

MOTIVATING DENTISTRY STUDENTS: A BIOFILM PROJECT TO FOSTER ENGAGEMENT AND INTERDISCIPLINARY LEARNING

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Abstract

Within the framework of the Teaching Innovation Strategies promoted at Universidad San Pablo-CEU, the BioFilm project has been developed in School of Medicine for first-year students enrolled in the Dentistry degree, which is offered to students from all nationalities in two languages: Spanish and English. Some dentistry students do not consider the application of basic science subjects “on real world” or their future profession, making learning process overwhelming. Within the School of Medicine, dentistry students take the subjects of Biology (1st semester), Genetics and Biochemistry and Physiology (2nd semester). To address the need to boost student motivation in these subjects, the BioFilm project was developed. This is a single project that spans various subjects across two semesters, with different student work submissions. The project involved 150 students and was mentored by 9 supervisors, also lecturers on the subjects, from two different departments and schools: Department of Chemistry and Biochemistry (School of Pharmacy) and the Department of Basic Medical Sciences (School of Medicine). To increase engagement and motivation, a transversal and multidisciplinary Project based learning approach was developed. Students were asked to present informative videos on chosen topics that cover all subjects involved in the learning project, thereby deepening the learning process. Using Information Communication Technology (ICT) tools, students were challenged and their willingness to engage in the work improves, as they are very familiar with these short videos in their spare time. Through the evaluation of these videos, it is determined whether the students have successfully integrated the knowledge acquired from the different subjects. Additionally, the project promoted a transversal and horizontal learning experience, ensuring that students develop a comprehensive understanding of different subjects. This method fosters project management, teamwork, critical thinking and the ability to communicate complex concepts effectively. In conclusion, the Biofilm project enhances the learning experience of the first-year student at Universidad San Pablo-CEU by facilitating interdisciplinary courses coupled with the integration of ICT tools as well as sharpening critical analysis, problem-solving, and communication skills. Creating didactic videos has twofold benefits in the context of the project, as it guarantees comprehension of the content and teaches the students how to use the acquired knowledge in their future profession. Such an innovative method of teaching and learning is believed to increase student’s interest and participation in academic work which will raise overall achievement as well as enhance the quality of educational experience.

Keywords: *Project based learning, transversality, integration, dentistry, ICT tools.*

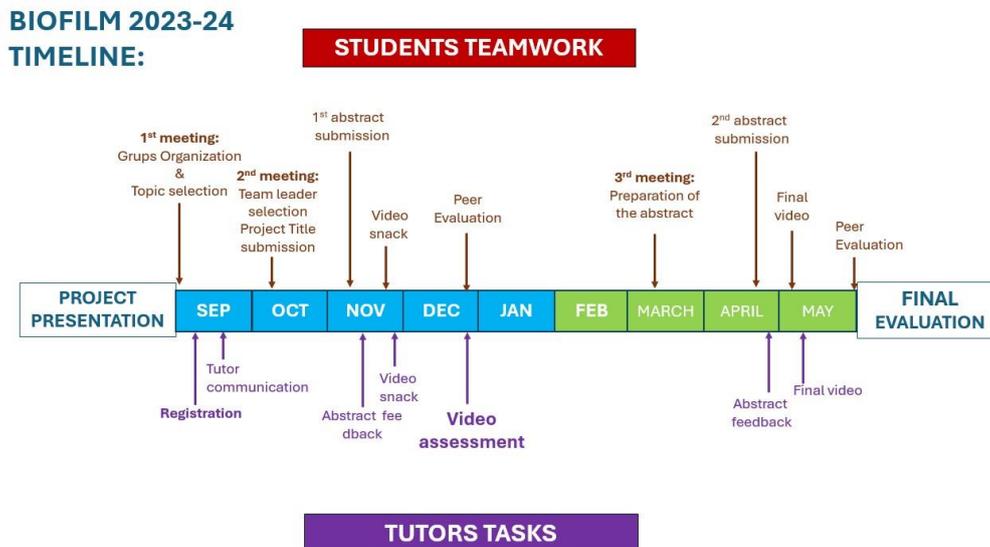
1. Introduction

Teaching basic sciences to first-year dentistry students is challenging due to the clinical profile of the class. Traditionally, their curricula have been structured in isolated subjects, compromising the opportunity to integrate the acquired concepts across diverse basic and clinical subjects. Furthermore, dentistry students often fail to see the application of these subjects to their future profession and struggle to integrate the syllabi, making the learning process overwhelming. Thus, the learning process hinders their ability to grasp essential topics across the integration of different fields of study that are essential to understanding biological systems (Nehm, 2019).

