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Aprendizagem cooperativa em tempos de Covid-19: uma experiência de ensino coordenado de epistemologia e metodologia

Dante Flavio da Costa REIS JUNIOR [1]

Resumo
Neste artigo expomos o planejamento e a execução de um plano de ensino envolvendo turmas de calouros e veteranos de um curso de Licenciatura em Geografia. Durante quatro semestres consecutivos, promovemos um encontro entre alunos matriculados em disciplinas que abordam temas de teoria da ciência e projeto de pesquisa científica. O objetivo foi tirar proveito da excepcionalidade de um regime de ensino a distância e testar um modo de aprendizagem cooperativa: fazê-los conscientizarem-se da ciência como prática que envolve planejamento e comunicação. Concluímos que a experiência foi válida para uma educação sobre a natureza da ciência; e que, apesar de certos percalços, plataformas tecnológicas viabilizam interações e aprendizagens satisfatórias – sejam em atividades síncronas ou assíncronas.

Palavras-chave: Ensino remoto. Geografia. Pandemia.

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Cooperative learning in times of Covid-19: an experience of coordinately teaching epistemology and methodology

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Abstract
In this article we present the planning and execution of a teaching program involving groups of freshmen and veterans from a Geography undergraduate course. During four consecutive semesters, we organized meetings between students enrolled in disciplines that congregate themes of science theory and scientific research project, with the intention to make the best of the exceptionality of a distance learning/teaching environment and assess the idea of cooperative learning: furthering the awareness of science as a practice which involves strategy and communication. We concluded that, regarding the nature of science and its education, the experience was valid, and that, despite certain mishaps, technological platforms enable satisfactory interactions, whether in synchronous or asynchronous activities, and learning.

Keywords: Remote teaching. Geography. Pandemic.

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El aprendizaje cooperativo en tiempos de Covid-19: una experiencia de enseñanza coordinada en epistemología y metodología

Dante Flavio da Costa REIS JUNIOR

Resumen
En este artículo artigo presentamos la planificación y ejecución de un plan de enseñanza que involucra a las clases de primer y último año de un curso de pregrado de Geografía. Durante cuatro semestres consecutivos, promovimos un encuentro entre estudiantes matriculados en disciplinas que abordan temas de teoría de la ciencia y proyecto de investigación científica. El objetivo era aprovechar la excepcionalidad de un régimen de enseñanza a distancia y ensayar una modalidad de aprendizaje cooperativo: concienciarles de que la ciencia es una práctica que implica planificación y comunicación. Concluimos que la experiencia fue válida para una educación sobre la naturaleza de la ciencia y que, a pesar de ciertos contratiempos, las plataformas tecnológicas permiten interacciones y aprendizajes satisfactorios, ya sea en actividades sincrónicas o asincrónicas.

Palabras clave: Aprendizaje a distancia. Geografía. Pandemia.

Introduction

The year 2020 marked a significant point in the social history of the planet and had undeniable effects on education. Universities, for example, had to mobilize their staff to implement measures that would at least mitigate the impact of the Sars-Cov-2 virus pandemic on academic training. Many institutions, after several months of observing the situation and contemplating what to do (and how) while life did not return to "normal," decided to implement emergency remote teaching. At the University of Brasília, various modes of interaction with students were authorized - from sending instructional materials via email to synchronous meetings in virtual classrooms. Certainly, each teacher will draw their conclusions in the coming years about how well the measures taken fulfilled the expectations placed upon them. It may indeed be premature to definitively judge their effect, for instance, on teacher education programs. However, we believe it is important for some general impressions to be shared publicly, with the intention that, in the medium term, we exchange our experiences and can determine the best measures for the future in a system that will likely need to operate under a spirit of precaution. This should be done without sacrificing the programmatic nature of our respective disciplinary fields.

This text reports a recent personal experience. For over ten years, we have been responsible for teaching two mandatory courses offered every semester in the Geography Teacher Education program at the University of Brasília: "Introduction to Geographic Science" and "Methodology of Geography," which are taken by first-semester freshmen and sixth-semester seniors, respectively. We decided to share with the research community in the fields of teaching and teacher education an experiment that we proposed over four consecutive occasions, specifically during the four semesters affected by the pandemic, during which these mandatory courses continued to be taught.

At the University of Brasília, a complete return to in-person activities at the Darcy Ribeiro campus would only occur in June 2022. Thus, the experience of entirely remote teaching took place, in practice, over four consecutive semesters: those corresponding to the academic periods 2020/1, 2020/2, 2021/1, and 2021/2. However, given the period of "caution" and, of course, all the expectations we teachers had regarding the events at the beginning of the pandemic - these periods occurred on a "delayed" calendar: in practice, with a semester lag. Consequently, the official calendars for those four academic periods actually took place (in order) between August and December 2020, between February and May 2021, between July and November 2021, and between January and May 2022.

In the following sections, we will present an account of the measures taken and the effects obtained. At certain moments, we will associate the procedures and occurrences with some specialized literature—aiming to suggest to readers that at least part of what constituted our experience is already supported by research and publications in the field (so as not to convey the idea that what we experienced was exceptional or locally situated).

