Opportunities And Challenges For Teachers In Biology Programs With Theoretical-Practical Subjects From Two Colombian Institutions Of Higher Education Under Pandemic Restrictions

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Abstract

From beginning the COVID-19 pandemic, academic institutions worldwide were forced to close their campuses and adjust their teaching to a distance education model. One of such tasks of major difficulty was related to academic programs that involve fieldwork or lab practices, which cannot be adequately cover by using only computers, videos, or demonstrative actions. Despite these concerns some adjusts, or new alternative proposals were developed by the teachers, such as the use of new teaching sources, however those cannot be thought of without consideration of their learning implications on the modern students: digital natives, more participatory and wishing to strengthen their further practical skills. By using an at-home lab integrating computer, in vivo samples, digital camera, and remote tools and online platforms, we described the experiences of teaching-learning online during the current pandemic, at the Universidad de Ibagué and Universidad del Tolima in Ibagué, Colombia. After feedback we highlighted the opportunities and the main issues, concerns, and further challenges in both teachers and undergraduate students of biology programs for continuing under a hybrid teaching and learning during new normal age or post-pandemic in higher education without neglecting quality assurance.

Keywords: biology; Colombia; coronavirus; higher education; telework.

1. Introduction

The first case of coronavirus was officially reported in Wuhan (China) on December 31, 2019. On March 11, 2020, the world health organization-WHO declared COVID-19 a pandemic, with more than 118,000 cases in more than 110 countries. and territories around the world, under a growing threat of global dissemination (Jandrić, 2020). From that moment on, the governments of different countries responded in radically different ways, even without being clear about what effective measures to adopt (eg, border closure, self-isolation, social distancing and/or quarantine). Starting in March 2020, schools, colleges, universities, and research centers around the world began the rapid or gradual transition towards online educational interaction (Ibarra-Caicedo, 2021a; Melo-Becerra et al., 2021). For families, children, and students self-isolating or socially distancing, the opportunity to successfully complete that academic year was very important. However, this achievement was associated with very stressful conditions for both them and their families as well as for the teachers (Digión and Álvarez, 2021; Miguel, 2020; Moral et al., 2021).

Some universities – which were already operating virtually –, academic programs and teachers (mainly the younger ones) were relatively well prepared for teaching and promoting research online; Others worked at nights and weekends developing audiovisual material to be available remotely, with the support of their students and colleagues (Cipagauta, 2021). In other cases, due to the workload that was generated, some teachers designed and recorded class sessions and then shared them with the students, as a way of fulfilling the complete development of the subjects as best as possible. Finally, many academics achieved this transition quickly, supported by the virtual tools available at the time, familiarization with

new computer programs and by the large amount of free material already existing online (videos, infographics, virtual laboratories). Those who taught individually and contextually faced different challenges (Jandrić et al., 2020), as is the case of teachers linked to postgraduate training.

One of the challenges of teachers for the comprehensive training of their students in higher education institutions (HEIs) with face-to-face programs, is to achieve and maintain an innovative didactic proposal to carry out activities in practical (P), theoretical-practical subjects. (T/P) or T/P that involve at least one field trip (outside the classroom/laboratory or the university campus). Although the inclusion of complementary virtual practices had already been noted in previous educational experiences (Barberá and Badia, 2005; De la Sen and Díaz, 2009), this situation was much more evident when the need arose to carry out these practices in the context of the COVID-19 pandemic (Argel et al., 2020; Vargas-Straube et al., 2021). For several years now, in the virtual or remote environment, it has been developed in universities with its programs, online training (video chat courses, webinars, podcasts), free access repositories, among others. What had not happened is that millions of people worldwide used the tools of the Internet and social networks at the same time and for the same purposes (Cevallos et al., 2021; Giraldo et al., 2021; Moreira et al., 2021; al., 2020).

Among the other challenges associated with the pandemic and those that will persist for a long time, is the fact that students who take virtual subjects must have a series of prior knowledge and emphasis (depending on whether it is a mandatory subject or elective), some of them marked by the footprint or potential gaps left by this new teaching-learning modality, which they were faced with for at least three academic periods (2020 and 2021). Likewise, from the teacher's point of view,

management of the difficulties is foreseen to put students in contact with processes that are carried out in a real way in companies and industries or that are directly related to their professional future (De la Sen and Díaz, 2009).

