Diversitas Journal
ISSN 2525-5215
Volume 8, Número 1 (jan./mar. 2023) p.0172– 0181
https://diversitasjournal.com.br/diversitas_journal

Photosynthesis teaching through a pedagogical practice: an essential methodology during blended learning

Ensino da fotossíntese através de uma prática pedagógica: uma metodologia imprescindível durante o ensino híbrido

SANTOS, Valdelice Ferreira dos[1]; SANTOS, Edlânia Nunes dos[2]; OLIVEIRA, Teresa Cristina Gomes[3]; ROCHA, Josefa Eleusa da[4]

(1) 0000-0003-3945-3499; State University of Alagoas (*Universidade Estadual de Alagoas*). Arapiraca, Alagoas (AL), Brazil. Email: valdeliceleticia@gmail.com.
(2) 0000-0003-1090-7944; State University of Alagoas (*Universidade Estadual de Alagoas*). Jaramataia, Alagoas (AL), Brazil. Email: edlaniasanttos8@gmail.com.
(3) 0000-0003-0603-1388; State University of Alagoas (*Universidade Estadual de Alagoas*). Arapiraca, Alagoas (AL), Brazil. Email: teresacristinahs@gmail.com.
(4) 0000-0001-8175-1305; State University of Alagoas (*Universidade Estadual de Alagoas*). Arapiraca, Alagoas (AL), Brazil. Email: eleusa.rocha@uneal.edu.br.

A B S T R A C T

The acquisition of knowledge in contemporary times is in constant change, despite the initiatives to carry out teaching methodologies as educational support. Therefore, the implementation of pedagogical practices by the teachers, stimulates the interaction of students and expands learning opportunities. In this sense, the present study aimed to report an educational practice on the photosynthesis process that was developed in a first-year high school class at the state basic education school in the county of Arapiraca - Alagoas. Thus, the items for the development of the experience were requested from the students, which consisted of transparent glass or plastic containers, sodium bicarbonate, water and vegetable leaves. Thus, on the day of practice, questionnaires were distributed before and after the experiment in order to assess the learning related to the topic addressed. After practice, the necessary observations the effects of photosynthesis on the recipients were realized, as well as the analysis of the results of the pre-test and post-test evaluation. Thus, it was noticed that the experiment proves to be efficient, not only for the understanding of the theory, but also promoted the strengthening of interpersonal bonds, having in a view the return of in-person classes after a long period of social distancing imposed on society due to the pandemic scenario of the new coronavirus.

R E S U M O

A aquisição do conhecimento na contemporaneidade encontra-se em constantes mudanças, apesar das iniciativas em efetuar metodologias didáticas como suporte educacional. Logo, a implementação de práticas pedagógicas por parte dos docentes, estimula a interação dos discentes e expande as oportunidades de aprendizado. Nesse sentido, o presente estudo teve como objetivo, relatar uma prática educacional sobre o processo de fotossíntese que foi desenvolvido em uma turma do 1º ano do Ensino Médio de uma escola estadual de educação básica em Arapiraca - Alagoas. Dessa forma, foram solicitados dos estudantes os itens para o desenvolvimento da experiência que consistiu em recipientes transparentes de vidro ou plástico, bicarbonato de sódio, água e folhas de vegetais. Assim, no dia da prática, foram distribuídos questionários antes e posteriormente ao experimento com o intuito de avaliar o aprendizado referente ao tema abordado. Após a prática, foram feitas as devidas observações dos efeitos da fotossíntese nos recipientes, bem como a análise dos resultados da avaliação pré e pós-teste. Assim, percebeu-se que o experimento se mostrou eficiente, não apenas para a compreensão da teoria, mas promoveu o fortalecimento dos vínculos interpessoais, tendo em vista o retorno às aulas presenciais após um longo período de distanciamento social imposto na sociedade devido ao cenário pandêmico do novo coronavírus.

INFORMAÇÕES DO ARTIGO

Histórico do Artigo:

Submetido: 28/03/2022
Aprovado: 09/10/2022
Publicação: 10/01/2023

Keywords:

Didactic, botany, pandemic.

Palavras-Chave:

Didática, botânica, pandemia.

