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PROJETO REMOTE DESIGN STUDIO: RELATÓRIO FINAL

REMOTE DESIGN STUDIO PROJECT: FINAL REPORT

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Abstract

This paper presents the final report of the Remote Design Studios (RDS) Project. It gathers the results of a survey conducted on teachers of architecture, urbanism, and landscape design at higher education institutions. A consultation gathered information on remote online design teaching activities during the first academic semester of the Covid-19 pandemic. The survey was carried out by researchers from Nomads.usp - Center for Interactive Living Studies of the University of São Paulo, Brazil, from June to August 2020, and included 166 respondents from institutions in 14 countries. This report presents information referring to respondents from Brazilian educational institutions located in 14 states. The methodology included a consultation through an online questionnaire, a gathering of student design exercises made available by some interviewees, and the collection of suggestions for computational applications especially suitable for remote design processes.

Keywords: Design teaching, Remote teaching, COVID-19, Survey

The Remote Design Studios Project provided questionnaires to interviewees in Portuguese, English, and Spanish, which are available at:

Portuguese: https://bit.ly/3eDAQCC
English: https://bit.ly/3i5daJt
Spanish: https://bit.ly/2ZdVCSL

1 Introduction

The new coronavirus pandemic has influenced social relationships in different aspects of everyday life. The new reality imposed restrictions on the use and access to collective spaces, where intense exchanges between individuals used to take place. Academic activities are among those that have been subject to suspension restrictions since March 2020. In May of the same year, the International Institute for Higher Education in Latin America and the Caribbean (UNESCO IESALC) estimated in a report that, only in this region, the temporary closure of higher education institutions had already affected 23.4 million students and 1.4 million teachers. At the time, this meant "more than 98% of the region's higher education student and teacher population." (UNESCO, 2020, p. 12).

In Brazil, the Ministry of Education Ordinance No. 343 authorized, since March 17, 2020, "exceptionally, the substitution of face-to-face in-progress courses, for classes that use information and communication means and technologies" (Brasil, 2020, our translation). Although this ordinance addresses the higher education institutions of the Federal Education System, public and private institutions in the states and municipalities also had to follow it. Some of them have simply suspended teaching activities, while several public and private institutions have implemented a remote teaching modality that differs from face-to-face classes and the commercially-known distance learning or EAD in the Brazilian acronym.

In such a context, Nomads.usp - the Center for Interactive Living Studies, from the Institute of Architecture and Urbanism of the University of Sao Paulo, Brazil, conducted the research project Remote Design Studios (RDS), surveying teachers of architecture, urbanism, and landscape design on their modes of communication and didactic-pedagogical procedures in remote undergraduate courses taught during the first semester of the Covid-19 pandemic[1]. The consultation was carried out through an online questionnaire, available in Portuguese, Spanish, and English. This report aims to make publicly available part of the raw data obtained from the responses to the questionnaire, which were received between June 24 and August 10, 2020.

Dr. Patrícia Alejandra Behar, Full Professor at the Faculty of Education of the Federal University of Rio Grande do Sul, Brazil, and researcher on pedagogical models for Distance Learning and Informatics in Education, says that in the context of the coronavirus pandemic

> It was necessary to think about Internet-mediated pedagogical activities, punctual and applied according to the restrictions imposed by Covid-19, to minimize the impacts on learning arising from in-person teaching. The curriculum of most educational institutions was not designed to be applied remotely. (Behar, 2020, our translation, emphasis added)

Students and teachers had to face doubts and uncertainties arising from the need to adapt face-to-face activities to the remote mode. Although such adaptations have been implemented in the various areas of knowledge, we highlight significant impacts for the courses and activities in theoretical-practical training. The warning had already been pointed out in May 2020 in an IESALC report:

> We must also consider that those subjects which include the development of professional competences through practice (clinics, pedagogical residencies, design careers, engineering, science, and generally all those heavily dependent on practical workshops, laboratory work, or institutional practices) are a source of greater uncertainty, which will lead to a number of differentiating effects at each university, and on a systemic scale. (Unesco, 2020, p. 25, emphasis added)

Indeed, since face-to-face activities were suspended at universities, the teaching of architecture and urbanism and, especially, the teaching of design faced the question of how to carry out remotely activities that are typically guided by practices and discussions. They involve means, such as the design and production of models (both physical and digital), that are commented on, criticized, and reworked collectively and synchronously. Besides, the training of architects and urban planners often involves field and construction site visits. Such activities put students and teachers in contact with other agents and stages of the design and production processes, whether on an architectural, urban, or landscape scale.

On the other hand and out of campuses, there is a practice little systematized and little known in Brazil, which involves architects working remotely in architecture offices, especially in industrialized countries, since before the current pandemic. They work both on large international projects or local-scale interventions and rarely meet teammates in person. This practice was already supported by BIM applications and videoconferencing discussions and has become a reference this year for, for example, French offices required by law to telework (Crabié, 2020). The assertion, much heard among design teachers, that it is not feasible to teach architectural design in remote mode, is thus opposed to the question "How to train architects to compose such teams, qualified to develop collaborative projects at a distance?".

This report is structured into three main parts: 1] the project goals, 2] the methodological procedures employed, and 3] the results. The objectives and methodological procedures are described in specific items (items 2 and 3, respectively). The results presentation is divided into three items that aim to: characterize the respondents (item 4); present a reading of the responses highlighting the most expressive percentages for each question (specific to respondents attached to Brazilian educational institutions, item 5); and present a collection of applications suitable for online design discussions (suggested by respondents from Brazilian and foreign educational institutions, and by Nomads.usp researchers, item 6).

2 Research objectives

This survey was intended to consult teachers and professors of architecture, urban, and landscape design on modes of communication and didactic-pedagogical procedures in remote online undergraduate courses taught during the COVID-19 pandemic. The querying involved faculty members from schools of architecture in Brazil, Latin America, and further countries, and had as main goals:

i. Producing an overview of remote teaching modes of architecture, urbanism, and landscape design during the COVID-19 pandemic;

ii. Contributing to the formulation of remote design courses to be offered during the confinement period;

iii. Expanding reflection on online collaborative activities in design teaching;

iv. Contributing to the discussion on the inclusion of face-to-face/remote hybrid structures in regular design courses;

v. Stimulating dialogue on this topic, by disseminating results in academic circles.

3 Methodological procedures and activities carried out

The main methodological procedures were a consultation through a questionnaire, the systematization and analysis of collected data, and an exploratory investigation of computer applications. The activities carried out included: 3.1. The questionnaire preparation and dissemination; 3.2. The reading, systematization, and analysis of collected data; and 3.3. The testing and exploration of computer applications.

3.1. The questionnaire preparation and dissemination

The online questionnaire was prepared using the Google Form tool. Questions were defined in a remote meeting of the project's researchers. In addition to respondents' personal and professional information (name, e-mail, and institution), the final questionnaire included questions of the following nature:

i. On the activities carried out: These questions refer to the exercises' scale and scope, and the nature of the activities performed. For each question, a comprehensive list of answers was presented, and respondents should indicate pertinence by choosing between the Yes or No answer options.

ii. About computer applications: These questions refer to using computational applications for the representation and modeling of projects and communication between students and teachers in remote activities. In the lists of computer programs and communication applications presented, respondents should indicate their use according to the categories: Mainly, Complementarily, and Not used;

iii. On the courses' dynamics: These questions refer to the courses' structure and the classes' dynamics. To answer these questions, respondents should select an alternative from a pre-defined list;

iv. On the students and their resources: These questions refer to the attitude of students in remote activities, as well as the resources they had available according to the respondents' assessment. Questions should be answered with Yes or No;

v. Preliminary assessments: These questions sought to stimulate the respondents' perception of the activities performed. After reading statements about the activities carried out and their products, respondents should indicate their degree of agreement by selecting one of the following options: I fully agree, I partially agree, I tend to disagree, or I totally disagree.

In addition to multiple-choice questions, two written-response questions have also been proposed. One of them requested the indication of specific communication applications suitable for design discussions (the possibility of drawing on students' drawings, the possibility of drawing by hand, etc.). The other question asked respondents to make suggestions on how to improve remote design teaching courses.

The questions for each thematic axis were developed by the project researchers and, once defined, were made available to all Nomads.usp researchers. At this stage, all researchers at the Center, in different degrees of training, could evaluate and criticize the questions and make suggestions. After this step, the link to the questionnaire went to public disclosure, as well as a presentation text and an official flyer. The release was carried out according to three strategies: by publishing on Nomads.usp social networks and by Nomads.usp researchers; by sending e-mails to graduate programs in Architecture and Urbanism, and to directors of undergraduate courses, asking them to forward the message to potentially interested people; and by sending individual e-mails to teachers in Brazil and abroad, selected in the proceedings of scientific events, and from websites of higher education institutions that offer training in architecture and urbanism.

3.2. The data reading, systematization, and analysis

After publicizing the questionnaires between June and July 2020, the responses received until August 10, 2020, were read and systematized. Data systematized in spreadsheets generated graphs that are presented in topics 4 and 5 of this report. The answers to the written question on suitable applications for design discussions helped to fill in the table presented in item 6. The answers to the written question on suggestions for improvement of remote design teaching will not be included in this report. We recommend reading the article "Remote online, design teaching: lessons from a pandemic" (TRAMONTANO et al., 2020, Portuguese only), which is dedicated to discussing the respondents' suggestions.

3.3. The testing and exploration of computer applications

A list of computational applications used by teachers in design teaching practices has been developed from the interviewees' responses. Some applications were selected for a further exploratory phase, conducted by the project's research team. The selected applications should simultaneously offer resources for communication and representation and discussion of architectural projects. For testing them, synchronous communication sessions were held between researchers, using the suggested programs and architectural and urban planning projects.

4 About the respondents

The questionnaire targeted teachers from public and private higher education institutions in Brazil, Latin America, and abroad. At the end of the disclosure period, 655 e-mails had been sent inviting teachers to answer the questionnaire. Of these e-mails, 359 were sent to teachers from Brazilian educational institutions, 220 to teachers from institutions in other countries in Latin America, and 76 from countries in other regions of the globe. By August 10, 2020, the questionnaire had gathered 166 respondents: 124 of them from Brazil, 34 from other Latin American countries, and 8 from countries in other regions.

The number of respondents covers 14 countries, i.e. Brazil and 7 other countries in Latin America, and 6 countries in other regions of the world. In the case of Latin America (excluding Brazil), the group of respondents covers 17 educational institutions, and Colombia is the country with both the largest number of respondents in the region (12 respondents) and the largest number of institutions represented (5 institutions). Also represented Latinamerican countries (excluding Brazil) are Mexico, Peru, Argentina, Chile, Uruguay, and Ecuador. Figure 1 presents a complete picture of the countries with the number of respondents and institutions.