In this document, some Colombian experiences related to the experiences of teachers of theoretical-practical subjects (T/P) and T/P with field trips of the in-person Environmental Biology and Biology programs at the University of Ibagué are highlighted (UI, private institution) and the University of Tolima (UT, public institution), respectively, during the beginning and part of the dynamics of the COVID-19 pandemic (March 2020 – October 2021). Although emphasis is placed on the subject Zoology, given the successful results, this experience can be applied to other similar subjects. Likewise, other elements are highlighted that are associated with opportunities for improvement for both students and teachers, depending on the restrictions or not, related to access to equipment and the Internet and under the expectation of continuing in teaching-learning mediated by an education. hybrid during the post-pandemic, which promotes or strengthens educational quality assurance.

2. Revelation of digital gaps (≈ social inequality)

A critical factor in both public and private Colombian HEIs at a regional level and even at a national level is the identification and recognition of digital gaps, mainly in the use and access of information and communication technologies (ICT). However, this is a widespread situation in most Latin American countries, which became even more evident during the pandemic. Some elements of social inequality were confirmed, related to the conditions to access virtual education, depending, among other things, on geographical location, economic and technological resources, and training and experience in the use of ICT (Gómez-

Arteta and Escobar- Mamani, 2021; Miguel, 2020). In addition to the lack of preparation of the educational community (teachers, students, administrators, parents, etc.), there was also the lack of timely response from the educational system and governments in general, which exposed many shortcomings, including of those who were already familiar with them (digital illiteracy), which caused the digital gaps in the areas of access, use and competence in ICT to deepen during the crisis due to the SARS-CoV-2 coronavirus, threatening the options and overshadowing the interests of educational subjects (Gómez-Arteta and Escobar-Mamani, 2021; Villela and Contreras, 2021).

In the case of access, knowledge and training in the use of ICT, the majority of the population in urban areas has better opportunities to use the Internet, compared to rural areas. Like other Latin American countries, a low percentage of rural resident students have Internet at home under the restrictions of the pandemic. Therefore, during this situation, strong inequalities were further exacerbated, depending on the socioeconomic condition of the students (Bercheñi and Mariño, 2021; Ordorika, 2020; Ruiz-Aquino, 2020). However, the digital transformation required by COVID-19 contributed to strengthening knowledge and accelerated or "mandatory" training, mainly in teachers and students, adapting both their work spaces and the reprogramming of Internet speeds and repowering or changing your computer equipment; These devices represent an essential tool for studying and working in an increasingly interconnected world.

In one way or another, each of these actions that were voluntarily or involuntarily generated as a result of the need to continue with the teaching-learning process, under different levels of connectivity, allowed, to a certain extent, a reduction in the digital divide in all sectors, by generating more spaces for activities that were

previously unthinkable or were underestimated in person. It also contributed to the consolidation of technologies based on artificial intelligence, the growth of the countries' infrastructure and the improvement of digital platforms and mobile applications (Núñez-Cortés, 2021). Overall, the COVID-19 crisis showed that access to technology is essential for remote education, and highlighted the urgent need for a national effort to close these gaps (Vargas et al., 2020).

In the Colombian universities analyzed, one private (https://www.unibague.edu.co/) and one public (https://www.ut.edu.co/), alternatives were created to support low-income students. resources that presented some impediment or that belonged mainly to low socioeconomic strata. In this sense, both universities strengthened access to scholarships, promoted agreements with Internet service provider companies, in addition to various economic incentives (solidarity bingos, no registration fee) or the supply of equipment (tablets equipped with SIM cards and data plan) to avoid dropouts and guarantee the best possible academic performance. Despite shared efforts, some restrictions continued, marked by lack of parental employment or the redistribution of income to meet vital needs such as food and health.

Below, some of the elements that generated opportunities for improvement and challenges for quality assurance in the selected HEIs are highlighted, taking as reference the experiential analysis of teachers in the area of zoology.

3. **Routine classes, research projects and tutorials in degree work**

Although many universities tried to maintain the admission process without major inconveniences, since the declaration of a pandemic, the start of work was always subject to the dynamics of contagion and repeated quarantines; and regarding the

development of events, universities focused on the planning and construction of their remote classes based on virtual environments (Figueroa et al., 2021).

