



Science and English Integrated Learning Project: a way to enrich high school students' critical thinking and communication skills

Projeto integrado de ciências e inglês: uma forma de enriquecer as habilidades dos alunos de ensino médio

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ABSTRACT

The purpose of this chapter is to present a project that integrates Science and SDGs discussions in English, aiming to help students to develop their critical thinking skills and argumentation, while also providing them the opportunity to practice English and interact with people from various backgrounds. The authors present the importance of English as a universal language, especially in the scientific field; the experience of the program through the teaching assistants' point of view, the integration of the 17 United Nations' Sustainable Development Goals and its importance as a discussion topic, and the use of Information Communications Technologies as a tool for teachers.

Keywords: report. science education. english as a second language. SDGS, technology in the classroom.

RESUMO

O objetivo deste capítulo é apresentar um projeto que integra ciências e Objetivos do Desenvolvimento Sustentável em inglês, buscando auxiliar estudantes no desenvolvimento de habilidades de pensamento crítico e argumentação, ao mesmo tempo que promove a oportunidade de praticar a língua inglesa e interagir com pessoas de culturas e experiências de vida diversas. Os autores apresentam a importância da língua inglesa como meio de comunicação universal, especificamente no campo científico; a experiência do programa pelo olhar dos professores assistentes, a integração dos 17 Objetivos do Desenvolvimento Sustentável das Nações Unidas como tópico de discussão com os alunos; e o uso de tecnologias da informação e comunicação como ferramenta para a educação.

Palavras-chave: relato de experiência. educação em ciências. inglês como segunda língua. ODS, tecnologia na sala de aula.

INTRODUCTION

Intercultural communication helps to build bridges between individuals and communities of different cultural backgrounds and promotes understanding, respect, and cooperation among them.

Thus, being able to understand different cultural aspects and points of view can promote problem-solving skills and it can increase knowledge, creativity, and innovation by bringing together different perspectives and ideas. In a globalized world, effective intercultural communication skills are increasingly necessary for success in both personal and professional contexts.

Thinking about this scenario, the authors of this chapter, international researchers at a Japanese university, participated as teacher assistants in a science program that aimed to help Japanese high school students develop their English skills through science discussions.

In this Science program, Japanese students had weekly meetings with the authors of

these chapters, among other international researchers from the same university, and could debate different topics that are popular nowadays in the Science field, such as global warming, SDGs and pandemics. The meetings were held online, using the Google Meets application, and each meeting had from 15 minutes to 30 minutes of duration.

This chapter will share the experiences, ponder the educational practices that were performed, and discuss skills that could be developed throughout this program.

DISCUSSION

English as Mean of Instruction

The widespread use of English as a lingua franca, or a common language for communication between people who do not share a native language, can be traced back to the British Empire. In the 19th and early 20th centuries, the British Empire was one of the largest and most powerful empires in the world, with colonies and territories spanning across Asia, Africa, and the Americas. As a result of Britain's global reach, the English language became widely used as a means of communication between people from different parts of the world. Additionally, the rise of the United States as a global superpower in the 20th century further solidified the status of English as a lingua franca.

Although nowadays the scenario is not the same, the widespread use of English in international communication, has made English the dominant language of international business, science, and diplomacy, so English as lingua franca is still very powerful, and those who can share their thoughts in English are able to communicate with more people from different background, as it is the language most people go for, when learning a second language.

Having English as mean of instruction for the Science project brings several benefits, such as improved language skills, broadening of vocabulary, grammar practice and speaking skills. It also can better prepare the students for a globalized world. Since Science is an international field, by using the English language, students have access to a wider range of resources and literature, including scientific journals, books, and websites.

Overall, having the Science program performed in English can provide students with the skills and knowledge they need to succeed in a rapidly changing world.

An Overview of the Science Program

Since the main objective of the program is to motivate students to pursue Science related fields, scientific thinking is high on the agenda. Scientific thinking skills can be defined as the principles of scientific inquiry (observation, hypothesis, data collection, analysis, conclusion) to solve a problem through reasoning activities (Kuhn, 2002). Reasoning activities, such as discussions, have been shown to improve scientific thinking skills (Murphy, 2017).