Indeed, inexperienced in teaching in a "distance" format, we restructured our course programs largely based on “intuition,” meaning we conjectured measures that seemed relevant to us. Consequently, there was a high risk that these measures might not be the most appropriate. Thus, the objective of sharing with readers, possibly specialists, what we refer to here as an “experiment.”

In any case, it was interesting and enlightening to contact a process we undertook while preparing the write-up about this experience a series of publications that already report on what we have been recently experiencing in the realms of school and university education. There are very enlightening accounts of how lockdown experiences impacted the execution of studies in the natural sciences at the secondary education level information that becomes very clarifying when compared to periods prior to the pandemic, for example, in a national context (YOSEF; TALKER; SADEH, 2021). Similarly, valid reflections address the drama of having to deal with the inequality of access to information technologies in higher education which Covid-19 only exacerbated (PIRES, 2021). Regarding special disciplinary fields, it is worth mentioning that the Journal of Social Science Education released a special issue in 2020, which included contributions discussing the capacity to confront uncertainties arising from the pandemic and remote teaching in emergency situations—highlighting cases where digital modes (with today’s widely disseminated “webinars,” for example) had to be spontaneously and temporarily implemented, along with all the resulting didactic and pedagogical effects (JSSE, 2020; TORRAU, 2020).

Initial Overview: Characterizing the Courses and Intuiting an Approximative Strateg

“Introdução à Ciência Geográfica" (Introduction to Geographic Science) (ICG) is an epistemological course designed to introduce new Geography Teacher Education students to the realm of knowledge production in Geography. Two key factors make learning about the nature of geographic science particularly challenging: (1) its history spans at least twenty-five centuries, requiring a minimum understanding of the shifts in meaning surrounding what constitutes "science" over such a long period, and (2) Geography's unique focus on both natural phenomena - such as

atmospheric, geomorphic, and ecological processes - and political and sociocultural phenomena, including demographic, territorial, and regional economic issues. This dual focus theoretically demands a "hybrid" philosophy of science, one that is attentive to the specific characteristics of both the physical and human sciences. Consequently, ICG involves discussions on the theory of scientific knowledge, with the aim of clarifying the nuances and ambivalences of Geography. The course goes beyond merely presenting a historical overview of the field (covering periods, figures, and accomplishments); it must also demonstrate the complexities that arise from Geography's heterogeneity, which, in scientific practice and teaching, leads to a wide array of themes, languages, and methods. Authors like Graves and Moore (1972), Gregg and Leinhardt (1994), and Bavoux (2009) offer well-developed reflections on the nature and challenges of the geographic field.

"Metodologia da Geografia" (Methodology of Geography) (MG), on the other hand, is a course aimed at guiding sixth-semester students in defining a research plan, which involves recognizing certain normative stances from which a systematic study should be developed. The challenge in teaching MG lies in the appropriate way to frame an unavoidable discussion: since students in this course are already at an advanced stage of their degree (having completed core courses associated with both the Physical Geography, GF, and Human Geography, GH, domains), how can a "unified" methodological approach be designed? In other words, how can we create a methodology program that remains relevant across a range of topics, from a study on the current state of biodiversity in a given morphoclimatic region to a research project on the sense of belonging among residents of a village newly exploited by the tourism industry? Preparing a methodology course for such a scientifically diverse field is as intellectually stimulating as it is challenging, given the coexistence of divergent paradigms from naturalism and culturalism. For example, GF sectors may be philosophically influenced by physicalist epistemology, while GH sectors may be influenced by philosophical systems such as humanism. Authors such as Graham (2005), Clifford, French, and Valentine (2010a), and Herod and Parker provide valuable insights into the methodological diversity of geographic studies (2010).

However, this complexity can be turned into an asset for teaching and learning activities. Hence, the potential interaction between ICG and MG students becomes significant, as it is reasonable to conjecture that the former will grasp the fundamentals of geographic science more efficiently if they are presented with concrete case studies designed by the latter. In other words, while MG students work on developing argumentative practices (aiming to make their research intentions clear), ICG

students focus on identifying the manifestation of theory in practical research plans. Thus, at least "in theory," this interaction should foster mutual understanding, as the exchange would strengthen two aspects that, without interaction, might remain incomplete: gaining a better understanding of theoretical explanations in an applied context (ICG) and ensuring that the objectives behind a research plan are theoretically sound (MG).

During the four exceptional academic periods, the following points were emphasized for ICG: "the nature of scientific knowledge" (demonstrating the relationships between epistemology and ontology, and exploring the role of normative and contextual factors); "history and theory of geographic science" (highlighting key episodes and figures, and presenting the characteristics of scientific practice in Geography); and a unit of "exercises," in which interactive/cooperative learning experiences were conducted, allowing first-year students to engage with these activities after having been exposed to some preliminary theoretical content provided through the first two points of the program. For MG, the emphasis was on the following points: "the nature of scientific research" (examining the roles played by logical-cognitive values and social conditioning, respectively); "the structure of a research plan" (outlining each procedural step and demonstrating their interdependence); and a unit where this research plan would be understood in a more "practical" instance, encouraging students to design the components of a project to be executed. The goal was for senior students to optimize this exercise through an interactive dynamic, in which they would be prepared to convince interlocutors, supported by analytical exercises undertaken during the first two points of the program.