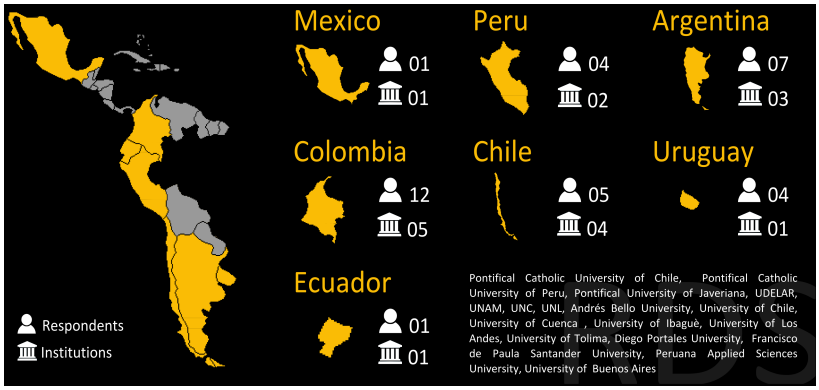

Fig. 01: Latinamerican countries (excluding Brazil) highlighting those who had respondents in the poll. Total of respondents and institutions by country, in addition to the list of institutions in the lower right corner. Source: Authors, 2020.

Regarding Brazil, the number of respondents covered 14 states, from 4 macro-regions (Northeast, Midwest, Southeast, and South). The group totals 124 respondents from 62 institutions. The state with the highest number of respondents is São Paulo, with 63 respondents from 23 institutions. Among the Brazilian institutions that had respondents, 73% are private and 27% are public. It is also noteworthy that 14 major Brazilian public institutions sent us important information, despite not offering remote courses in the first half of 2020.

The public institutions with the highest number of respondents were the Faculty of Architecture of the University of São Paulo (FAU-USP), followed by the Federal University of Mato Grosso do Sul (UFMS) and the State University of Campinas (UNICAMP). Among private educational institutions, those with the highest number of respondents were Mackenzie Presbyterian University, Paulista University (Unip), the Catholic University of Minas Gerais (PUC-MG), and the Catholic University of Rio de Janeiro (PUC-RJ). Figure 2 presents information about institutions and respondents in Brazil, as well as the list of universities that had respondents until August 10, 2020.

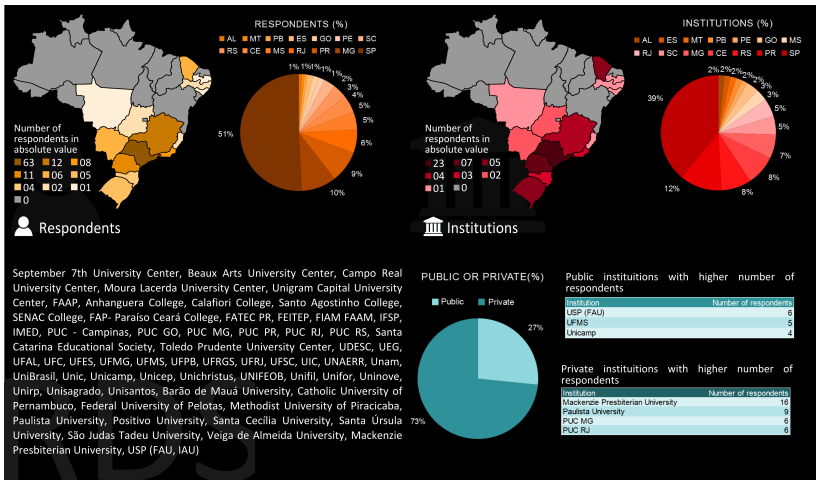

Fig. 02: Respondents by Brazilian state, by type of institution private or public, and list of participating institutions. Source: Authors, 2020.

5 Replies

This item presents the graphics resulting from the responses to the questionnaire. We introduce the questions and highlight in the text which answer options were indicated by at least half of the respondents. In the questions that propose a gradation to express the degree of agreement, we highlight both the options with the highest number of respondents and those with the least amount.

5.1. On the characterization of the courses' activities

For the question: What was the scale and scope of the exercise(s) developed with the students? Through the options, Yes or No, respondents should indicate which following project scales were considered: Architecture (building design); Urban Project (design of urban fragments); Urban Planning (territorial planning); Landscaping (design of open spaces).

Respondents could indicate one or more categories, so that the options Architecture (building design) and Urban Design (design of urban fragments) were indicated as Yes by more than half of the respondents – 75.8% and 60, 9%, respectively. Figure 3 presents the graph with the percentages of all categories.

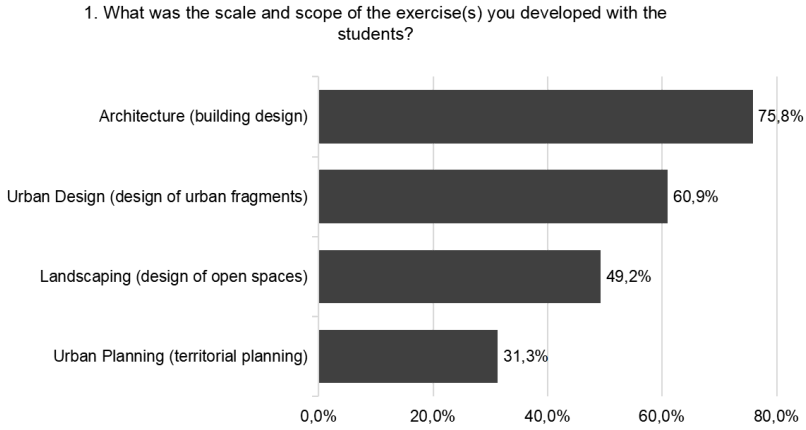

Fig. 03: Graph with the percentage of respondents who indicated the option Yes in each of the categories presented for the scale and scope of the proposed exercises. Source: Authors, 2020.

For the question: What was the nature of the activities carried out? Through the options, Yes or No, respondents should indicate which one(s) of the six groups of procedures applied.

More than half of the respondents responded Yes for all the available categories. Percentages range between 92.2%, for the category Collection and organization of information as a subsidy for the project, and 64.1%, for the category Digital modeling of urban areas or existing buildings. Numbers for all categories are shown in figure 4.

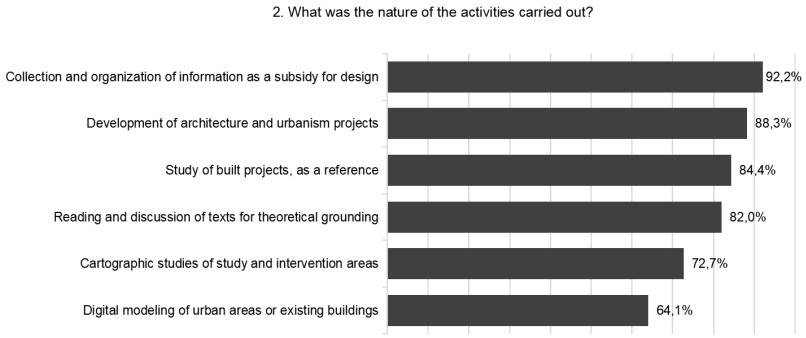

Fig. 04: Graph with the percentage of respondents who indicated the option Yes in each of the categories of proposals for the nature of the activities carried out. Source: Authors, 2020.

5.2. On computational programs

Regarding computational means, a question asked: What computer programs were used to carry out the activities? The list of choices offered six categories of computer programs that allow drawings and modeling of architectural projects. The categories Drawing by hand with an instrument, Hand drawing without an

instrument, and Others were also available. For each category, respondents were asked to indicate whether they have been used Mainly, Complementarily, or Not Used at all.

The categories Graphic Programs for technical drawing and Graphic Programs for modeling were the only ones which have been indicated as being used Mainly by more than half of the respondents. None of the categories was indicated as Complementary use by more than half of the respondents, and the category Parametric Modeling programs was the only one which was indicated as Not Used by more than half of the respondents. The entire graph is shown in figure 5, below.

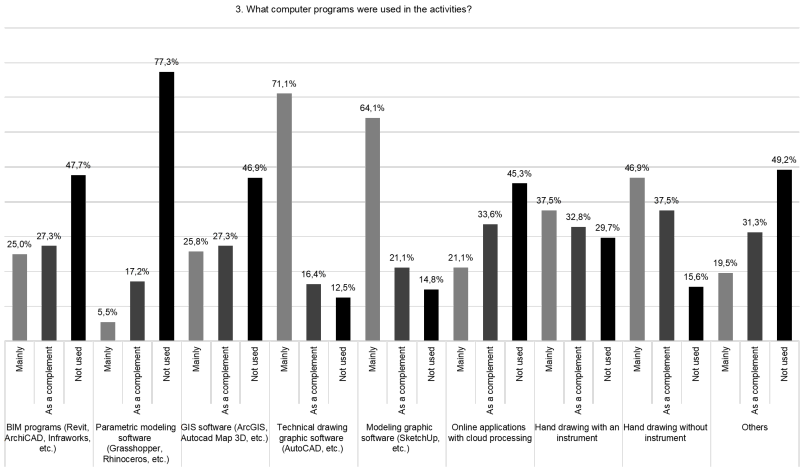

Fig. 05: Graph with the percentage of respondents who claimed to use Mainly, Complementarily or Not to use the means considered, in addition to the option Others to indicate the use of means that had not been indicated in the questionnaire alternatives. Source: Authors, 2020.

Next, respondents should answer the question: What applications were used for communication between teachers and students? As in the previous question, respondents had access to a list of applications – in addition to the option Others – and should choose among the options Mainly, Complementarily, or Not used, considering a set of indicated applications.

None of the programs was indicated by at least half of the respondents as having been used Mainly. However, Google Meet and Zoom platforms got the highest referrals – 43.8% and 43.0%, respectively. Also for the Complementary use option, none of the applications were indicated by more than half of the respondents. The option Not used was checked by more than half of the respondents in eight of the eleven options indicated. Final numbers can be accessed in figure 6.

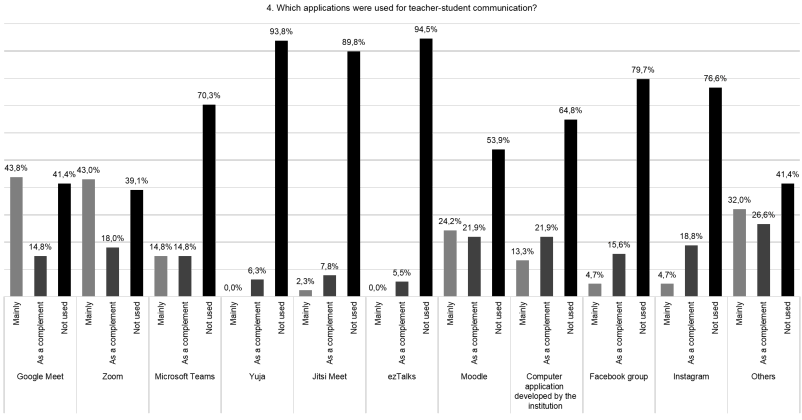

Fig. 06: Graph with the percentage of respondents who claimed to use Mainly, Complementarily or Not to use the applications, in addition to the option Others. Source: Authors, 2020.

