INTERDISCIPLINARY SCICENCE AND ENGLISH CLASS UNDER THE PERSPECTIVE OF ACTIVE METHODOLOGY – A CASE STUDY

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Abstract: While passive learning strategies assume that students will learn just by listening to the information that is transmitted to them by a professor or a teacher, active learning strategies suggest a deeper understanding of a subject. The way children think depends on how they actively interact with the environment that surrounds them in order to build new cognitive structures. Taking this into consideration, Biopark's Science Club, located in Toledo, Paraná, Brazil, is a private initiative that seeks to allow children to discover the world of scientific research and experimentation, instigating their creativity and their ability to work in teams, and presenting their results to Society. The project follows an interdisciplinary approach, including science, robotics, entrepreneurship and English as subjects. English is taught focusing on scientific terms and on building up students' vocabulary, in an interdisciplinary way. Interdisciplinarity combines different subjects and makes students and teachers work in teams, boosting the educational experience, contributing to the development of lifelong learning skills. This case study presents an interdisciplinary experience involving English and science teaching, under the perspective of active methodology, giving an example of experiment that was performed by Biopark's Science Club students. The mentioned experiment consisted in using red cabbage juice as a pH indicator and was performed by a group of fourth and fifth graders. The class content about acids, bases and pH indicators was presented in English. At the end of the class, students were informally asked what they thought about having integrated science and English classes, how important it was for them to study English through a more scientific approach, and if they understood how English and science can be related. It was observed that students were actively engaged in all steps of the class, asked questions and performed the experiment in groups, sharing lab equipment and tasks, working as a team. It can be seen that by working in groups they improve their organization skills, as they need to take their own notes, follow some steps to get to an expected result and share tasks. They also develop respect, tolerance for others and communication skills. Overall, we can say that Biopark's Science Club students understand and have a positive feeling about the integration of science and English during classes. They are aware of the importance of learning and improving their second language skills in order to open their opportunities to show their results not only locally, but in the international community. Working with two or more subjects together help them see the big picture, the real world, where different areas are connected all the time. Besides language skills, they have the opportunity of developing a great number of other skills, such as problem solving, tolerance and respect for others, organization, creativity and self-confidence.

Keywords: Interdisciplinarity; English; Science; Active learning.

INTRODUCTION

While passive learning strategies consist of the assumptions that students will learn just by listening to the information that is transmitted to them by a professor or a teacher, active learning strategies suggest a deeper understanding of a subject, as students are more directly involved with the material (MCKEACHIE, 1999; LUNDAHL, 2008). According to biologist and psychologist Jean Piaget's beliefs, the way children think is not shaped by what adults teach them or by environmental influences, so they have to actively interact with the environment that surrounds them in order to build new cognitive structures, being part of an active construction process (CRAIN, 2014).

Biopark's Science Club, located in Toledo, Paraná, Brazil, is a private initiative that started in 2018, aiming to allow children to discover the world of scientific research and experimentation, encouraging them as young learners and young scientists, instigating their creativity and their ability to work in teams, and presenting their results to Society. The project follows an interdisciplinary approach, including science, robotics, entrepreneurship and English as subjects. As the purpose is completely hands-on, project ideas come from elementary and high school students and are developed by them, making them actively engaged in all the steps that take place during classes. Students and teachers have Portuguese as their fist language, so English is, in this scenario, a second language that focuses on scientific terms and on building up students' vocabulary. As for entrepreneurship classes, they allow students to think about some aspects like what they need to do to transform their projects into products, how to calculate cost-benefit, how to communicate their ideas to the public, and many more.

Interdisciplinarity in the learning process is gaining more popularity over time. According to Jones (2009), the interdisciplinary approach combines different subjects and makes students and teachers work in teams, boosting the educational experience. The benefits that it provides for students contribute to the development of lifelong learning skills that will be critical to their future.