The ICG and MG programs were reconfigured due to the extraordinary nature of the academic semesters. However, the fundamental topics were preserved, and the subjects were duly adjusted to a work regime that could be partially interactive and autonomous. To achieve this, students would receive, weekly or biweekly, text files and instructions for examination via their email inboxes and virtual support platforms.

Specific Definitions of the Experimental Programs: Activity Design

We aimed to ensure that the core objectives of one course were potentially coordinated with the core objectives of the other, presuming that this minimum alignment could foster synergy between the analytical and communicative activities of each class. In this sense, the fundamental objectives of **ICG** were: to present (and exemplify) the theoretical and contextual aspects of scientific knowledge; to stimulate reflective and comparative skills, emphasizing Geography’s scientific character; and to

demonstrate the diversity of the geographic field and the richness of its approaches. Meanwhile, the objectives of **MG** were: to demonstrate the cognitive, social, and ethical values of scientific work; to enable the formulation of a research "pre-project" (which we referred to as an “Anteproject”) by characterizing and exemplifying each of its components (the traditional Object, Objectives, Justification, Hypothesis, etc.); to encourage critical examination of research in Geography by analyzing the languages and tools used in studies; and to stimulate the development of communicative skills so that students could assess the intelligibility and feasibility of their own research plans.

In the first few weeks, we would develop the theoretical topics of each course. Meetings were held via a virtual platform (Teams), where the topics would be explored from various perspectives, and any doubts would be shared and resolved within a cooperative dynamic. Subsequently, for four consecutive weeks, students from both courses would be involved in a “meeting”: ICG freshmen would interact with MG seniors, gaining practical insights from the experience and strengthening their understanding of the nature of scientific research in Geography.

In the following weeks, we would continue to develop the respective course programs: in the case of **ICG**, exploring more contemporary trends in geographic thought, and in **MG**, continuing the explanation of the structural components of the Anteproject.

Promoting Learning with Theoretical Content through a Reading-Based Approach

ICG students were expected to adopt a book as a "basic guide" for understanding the nature of Geography. There were two options: *"História da Geografia"* (History of Geography) by Paul Claval (2006) and *"Geografia: uma brevíssima introdução"* (Geography: a very brief introduction) by John Matthews and David Herbert (2021). Both publications had the advantage of being relatively concise and written in accessible language - making them suitable for young students recently graduated from high school. The first book would allow students to learn about the roles played by various key figures in the history of the discipline and the transformation of the field over the centuries. The second, in contrast to a historical narrative, would introduce students to an approach that characterizes the geographic field, serving as a guide more aligned with the "theory of Geography." Since our lectures

would emphasize both historical and theoretical elements of the discipline, either book chosen by the student would provide satisfactory supplementary support[2].

MG students would also select a manual to analyze the variety of technical procedures common or specific to the sectors of Physical Geography (GF) and Human Geography (GH). There would also be two options: *"Key Methods in Geography"*, organized by Nicholas Clifford, Shaun French, and Gill Valentine (2010b), and *"Research Methods in Geography"*, organized by Basil Gomez and John P. Jones III (2010). Both are extensive books featuring contributions on diverse topics related to special types of data collection, organization, and analysis (quantitative and qualitative studies, cartographic production, the use of audiovisual documents, etc.). These manuals are highly advantageous as they contain chapters that serve as detailed instructions on how to apply techniques in exemplified contexts—encompassing procedural methods recognized as useful for studying various fields of geographic phenomena. Since the course included lectures on the epistemic criteria necessary for conducting objective research, both in relation to physical-environmental phenomena and socioeconomic problems, either book chosen by the student would provide a rich array of thematic examples[3].

ICG and MG students would receive digitized copies of the aforementioned books—this distribution would take place following the first virtual meeting, which was exclusively dedicated to presenting the course plan and explaining the assessment activities.

Engagement of students based on minimum guidelines

Cooperative dynamics in teaching are widely evaluated in their potential across the literature. Noteworthy are the roles students must assume, the care taken in proposing work relationships among members that are effective (to encourage participation and ensure they feel motivated to express their ideas, for example), along with a series of "formulation and encouragement practices" (JOHNSON; JOHNSON; HOLUBEC, 1999, p. 37). Students should understand the materials they are studying, retain knowledge by explaining the relationship between what is being studied and prior knowledge, seek more information to clarify the fundamentals, and, by critiquing ideas (not their peers), experience a change of opinion when logically persuaded to do so. Dynamics such as "learning with colleagues" emphasize that cooperative learning requires students to "work together in small groups

[2] It is important to clarify that the option "Geografia: uma brevíssima introdução" would not yet be available during the first period of the experiment.
[3] Methodology manuals for geographers in Portuguese are rare, but the senior students were receptive to the proposal of reading books in English.

to support each other, to improve both their own learning and that of others" (JOLLIFFE, 2007, p. 39). The effectiveness of this approach, of course, requires certain key elements, such as individual responsibility, interpersonal skills, and face-to-face interaction. Furthermore, the unique circumstances in which physical proximity is absent do not always result in a loss: studies show that in-class discussions sometimes cause students to lose focus and pay little attention to others' contributions, whereas, in "online" discussions, students may engage more deeply, considering their peers' contributions and articulating their own ideas more carefully (LINN; DAVIS; EYLON, 2004, p. 62). Let's turn to our experiment.