DOI: 10.48017/dj.v8i1.2306

Introduction

Today, the teaching of biological sciences has become a great challenge for teachers of public institutions, since the structural conditions of schools, the social context of students and the teaching resources available constitute the problem experienced in the educational process. Thus, the teacher is assigned the construction of educational measures that make the school environment more attractive, making use of motivating pedagogical tools that contribute to the educational process and promote good interpersonal relationships (Souza et al., 2016).

In this sense, Santos et al. (2012) highlight traditionalism as a very recurrent teaching method among science teachers during the approach of the subjects that make up Botany, especially in the content of photosynthesis. Therefore, by making use of this form of teaching, students are limited to the ability to create and make decisions, thus generating demotivation and a distancing from the theme with their life context.

For Macedo (2008), the expression photosynthesis represents the "synthesis using light". The beings that perform this process, that is, plants, provide the transformation and storage of energy from sunlight in organic molecules that, in turn, are synthesized by water and carbon dioxide, occurring a release of oxygen gas (O_2). The resulting product of the photosynthetic process (organic molecules) is abundant in energy, which is stored in chemical associations and will later be able to be used to stimulate processes developed by plant cells.

Regarding the return to face-to-face classes, in view of the current global pandemic, Gabriel et al. (2021) point to social distancing as one of the main actions to contain the spread of SARS-Cov-2, resulting in the suspension of face-to-face classes, which caused profound impacts on the Brazilian educational system. Thus, hybrid teaching has been adopted by public schools to continue the school year during the period of global crisis in public health resulting from the pandemic scenario by the action of Covid-19.

Towards of the above, in view of the difficulty of assimilation of the content addressed by the students, as well as the challenges of stabilization of education with the return to classroom classes during the coronavirus pandemic, the objective was with this study to report an educational practice on the photosynthesis process, and which was developed in a class of the 1st year of high school in a state school in Arapiraca - Alagoas.

Theoretical Foundation

The acquisition of knowledge in contemporary times is constantly changing, despite initiatives in making didactic methodologies as educational support. Thus, the teaching and learning process still makes use of theory and memorization as the main way to transmit information. In this sense, the use of educational practices has become a major challenge for the success of the educational process (Carmo et al., 2019).

According to Rossasi and Polinarski (2011), the implementation of pedagogical practices during Biology classes are of great relevance because they allow students direct contact and observation to phenomena, as well as the manipulation of the material used. In addition, such methodologies encourage students to develop critical sense in the face of adverse outcomes, thus promoting learning opportunities.

Therefore, in view of the challenges of addressing certain themes aimed at the study of plants in basic education, Brandão et al. (2021) highlight photosynthesis as a complex content with regard to the method of being taught, because other areas of knowledge such as Chemistry and Physics are needed for a better understanding and learning of such biological process.

According to Marenco et al. (2014), the photosynthesis process is a physiological mechanism where vegetables, some bacteria (cyanobacteria) and algae that present chlorophyll in their constitution synthesize organic compounds such as glucose ($C_6H_{12}O_6$) and oxygen (O_2) from sunlight, water (H_2O) and carbon dioxide (CO_2). The product of this metabolic event supports the basis of the food chain, in which the organic substances produced by green plants are used as a food source for the trophetropy beings.

However, since the beginning of 2020 with the outbreak of the SARS-Cov-2 virus (coronavirus) pandemic, which causes the Covid-19 disease, Brazil, like the other countries, has faced chaos resulting from social isolation, which is a measure to reduce the spread of the virus. Among the norms established by the World Health Organization – WHO (*Organização Mundial da Saúde - OMS*) and welcomed by most countries, they caused the closure of public and private educational institutions by interrupting the model of classroom education, replacing it with online classes (Almeida & Alves, 2020).

In this sense, with the return to the school environment, in view of the importance of didactic methodologies that corroborate with the student education, as well as the requirements arising from the new educational model adapted to the norms arising from the pandemic scenario, the teacher is assigned the use of new methodologies in his didactic experiments. That is, the association of pedagogical models linked to the construction of skills and competencies, where students are encouraged to solve issues, and not only to abstract knowledge (Pessoa et al., 2020).