Besides practicing communication skills, students also had discussions that aimed to train their scientific thinking explicitly and implicitly, in a two-way communication, with the teacher assistant as a partner who encouraged students to convey ideas and ask questions

actively. Through discussion, students are not only guided to convey ideas in verbal form, but also to perform scientific reasoning skills. The teacher assistant supports the student as a discussion partner and explores the logical reasons for each answer, such as by asking students to provide examples or analogies to explain their ideas or answers. In addition, having participated in many previous discussion sessions, students can use new science-related vocabulary in expressing opinions logically. The teacher assistant also encourages students to ask questions and to dig deeper into the topic or issue being discussed.

Teaching Report by the Authors

The specific topics covered in each meeting are predetermined by the program supervisor. Teacher assistants can adapt the topics to their students' interests and English language skills, but in the authors' case, the topics followed the initial design. This is because although some of the topics are related to actual and high-level issues, in the practice of the conversation sessions, the depth and breadth of the topics discussed can be adjusted to the students' insights.

The depth of discussion topics increased with the sequence of meetings. In the early meetings, the topics discussed were mostly about students' own experiences and thoughts. Students and teacher assistants discussed personal information, educational background, school and family, and personal motivations for them to study and conduct research in the future.

There were also meetings in which the topics discussed were more specific, especially related to issues that affect current society. This was done to understand how deep the knowledge of students is about environmental issues and to encourage students to criticize what is happening, according to their capacity. Students were challenged to explain their understanding, analyze the good or bad effects of a phenomenon, and to provide possible solutions that they can propose.

In a meeting that discussed climate change, students were not only challenged to explain the causes, processes, and impacts on nature and humans, but also to provide reasonable proposals for the problem, especially for the area where they live. Unlike the topics in the earlier meetings, this topic required a more specific collection of science terms, in addition to an in-depth analysis of human activities and the chemical processes that go along with them, to create a solution to the climate change they were already feeling.

There was also discussion about epidemics and pandemics. Students have been asked to study the topic prior to the session, so they had some idea of the causes, processes, impacts and solutions. Although students were unsure about the causes of the virus and the chronology of its spread, they tried to explain the process of the virus spreading between humans. Some students explained the importance of vaccines, from a biological point of view.

The issue of renewable energy was also discussed in the meetings. Students are required to be sensitive to environmental conditions related to the use of fossil and conventional fuels. By being challenged to explain the importance of finding and using renewable energy that is environmentally friendly, they put forward reasons and supporting evidence related to the unfriendliness of fossil fuels, making correlations to climate change that had been discussed in

the previous meeting. In addition, some students also presented their views on the potential of renewable energy that can be implemented in their region, with scientific evidence.

Since the students also come from a wide variety of majors and research interests, the conversation sessions covered not only natural science, but also social and humanities topics, such as SDGs. The goals covered were no. 16, which is global peace and justice, and no. 17, about partnership for the goals to be achieved.

Students who had studied SDGs before the sessions, and when discussing no. 16, they explained how far they understood the topic. Some students were able to explain the conditions of today's society that demand the importance of justice for all and each one gave an opinion on how far justice has occurred around them. Some of the students even expressed their hopes and specific steps to be taken to promote these values of peace and justice, if they become leaders in the future.

As for the topic of SDGs no 17, discussion was interesting because after students understood the meaning of partnerships, they were challenged to provide similar examples that they had experienced. Students were also asked to elaborate opinions on the quality of partnerships established between Japan and other parties. Some students even made suggestions on how to establish unique partnerships in the future.

For the last meeting, the discussion turned more towards the students' specific plans for their research. Although in the earlier meetings, research had been briefly discussed, at this meeting students were required to have a specific timeline for their work plan for future research. As a discussion partner, the teacher assistant also provided comments and views on the future plans made by the students.

At the end of the program, all students gave positive responses and comments on the significant changes they felt from this conversation session. There were comments, made by the students, that they were getting used to quickly formulating arguments for each opinion, and that the scientific and logical reasoning in English became stronger. Some other students who were preparing for the presentation of their research results also felt more confident and were excited to provide logical explanations in their presentation design.