The practical aspect of the courses required a "cooperative" interaction. The goal of this exercise was to help the freshmen recognize the practical and applied projections of scientific theory in concrete situations by learning about the research plans prepared by MG senior students. The idea was that, over four consecutive weeks, the seniors would act as "tutors" to the ICG students, demonstrating: (1) the spatial focus of their studies, (2) their methodological choices, in terms of concepts and tools, and (3) the criteria they applied in these decisions. These three elements were suggested to the freshmen as points to focus on during the dynamics; however, this suggestion was not disclosed to the seniors. The seniors received specific instructions about what to highlight in their presentations; that is, elements they were expected to explore when presenting their study plans (which were also not shared with the freshmen). For MG students, the aim was to develop didactic strategies to communicate their research intentions to a new university audience (who still had little knowledge of the nature of scientific practice in Geography). These intentions were to be presented in the form of: (1) the research objectives, (2) the justification of its relevance, (3) the theoretical framework they intended to adopt, and (4) the methodological structure planned for future execution (particularly the concepts and tools, already considering their respective utility). These were the four elements we explicitly recommended they explore in their presentations. Thus, the exercise posed an interesting challenge for the seniors: engaging them with the intellectual commitment of developing a research plan that was both coherent and persuasive.

They were given creative freedom to organize and facilitate the meetings. These could take place, for example, via virtual platforms (Meet, Zoom, Teams, etc.); simple tools like email exchanges or WhatsApp calls; audio or video recordings, which could then be shared as digital files or made available via links to a temporary hosting platform (such as YouTube). The only requirement was that there be at least one dynamic interaction each week for four consecutive weeks.

The tasks were thus set. Freshmen knew they had the goal of capturing three informational elements during their tutor's presentation, while the seniors knew they had to develop four key elements of their research proposal. Neither was aware of the other's goal—and we believed that ignoring the analytical parameter of their counterpart would serve as an interesting factor to later assess the degree of success (or failure) of this interactive learning dynamic, which was clearly defined by an intended alignment between missions and expectations. In other words, the exercise's effectiveness was expected to emerge naturally, without additional guidance.

To provide a framework for evaluating the success of the initiative, we asked all participants to write a report. Taking care not to overly direct the format of these descriptive reports, we gave them some basic guidance as a recipe for composing their experience narratives helping them, at the very least, to gather and organize the most essential data. From a general perspective, we requested that students describe, with as much detail as possible, how the interactions unfolded and what they were able to learn and conclude: freshmen were to focus on their tutor's research intentions, while seniors were to reflect on the feedback received from their "pupils." We hoped to draw some thoughtful conclusions as students revealed the steps they had taken and offered judgments about their experiences, imagining that the reports would convey assessments of the degree of satisfaction experienced (whether by the communicators or the observers).

Here are some of the recommendations made to the ICG freshmen:

(1) They were encouraged to note every detail that could enrich their description such as the dates and times of meetings (or material submissions), the duration of each weekly activity, and the type of resource used by the tutor;

(2) hey were asked to analyze their peer's arguments with attention and critical thinking to fully understand the research plan. Relevant questions included: (2a) What were the "motivations" for their choices (regarding the subject and spatial focus)? (2b) Is it possible to see the "context" of the research they intend to carry out (time, place)? (2c) Is there an "intention" to demonstrate or prove something (a fact, a trend)?

(3) They were also asked to critically analyze the steps their peer appeared to be taking for their future study. Valid questions included: (3a) Does their study plan seem to have a "logical organization" (are the concepts and intended tools coordinated)? (3b) Does their study plan include a "timeline" (i.e., stages to be completed within specific deadlines)?

We emphasized, however, that freshmen should feel free to incorporate other observations and ask creative questions according to their curiosities.

Here are the special suggestions we made to the MG seniors (advice that could help them right from the start in preparing or conducting interactive activities with the ICG students):

(1) hey should plan a clear way to communicate their intentions and decisions so that the freshmen could understand how they intended to execute, "in practice," the scientific study plan. Important points to address included:(1a) The general objective of the investigation, (1b) The relevance or positive outcomes they expected from the research results, (1c) The theoretical support they believed was essential for the study at that preliminary stage (authors, theoretical frameworks), (1d) The methodological structure that was, at least provisionally, outlined. This section should include not only the set of concepts they considered useful for the research but also two other pieces of information: the set of tools that would be critical for capturing or processing data, and a draft of the stages to be completed; that is, some idea of the logical order of actions.