In routine classes of academic programs; That is, in those face-to-face subjects that were forced to transition to virtuality, new approaches were developed, greater emphasis on asynchronous work supported by complementary or explanatory videos, directed documents (articles, book chapters), virtual laboratory guides , reorganization of subjects, among others. Professors and students had constant training in remote tools, information management in repositories, strategies for exams and laboratory practices, and strengths in virtual environments. In the case of students who began their research project associated with their degree work, which included laboratory and/or field activities, they found themselves seriously behind. For these students, emphasis is placed on the need to use the electronic databases subscribed by the IES, for current topics and review of classic articles, in such a way that they could have a document that is as complete as possible, until it can be resumed. field or laboratory activity. In other cases, some students chose to change degree modality, analyze previously collected information, or suspend the academic semester while they could resume experimentation and data collection. In the case of the Biology Program, the University of Tolima endorsed the graduation through the presentation and defense of a Monograph; that is, an exhaustive review on a topic of biological, ecological or environmental interest.

As restrictions were lifted and the gradual return to universities was endorsed, the subjects that had already demonstrated adequate development of their content, through the use of several of the strategies mentioned above along with demonstrative and 3D videos, resumed activities. laboratory with demonstrative experimental practices in the traditional format (Argel et al., 2020)

vs. demonstration practices in pandemic or alternation, in both universities (UI, UT). During the alternation time, and even since when the quarantine was partially lifted, green spaces such as botanical gardens, urban forests, and biological collections (museums, herbaria) were privileged for the development of subjects (T/P) or T/ P with field trips, faced with the difficulty of carrying out off-campus activities and collecting data for at least almost two years. In any case, personal protection elements were required, and other biosecurity protocols such as social distancing and capacity in the most crowded spaces were maintained.

4. **Theoretical-practical subjects (T/P) and T/P with field trips**

In areas of study such as biology, chemistry, physics, psychology, languages, nursing, medicine and other related professions, teaching needs emphasize the importance of developing theoretical and practical (T/P) aspects. A good part of these subjects include activities with laboratory practices, and several of them are T/P with field trips. In developing the practical aspects (both in the laboratory and in the field), special emphasis is given to activities that teach students experimental methods, how to synthesize observations and a range of communication and practical skills that were completely limited during confinement and were extended throughout remote learning (Gamage et al., 2020).

Although virtual interaction works well for the construction of knowledge through the delivery of content and the supervision of some processes, it has limitations for developing practical skills in the laboratory and in the field. For example, to carry out a laboratory for the subject Zoology (integrated, invertebrates, or vertebrates), for the Biology or Environmental Biology Program, it is necessary to use specimens of organisms found in biological teaching or scientific collections, or by collecting organisms in the field during practices. However, remote learning began

to limit students' skills, since it is almost impossible to replace the immersive and realistic nature of practical activities. Therefore, several challenges were raised regarding how university teachers can generate alternatives, especially when they have equipment and audiovisual expertise (Figure 1), which allow them to interact with the student in a practical way, under a virtual approach.

Figure 1. Organization of the work area at home for the development of theoretical or theoretical-practical subjects. a) Equipment with a camera, tripods and flashes for live transmission, b) setup for conducting pre-recorded classes or live interaction, c) provision of a whiteboard, recording camera and connectivity with the computer and some interaction tool (eg, Cisco Webex®, Facebook Live®, Google Meet®, Microsoft Teams®, YouTube®, Zoom®).

For these virtual laboratories, simulation and augmented reality tools were used, freely accessible online with 3D specimens (eg, https://3 dlabs.upm.es/web/laboratorios.php?idioma=es). Remote laboratories allow experiments to be conducted over the Internet, while video-based activities

provide a step-by-step overview of a real laboratory so that students can visualize the entire experimental process and its environment through a video transmitted by the teacher from his adapted workspace at home, using urban fauna or specimens purchased at the supermarket. The laboratory design allowed students to perform experiments that incorporated autonomous, interactive, and collaborative learning in external and internal anatomy (Figure 2).

Figure 2. Home work area for synchronous interaction with students of the T/P Zoology subject of the Environmental Biology Program at the University of Ibagué (Tolima, Colombia). a) assembly with a camera attached to a stereomicroscope, computers and invertebrate sample, b) image of the invertebrate to share with the students seen on the link computer, c) final assembly to carry out the session during the scheduled class. The arrow indicates one of the organisms (in plastic) used in the class, when biological samples are not available.