However, in addition to the organization of the entire schedule and planning for the resumption of the school environment, as well as the way to teach the content of the curriculum, it is necessary to consider the sanitary issues that embody or minimize the risks of contagion of the new coronavirus. Since, according to “Unesco” data, the association responsible for monitoring the effects caused by the pandemic on education, the closure of schools directly harmed about 72% of students worldwide (*Organização das Nações Unidas para a Educação, a Ciência e a Cultura - Unesco*, 2020).

Thus, the World Health Organization (WHO), Unesco and other international agencies recommend some criteria when programming the resumption of face-to-face school activities and alert to indicators such as: contagion rate, availability of clinical beds and Intensive Care Unit (ICU), total new cases and percentage of positive tests that reflect the local and country reality. Therefore, it is essential to protect the entire school community and to reduce the spread of SARS-CoV-2 (Gutiérrez et al., 2021).

Methodological Procedures

The practice was developed by academics of the Degree course in Biological Sciences of the State University of Alagoas (*Universidade Estadual de Alagoas - UNEAL*), scholarship holders of the Pedagogical Residency Program (*Programa Residência Pedagógica - RP*), in a state school located in Arapiraca - AL, in which 45 students of the 1st year of High School participated, which in turn was selected for the study, because it is the class contemplated by the project in which the RP activities are developed.

The methodology applied in the experiment was based on the study by Rodrigues (2019), however, instead of the aquatic plant *Elodea sp*. used by the authors in the practical activity, ornamental plants leaves collected at the school where the experiment was carried out were used.

For carrying out activities, the content on photosynthesis was initially addressed, using as a source the textbook entitled: "*Biologia Moderna*" (Modern Biology), produced by the authors: Amabis and Martho, in 2016.

Sequentially, in order to verify the learning of the proposed content, a semi-structured questionnaire was elaborated and applied to the students, being previously developed to obtain information such as: 1 - What is the cellular organelle in which photosynthesis occurs? 2 - What is the pigment present in cells that allows the occurrence of the photosynthesis process? 3 - What are used by the plant during photosynthesis? 4 - What is produced by plants after photosynthesis? 5 - The photosynthetic process occurs in two phases (light and dark), where each of them occurs?

The material requested for use in practical activity was: a transparent container, which may be a pet bottle or a glass pot; sufficient amount of water to fill the container; leaves of plants collected in the garden of the school in which the activity was developed; and a tablespoon of baking soda for each experiment.

As for the performance of the activity, it was developed in two moments, where the first was with half of the class and the second with the other half, respectively, due to the hybrid teaching model adopted by the state school system that houses 50% of the capacity of each classroom.

Thus, on the day of practice, the room was organized into groups, forming 5 teams with 4 or 5 components and at that time, a representative of each group went to the school garden

to collect the leaves of plants. After collection, they returned to the room and, together with the other components, began the preparation of the experiment.

Then water, bicarbonate and a sufficient amount of leaves were placed in the containers. Soon after, the sample was taken to the external area of the classroom to receive sunlight, and later the changes resulting from the photosynthetic process were observed.

About 30 minutes later, observations were made of the containers, where the effects of the biochemical process were noticed through the bubbles being released by the leaves. After the conclusion of the practice, the post-tests were distributed for the students to answer the proposed questions, and be evaluated in relation to assimilation related to the theme under study.

Results and Discussion

The didactic experience effectively favored, consisting of a relevant strategy for a better understanding of the theory concerning the biological process of photosynthesis in the classroom. Through the proposed practice, the students were contemplated and opportunistized to observe, with the naked eye, effects resulting from plant physiology, as well as becoming critical, participative and interactive during the moments of the activity addressed.

During the pedagogical practice, 45 students participated directly and actively, where each group built the experiment using the requested materials, and later, evaluating the results of their respective works, in addition, there was a strengthening in personal bonds, providing interpersonal relationships.

Regarding the photosynthetic process, it was observed after the exposure of the experiment to the sun, the presence of bubbles in the container (Figure 1) from plant physiology, where after the leaves were submitted to the presence of water, sodium bicarbonate and sunlight, had as by-product the photochemical reaction the release of oxygen (O_2), which was noticeable through the bubbles presents in the leaf area.

Figure 1.