Considering the four semesters of the experiment, around 160 students participated in the activities, including both ICG and MG classes (see Table 1). Initially, we aimed for the seniors' participation in the special communicative interaction with the freshmen to be voluntary. However, in practical terms, since not all seniors volunteered, we divided the ICG classes into "quotas" based on the actual number of MG students engaged in the activity. Since freshmen classes tend to be larger than the more advanced Geography classes, each MG tutor was generally responsible for an average group of four to eight ICG students.

Table 1 - Number of students involved in the experiment

	ACADEMIC PERIODS			
	2020/1	**2020/2**	**2021/1**	**2021/2**
nº *Freshmen* [**ICG**] (Adhesion to Activity)	[30] (83%)	[25] (59%)	[25] (83%)	[20] (77%)
nº *Veteran* [**MG**] (Adhesion to Activity)	[18] (24%)	[22] (14%)	[14] (43%)	[8] (13%)
	The total number of students [ICG + MG] participants in the experiment: **162**			

Fonte: Organizado pelo autor.

Analysis of the results: data obtained and balance of the effects on learning

In this section, we will present the points we identified as positive and problematic, doing so by commenting on the types of feedback observed in the reports. We will illustrate these points with

excerpts from the reports and highlight the particular characteristics of the research type they referred to.

Regarding the resources employed, we observed the use of platforms such as Teams, YouTube, Anchor, and Spotify (in many cases, for recording and hosting instructional videos or podcasts), the creation of WhatsApp groups (to facilitate quick consultations and optimize necessary notifications), as well as the sending of "PDF" files via email or the sharing of folders on Google Docs (usually text documents aimed at summarizing the theoretical foundations of the topic at hand).

There was a balanced proportion between synchronous and asynchronous formats. Overall, the possibility of watching recorded presentations at a more convenient time for peers was positively received. In some cases, seniors requested small readings and even the analysis of cartographic documents, encouraging freshmen to practice their interpretative skills.

Demonstrating the wide range of phenomena inherent to geographical science, the topics covered by the research projects were diverse. To illustrate, we will characterize three proposals.

One senior aimed to demonstrate the viability of 3D printers as an effective educational tool. Exploring the topic of "relief models," the student proposed a study to prove the applicability of this tool for creating models that address issues like watershed shapes and mountainous landscapes. The student highlighted several virtues, including the potential to bridge Physical and Human Geography (considering topics like topography and urban visualization), the underlying idea of promoting learners' agency in their own educational process, and the belief that geography as a field has the credentials to stimulate other cognitive faculties. As the student noted, the goal was "[...] to break the stereotype that Geography is only responsible for classifications and descriptions" (Excerpt from Senior Report, "TR-V").

Another senior proposed a study in the field of geomorphology, focusing on karst formations in a protected environmental area. Specifically, this was an investigation into the limestone tufa formations located in northeastern Goiás, near the headwaters of the Vermelho River, with the aim of examining the concept of "landscape heritage." The student emphasized the possible link between scientific studies and social values, highlighting the "need to protect" these natural environments. The senior demonstrated that a systematic investigation into paleoenvironmental reconstructions, once the karst dynamics were understood, could and should inform conservation projects for this crucial environment, which holds significance in tourism, economy, and culture.

This proposal stands out as a case of demonstrative success, even with the real risk that freshmen might not grasp the specialized nature of the study. Despite the technical depth, the senior successfully conveyed the significance of connecting the involved factors and the resources necessary

to understand their roles. Perhaps unintentionally, the student demonstrated the systemic structure of geographical science objects, linking this ontology to the utility of specific methodological tools for obtaining reliable descriptive information about landscape components. Many reports confirmed the freshmen's understanding of the research objectives, including the study of depositional environments' geochronology, the dynamics of carbonate concretion formation, and the correlation between these features and past events. Freshmen noted being introduced to systems theory, dating techniques, and key concepts such as "paleoclimate," "fluvial regime," and "conservation unit."

Illustrating a third proposal, a senior student aimed to analyze questionnaires filled out by incoming Geography students, conducting a survey to explore the doubts they might have about climatology. Her specific objective was to correlate these doubts with climatological events recorded in the last decade and reported by the media to the general public. The student sought to work with an interesting line of reasoning: to infer the role of the internet as a medium that, although it can and should disseminate scientific content, also contributes to the spread of “denialist views” (regarding atmospheric phenomena and climate change, in this case). It is interesting to note that there was a good understanding of the tutor’s objectives, perhaps beyond what she explicitly communicated. We infer this because, in her report, there are no indications that she emphasized the relevance of her study in a more direct way. However, we noticed in the freshmen's reports what seems to be an autonomous conjecture on their part - likely made possible by some level of explanation she provided, which ultimately proved successful.

> The researcher shows a keen interest in scientific dissemination, committing herself to tracking the unresolved questions of students and expanding the understanding of the interconnections between the environment and climate. In doing so, she contributes to a deeper comprehension of the topic and promotes the transmission of accurate information. (Excerpt from Freshman Report [“TR-C”]).

The inference regarding the success of veteran students in instructional communication: reports of freshmen

The cases that involved synchronous meetings successfully took advantage of online interaction, with veteran students facilitating dialogue and encouraging questions. Nevertheless, email exchanges were also widely used to address doubts, with reports from freshmen expressing satisfaction with their tutor's prompt responses and suggestions for further reading.