Although the reception of these methodologies by the students was mostly positive, the gaps that can be perceived in Biology students are highly variable, to

the point that a fourth semester student has not yet been able to have a physical contact and less an expertise to properly handle a microscope or a stereomicroscope. In addition, there is a great limitation, which is associated with the scientific documentation skills that the teacher may have and the time for class preparation. For example, during 2020 and part of 2021, the laboratory's practical classes were prepared using these approaches, but the technical skill for the setups (Figure 2) and the necessary resources can be very high, and in many cases , represents great physical and mental exhaustion for the teacher.

The other limitation is related to the importance of culture and environment in students' practical learning experiences; However, when the limitations on access to the campus decreased and the gradual, progressive and safe return to the new normality through in-person and remote laboratory classes, it allowed, during the alternation, accidental, fortuitous and casual encounters that improved ties with colleagues and the Learning became more enjoyable. Therefore, group cohesion, trust, respect and adequate group work were important. However, these "innovative" approaches require extensive technological management (Figures 1 and 2), which most universities and teachers do not have.

5. **Development of skills and learning outcomes**

There is a generalized discussion, on the one hand by the teachers who guide T/P subjects and, on the other, by the students who took them under the restrictions imposed by the pandemic, related to the fact that the competencies, mainly those of "knowing -do" were not able to be incorporated for at least 1.5 academic semesters; that is, for a tripartite set of several subjects. Therefore, a priori it is judged that the level of these competencies and the same learning results are associated with a detriment to the quality of the training of future professional

biologists. Likewise, an atmosphere of difficulties for mastering certain topics is created in advance, especially for those interested in postgraduate training. This situation is more complex when it is considered that several T/P subjects in the curriculum at both universities did not have the strength of the associated field trips or practices. At both the UI and the UT, during the period 2020 and the first semester of 2021, there was no possibility of carrying out academic internships outside their campuses. Only in a few cases, and towards the end of 2021, some exits to nearby urban or rural green environments were consolidated; However, capacity restrictions, social distancing, continuous use of personal protection elements, among other biosafety protocols (eg, organization of groups to enter vehicles and transportation itself) were maintained.

6. **Safe return to campus: alternation and restart of presence**

It has been observed that the COVID-19 crisis has had and will have a significant impact on the enrollment of national and international students, with negative effects especially on private HEIs (Ordorika, 2020; Santana-Sardi et al., 2020). Several students started their semester, but were not able to complete it successfully. Among other aspects, due to the situation of access to equipment and permanent connectivity. After overcoming international, national, regional and local restrictions, supported by the maintenance of biosafety protocols, even with a good part of the university community with the complete vaccination schedule (one or two more booster doses), the options for progressive return to the main campus to carry out teaching activities, initially in theoretical and T/P subjects with options to develop demonstrative laboratory practices. The universities made frequent calls through consultations or online forms (Figure 3), which included questions related to the health situation of the staff and the teacher's willingness to

resume daily activities. However, there are some challenges related to the availability of capacity (number of students, laboratory assistants, and teachers) for the correct application of biosafety protocols, and the strategies for verifying the status of the samples (specimens deposited in collections). of teaching).
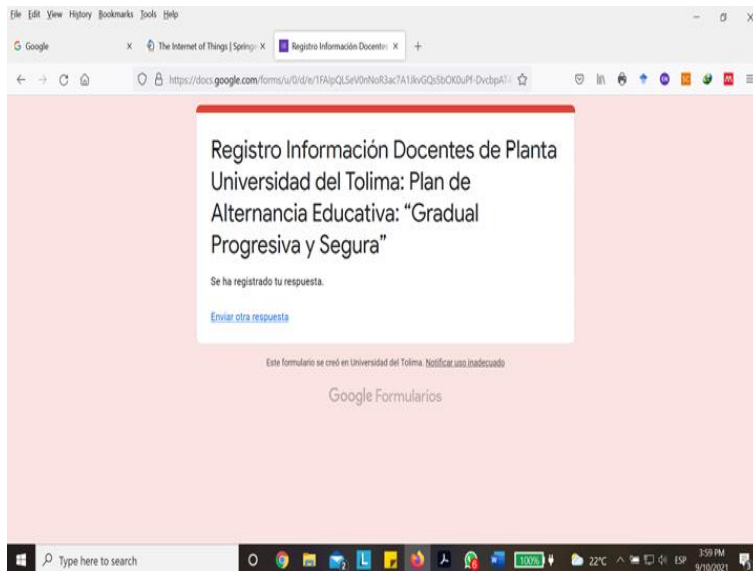

Figure 3. Example of the final record of one of the forms requested from teachers by the Academic Vice-Rector of the University of Tolima, to resume daily activities on the central campus, through an Educational Alternation Plan. Similar forms were proposed for students. This plan is supported and permanently updated in accordance with the dynamics of COVID-19, following the guidelines of the university well-being area, which in turn is supported by the guidelines of the Ministry of Health and Social Protection of Colombia (https:// www .minsalud.gov.co).