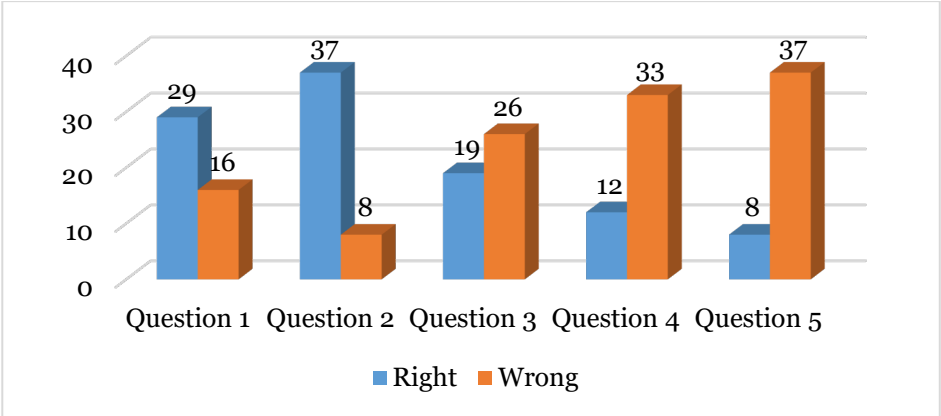
Oxygen release (O_2) in container, after sun exposure.

Source: Author file, 2021.

After analyzing the activities distributed before practice (pre-test), a sharp index of errors on the subject taught was observed (Figure 2) mainly in questions 3, 4 and 5 that address the items used in the process, the resulting product and places where the photosynthesis steps occur. Thus, the complexity of it is emphasized when offered without the use of pedagogical practice as an educational support.

Figure 2.

Results of the activity developed before the experiment.

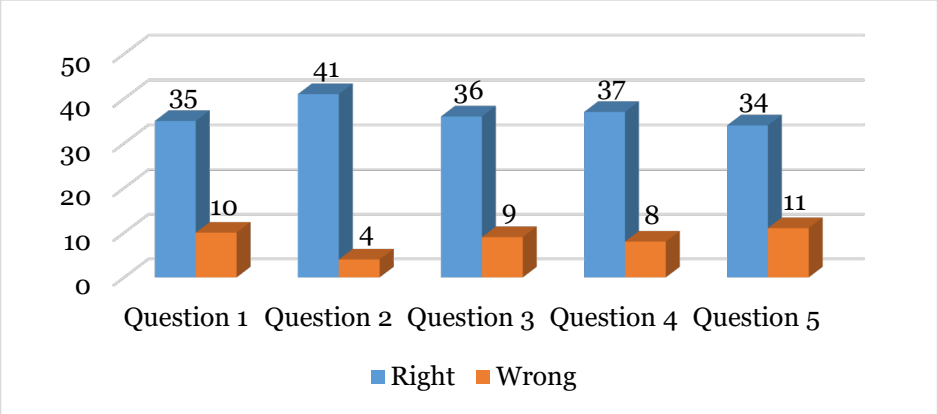


Source: Author file, 2021.

However, based on the data presented in Figure 3, there is a considerable growth in the number of rights in all questions of the proposed activity after the experiment. In this case, it is possible to affirm that the percentage difference between pre-test and post-test questionnaires, as well as the learning index, is relevant and satisfactory, evidencing the importance of such procedures for educational construction.

Figure 3.

Results of the activity developed after the experiment.



Source: Author file, 2021.

In view of the above, based on the data presented regarding the choice of practice as a facilitating method of educational formation, Oliveira et al. (2021) emphasize that the learning process becomes more expressive when students are encouraged to develop activities requested by teachers, engaging in relevant experiments that benefit not only academic growth, but society in general.

In this case, the teacher is the mediator and facilitator of educational training and has in his hands a large number of tools or means that simplify his professional task, and when making use of such methods, not only enriches, but gives meaning to what is taught (Modelski et al., 2018).

Moreover, with the return of face-to-face classes in the hybrid format, it is essential to rethink teaching methodologies, since since the beginning of 2020 the world population has been affected by the Covid-19 pandemic. Thus, the faculty is encouraged to review their concepts and adapt to new paradigms in the educational sphere, improving new possibilities and adapting to new school trends (Almeida et al., 2021).