In science teaching, integrating disciplines helps students to understand that, even if subjects present many differences, they are all part of a bigger system and share the same purpose and philosophy (RAMSEY *et al.*, 1997). Integrating science and English in classrooms in Brazil is something that happens mostly in bilingual schools. In this case, coordinating the science curriculum and instructions in English should be fostered to help English Language Learners not only learn the needed academic content, but also improve their proficiency (LEE and BUXTON, 2013). Rich content, high standards, interactive learning, and hands-on real-world experiences are highly recommended by standards for excellence in science and bilingual education, which can succeed through a language-sensitive inquiry science curriculum (HAMPTON; RODRIGUEZ, 2001).

At Biopark's Science Club, teachers from different expertise plan and develop activities together. An example of interdisciplinary class that was performed involved the subjects science and English in a practical activity, in order to use red cabbage juice as pH indicator. Besides focusing on an interdisciplinary approach, classes at Biopark's Science Club focus on, creativity, curiosity, problem solving, teamwork, critical sense, data analysis, among others, in order to attend local, regional and national demands.

MATERIAL AND METHODS

The Students

This activity was developed with students from fourth and fifth grade (8-9 years old), who have classes at the Science Club once a week. They come from different schools – public, private or bilingual, and have very different levels of fluency, considering English. Some of them have been exposed to English as a second language from a very young age, while others have had very little or no contact to English at all. For this reason, English is not taught in a grammatical perspective as it is usually done in regular or language schools. Because the project wants to insert them in the scientific world, and because English fluency opens many doors in scenario, the second language is taught in a more dynamic and specific way.

In the class here described, as well as in all other classes during the year, students sit in groups in which they talk, take notes, perform experiments and discuss results.

Classes in the program

As mentioned above, student have four different disciplines – science, robotics, entrepreneurship and English. In their schedule, science and robotics are the main ones, and entrepreneurship and English integrate the program to support them. Talking about English more specifically, they have two classes a month, being one of them in the science lab, and the other one in the robotics lab. It is important to mention that the English teacher is also graduated in biology, which makes it much easier to work in shared and interdisciplinary projects.

Content

The class content consisted of acids and bases, as well as pH indicators, and was presented in English. In the beginning of the class, students were asked about what they knew about acids and bases. After that, they were shown a pH scale with some daily use items, such as milk, water and soap. Then they did some activities using a printed scale and answering some questions about acids and bases properties.

To check what they remembered, they played a game developed on the website Canva, downloaded as a Microsoft PowerPoint presentation. To play the game, they needed to guess if the item or product was acidic or alkaline. Then, the item or product moved to the correspondent category, so that they could check their guess. The game had also the intention of helping them remember the vocabulary (in English) related to the content, as well as practicing word pronunciation.

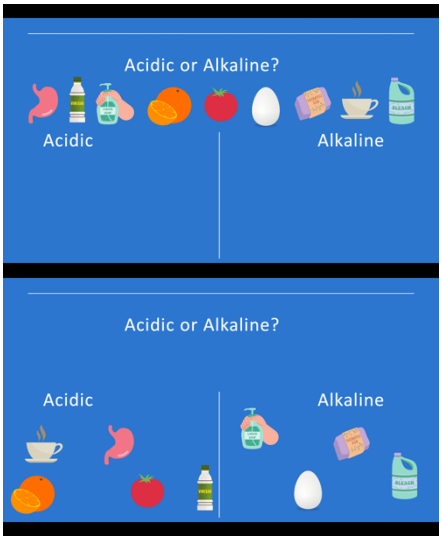

Figure1. Game about acidic and alkaline items/products developed on the website Canva and downloaded as Microsoft PowerPoint file. Source: The authors (2022)

Experiment – Using red cabbage juice as pH indicator

The experiment was performed in groups of three, and the methodology was and adaptation of the one described in Jones *et al.* (2012). For the first part, each group received a mortar and pestle. Then they filled it with 150 g chopped red cabbage and covered it with 400 mL distilled water. After that, they used the pestle to crush the red cabbage and get the extract from it, and then filtered the resulting mixture to separate the juice from the vegetable.

For the second part of the experiment, each group separated and identified 5 test tubes with the following labels: 1) baking soda; 2) washing powder; 3) milk; 4) vinegar and 5) citric acid. Then they filled each test tube with 5 mL of red cabbage extract. Finally, they added the substances according to the label and agitated it.