7. **Strategies for quality assurance**

After the declaration of a pandemic, all sectors were forced to comply with the standards established by the WHO and their own health policies in accordance

with the dynamics of deaths, infections and capacity in the health centers of each country. Therefore, companies, workplaces, and educational institutions at all levels had to reinvent themselves in accordance with the measures implemented (biosafety protocols), while access to some of the approved vaccines transitioned. Authorization is then given for both public and private entities to resume their activities using distance education systems, which will be subject to the evaluation of the competent bodies in the case (Figueroa et al., 2021).

We discuss some elements that can be broadly applied to other university majors other than biology, from the perspective of teachers. However, the emphasis is placed on the Biology and Environmental Biology programs at UT and UI, respectively. It is about recognizing the elements that promote quality assurance and the opportunities and challenges of the pandemic under three different scenarios (Figure 4). Scenario 1 highlights the assurance of educational quality endorsed by the respective institutional and/or program quality accreditations, under a situation of academic normality before the pandemic. That is, daily face-to-face activities without any restrictions, except for day-to-day activities and without external pressure of a global nature. There is a greater effort by the teacher in master sessions, greater participation in practical laboratory activities and field trips, and proportionally less use of the computer and Internet. Scenario 2 occurs under the official declaration of the pandemic, with several restrictions marked by quarantine, remote work or from home, border closures, self-isolation and social distancing, the hope of obtaining a dose of vaccine, closure of HEIs and its laboratories, greater use and application of ICT with the support of the Internet (virtual tools, online training, social networks), limitation of mobility for the development of field trips. However, the use of qualitative or quantitative research

is promoted here, taking advantage of the advantages of the information available in the cloud or digital repositories. The Internet and social media or networks make it possible to collect textual data, sequences, images or narratives about a limited reality for in-person access (Hernán-García et al., 2021). Under scenario 3, the start of alternating educational activities is established in principle (Ibarra-Caicedo, 2021b) and a safe, gradual and progressive return to daily face-to-face activities on the main campuses of the HEIs (Melo-Caicedo, 2021b). Becerra et al., 2021). The integration, even proportionally, of field, laboratory and Internet use activities is highlighted, in addition to other opportunities for the management of information collected with the support of training or experiences received in virtual environments, teleworking, teleeducation, among others. others (Figure 4).
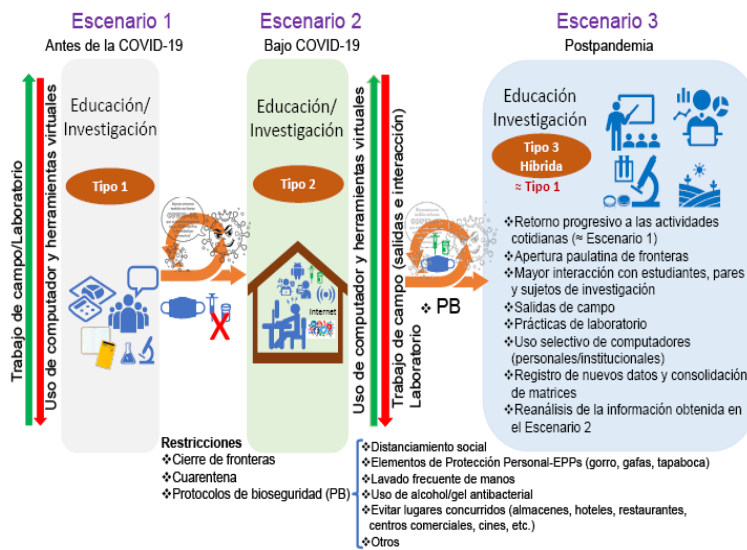

Figure 4. Interaction scenarios for teachers and students of two Colombian higher education institutions in the face of the dynamics of the COVID-19 pandemic, and the challenges and opportunities for quality assurance. Emphasis is placed on educational and research activities in the undergraduate courses of Biology and

Environmental Biology of the University of Tolima and the University of Ibagué, respectively, associated with theoretical-practical subjects (T/P), and T /P with field trips. Theoretical subjects can take advantage of the advantages of confinement (scenario 2), while the T/P with field trips are subject to the maintenance/lifting of restrictions and compliance with biosafety protocols (scenario 2), to the opportunity of a transition under the alternation model (gradual, progressive and safe return to in-person education), and a subsequent mixed education, strengthened during the post-pandemic (scenario 3).