Notably, many students indicated that they understood the significance of the veterans' research objectives. For instance, some recognized the value of certain tools in enhancing the learning of

geology and geomorphology topics. In one case, a MG student conveyed the idea that technology-supported teaching can create opportunities for dynamic, experiential learning. This, in turn, led some students to appreciate the importance of "creativity" in teaching, highlighting a topic that could be further explored in teacher training.

It was interesting that the experimental exploration of physical geography topics suggested that the development of concepts in this field requires more than just textbooks. Geographic knowledge, therefore, extends beyond easily accessible reference materials, and it became clear that researchers should be mindful of how their specialized languages and methods are conveyed in media and taught in schools - particularly if these concepts are presented inaccurately or inadequately.

> I found the arguments excellent, as in this era of abundant information, people who have less skill or time to verify sources end up falling for fake news, which undermines responsible science, which is essential for our lives (TR-C).

There were activities that fostered the understanding of the richness inherent in the technical dimension of science. Demonstrating that many operations (such as handling databases) involve a modeling exercise that is crucial for obtaining interpretable results. Thus, we estimate that there was a good assimilation of the idea that scientific research in Geography involves the well-guided handling of data files and platforms for processing them (data related to topography, for instance). Regarding the involvement of technicalities in scientific practice, some freshmen demonstrated an understanding of the methodical care required in many scientific processes: "In the laboratory stage, the collected sample is sent to the corresponding laboratories. Here, special care is needed to avoid cross-contamination, which could alter the results" (TR-C).

As for the understanding that there is a procedural logic behind scientific practices, the reports were insightful. Saying that the chains of actions are "[...] paths to be followed to achieve the desired scientific objective" (TR-C) is an interesting perception of the importance of predefining a logical architecture for future investigative action. The reports showed clear signs of understanding the notion of "sequential steps" to be followed - an aspect made evident by the emphasis veterans placed on the tools that would be employed for data collection and tabulation, creating graphs, comparative analysis of results, and establishing relationships based on examining the magnitude of events (such as atmospheric ones) within time series. There were evident impressions of benefits from the activity, for both sides.

> The steps for building a well-structured project were presented, with solid theoretical sources and a clear motivation from the veteran. A timeline for completing each stage was well outlined [...] (TR-C).

> [...] this activity also helped me gain a broader understanding of the stages of development [...] As for the freshmen, I believe the outcome was also significant [...] guiding them in a meaningful way in terms of methodology and the development of their future final work (TR-V).

An interesting point, detected in almost all intervention plans and satisfactorily grasped by the ICG students, was the key role that literature reviews play in ensuring that the intended investigative actions are systematically organized. It was understood that it is crucial for the researcher to be confident about how well-supported or underexplored their topic is in the relevant literature (allowing them to confidently assess the originality of their study or the extent to which they must rely on other disciplinary fields). Additionally, they understood that multidisciplinary bibliographies can support the construction of knowledge in areas where the target issue is still relatively underexplored (such as studies involving the use of technological artifacts, where it makes sense for the researcher to examine how other fields have been utilizing the same tools).

Reports indicated a good understanding of the importance of seeking documented research experiences that highlight the phenomenon being studied or support the claims made about it. There seems to be a clear grasp of the importance of academic literature and the relevance of understanding "experiences already carried out" (TR-C) and how "the subject is viewed in the scientific community "(TR-C).

> To substantiate the highlighted solution, the clarification of concepts and actions is used, along with the analysis of previously documented cases. [...] The credibility of the research is enhanced by referencing observable examples [...] (TR-C).

This suggests that the veterans were able to clearly communicate the importance of indicating the contextual functionality of each type of bibliography to be explored, referencing books and dissertations relevant to the specific topics. Such literature, for example, supports evidence on how a given phenomenon is spread across different "regional contexts"—a demonstration approach intrinsic to geographic reasoning. It was commendable that some veterans advised using data sources that typically provide substantial support for examining issues related to agriculture, environmental sanitation, supply chains, housing, land division for construction, biome and water resource monitoring, park conservation, and food security. These involve types of data that hold explanatory power and should be utilized effectively by researchers to substantiate their claims, such as the explanatory potential in the so-called “indicators”—for example, economic production and water treatment indicators, which are highly useful in socio-environmental sciences. The exercise fostered

an understanding that the bibliographic search "[...] plays a fundamental role in the preliminary development of the theoretical base that will support the research to be conducted" (TR-C).

We observed cases where it became clear that biographical factors (personal experiences) tend to influence a researcher's choices and inclinations. This was evident when veterans, while justifying their thematic choice, revealed they were also motivated by experiential components: an affinity developed since basic education, participation in extracurricular university projects, or experiences in scientific initiation or pedagogical residency programs etc. It was also interesting to see, in certain reports, that freshmen spontaneously noted what they perceived as a diagnosis, suggesting that the veteran may have presented very legitimate investigative intentions but was perhaps driven to pursue the study due to a personal connection to the topic or method. Reports conveyed the perception that the veteran may have been personally affected by the nature of the study: "the project seems to have been created from a personal experience [...]" (TR-C); "[...] the tutor [...] highlighted her family history, where her mother and family come from a traditional community" (TR-C).