5.3. On the disciplines dynamic

Regarding the courses' dynamics, two questions were initially asked: 1] The FACE-TO-FACE course exercises are usually done individually or in groups? and 2] The ONLINE course exercises were done individually or in groups?. For each of the questions, respondents should indicate whether the exercises were performed individually, in pairs, or groups.

Although the percentages are different in the face-to-face and online courses, in both cases most respondents indicated that the exercises occurred in groups (54% in the face-to-face and 45% in the online mode),

followed by the percentage of individual exercises (34% in the face-to-face modality and 41% in the online modality) and, finally, exercises in pairs (12% in the face modality and 14% in the online modality). Figure 7 shows the graphs with the answers.

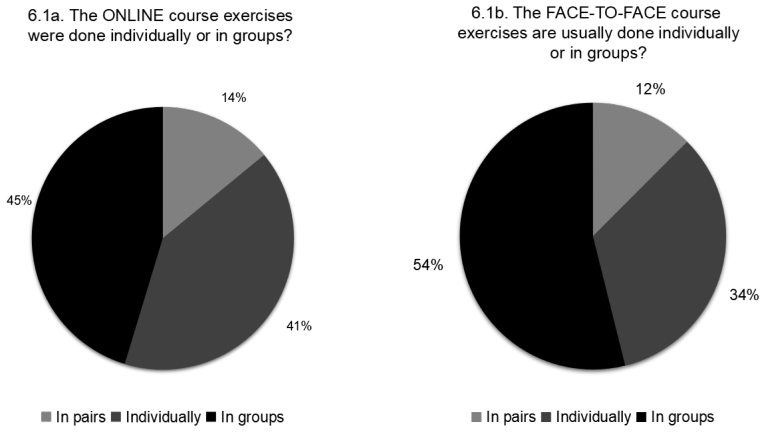

Fig. 07: Graphs with the percentages indicating the number of students in the activities carried out in the online and in-person modalities. Source: Authors, 2020.

The following question was asked regarding the *online* course: How many students are there in the class? Respondents should choose between four intervals as explained in the subtitle of the graph in figure 8. Most respondents (56%) indicated that their class had 30 students or less, followed by 32% who indicated classes between 31 and 50 students. The remainder 6% of respondents indicated that they had between 51 and 70 students in their classes, and another 6% indicated that they had worked with classes with more than 100 students. Other choices had no mention. The corresponding graph is in figure 8 below.

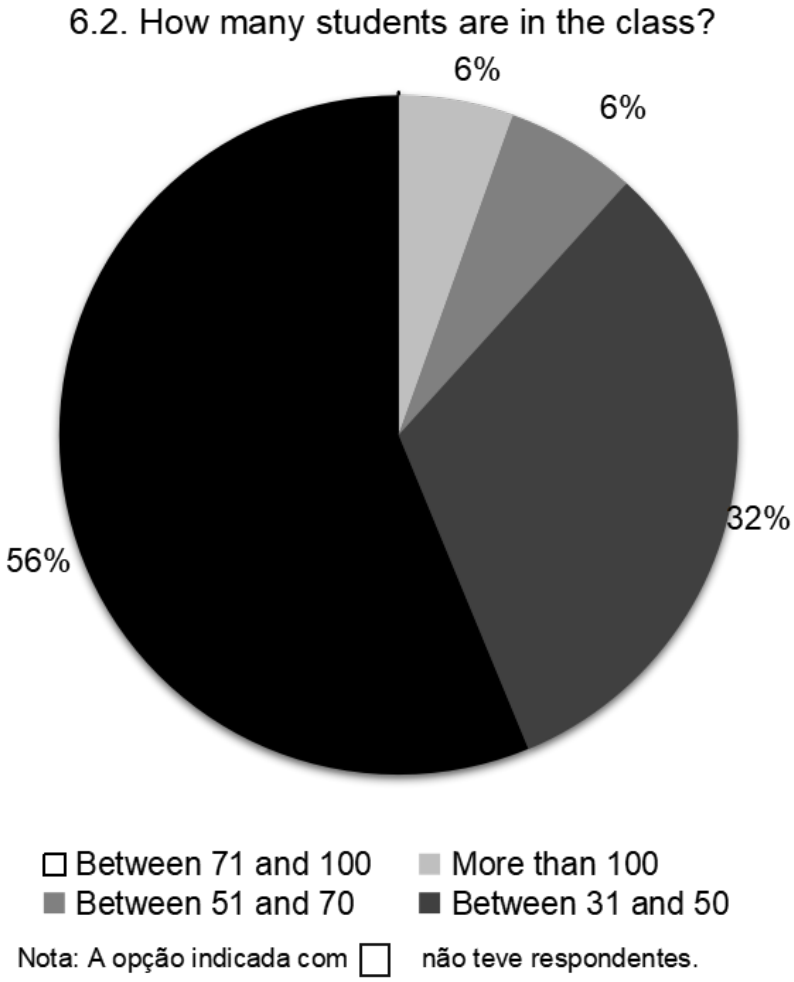

Fig. 08: Graph with percentages indicating the number of students in the classes of remote activities. Source: Authors, 2020.

About the length of the exercises, interviewees were asked: How many weeks did the exercises last? None of the options was indicated by at least half of the respondents. However, among the 9 options proposed, according to the subtitle of the graph in figure 9, the sum of the first 3 options with the highest number of

respondents exceeds 50%. The options with the highest number of respondents were 4 to 5 weeks (21%), less than 4 weeks (20%), and 15 to 16 weeks (16%).

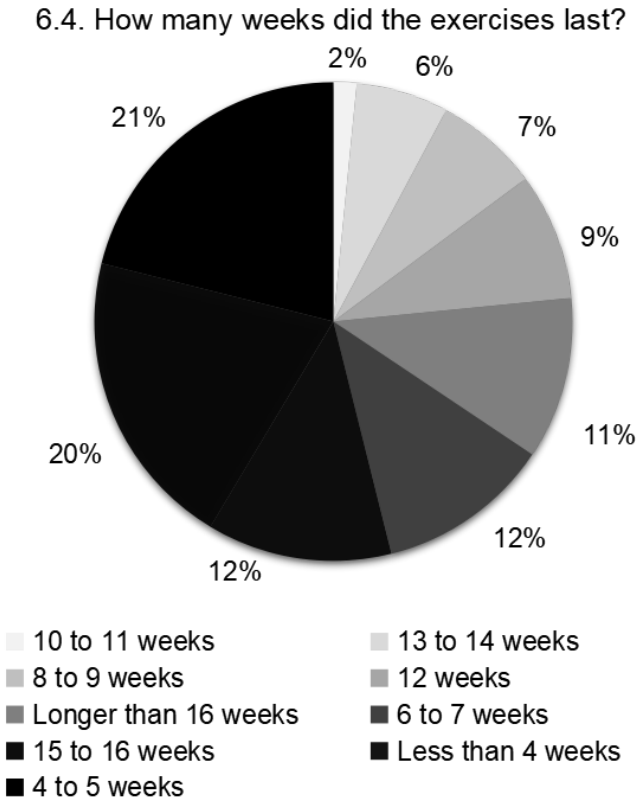

Fig. 09: Graph with the percentages of respondents for the length of the proposed exercises. Source: Authors, 2020.

Regarding the frequency of consultations, the question was asked: How often did each student or group have a work session with the teacher(s)? The Weekly option was chosen by 87% of the respondents, and the remainder answers were distributed among the rest of the options, as shown in the graph in figure 10.

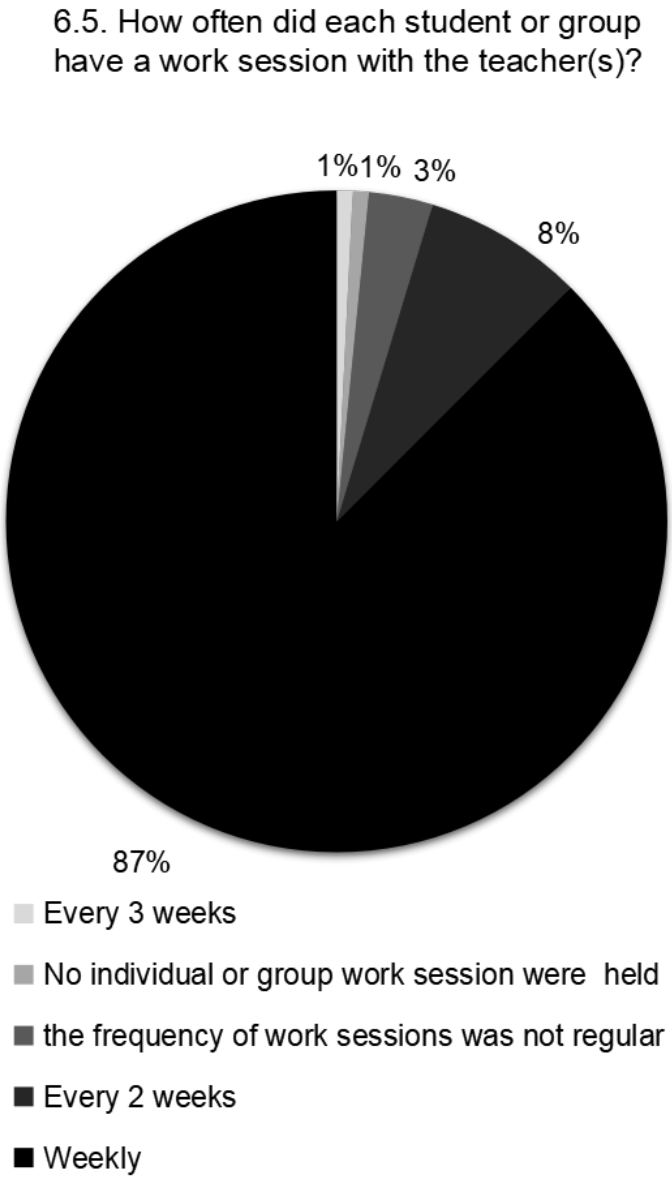

Fig. 10: Graph with the percentages of respondents for the duration of the proposed exercises. Source: Authors, 2020.