Integrating SDGs as Content

Based on the need for collaboration between countries to promote the sustainable development of humanity, the United Nations General Assembly created, as part of the Post-2015 Development Agenda, 17 goals or objectives for global sustainable development (SDG's) (Griggs *et al.*, 2017). The goals are, respectively: 1) no poverty, 2) zero hunger, 3) good health and well-being, 4) quality education, 5) gender equality, 6) clean water and sanitation, 7) affordable and clean energy, 8) decent work and economic growth, 9) industry, innovation and infrastructure, 10) reduced inequalities, 11) sustainable cities and communities, 12) responsible consumption and production, 13) climate action, 14) life below water, 15) life on land, 16) peace, justice and strong institutions and finally 17) partnerships for the goals.

One of the main instruments for implementing the SDGs at a global level is the involvement of students in the formulation of solutions that can meet the problems presented in the 17 previously mentioned UN goals. It is important that students, from the most elementary

levels of education to university, are involved in this process (Chaleta *et al.*, 2021).

From this perspective, several governments have adapted their educational systems in order to include the teaching and discussion of SDGs in the school curriculum. Considering the countries of the teacher assistants, in Brazil, according to Motta e Moreira (2021), The SDG's, have been implemented in the Brazilian National Common Core Curriculum (BNCC), in particular the goals that have to do with promoting quality education. In Indonesia and Costa Rica, SDGs are encouraged to be discussed by the teachers throughout the Science curricula.

In Japan recently there has also been an effort to make SDG discussions part of the students' curriculum, both as part of the mandatory activities as well as a complementary part of the various extracurricular activities that are included in the Japanese educational process (Morita; Okitasari & Masuda, 2020). In order to accomplish these goals, several educational institutions, from primary schools to universities, have encouraged their students to develop projects that work on the different aspects of the 17 United Nations Sustainable Development Goals. Within this context, the University of Chiba has promoted for the past 3 years an integrated project to teach Science and English to Japanese high school students with the aim of training the new generation of Japanese researchers. In order to achieve this objective, the project aims to promote students' critical thinking from two perspectives. First, promoting scientific debate within the possibilities and repertoire available to high school students. Second, these discussions are mostly in English, in order to challenge these students to communicate in the language that is mostly used in the scientific community, even if it is challenging for them.

Topics discussed in English during this program developed and implemented by the University of Chiba in Japan, comprised the following topics covered by the SDGs: Discussions on climate change; Discussions about pandemics throughout history; Discussions on sustainable energy sources; Global Peace and Justice and Multinational Partnerships.

In line with the goal no. 13 set by the UN, during this program, Japanese high school students reflected on the role they can play in raising awareness of climate change. Students were encouraged to think about the current situation of the environment and how human beings have contributed to the acceleration of climate change. It was interesting to note the solutions proposed by the students to deal with this problem on a personal level. Most students suggested the most common solutions, such as reducing the use of electricity, separating and recycling waste, among others. On the other hand, some students were surprised to learn that Japan is the 5th largest emitter of greenhouse gasses. Apparently, many of them haven't been paying attention to the absurd amount of plastic used to pack things that don't necessarily need plastic, or even the factories that dot the Japanese urban landscape.

Another theme discussed during this program and which is also part of the 17 goals established by the UN are multinational partnerships. Students were encouraged to think about the importance of cooperation between different countries to promote development and overcome different problems. They were especially motivated to think about how Japan can contribute to the development of countries located on the economic periphery of the planet. Most students suggested that direct cash contributions or humanitarian aid are the best forms of help, but others also suggested that alternative forms of assistance such as teaching a foreign language, or even technology transfer could be an important tool. to achieve that goal.

In addition to the topics mentioned, these students discussed several other subjects. However, probably the most transformative experience for these students was being able to have these discussions in English. For most Japanese students, interacting with foreigners is not a common occurrence. If these students come from schools and communities in the countryside of Japan, this becomes even more difficult. Thus, it can be seen that integrating the practice of English as a universal language associated with discussions on current issues was, in a way, a transforming experience for both students and tutors in this program.