The dynamics of the pandemic confirmed the importance of ICT in the teaching process in traditional university education; that is, in those HEIs with face-to-face academic programs. Furthermore, the strengthening of skills in the management of virtual tools and environments of both teachers, students and administrators during restrictions and interactions from home, guarantees that this knowledge is put into practice even after the pandemic (scenario 3), since that it is important for teachers to be aware of why, for what and when they use ICT in their work, based on theories and approaches that give rise to methodologies and pedagogical strategies for working inside and outside the classroom (Arriaga et al. , 2021). However, under the context of COVID-19, both in public and private institutions, a lack of minimum or ideal conditions has been evident to continue with the course of the semester school year, which operated without major trauma in person, when not The restrictions imposed by the pandemic were in place. In higher education, needs are evident with respect to more specialized knowledge, subject to social demands and economic demands (Miguel, 2020). Likewise, it is necessary to go deeper in the sense of knowing what the educational community thinks: students, teachers and administrators, with respect to the real obstacles, the challenges they face and

the skills they are developing or need to develop to face this pandemic context and subsequently (Miguel, 2020; Moral et al., 2021).

The different scenarios (Figure 4), the digital divide and the very dynamics for a return to daily tasks carried out in person, which were carried out before the pandemic was declared, have affected the planning and development of teaching, and the evaluation of results. However, this feedback has made it possible to verify that not all teaching, in programs with a high practical component, can be carried out virtually. Some content can be virtualized, others require interaction, in addition to being virtualized, and others necessarily require physical presence (Núñez-Cortés, 2021).

8. STEA ApproachM+H: an alternative in times of COVID-19

The resignification of universities in their being and acting, through a new style of organization for the immediate future, should emerge as a balm of hope for collective construction in education, which needs to respond to the new challenges that countries face. , in the midst of an unprecedented higher education crisis, deepened by the pandemic (UNESCO, 2020).

Therefore, this new style based on projects with a STEAM+H (Science, Technology, Engineering, Art, Mathematics and Humanities) approach represents an alternative in times of COVID-19 and digital transformation (Fardoun et al., 2020). Initially, the STEM approach emerged during the 1990s, at the hands of the National Science Foundation (Ring et al., 2017), where new methodologies focused on these branches of knowledge, focused on the development of scientific competencies. -technological. However, this teaching-learning model was the beginning of a development that led to including the Arts (STEAM) – given that they generate creativity and innovation – and later the humanities

(STEAM+H). The STEAM+H approach allows integrating knowledge from different disciplines to cultivate transformative, innovative and creative thinking and skills to advance towards sustainable development and achievement of the 2030 Agenda, in addition to forging skills that turn students into empowered citizens who participate. in addressing the problems that today affect localities, countries and of course regions (Skorton, 2019; UNESCO, 2019).

In this sense, universities, by assuming the competency approach (an expanded concept of "comprehensive training") as a fundamental dimension of their institutional educational project, can deeply cultivate a student body that uses the STEAM+H approach, through dialogue. of knowledge, in which the institution becomes an actor that incorporates competencies with high creativity and great ability for innovation and resolution of complex problems. Although it is recognized that STEAM+H education is a relevant proposal to face educational processes in times of COVID 19, it is necessary to analyze the context, since not all of them present the minimum conditions for its implementation (Vargas et al., 2020). However, it is necessary to establish an approach plan to evaluate the situations in which these projects could be implemented. This approach would be much more massive and probable under the current panorama, which, although not the best, does allow a transformation in the digital divide based on remote teaching of a new educational community in the post-pandemic.