This scenario was identified by the lecturers of Biology (1st semester), Genetics and Biochemistry, and Physiology (2nd semester), three basic subjects often perceived as heavily memorization-based, with

new and complex concepts that intimidate and disengage students. As Science, Technology, Engineering, and Mathematics (STEM) educators are often challenged and encouraged to refine their curricula to offer a balance between acquiring knowledge and its application to real-world contexts (Freeman et al., 2014), the Biofilm project, based on Project-Based Learning (PBL) strategies, was designed and tested in a pilot course during the academic year 2023/2024.

Figure 1. Project Biofilm timeline and key milestones of student tasks (top) and faculty tasks (bottom).



In this context, PBL engages students in a problem-solving scenario, promoting self-directed learning, the application of knowledge in practical settings, students' autonomy, capacity for communication and teamwork, and higher-order thinking skills (Freeman et al., 2014). It also creates a dynamic learning environment where students actively participate, learn from diverse perspectives and knowledge areas, and build transferable skills (Pranjol, Oprandi, and Watson, 2024). As this strategy not only promotes knowledge acquisition but also enhances communication, it would create a robust framework for effective and inclusive education given the multicultural origins of the CEU San Pablo University students. Thus, to ensure the integration of the acquired knowledge in the three previously mentioned subjects, first-year dentistry students were organized into work groups and selected a topic previously proposed by the lecturers. Throughout the academic year, they were encouraged to submit two videos, one per semester, in which they condense and integrate the knowledge from the different subjects in an engaging and informative manner.

2. Objectives

- Creating an innovative strategy to increase students' interest and motivation in the 3 subjects involved.
- Integrating the concepts acquired over the two semesters, promoting interdisciplinary learning.
- Using information and communication technologies in the presentation of PBL results.
- Facilitating the development of other competencies such as teamwork, critical thinking, and the transmission of complex concepts, skills necessary for their future professional careers.

3. Methods

3.1. Participants

The project involved 150 first-year students from the Dentistry degree, which is offered to students from all nationalities in two languages: Spanish and English. 72.47% were female, and the average age was 18-20 years old. The students were organized into working groups of 5-6 members. Nine professors supervised the groups, assuming responsibility for the subjects of Biology (1st semester), Genetics and Biochemistry, and Physiology (2nd semester). The project Biofilm was approved by the Ethics committee of the University San Pablo CEU with the reference 776/23/96.

3.2. Group distribution and topic assignment

Students freely selected their groups and the topic to work on from 10 predefined topics established by the instructors considering the common aspects of their syllabi. The topics were assigned at the beginning of the course to ensure proper organization of the work and encompassed transversal aspects across the subjects involved, such as renal physiology, glucose metabolism, and cholesterol synthesis, among others. After the distribution of groups and topics, a tutor was assigned to each group to monitor the progress of the work (Figure 1).

3.3. Video creation

During the first semester, students worked on creating a short one-minute video or “snack”, focused on the biological perspective of the assigned topic. In the second semester, they developed a second video lasting 3 minutes, integrating content from the subjects of Genetics, Biochemistry, and Physiology along with the knowledge acquired in the previous semester. In both semesters, students submitted a preliminary script for their videos and participated in tutoring sessions that provided guidance and support to enhance their work.

3.4. Use of technological tools

The TEAMS platform was utilized as a virtual space to coordinate the project, enabling the submission of videos, script summaries, and tutoring sessions. Through this platform, professors continuously monitored and supervised students' progress. For video production, students chose the tools they considered most suitable, enhancing the diversity of approaches and outcomes.

3.5. Evaluation

The project assessment was built on three main components. First, the preliminary scripts for the videos were evaluated, accounting for 5% of the total grade. Second, a peer evaluation was conducted, which contributed 15% to the final grade. In this evaluation, students assessed the videos produced by other groups using the same rubric that was later used by the professors. Additionally, each student evaluated their own group members and performed a self-assessment, both also based on the same rubric. Lastly, professors applied the same rubric to evaluate the final products, considering aspects such as originality, integration of subject content, ability to synthesize information, teamwork, and the formal quality of the presentation (80%). This project grade weighed 5% of the final grade in the three subjects.