Regarding the length of each guiding session, interviewees were asked: In general, how long did each work session last? The option Less than 30 minutes was indicated by 52% of respondents, followed by 29% who indicated that the sessions lasted between 30 and 45 minutes, and by 8% who indicated the guiding sessions lasted more than 120 minutes. The percentages of all options are shown in the graph in figure 11.

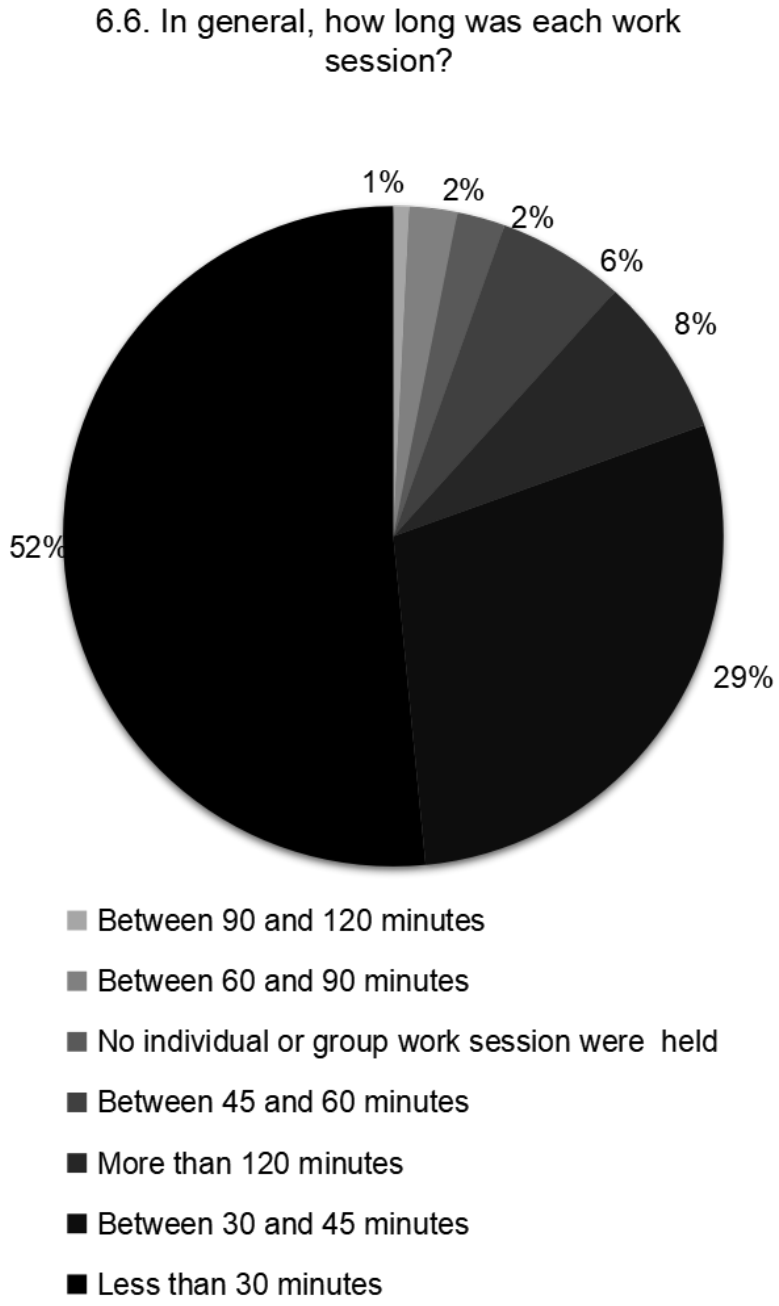

Fig. 11: Graph with the percentages of respondents for the duration of visits. Source: Authors, 2020.

5.4. On the students and their resources

This set of questions raised data on students' participation in the proposed activities. The questions sought to find out if the institutions carried out surveys to know the reality of students in their home environment, what was the students' attitude towards the proposed activities, and how the interviewees classified the students' resources to carry out the activities.

Regarding the conduct of surveys with students, the following question was asked: Was a survey conducted with students to map their work-at-home conditions? Respondents should choose between Yes or No, so 58% indicated the answer No, and 42% indicated the answer Yes, as shown in the graph in figure 12.

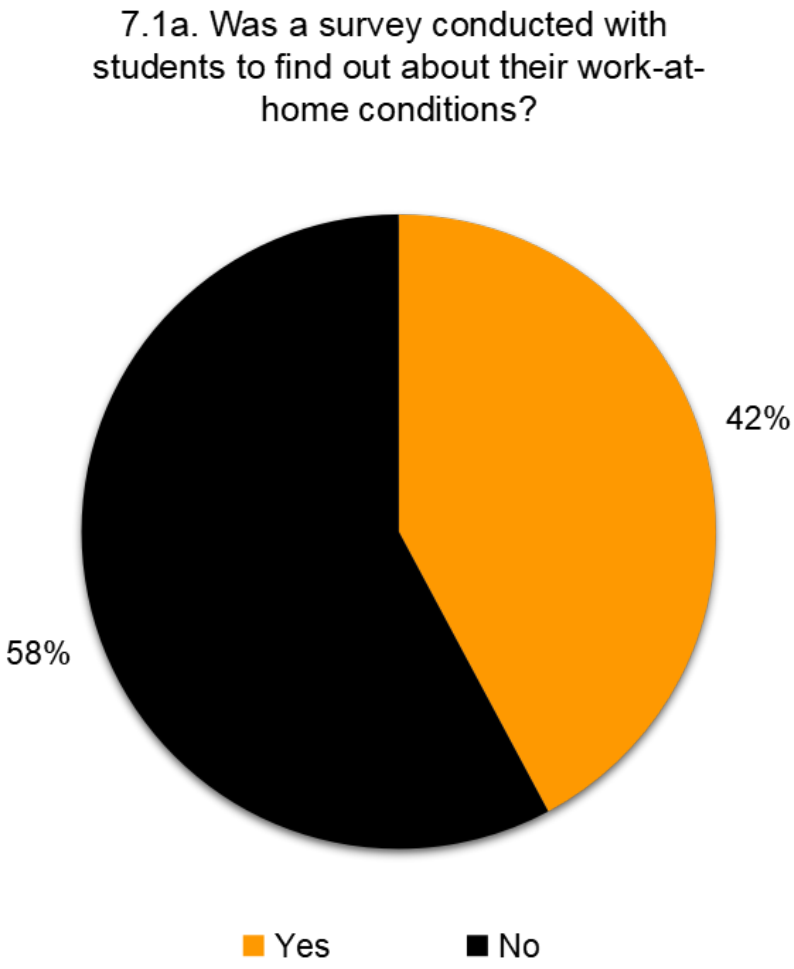

Fig. 12: Graph with the percentages of Yes and No of respondents for the question about surveying students. Source: Authors, 2020.

Additionally, the following question was asked: If so, would it be possible to have access to the questions and results? In this case, 80% of respondents indicated the answer No, and 20% indicated Yes, as shown in the graph in figure 13.

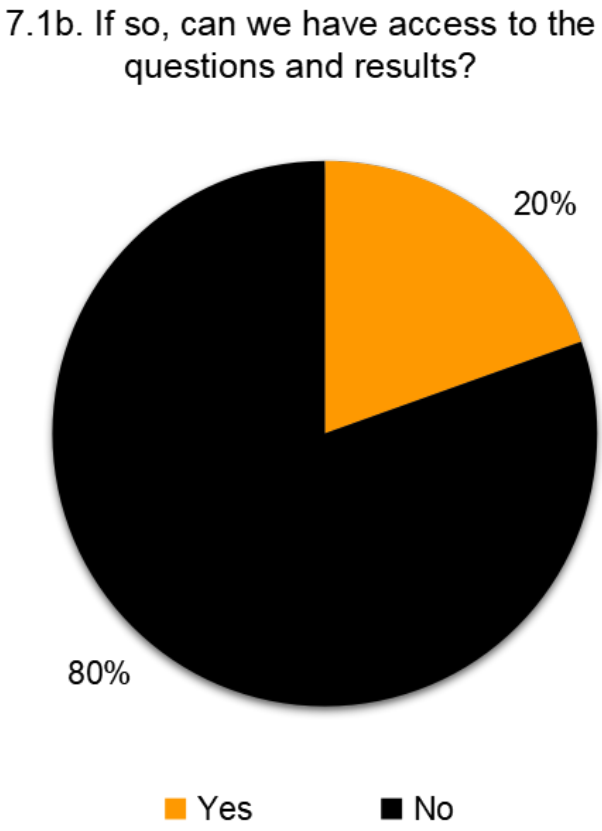

Fig. 13: Graph with the percentages of Yes and No of the respondents for the question about giving the researchers access to the survey results with the students, if it exists. Source: Authors, 2020.

Regarding the respondents' impression of the students' attitude towards the proposed activities, the following question was asked: Was there any resistance from the students to the new activities proposed by the teachers? In this case, 70% of the respondents indicated the option No and 30% indicated Yes, as shown in the graph in figure 14.

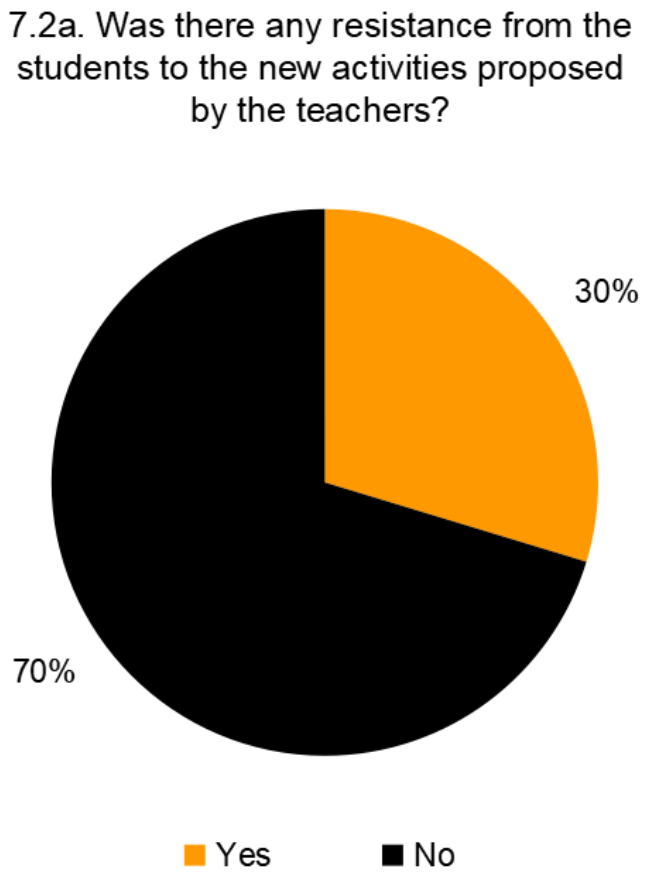

Fig. 14: Graph with the percentages of Yes and No of the respondents about some resistance of the students to the new activities proposed by the teachers. Source: Authors, 2020.