ICT as a medium of instruction

The digitalization of education, associated with the intensive integration of Information and Communication Technology (ICT) due to the pandemic, has led to the emergence of a need to develop trans professional competences of schoolteachers so that students can properly achieve their learning expectations as well as a higher technological and scientific literacy rate. (Yurinova *et al.*, 2022). For this reason, the incorporation of ICT in any learning experience must occur gradually and efficiently, so that teachers and students can learn the necessary skills to make efficient use of these technologies.

Nowadays, ICTs are widely used in education to enhance teaching and learning processes. It provides access to vast amounts of information, enables communication and collaboration, and supports the creation and sharing of educational content. Some specific ways ICT is used in science education include allowing students to perform virtual experiments, simulations, and data analysis in a safe and controlled environment, providing access to a wealth of science-related information, multimedia resources, and educational videos and enabling students to collaborate on projects, share ideas, and engage in online discussions about science-related topics.

During the development of this program, it was possible to engage into distance learning activities by using ICTs that allowed live interactions between the teachers and the students. Usually, teachers will use Google Meet to provide a short overview of the Science topics designated, as well as other audiovisual resources such as videos or images to support the discussion or engage the students into a more active learning experience. The potential for broadband video conferencing for distance education lies in how it empowers students by increasing the flexibility of learning situations so that students can choose to participate in real time, archived or face to face activities as their needs and finances allow.

Sometimes in formal education environments such as schools or universities, there are few opportunities to organize and decide the pace of the learning activities. While it might seem irrelevant as it is not necessarily an aspect that is taught in class, being able to manage time effectively can be a determinant factor of the students' performance. According to Wilson *et al.* (2021), students that had had some time management training experience, failed fewer subjects and rated better at short-term planning. These students manage to improve their performance, and this allowed them to have a better transition into university as they were able to adapt and organize their daily life activities more efficiently.

Also, another benefit of using video conferencing as a teaching medium implies engaging remote students more fully and intellectually in their learning by combining videoconferencing with traditional learning activities and other ICT resources despite their

geographical location or cultural background (Öztürk & Tuncer, 2021). The use of ICT in bilingual educational environments is particularly important because real-time communication and interaction are fundamental for an effective acquisition of language as well as a good understanding of the contents studied. From this perspective, Google Meet not only mediates real-time communication and interaction between the teacher and the students, but it can also support collaborative learning in science which could lead to more meaningful learning experiences.

After their introductory sessions, which consisted of at least three different science topics (world pandemics, global warming, renewable sources of energy), students were able to select a topic they would like to research about and proceeded to develop their research presentation using Google Slides or PowerPoint. Research in science plays a crucial role in advancing our understanding of the world and improving our technology and way of life. It helps to generate new ideas, test hypotheses, and validate or refute existing theories. When students start investigating, this might also help to identify problems and find solutions, leading to the development of new products, treatments, and technologies in the future. It also allows students to make informed decisions based on evidence and advance society's knowledge base.

When technology is efficiently incorporated in learning activities, students are expected to be more interested in studying science. ICTs can provide different opportunities to make learning more fun and enjoyable, especially when in traditional lecture environments it might be difficult to encourage more active participation. (Henderson, 2020).

As mentioned before, one of the main goals of this program was to promote a better understanding of scientific concepts as well as the role that research plays in scientific progress and new discoveries. Students who are engaged and interested in things they are studying, are expected to have better knowledge retention and in this case, most of the students showed their willingness to participate and improve their learning capacities.

The students who were part of this program not only learned scientific thinking skills by discussing science-related topics but were also able to learn how to manage their time effectively and reinforce their English language skills. This is one of the great contributions of the program to the students and by incorporating ICT as a medium of instruction, the students also had the opportunity to become familiar with these tools and their use within the learning activities.

FINAL CONSIDERATIONS

It is possible to understand why science discussion in high school should be encouraged. Only through practice students can develop skills necessary for critical thinking, and being able to do so in an environment which allows them to communicate in English can enrich also their communication skills in a foreign language.

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