In this context, considering the relevance of face-to-face activities, the experiment allowed the observation of the photosynthetic process, in which oxygen bubbles were seen inside the container and which is the result of the photochemical stage, also known as the clear phase. Liesenfeld et al. (2015) emphasize the complexity of the theme and should not be taught in only one class, besides, it is necessary to rethink practices on the subject, promoting experiments that enable the dynamic of the occurrence of the chemical stage or dark phase.

Corroborating with Liesenfeld et al. (2015), Brandão et al. (2021) in their study point to Botany, more specifically photosynthesis, with marked challenges during its approach, constituting a complex process for its understanding, because it is an interdisciplinary content that includes other areas of study, such as Chemistry and Physics.

Final Considerations

The methodological strategy developed in the partner institution of the Pedagogical Residency Program (*Programa Residência Pedagógica - RP*) proved relevant for the explanation of the theme addressed, which consists of complex terms and processes to be understood only in the transmission of theory. Therefore, by associating concepts with certain didactic activities, participation, cooperation, observation and debate of ideas between students and teachers are promoted, enabling a more effective assimilation of theory for the construction of the teaching and learning process.

In addition to academic improvement, there was an active participation of students, as well as a strengthening of interpersonal bonds, evidencing the importance of practical activities, especially during the period of return to face-to-face classes in a hybrid way, due to the pandemic scenario faced by the world population since the first half of 2020.

Therefore, the present study revealed that the students presented a deficit when submitted to the evaluation method developed before pedagogical practice, thus evidencing a limited or low understanding of the theme. However, at the moment after the experiment, when asked about the photosynthetic process, a marked growth curve was observed regarding the absorption of knowledge, concluding that the lack of mastery of certain concepts is associated with the methodological forms applied in the classroom.

Thus, it was concluded that the use of teaching practices, especially during the transition from remote teaching in the pandemic period to the return of classes in a hybrid way, was of paramount importance for the acquisition of students' knowledge, in view of the data obtained through the research. Therefore, it is expected that the study developed can contribute to future research and, in addition, help teachers to work on this pedagogical theme during the planning and application of the contents offered in the classroom.

Funding Agency

The present work was developed with the support of the Coordination for the Improvement of Higher Education Personnel in Brazil (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil - CAPES*).

REFERENCES

Almeida, P. R, Jung, H. S., & Silva, L. Q. (2021, 01, 09). Retorno às aulas: entre o ensino presencial e o ensino a distância, novas tendências. *Revista Prâksis*, *3*. 96-112. https://periodicos.feevale.br/seer/index.php/revistapraksis/article/view/2556.

Almeida, B. O., & Alves, L. R. G. (2020, 18, 08). Letramento digital em tempos de COVID-19: uma análise da educação no contexto atual. *Debates em Educação*, *12* (28), 1-18. https://www.seer.ufal.br/index.php/debateseducacao/article/view/10282

Brandão, A. C. L., Fernandes, S. D. C., & Delgado, M. N. (2021, 23, 08). Uso do método de ensino investigativo na abordagem da fotossíntese no Ensino Médio. *Revista eixo*, *10* (2), 37-47. http://revistaeixo.ifb.edu.br/index.php/RevistaEixo/article/view/863

Carmo, E. P. M., Araújo, J. P., Corrëa, M. A., & Leite, D. C. (2019, 02, 06). Oficinas pedagógicas: estratégias para o ensino de educação ambiental em Cametá-PA. *Ciências em Foco*, *12* (1), 14-24. https://econtents.bc.unicamp.br/inpec/index.php/cef/article/view/9886.

Gabriel, N. S., Marçal, G.A., Imbernon, R. A. L., & Pioker-Hara, F. C. (2021, 10, 02). O retorno às aulas no pós-pandemia: estudo de caso e análise comparativa entre o ensino público e o ensino privado. *Terrae Didatica, 17*. e02105-e02105. https://periodicos.sbu.unicamp.br/ojs/index.php/td/article/view/8663375

Gutiérrez, A. C., Périssé, A. R. S., Barbosa, B. P., Santos, C. V. B., Castro, H. A., Pereira, J. D. F., Sampaio, J. B. C., Menezes, L. A., Nehab, M. F., Moura, M. M. D., Ribeiro, P. C., & Ferreira, V. M. (2021). *Recomendações para o planejamento de retorno às atividades escolares presenciais no contexto da pandemia de Covid-19*. Arca. https://www.arca.fiocruz.br/handle/icict/48700