Regarding the influence of the students' resistance to the proposed activities, the following question was asked: Did this resistance prevent/delay/hinder the activities? In this case, 81% of the total respondents answered No and 19% answered Yes, as shown in the graph in figure 15.

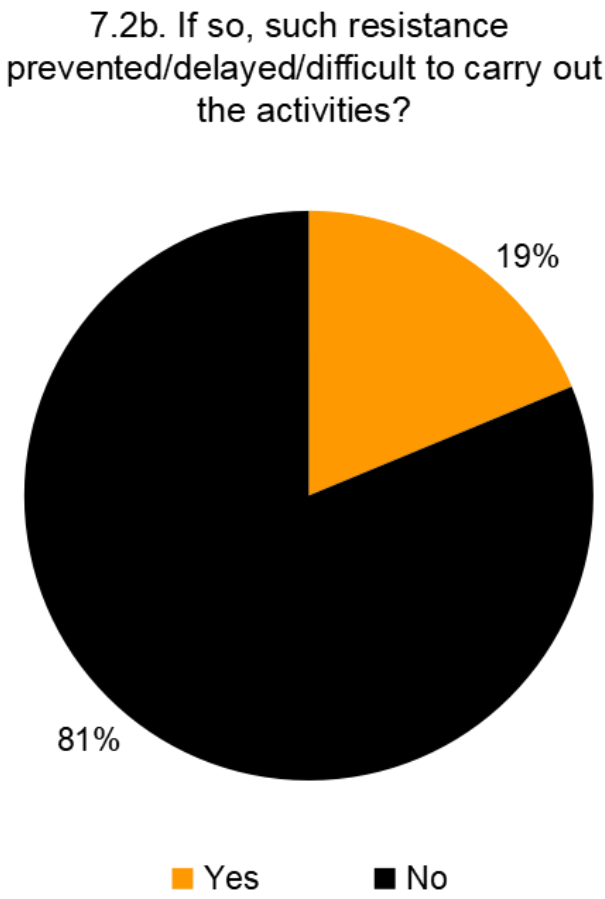

Fig. 15: Graph with the percentages of Yes and No of the respondents for the question about the influence of the students' resistance to the proposed new activities. Source: Authors, 2020.

About the students' dedication to remote activities, the following question was asked: Was the students' dedication more remarkable than in the face-to-face course? The answer No was chosen by 55% of the respondents, and 45% indicated the answer Yes, as shown in the graph in figure 16.

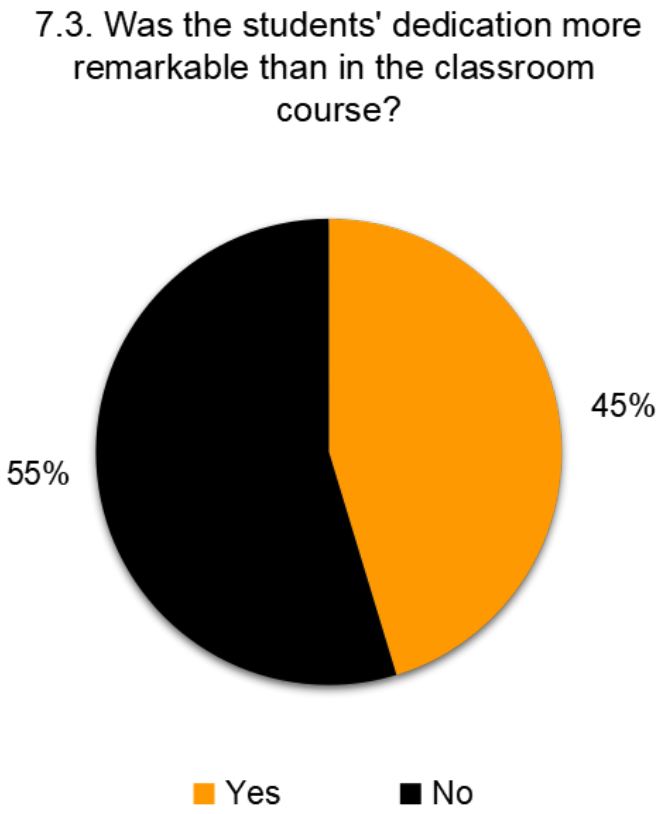

Fig. 16: Graph with the percentages of Yes and No of the respondents for the question about the dedication of students in a face-to-face course. Source: Authors, 2020.

Regarding the students' resources to carry out remote activities, the following question was asked: Did most students have a suitable computer? The answer Yes was chosen by 79% of respondents, while 21% indicated the answer No, according to the graph in figure 17.

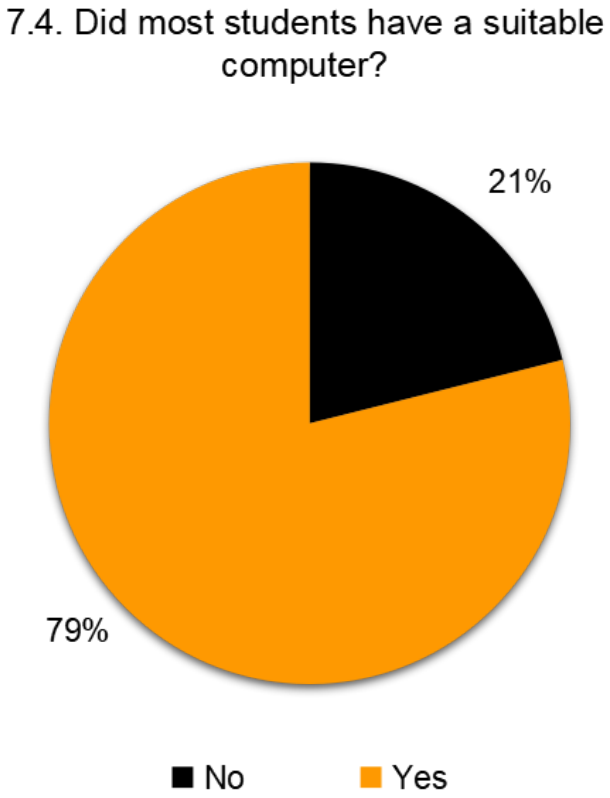

Fig. 17: Graph with the percentages of answers Yes and No for the question about the majority of students having an adequate computer. Source: Authors, 2020.

Still, about the students' resources, the following question was asked: Did most students have an adequate Internet connection? For this question, 75% of respondents indicated the answer Yes, while 25% indicated the

answer No, according to the graph in figure 18.

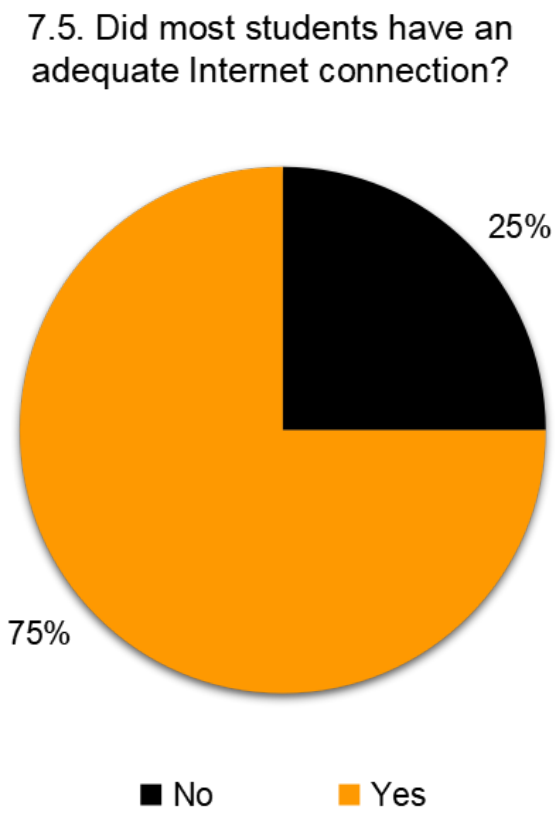

Fig. 18: Graph with the percentages of Yes and No answers to the question about the majority of students having an adequate internet connection. Source: Authors, 2020.

Finally, regarding the students' home environment, the question was asked: Did most students have good conditions at home? For this question, 76% of respondents indicated the answer Yes, while 24% indicated the answer No, as indicated in the graph in figure 19.

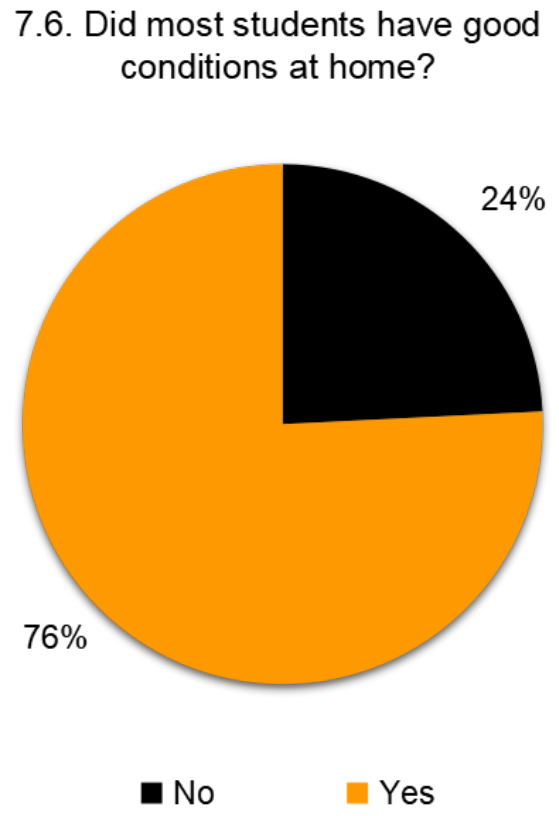

Fig. 19: Graph with the percentages of answers Yes and No for the question about whether the conditions in the students' home environment. Source: Authors, 2020.

5.5. Preliminary assessments

Finally, a block of questions was proposed for the respondents to prepare a preliminary assessment of the activities carried out. Faced with some statements, respondents should indicate their degree of agreement according to the scale I fully agree, I partially agree, I tend to disagree and I totally disagree.

Regarding the statement: The scale and scope of the exercise proved to be adequate for online activity, the option most indicated by the respondents was I partially agree, with 55% of the indications. On the other hand, the option with the lowest percentage of responses was I totally disagree, with 2 % of indications. The graph with the percentages is represented in figure 20.

