Abstract

Open and dynamic inquiry-based teaching is an important educational tool for developing critical thinking, scientific literacy, and autonomous research skills among high school students. In the high school biology curriculum, open and dynamic inquiry is manifested in a project called "BioHeker" (Bio-Inquiry), which is a practical assignment used for alternative assessment, comprising 30% of the school evaluation in Biology. This is a writing project on a biological topic that includes a field study and is based on an open inquiry in which the student works autonomously, decides on inquiry tools, plans, and executes all stages of the inquiry process. In this process, the teacher accompanies the student, providing guidance and the necessary framework for the students' learning processes.

In addition to the teachers and the students, there is another relevant educational factor in the school learning environment, related to open inquiry in the biology field: the lab technician, who is a professional employed by educational institutions. The lab technician's role includes full responsibility for operating the lab, including aspects such as ordering equipment and materials, maintaining lab cleanliness, and ensuring safety procedures. The lab technician plays a central role in the BioHeker project by assisting teachers and students in conducting experiments in the lab. Despite the central role and importance of the lab technician in open and dynamic inquiry, no studies have yet examined the collaboration between biology teachers and lab technicians, in teaching open and dynamic inquiry in biology, and the impact of this collaboration on various aspects related to open and dynamic inquiry, or on how these collaborations can promote and enhance students' skills and abilities.

Therefore, the aim of the current study was to characterize the attitudes of lab technicians and biology teachers regarding the characteristics of team-work between them, and their perceptions about open and dynamic inquiry during the inquiry process.

Three research questions were drafted, each one is slightly different and tailored to the quantitative and qualitative paradigms. The first question addressed the attitudes of the lab technicians and the biology teachers toward teamwork. The second question focused on the perceptions of the technicians and the biology teachers regarding

aspects of open and dynamic inquiry. The third question examined the correlations between the attitudes of the teachers and the lab technicians, and their perceptions of aspects about open and dynamic inquiry.

The study used a mixed-methods approach, combining quantitative and qualitative research methods. In the quantitative part, 88 biology education staff members participated, including 46 biology teachers and 42 lab technicians, who completed a questionnaire about the various aspects of the lab technicians' contributions to open and dynamic inquiry. The questionnaire covered two main areas: attitudes toward teamwork, and perceptions about aspects of open and dynamic inquiry. The attitudes toward teamwork included three scales: interdependence and collaboration of the lab technician in the inquiry process, the role of the lab technician in facilitating collaboration in the inquiry process, and the mutuality of relations and collaboration between the lab technician and the teacher. The perceptions of aspects about open and dynamic inquiry included four scales: learning as a process, changes occurring during the research, procedural understanding, and affective points of view.

In the qualitative part, semi-structured in-depth interviews were conducted, with seven lab technicians and 11 biology teachers. Additionally, eight joint interviews were conducted, with two interviewees each, one is a lab technician, and the other is a biology teacher, who worked together. In addition to the interviews, three observations were made in high school labs, to observe the teamwork between the lab technician and the biology teacher during the teaching and mentoring of students in the BioHeker project.

Regarding the first research question, the quantitative findings showed differences between teachers and technicians in their attitudes toward teamwork. Teachers perceived the interdependence and collaboration of the lab technician in the inquiry process and their role in facilitating collaboration as lower than the technicians themselves did. However, no difference was found between the teachers and the technicians concerning the mutuality of relations and collaboration. The qualitative findings related to this question revealed, within the category of lab technician involvement, themes such as the degree of involvement, the significant role in the BioHeker project, and the individual work and support with the students. Within the theme of the role as facilitating cooperation, there were found categories related to decision-making, individual work with students, and role definition. Additionally,

there was found a theme about the reciprocity of relationships and cooperation. Overall, the qualitative findings were compatible with the quantitative findings.

Regarding the second research question, the quantitative findings showed that the teachers' perceptions of aspects of the open and dynamic inquiry, in relation to the lab technicians, were lower than the technicians' perceptions themselves, across all four measures: learning as a process, changes occurring during the research, procedural understanding, and affective points of view. The qualitative findings revealed that within the theme of learning as a proces, there were categories related to pedagogy, inquiry planning, and inquiry documentation. Within the theme of changes occurring during the research, there were found categories related to problems during inquiry, and to generating new ideas. Within the theme of procedural understanding, there were found categories related to controls and repetitions, and to statistical data processing. Within the theme of affective points of view, there were found categories concerning the relationship between students and technicians, and the emotional experience. For this question as well, the qualitative findings were compatible with the quantitative findings.

Regarding the third research question, differences were found in the strength of the correlations between attitudes toward teamwork, and the aspects of open and dynamic inquiry, between teachers and technicians. Among the teachers, significant correlations were found between all teamwork measures and all open and dynamic inquiry aspects. However, among the technicians, no significant correlations were found between the involvement of the lab technicians and emotional aspects, and no significant correlations were found between the reciprocity of relationships and cooperation, and procedural learning and understanding. The qualitative findings provided a deeper understanding of the differentiation in these correlations.

The main conclusions arise from the study indicate differences in the perception of the lab technician's role, between teachers and technicians. Teachers perceive their responsibilities in pedagogical aspects as exclusive to them, they express a desire for greater involvement and assistance from the lab technicians, in pedagogical and emotional aspects. On the other hand, the technicians describe their role as focused on technical areas, and sometimes involving pedagogical and emotional aspects, but they find their role satisfactory and do not express a desire to expand it. However, there was a complete agreement between the teachers and the technicians regarding the

importance of collaboration, for the success of the inquiry process, and about the way that open communication between the teachers and the technicians can support student learning processes and motivation.

Theoretically, the study's findings may contribute to aspects such as collaboration in educational contexts, understanding the role of the lab technician, and aspects related to student motivation during the inquiry process. Regarding collaboration, the study's findings can support and strengthen theories that address the importance of interactions and mutual dependency among team members. Concerning the understanding of the lab technician's role, the findings can contribute to understanding the technician's importance in pedagogical and emotional aspects, beyond the technical operation of the lab. In terms of motivation, the findings can contribute to understanding how the school system can collaborate to support motivational processes among students.

Practically, the study's findings can assist in developing training programs for teachers and lab technicians that focus on collaboration, communication, and interaction between them, aiming to enhance the support for the students. For example, unique training programs can provide practical tools for improving the interactions between teachers and lab technicians and promote the implementation of these collaborations to support students' learning processes. Training programs focused on lab technicians can help strengthen their pedagogical abilities and emotional support skills, for the students' learning processes. Additionally, the study's findings highlight the importance of creating an equitable work environment among different staff members, such as biology teachers and lab technicians, to enable each one of them to realize their personal and professional potential, and effectively contribute to the educational process.