Liesenfeld, V., Aefelli, V. C., Silva, T. M., & Oliveira, J. P. (2015, 07, 02). Fotossíntese: utilização de um modelo didático interativo para o processo de ensino e aprendizagem. *Revista de Ensino de Bioquímica*, *13* (1), 9-26. https://pdfs.semanticscholar.org/f0f1/62b50746c5a2500dde39f19d3292e7a39fc8.pdf

Macedo, A. C. (2008). Descobrindo os processos da fotossíntese: produção de material didático para o ensino fundamental II e médio [Trabalho de conclusão de curso, Universidade Estadual Paulista, Instituto de Biociências de Botucatu-SP]. Repositórios Latinoamericanos. https://repositorio.unesp.br/bitstream/handle/11449/155018/000615054.pdf?sequence=1

Marenco, R. A., Antezana-Vera, S. A., Gouvêa, P. R. S., Camargo, M. A. B., Oliveira, M. F., & Santos, J. K, S. (2014, 01, 12). Fisiologia de espécies florestais da Amazônia: fotossíntese, respiração e relações hídricas. *Revista Ceres*, *61*. 786-799. https://www.scielo.br/j/rceres/a/4sfWXxjswvKYskXpVf57qTn/?format=pdf&lang=pt

Modelski, D., Azeredo, I., & Giraffa, L. (2018, 01, 01). Formação docente, práticas pedagógicas e tecnologias digitais: reflexões ainda necessárias. *Pesquiseduca*, *10* (20), 116-133. https://repositorio.pucrs.br/dspace/bitstream/10923/14546/2/Formacao_docente_praticas_pedagogicas_e_tecnologias_digitais_reflexoes_ainda_necessarias.pdf

Oliveira, M. B., Silva, L. C. T., Canazaro, J. V., Carvalhido, M. L. L., Souza, R. R. C. D., Neto, J. B., Rangel, D. P., & Pelegrini, J. F. M. (2021, 05, 01). O ensino híbrido no Brasil após pandemia do covid-19. *Brazilian Journal of Development*, *7* (1), 918-932. https://www.brazilianjournals.com/index.php/BRJD/article/view/22597/18090

Organização das Nações Unidas para a Educação, Ciência e Cultura. (2020). Disrupção educacional e resposta COVID-19. https://en.unesco.org/covid19/educationresponse.

Pessoa, T. F. S., Santos, E. A. G., & Alves, M. A. (2020, 30, 10). Reflexões sobre as práticas pedagógicas no ensino superior em período de pandemia. *Disciplinarum Scientia: Ciências Humanas*, *21* (2), 119-132. https://periodicos.ufn.edu.br/index.php/disciplinarumCH/article/view/3460/2636

Rodrigues, K. F. S. F., (2019). Investigando a Fotossíntese no Ensino Fundamental [Monografia de Especialização em Educação em Ciências, Universidade Federal de Minas Gerais]. Repositório Institucional da UFMG. https://repositorio.ufmg.br/handle/1843/32718

Rossasi, L. B., & Polinarski, C. A. (2011). Reflexões sobre metodologias para o ensino de biologia: uma perspectiva a partir da prática docente. *Lume*. http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/491-4.pdf

Santos, K. G. S. (2012). Atividade investigativa: uma proposta para o ensino-aprendizagem da fotossíntese [Monografia de Especialização ENCI-UAB do CECIMIG FaE, Universidade Federal

de minas Gerais]. Repositório Institucional da UFMG. https://repositorio.ufmg.br/bitstream/1843/BUOS-9AJK3Z/1/monografia uma proposta para o ensino aprendizagem da fotoss ntese karine grazielle.pdf

Souza, L. M. O., Santos, J. B., Silva, B. S., Costa, M. T. N., & Conceição, E. S. (2016, 20, 05). Protagonismo de pibidianos em atividades extraclasse no ensino fundamental em um colégio de educação básica de Alagoinhas-BA. Anais de congresso nordestino de biólogos, João Pessoa-PB. http://congresso.rebibio.net/congrebio2016/trabalhos/pdf/congrebio2016-et-06-006.pdf