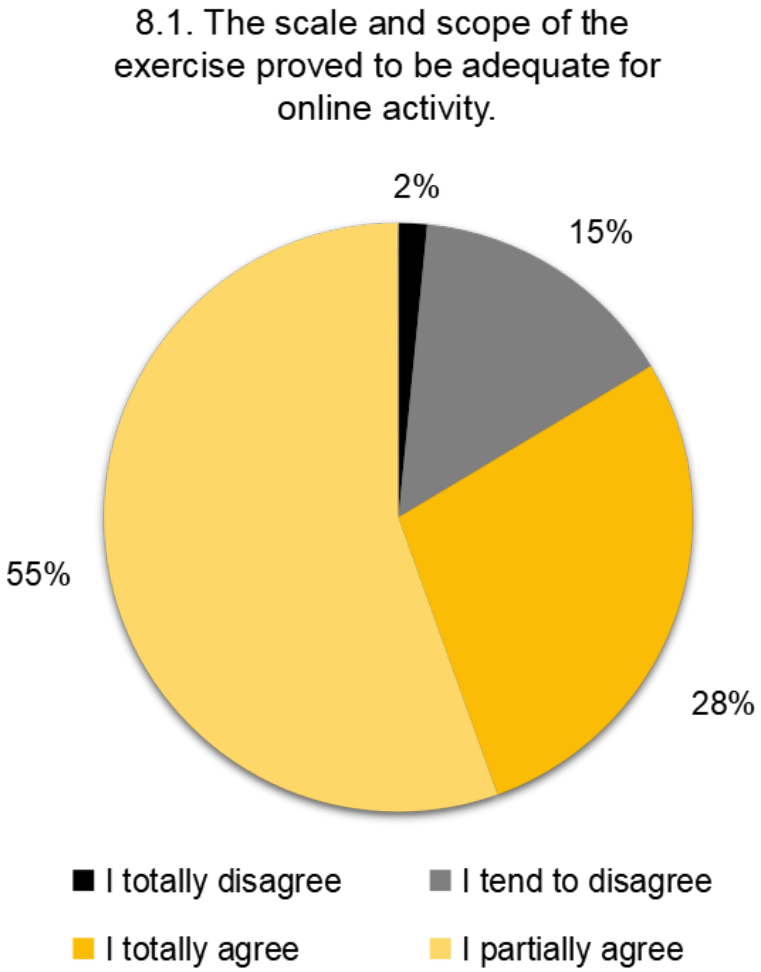

Fig. 20: Graph with percentages of responses from the preliminary assessment to the statement: The scale and scope of the exercise proved to be adequate for online activity. Source: Authors, 2020.

About the statement: Computer applications for design development were easily used by students, none of the options was indicated by at least half of the respondents. However, the two options with the highest percentage totaled 79% of the respondents, as those who partially agreed corresponded to 45% of respondents and I fully agree corresponded to 34%. The option with the lowest number of mentions was I strongly disagree, chosen by 6% of respondents. The distribution of all options is shown in the graph in figure 21.

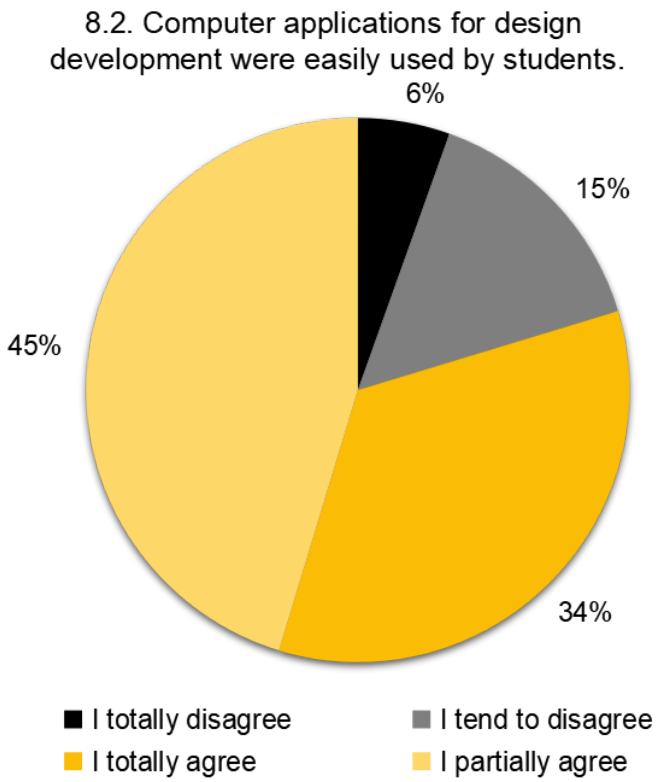

Fig. 21: Graph with percentages of responses from the preliminary assessment to the statement Computer applications for design development were easily employed by students. Source: Authors, 2020.

About the statement: The sessions with synchronous communication with the students were useful, 56% of the respondents indicated the option I fully agree with the statement. The option with the least respondents was I strongly disagree, indicated by 3%. The percentage of each option is shown in the graph in figure 22.

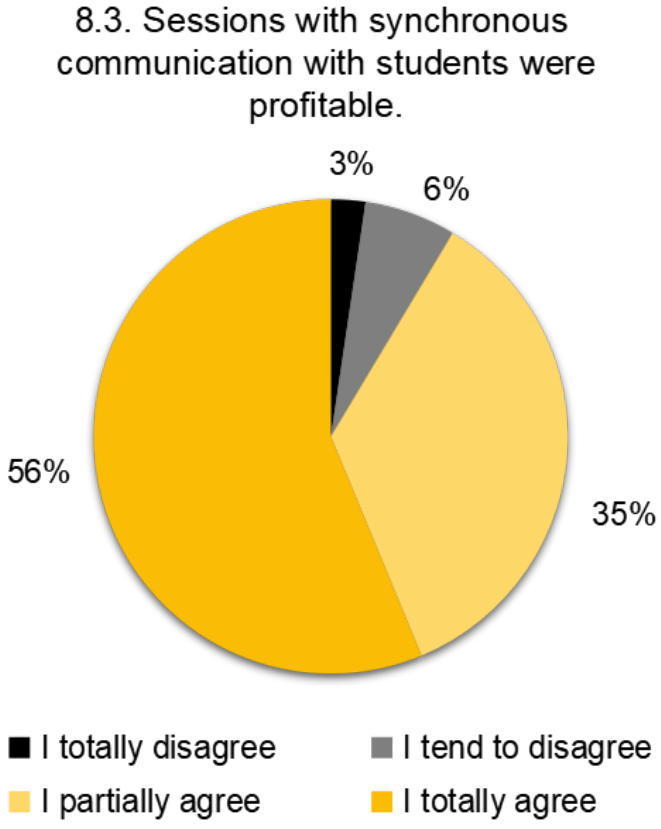

Fig. 22: Graph with the percentages of responses from the preliminary assessment to the statement The sessions with synchronous communication with the students were useful. Source: Authors, 2020.

About the statement: The objectives of the proposed activities have been achieved, none of the options were indicated by half of the respondents, but the options I fully agree and I partially agree totaled 94% of the indications, with percentages of 48% and 46% respectively. The option with the lowest number of mentions was I strongly disagree, being indicated by 1% of respondents. The graph with all percentages is shown in figure 23.

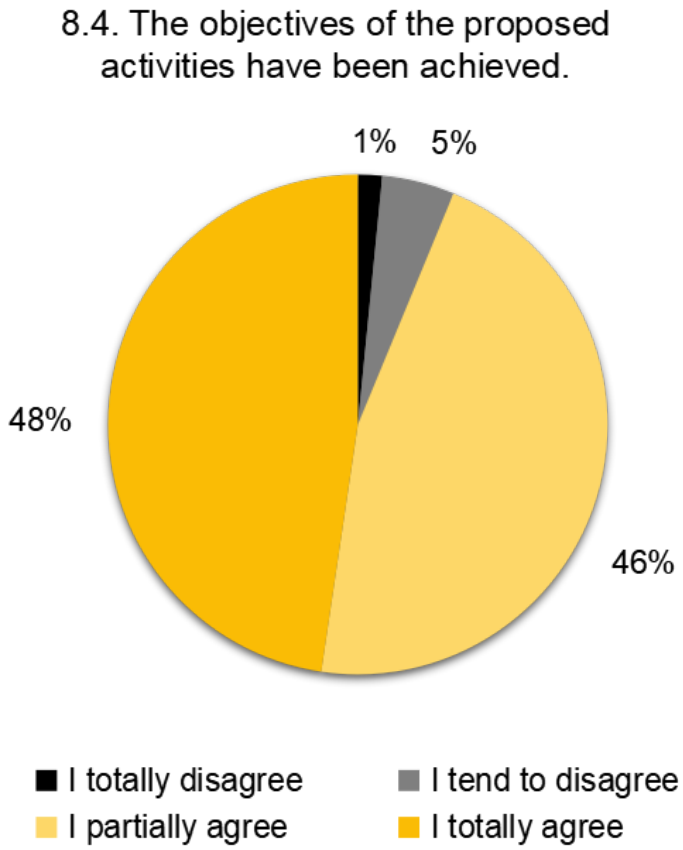

Fig. 23: Graph with the percentages of responses from the preliminary assessment to the statement The objectives of the proposed activities have been achieved. Source: Authors, 2020.

About the statement: Many losses were noticed compared to the face-to-face course, the alternative that had more respondents was I partially agree, indicated by 53% of respondents. On the other hand, the alternative with fewer respondents was I totally disagree, indicated by 6% of respondents. The complete graph for this statement is shown in figure 24.

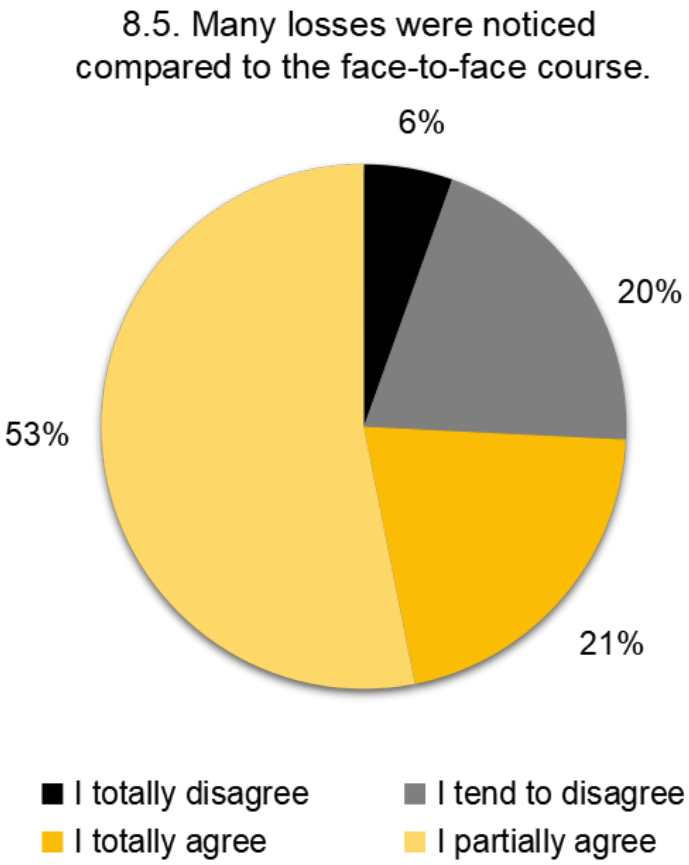

Fig. 24: Graph with the percentages of responses from the preliminary assessment to the statement Many losses were noticed compared to the face-to-face course. Source: Authors, 2020.