3.6. Satisfaction surveys

At the end of the academic year, students were invited to share their impressions through an anonymous satisfaction survey that included multiple-choice questions selecting the statement they most identified with on a scale from 0 "strongly disagree" to 5 "Strongly agree" (Likert scale).

4. Results

Of the 150 participants involved in the Biofilm teaching innovation project during the 2023 pilot course, 43.33% completed the final satisfaction survey. Overall, the results reflected the students' satisfaction with the project, where on average, students rated their satisfaction level at 7.6, and 83.07% would recommend it to other classmates (Figure 2).

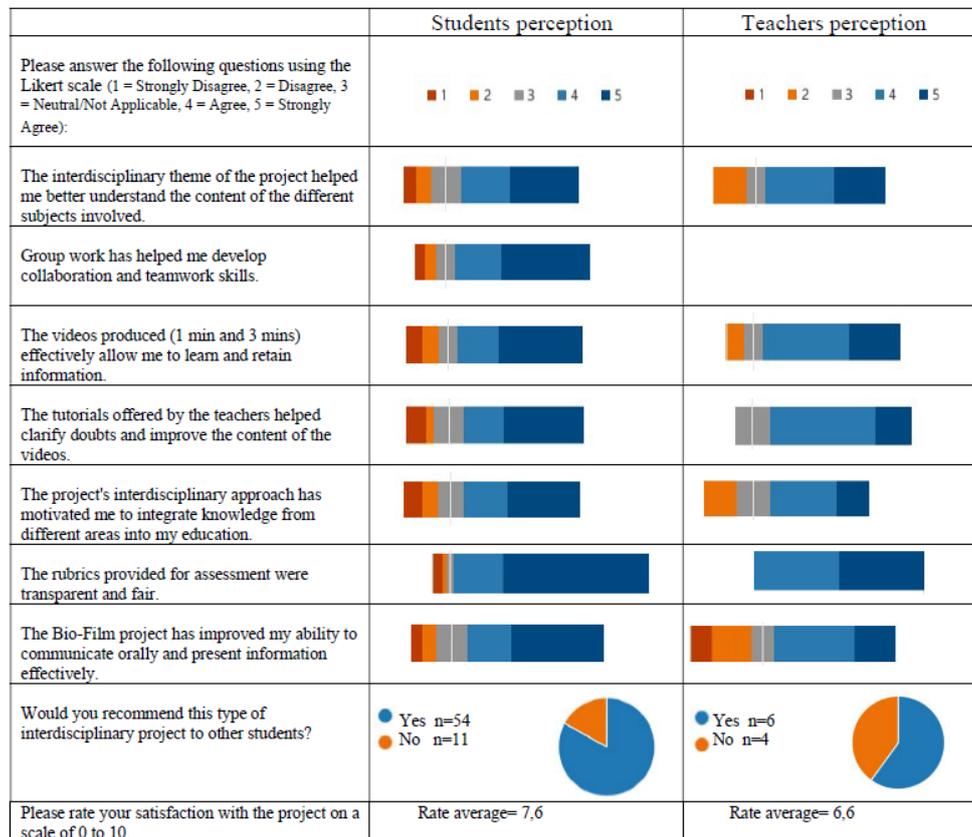
Most of the students consulted agreed or strongly agreed with the following questions about the development of the Project: When asked whether the interdisciplinary approach to biofilm has been effective in integrating the contents of the different subjects, if teamwork has helped me develop collaborative skills, if the videos made help me better understand the topic, if the tutorials offered were useful in clarifying my doubts and completing the work if the interdisciplinary approach has motivated me to integrate knowledge from different areas, if the rubrics provided for the evaluation were fair and clear and if the project has improved my ability to communicate orally and present information from different subjects. The perception of the teachers regarding these questions except (Teamwork question) was similar. For the teachers it was clear or very clear that the rubrics were clear and fair. However, when asked about the usefulness of the project, teachers from 0 to 10 rated it 6.6, one point less than the students' rating.