The last part of the experiment consisted in observing the resulting colors and comparing the regular pH scale to the red cabbage juice scale.

Students' opinions

At the of the class, students were informally asked what they thought about having integrated science and English classes, how important it was for them to study English through a more scientific approach, and if they understood how English and science can be related.

RESULTS AND DISCUSSION

Students were actively engaged in all steps of the class, asked questions and performed the experiment in groups. As instructed before, they shared lab equipment and tasks, working as a team.

As students at the Science Club are always required to work in groups, it can be seen that with time they improve their organization skills, as they need to take their own notes, follow some steps to get to an expected result and share tasks. They also develop respect and tolerance for others, as well as communication skills, as everybody in the groups can participate and give opinions.

Different students come from different social groups, have distinct cultures and have been through several and unique life experiences. Each of them can and should make their own contributions to the class, using all of this diversity in everyone's favor in a way that everybody, including teachers, can learn something from it. For Oliveira (2002), this is the reason why a teacher who acts only as an informer of scientific knowledge is replaced by one who, while keeping in perspective what needs to be taught, also wants to know what students are thinking, interprets their hypothesis, considers their arguments and discusses different interpretations.

Working in groups while integrating English and science is an incredibly rich experience for both students and teachers. Ramsey *et al.* (1997) reported their experience of integrating biology, chemistry and physics at Louisiana Tech University in an interdisciplinary science course saying that both the institution and the students are greatly favored by this experience, as instructors view their disciplines in new perspectives and improve instructional strategies, meanwhile students become aware that science is about questions and not answers, feeling free to question each other.

When studying interdisciplinarity in a team of young learners from the sixth, seventh and eighth grade, Boyer and Bishop (2002) highlighted that students noticed positive changes such as: forming long-term relationships, expressing a sense of belonging; the creation of a democratic learning environment where every student had a voice; tolerance for others, reflecting in personal growth, increased self-confidence, learning from differences and sense of leadership.

The class here described was more about performing an experiment, so that they could better understand basic topics in science. For this reason, they perform experiments related to pH, density, organization of matter and living organisms, solutions and mixtures and many more, to later get to more complex research involving, for example, microbiology, formulations, biological and alternative control, essential oils, and much more. This is very important because during the year they have the opportunity to present their own questions and daily life problems that they would like to solve, and having knowledge about these basic topics makes all the difference, as it facilitates proposing and working on solutions.

When asked what they thought about having integrated science and English classes and the importance of it, they said that: it helps improving vocabulary; it facilitates the comprehension of the second language because they are observing and listing to what they are doing simultaneously; it is important for their future projects; it improves learning and including a new language in their routine and future job market; it is cool because they can test their abilities; it is important because English is really present in their lives. It is clear that they understand that the two disciplines work together and not separately.

In a research program carried out in bilingual elementary schools in El Paso, Texas, where children were learning English as a second language and science through an inquiry approach, Hampton and Rodriguez (2001) found that the inquiry approach helped increasing students' language skills and vocabulary development in both Spanish and English, while also widening their understanding and skills in science.

As stated in Frizzo and Marin (1989), teaching must start from what a child already knows, considering everything that has been learned before, and respecting the level where the child is now.

CONCLUSION

Overall, we can say that Biopark's Science Club students understand and have a positive feeling about the integration of science and English during classes. They are aware of the importance of learning and improving their second language skills in order to open their opportunities to show their results not only locally, but in the international community. Working with two or more subjects together help them see the big picture, the real world, where different areas are connected all the time.

Working in groups allows them to develop several skills such as problem solving, tolerance and respect for others, organization, creativity, self-confidence and many more. It is also a great chance to use diversity in their favor, in a way that everybody in class has something to learn.

All of these is only achieved when it makes sense for the students, which justifies the need of having them making their questions, trying to find solutions for daily life problems, being protagonists in their learning process.

ACKNOWLEDGMENT

We thank Biopark Educação and its Science Club for the opportunity to work at such a dynamic and diverse environment and for providing us all the resources we need. We also thank our team and our students who are always helpful and supportive.

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