It would be excessive to automatically doubt the contributions that engaged research can offer in generating clarifying information (since such research can indeed support public policies of great social relevance). In dynamics like these, centered on teaching and learning about the nature of science, the most intriguing aspect is precisely allowing students to discover for themselves when a colleague's investigative intentions are ideologically motivated. From there, they can assess its effects: does such motivation necessarily undermine scientific validity?

As a reflection of a conclusive overview of the experience, the reports indicated a regular level of satisfaction. It was apparent that students gained a better understanding of what constitutes a scientific research project, particularly regarding its structure, organization, and format. Given the constraints of a pandemic and remote learning, the experience of grasping the "organizational nature" inherent in a research project was predominantly viewed as satisfactory: "Meeting during the pandemic has been a challenge, but with effort and persistence, everything worked out for both sides, and learning was the most important thing during these four weeks of meetings" (TR-C); "It was a pleasant experience that helped us better understand how to carry out this type of research. It also pointed us to some reliable sources for obtaining the necessary information for our work" (TR-C); "What interested me the most in this connection between us freshmen and the senior's presentation at the start of their thesis work was understanding the practical side of the studies and how they are conducted "(TR-C).

Findings of relative failures and unforeseen problems

There was a limited occurrence of a type of perception we had hoped for: the sense of "participation." We wished more freshmen had felt encouraged to interact with their tutor, even if it involved sharing uncertain opinions or technically flawed advice. Although this type of engagement wasn't as frequent as we had hoped, the reports did reveal an awareness among some freshmen that the presentation of topics was intended to help them develop their own understanding of the problem exercising inferential reasoning about potential correlations between the phenomenon in question and certain contextual factors (economic, health, cultural). While there were instances of understanding and a willingness to cooperate, this type of initiative was not widely observed: "He used the data that some students sent him, including mine, and we started to develop theories about the factors influencing [the phenomenon]" (TR-C).

Among the expressions of relative dissatisfaction were some predictable reports given the nature of the contact that could be established, and in some cases, explicit frustration due to insufficient interactivity - instances where certain seniors did not employ any synchronous resources. For example, there was a sense of a lack of deeper clarification regarding the theoretical foundations of the proposal, or the fact that the format of recorded videos made real "interaction" with the senior colleague impossible - which, we can deduce, was a desire of students who ended up not fully approving of the method chosen by the senior.

A practical element that was occasionally questioned concerned the duration of the videos: "[...] they were too short and his [senior colleague's] explanation was too direct [...] too summarized" (TR-C). However, this type of observation wasn't consensual, as there were also reports highlighting that the succinct format - short videos, "easy to understand" (TR-C) - aided in content assimilation. Regarding the duration of the proposed activities, few seniors held online meetings (recorded and hosted for later viewing) that lasted over an hour. While longer sessions don't necessarily guarantee quality, such a duration seems more suited to emphasize the essential details of each approach. Therefore, the feeling of insufficient clarification likely stemmed from the brevity of some interactions: "In general, the meetings weren't enough to put into practice and discuss the topic, leaving gaps that could have been filled with more sessions" (TR-C).

Another effect linked to the impression that activities could have been longer (or more frequent) was expressed through observations indicating a lack of clarity regarding the theoretical bases that the senior colleague claimed to have. Some reports indeed reflected dissatisfaction stemming from

an unclear explanation of the specific role each type of bibliography (sometimes merely cited) would play in supporting the researcher's understanding of the phenomenon or the applicability of a particular technical procedure mentioned for future use. Another related issue was a perception among some freshmen that the senior colleague showed considerable difficulty in providing an explanation for the phenomenon or, at the very least, committing to seeking evidence for future interpretative reasoning. This left some with the impression that the senior failed to offer "something more" beyond merely presenting a given situation - which can be quite frustrating for those expecting a project that promises significant revelations.

An unforeseen issue we encountered, as reflected in some reports, was the occurrence of interactions where the senior student ended up spending too much time (as the opposite extreme to other cases) on the exposition of the theoretical foundations of the subject in question. It appeared that the freshmen were more given a "lecture" on the topic rather than being clarified about the strategies for investigating specific aspects of it. Some reports suggested that while there was a wealth of information related to the problem being studied (which is undoubtedly important), there was not much explanation about the practical decisions needed to conduct a study that still aims to generate new information. This, we believe, may have led the freshmen to question: "What exactly does the senior still wish to discover, that they don't already know?"

The presentation of theoretical and technical content is sometimes essential to help the interlocutor understand the nature of the defined problem, as well as the variety of information already recorded by the scientific community that has focused on it. In this regard, introducing basic conceptual foundations, the history of the process or dynamics in question, existing legislation governing the phenomenon, and the techniques involved in the graphic representation of information are valuable points that could (and should) have been explored in some of the interactions. Indeed, there were reports where the students clearly understood the logical and demonstrative role of technical tools, such as cartography, which geographers traditionally use to spatially represent significant elements of their phenomenological analysis: "For a map to be recognized as a cartographic document, it needs a scale, title, legend, orientation, and projection" (TR-C).