5. Discussion

This article presents the implantation and results of a transversal PBL that encompassed three basic subjects (Biology, Physiology and Genetics and Biochemistry) of 1st year of dentistry, which until now have always generated rejection and little motivation among the students. As PBL is not systematically integrated as a teaching method in higher education, usually focused on a lectured format, it often relies on

teachers its implementation and integration (Freeman et al. 2014; Shpeizer, 2019). Lecturers were responsible for designing and planning the different deliverables, assigning the tutors based on their area of knowledge for each topic, developing the rubrics, and selecting the format for the project presentation.

Figure 2. Students' and teachers' perception in their learning and teaching experience during Biofilm project. Evaluation data were collected anonymously in Google Forms surveys at the end of the project.



In this pilot test, freshmen students were encouraged to freely form groups and choose the topic of the PBL during the first week of classes. These randomized assignments follow the suggestions by Burgess et al. (2020), where randomized group formation ensure a diverse background of students with different knowledge levels. This activity has created an ideal environment for first-year students to meet and allowed their quick integration into university life. Video creation in educational settings has demonstrated significant benefits in enhancing student learning and integrating various subjects. Thus, students not only consolidate their knowledge through the process of scripting, filming, and editing but also develop critical thinking and technical skills. This hands-on approach fosters a deeper understanding of the material, encourages creativity, and provides a platform for collaboration among peers. Moreover, the skills acquired such as digital literacy, storytelling, and project management, are invaluable assets that can aid students in their future academic and professional endeavors (Rasi & Poikela, 2016).

In recognition of the students' effort creating the Snack and final video throughout the semesters, their results were included in their final grade in each subject. This grade was based on both the professors' assessments and the students' evaluations through a peer review process, as well as the grades assigned among group members. While incorporating students' evaluations of their peers' PBLs into the overall grade can sometimes lack objectivity (such as potential conflicts arising from group work, lack of criteria for evaluation, and low engagement in reviewing videos), it can also encourage them to develop professional behaviour and actively participate in the project. Moreover, peer evaluations provided valuable feedback on team cohesion and the perception of actual productivity (Burgess et al. 2020).

The learning strategies adopted by the students not only involve their participation in a PBL making a commitment to their peers in the working group but also imply a change in dynamics with an increased workload that generates discontent and dropout among the students. In general, they prefer passive learning over the active despite the benefits of the latter (Taglieri et al. 2017). Nonetheless, the results of the satisfaction survey conducted at the end of the course reflected a high acceptance of the Biofilm project among the students, with 83.07% recommending it. There was a high proportion of "agree" and "strongly agree" responses to questions related to the improvement of integration, communication, and

teamwork skills (Fig. 2). This result aligns with those obtained by McInerley & Fink (2003), where after implementing Team-Based Learning (TBL), 81% of the surveyed students rated the project positively, stating that it not only benefited their learning but also the development of critical thinking, integration of concepts, and improved problem-solving efficiency. Despite this, the professors' perception of concept integration and their overall satisfaction was slightly lower. In this line, to ensure students learning, and develop additional tools for their future professional careers, several modifications have been made to Biofilm project in the present course 2024-2025. These include the introduction of three mandatory and assessable tutorials in the first semester and one in the second. Instead of the snack in the first semester, students will now present a three-slide overview of their project. The final video will be limited to 4 minutes, and Blackboard will be used as the communication platform. The increase in tutorials and the initial presentation aim to enhance students' supervision and ensure thorough integration of concepts across different subjects. Switching to Blackboard will facilitate communication, as it is the university's standard tool, whereas TEAMS caused issues due to students' unfamiliarity with it.

6. Conclusions

In the evaluation of the final product, which is the integrative video, the use of communication and video generation ICTs is emphasized. The assessment detects the ability to integrate knowledge, project management, teamwork and communication skills, including the correct use of oral and written language. Additionally, group work skills are promoted, which, in most cases, result in successful collaboration."

The motivation of the students, one of our primary objectives, is reflected in the results obtained from the perception survey, in which the majority would recommend this type of projects and perceive that it has helped them understand the different subjects that comprise the project. The correct coordination between professors and students is considered necessary for the success of the project. The use of communication platforms such as TEAMS and Blackboard has been crucial for the effective coordination of the faculty, both in the design of the project and subsequently during its implementation among professors and students.

The implementation of the pilot project in the past academic year (2023 -2024) has allowed us to make improvements, the most significant are the guidance provided by the tutor through three mandatory professor-student meeting sessions and making slight adjustments to the format of the first work submission.

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