The teaching approach for STEAM+H education not only allows for comprehensive curricular analysis and planning, but, through mixed methodologies (synchronous/asynchronous sessions), the teacher exposes, guides and interacts with the students and, on the other hand, On the other hand, participants can provide feedback in forums, interactive videos, commercial or open access

platforms, in order to carry out practices that help consolidate their learning. In this way, the actors involved can relate within the framework of an authentic learning community, as an emerging characteristic from transdisciplinarity, contributing from knowledge and experience, in the collective construction of knowledge, in which the actors propose solutions. to complex problems in the region, through collaboration, management, creativity and action (Skorton, 2019). Therefore, it is possible to integrate STEAM+H in classrooms as part of project-based education, continuously training teachers in an inter- and transdisciplinary way (collaboration between different teachers from various disciplines), creating physical/virtual and pedagogical spaces in where these projects can be developed for the benefit of students.

9. **Restrictions of this proposal**

Our experiences may be a little biased towards zoological subjects, which we manage to develop under the theoretical-practical conception, and which in turn, includes at least one field trip outside the spaces of the selected universities, as established in their respective curricular plan. In that sense, the reader must recognize that this is one of the experiences at work (teaching-learning) under remote interaction, with both synchronous and asynchronous activities and assignment of tasks, under a future perspective of hybrid education (in-person) . /virtual; Figure 4). Therefore, other particular cases must be evaluated where there may also be many successful experiences, given the opportunity for improvement and the same restrictions caused during the COVID-19 pandemic, which led to teachers having constant training with the aim of to improve their skills in the use of virtual tools, in the recognition of different platforms, and in the reinvention of their traditional way of teaching (Digión and Álvarez,

2021). Likewise, it generated in the students other expectations of commitment, responsibility and monitoring of the interaction sessions; for example, the advantage of not being able to attend and have the recording of the class or discussion about some pre-recorded session(s). Another aspect was related to the perception of the evaluation process from both parties, the teacher and the participants.

In the same order of ideas, these virtual teaching environments allow the communication of the teacher and the student through their learning platforms, either live or asynchronously, using procedures associated with ICT without limitations of time and space (Figueroa et al., 2021). Some of the options to consider are found in Vargas-Straube et al. (2021) in the case of experimental microbiology, aquatic ecology (https://doi.org/10.24918/cs.2021.34), and invertebrates (Novo et al., 2021). However, students' perceptions must be kept in mind based on the new alternatives for (self-)learning and interaction with the teacher (Ortíz-Moreno et al., 2020; Urzúa et al., 2020; Vargas-Straube et al. ., 2021), as well as the characteristics of the programs and subjects (practical credits); that is, if the latter are taught in a regular or concentrated manner, with the presence of a high number of students, and above all the needs associated with the infrastructure and laboratory material for an adequate performance of the experimental work (Argel et al. ., 2020; De la Sen and Díaz, 2009).

Finally, in T/P subjects during the alternation or progressive return to face-to-face, where a part of the students attend the classroom, laboratory or open space and the other continues under remote interaction, the use of content must be reevaluated, from the static/dynamic point of view; that is, whether the same practice is repeated or modified for subsequent cohorts. The use of samples or specimens in

external and internal dissection depths (ecomorphology) should also be reviewed, particularly when it is necessary to maintain rotations in a laboratory practice depending on the capacity (maximum number of users of the equipment/samples available) and the number enrolled and attendees of the subject. From our experience, traditional face-to-face education was relatively static in terms of content, technological appropriation (older versus younger teachers), and cohort management (same subject, different students [except repeaters]). This is, furthermore, an excellent opportunity for older teachers to recognize the current reality, without a priori classifying a method as ineffective, while at the same time they can replace their traditions and their tendency to repeat didactic or pedagogical formulas from the past (Prensky , 2001). In that sense, they must know how to overcome adverse factors such as customs, communal habits, idiosyncrasy, culture, among others. However, the problem of resistance to paradigm change, especially that of using ICT for the teaching-learning process, remains latent today among some colleagues (Arriaga et al., 2021). It is also important that the strengths and limitations are recognized, under the framework of what has been discussed as "digital natives and immigrants", when considering students and teachers, respectively (Guo et al., 2008; Jara and Prieto, 2018 ; Prensky, 2001). It is therefore necessary to promote the permanent training of teachers in the use and proper management of ICT, which allows the generation of pedagogical models and more interactive teaching strategies in accordance with the needs of future professionals (Jara and Prieto, 2018), who saw their practical skills limited as a result of the restrictions imposed on us by the COVID-19 pandemic.

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