The ideal, however, would have been for the senior student to carefully balance how much time to dedicate to this broad explanation - something not everyone considered. A good example of someone who successfully grasped the main goal of the interactive dynamic was:

> With the activity involving the ICG students, I realized that the content itself wasn't as important, since for some of them this must have been their first contact with certain geographical concepts. The main goal of the dynamic was to highlight the importance of Geography and to demonstrate how it is a science that can branch into various fields (TR-V).

This balance of pros and cons seems to suggest that, when exceptional didactic ventures are at play, the exposure to risks tends to increase if the teacher decides to explore unfamiliar resources outside their regular teaching routine. This means that, although learning successes may be observed, they should not absolve the teacher from identifying setbacks, highlighting them, and reflecting on ways to mitigate their effects in future circumstances.

Final considerations

In recent semesters, social distancing has imposed several didactic-pedagogical challenges on higher education agents. In this account, we present the learning outcomes achieved through an initiative that promoted virtual interaction between students from different disciplines and semesters. We anticipated that experiencing interaction with peers from different levels of study would provide a promising benefit: the participating students would be able, in a relatively autonomous way, to understand the "nature of geographical science" beyond the traditional, essentially theoretical approaches.

The interaction between peers confirmed the heterogeneous nature of Geography as a field. Preliminary projects were presented on the spatial expression of cultural activities, the utility of cartographic software, the relationship between political phenomena and territorial dynamics, the special branches of biogeography, the explanatory principles of meteorological phenomena, the logic underlying map construction, and more.

From a general perspective, there was good participation in the activities, as evidenced by attendance at virtual meetings. Senior students reported, in their logs, the number of "accesses" and "views" of the audiovisual documents they had made available. From an optimistic standpoint, we became convinced that the interactive activity, at the very least, helped participants assimilate two dimensions of scientific practice: the commitment to a systematic order of actions (presuming that participants associated this value with the logical and cognitive aspects of scientific reasoning) and the influence of the contextual environment on the direction scientists give to their studies (presuming they understood that scientific work is not immune to sociological factors).

Regarding this second dimension, it is likely that, in response to certain topics, freshmen may have questioned the level of "objectivity" their senior peers applied in conducting their scientific studies. Could they be influenced by moral, religious, or political perspectives? This is a rich point

for evaluating the presence of axiological factors in scientific practice - a topic covered in our ICG and MG curricula. We hope the students recalled this during their interactions.

Even if not entirely deliberate, the activity also facilitated awareness of certain elements of the psychology of science. Through the proposed practical experience, the value of the efforts of early-career researchers was highlighted: the presence of risks and difficulties, with students witnessing a peer facing obstacles - a reality inherent in every scientist's work. A simple struggle in precisely defining the research topic (and the persistence required until it is clearly articulated) can convey the message that scientific work also involves motivational components. This is particularly interesting in the dialogue between epistemology and methodology.

It is important, however, to highlight potential issues that emerged during the four seasons of the experiment's application. We believe that, rather than concluding this report by emphasizing the detected advantages, it is crucial to expose the risks that were saliently manifested. These insights can help us, as educators and researchers in science teaching, consider the necessary adjustments for future iterations. One significant setback is worth mentioning.

Some research projects, due to the nature of their topics, exposed freshmen to the risk of becoming more captivated by the appeal of the subject matter itself, potentially causing them to lose sight of the systematic organization required in an investigative project. This means that, despite the senior student not deliberately intending it, their audience may have been drawn in by the allure of the issues involved in the topic (such as approaches touching on political or environmental aspects). In this case, we must acknowledge that the theoretical introduction we provided in MG was not clear enough to guide the seniors effectively. It would be necessary to refine this aspect to ensure that they remain focused on transmitting what is most important: organizing a study that can conclude something about the problematized topic and demonstrating the viability of specific conceptual tools and technical instruments.

In an honest assessment, we would say that the well-communicated points were (1) the logical organization of research and the sense of order in the actions, and (2) the usefulness of the concepts and instruments to be adopted. Problematic, however, were the signs of failure (1) in exposing the criteria applied in theoretical and technical choices, and (2) in presenting the "intentions" behind the study—since, apparently, the "motivations" of the senior student were more visible.

Thus, while generally fruitful, the experiment, if replicated, would require us to provide much clearer instructions to each group, especially the senior students. An instructional reinforcement - perhaps simulating interactions in advance of the actual interactive dynamics - could optimize the learning outcomes for the freshmen.

Finally, it is essential to stress a problem many of us encountered during the remote teaching experience: the economic challenges faced by our students. Although the University of Brasília made efforts to alleviate the difficulties many students would face during social distancing (such as financial aid for purchasing internet packages), not all students have access to a comfortable home environment, nor reliable internet connections or technological devices (mobile or desktop) that are readily available to them at all times. This issue transcends, of course, the nature of the experiment itself. Nevertheless, it is crucial that we remain mindful of this type of external factor, which must be considered in the planning of our future teaching practices.

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