About the statement: Many gains were noticed compared to the face-to-face course, the most mentioned alternative was I partially agree, indicated by 50% of respondents. On the other hand, the alternative with the lowest number of mentions was I fully agree, indicated by 3% of respondents. The complete graph for this statement is shown in figure 25.

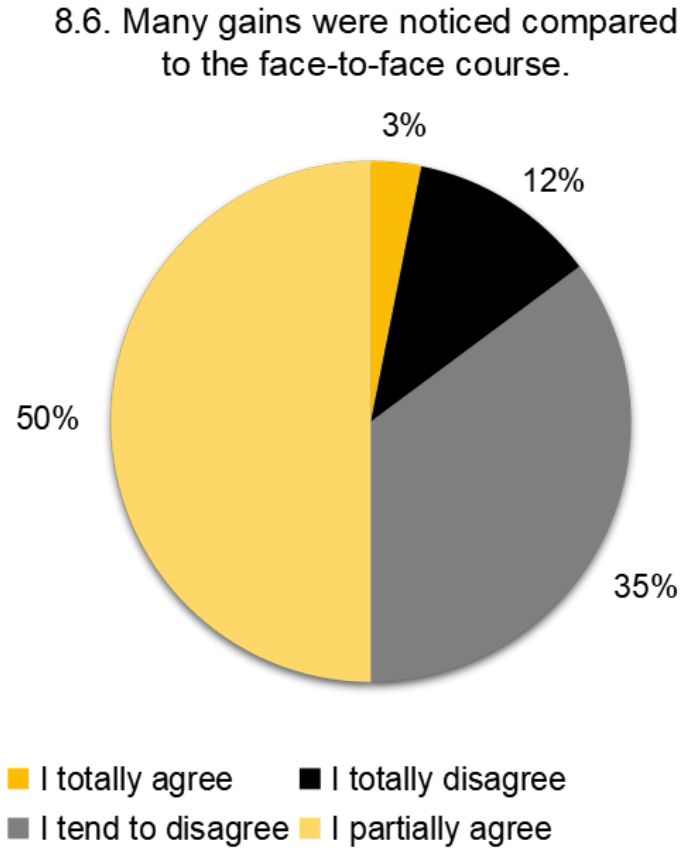

Fig. 25: Graph with the percentages of responses from the preliminary assessment to the statement There were many gains concerning the classroom discipline. Source: Authors, 2020.

About the statement: Most students were satisfied with the results of the activities, no option was indicated by at least a half of the respondents, but the addition of the options I fully agree and I partially agree account for 86% of respondents. Separately, they correspond to 46% and 40% of the respondents, respectively. The option with the lowest percentage of respondents was I strongly disagree, with 2%. The complete graph for this statement is shown in figure 26.

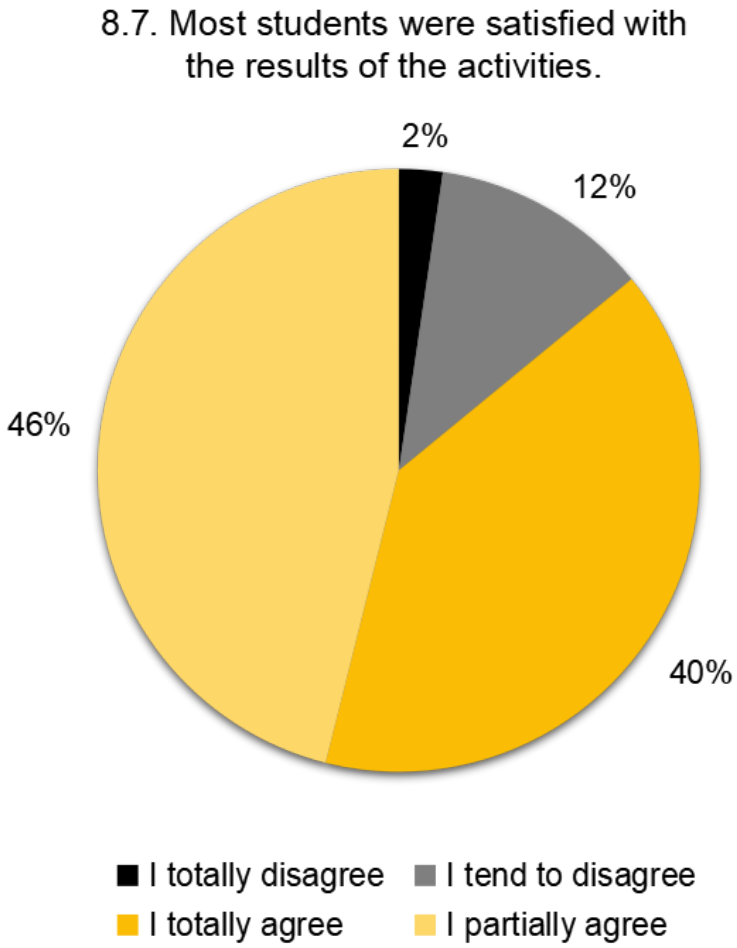

Fig. 26: Graph with the percentages of responses from the preliminary assessment to the statement Most students were satisfied with the results of the activities. Source: Authors, 2020.

About the statement: Teachers were satisfied with the results of the activities, none of the options were indicated by at least half of the respondents, but the options I strongly agree and I partially agree account for 80% of respondents. Separately, they correspond to 48% and 32% of the respondents, respectively. The option with the lowest percentage of respondents was I strongly disagree, with 4%. The complete graph for this statement is shown in figure 27.

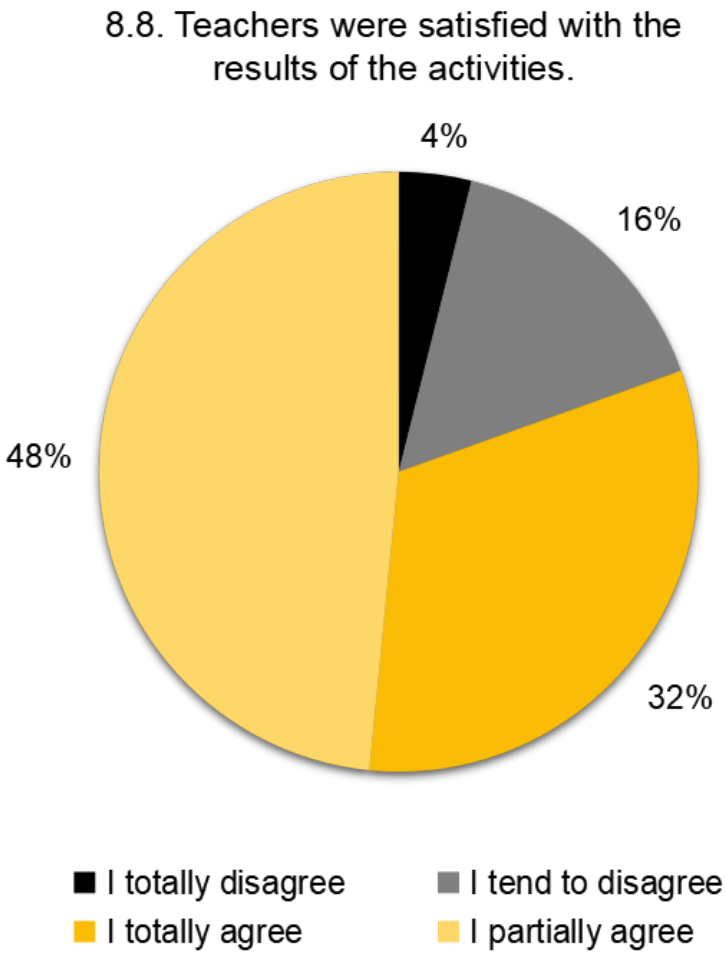

Fig. 27: Graph with percentages of responses from the preliminary assessment to the statement The teachers were satisfied with the results of the activities. Source: Authors, 2020.

About the statement: The drawings and models produced are of good quality, none of the options were indicated by at least half of the respondents, but the options I strongly agree and I partially agree account for 84% of respondents. They separately correspond to 47% and 37%, respectively. The option with the lowest percentage of mentions was I strongly disagree, with 1%. The complete graph for this statement is shown in figure 28.

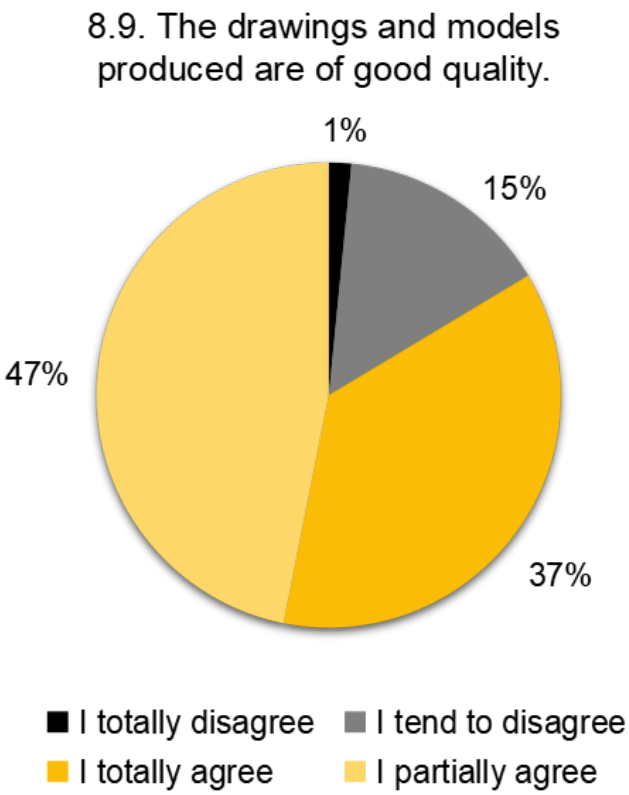

Fig. 28: Graph with percentages of responses from the preliminary assessment to the statement The graphic pieces produced are of good quality. Source: Authors, 2020.

