZ, A. Validade e fidelidade da versão portuguesa reduzida do web based learning environment inventory. **Revista Iberoamericana de Educación a Distancia**, v. 17, n. 1, p. 179-199, 2014.
KAO, C. P.; WU, Y. T.; TSAI, C. C. Elementary school teachers' motivation toward web-based professional development, and the relationship with Internet self-efficacy and belief about web-based learning. **Teaching and Teacher Education**, v. 27, p. 406-415, 2011.
KERR, M. S.; RYNEARSON, K.; KERR, M. C. Student characteristics for online learning success. **Internet and Higher Education**, v. 9, p. 91-105, 2006.
LEE, S. W. Y.; TSAI, C. C. Students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning. **Computers in Human Behavior**, v. 27, p. 905-914, 2011.
MAOR, D.; FRASER, B. J. An online questionnaire for evaluating students' and teachers' perceptions of constructivist multimedia learning environments. **Research in Science Education**, v. 35, p. 221-244, 2005.
MATEOS, M. **Metacognición y Educación**. Buenos Aires, Argentina: Aique, 2001.
NASCIMENTO, L. M. C. T.; GARCIA, L. A. M. Promovendo o protagonismo juvenil por meio de blogs e outras redes sociais no Ensino de Biologia. **RENOTE - Revista Novas Tecnologias na Educação**, v. 12, n. 1, p. 1-10, 2014.
ONG, C. S.; LAI, J. Y. Gender differences in perceptions and relationships among dominants of e-learning acceptance. **Computers in Human Behavior**, v. 22, p. 816-829, 2006.
PEIXOTO, J.; ARAÚJO, C. H. S. Tecnologia e educação: algumas considerações sobre o discurso pedagógico contemporâneo. **Educação e Sociedade**, v. 33, n. 118, p. 253-268, 2012.
SILVA, A. L. A auto-regulação na aprendizagem: a demarcação de um campo de estudo e de intervenção. In: SILVA, A. L. et al. **Aprendizagem auto-regulada pelo estudante:** perspectivas psicológicas e educacionais. Porto: Porto Editora, 2004. p. 17-39.
SILVA, A. L.; SIMÃO, A. M. V.; SÁ, I. A auto-regulação da aprendizagem: estudos teóricos e empíricos. **Intermeio**, v. 10, n. 19, p. 58-74, 2004.
SPECTOR, P. E. **Summated rating scale construction:** an introduction, quantitative applications in the social sciences. Newbury Park, California: Sage University Paper, 1992.
WON, S. G. L.; EVANS, M. A.; CAREY, C.; SCHNITTKA, C.G. Youth appropriation of social media for collaborative and facilitated design-based learning. **Computers in Human Behavior**, v. 50, p. 385-391, 2015.
ZIMMERMAN, B. J.; MARTINEZ-PONS, M. Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. **Journal of Educational Psychology**, v. 82, n. 1, p. 51-59, 1990.