About the statement: Drawings and models were produced in sufficient quantity, none of the options were indicated by at least half of the respondents, but the options I strongly agree and I partially agree account for 81% of respondents. They separately correspond to 43% and 38%, respectively. The option with the lowest percentage of mentions was I strongly disagree, with 4%. The complete graph for this statement is shown in figure 29.

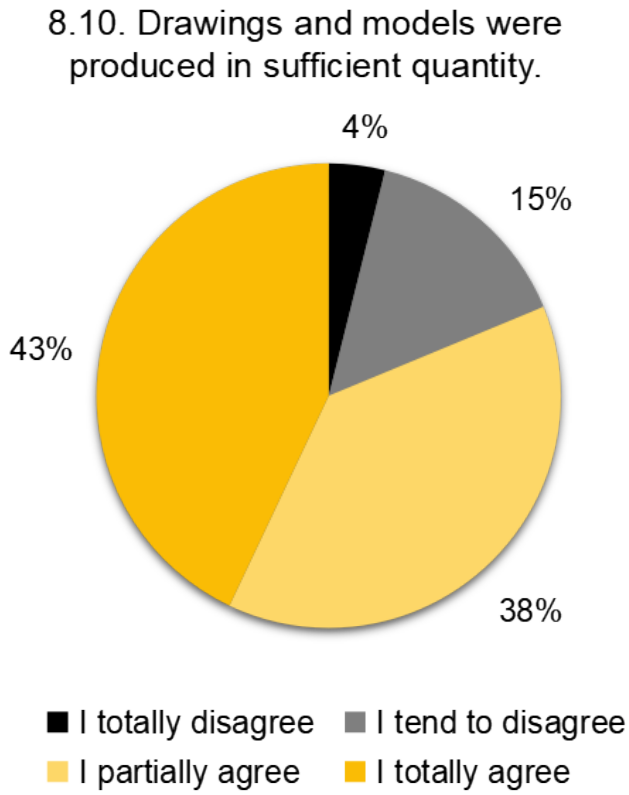

Fig. 29: Graph with the percentages of responses from the preliminary assessment to the statement The graphic pieces were produced in sufficient quantity. Source: Authors, 2020.

About the statement: The experience revealed that some online procedures could be integrated into face-to-face courses, none of the options were indicated by at least half of the respondents, but the options, I fully agree and I partially agree account for 81% of the respondents. They separately correspond to 43% and 38%, respectively. The option with the lowest percentage of respondents was I strongly disagree, with 1%. The complete graph for this statement is shown in figure 30.

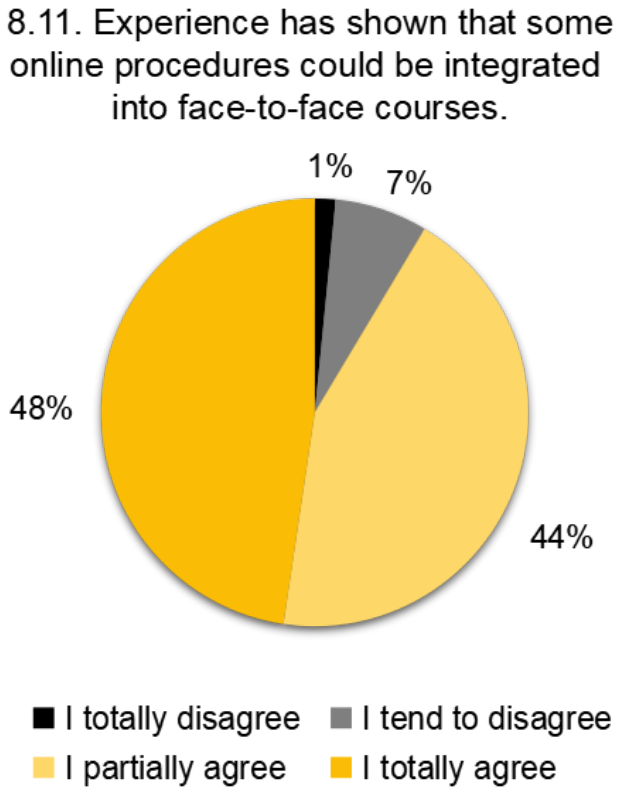

Fig. 30: Graph with percentages of responses from the preliminary assessment to the statement The experience revealed online procedures that could be incorporated into the face-to-face subjects. Source: Authors, 2020.

About the statement: The online course requires stricter procedures from all involved than a face-to-face course, none of the options were indicated by at least half of the respondents, but the options I strongly agree and I partially agree correspond to 80% of the respondents. They separately correspond to 43% and 37%, respectively. The option with the lowest percentage of respondents was I strongly disagree, with 5%. The complete graph for this statement is shown in figure 31.

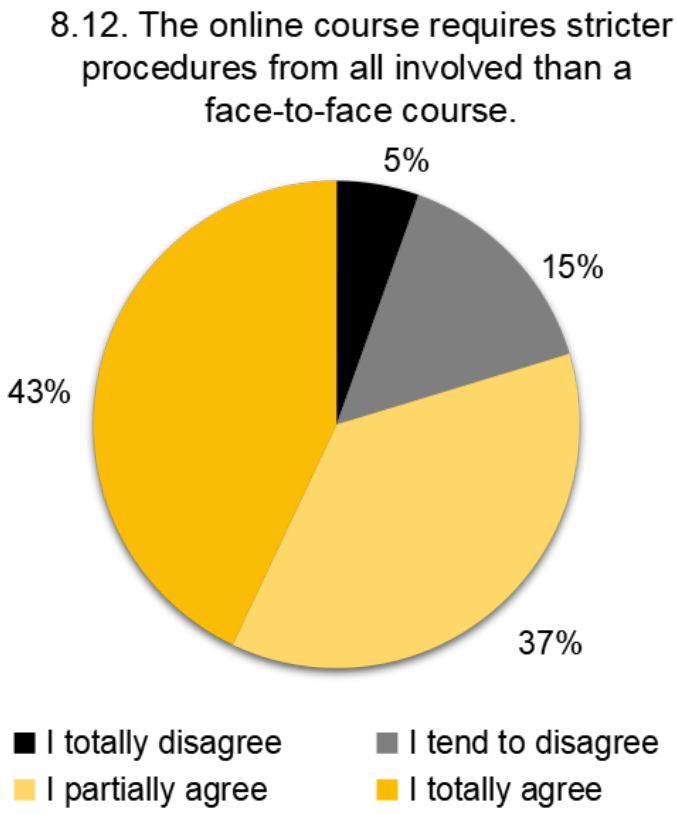

Fig. 31: Graph with the percentages of responses from the preliminary assessment to the statement The online course requires stricter procedures from all involved than a face-to-face course. Source: Authors, 2020.

6 Application surveys and experiments

Considering the written responses of interviewees from both Brazilian and international institutions, and collecting information from Nomads.usp researchers and their fellows, a set of applications[2] were gathered for being designated as having qualities for remote design teaching. The listing of these applications allows identifying a varied set of programs able to potentially respond to demands such as representation, modeling, and synchronous communication, even though not always simultaneously.

In architectural design processes and considering the role of representation, the model, and collective discussions during the design process, applications have been selected that went through an exploratory phase conducted by the researchers' team. Explorations took place individually, for applications with no possibility of collaborative work, or with other researchers if there was a possibility for collective and/or collaborative work. Table 1 shows the set of computer applications tested in the scope of the RDS project.

APP LINK PLATFORM	CATEGORY AND TOOLS	DESCRIPTION AND EVALUATION (based on the exploration carried out)
BIG BLUE BUTTON https://bigbluebutton.org/ **Windows, Mac, IOS, and Android**	Communication and presentation	- Open-source application for video conferencing, with chat, presentation, annotation, and screen sharing tools; - Requires registration on the platform; - Allows drawing on canvas and producing personalized surveys (only for the room owner); - Only the room owner could do screen sharing; - The owner of the room can configure how other people can access the room (microphone and camera turned off or not);
CONCEPT BOARD https://app.conceptboard.com/home **Windows, Mac, IOS, and Android**	Collaborative design; synchronous communication; web-based	- Application that allows drawings, designs, illustrations, and collaborative drawings; -Precise drawing tools; - Has a grid tool; - Many tools for the development of collective works; - Easy to recognize other users on-screen; - There is no free video call.
DRAWCHAT https://draw.chat/ **Windows, Mac, IOS, and Android (Web-based)**	Drawing; synchronous collaboration	- Synchronous collaboration whiteboard online application, which allows voice and video call communication; - No installation required, automatic loading via the web; - Synchronous collaboration with other users; - Voice and Video included in a free drawing area for collaborative activity; - Difficulty getting familiar with the tools; - Sharing with other devices from QR code; - Flexibility in the interaction between devices;
DUALLES	Browser extension	- Application that allows the browser screen to be divided into predefined proportions; -Assists in the division of screens for sharing in meetings by google meet, for example.
FORM IT https://formit.autodesk.com/ **Windows, Mac, IOS, Android, and Web-based**	Three-dimensional modeling; collaborative	- BIM-based software for 3D modeling and synchronous collaboration. It has an educational and paid version, which is part of the Architecture, Engineering and Construction collection; - It requires less computational resources when the applications are installed on the computer than when it runs in the browser; - Intuitive desktop; - Ease three-dimensional modeling; - Possibility to perform solar and electrical simulations; - Interoperability with BIM-based programs; - Direct link with the Dynamo plugin; - Synchronous collaboration with other participants; - Has a chat tool for synchronous communication; - Export and import possibilities in several file formats;
Google Meet Call Timer	Browser extension	- Allows you to time a presentation on the google meet screen.
Google Meet Grid View (fix)	Browser extension	- Allows you to frame all the people in a Google Meet meeting in the same mosaic.
INKSCAPE https://inkscape.org/pt-br/ **Windows, Mac, and Linux**	Non-collaborative drawing; application installed on a computer	- Vector drawing software suitable for artistic drawing, graphic design, and illustrations; - Illustrator and Corel Draw similar resources; - Import and export in several extensions; - Non-collaborative; - Relatively high demand for computational resources on the performed explorations;
MIRO https://miro.com/ **Windows, Mac, IOS, and Android (Web-based)**	Collaborative drawing; representation; presentation; synchronous communication; web-based and smartphone Application	- Application that allows team drawings in addition to the production of schematic drawings, diagrams, mind maps, text, arrows, and connectors; - In the free version it features voice call and chats for communication between team members; - Intuitive: it allowed free drawings to be made without previous experience with the application; - It allows the auto-correction of lines if the smart drawing option is activated; - Provides several templates for diagrams and task organization; - Has a grid tool; - Has comments and annotation tools (allows exporting in *.docx and *.pdf file extensions); - Export images in *.png and *.pdf file extensions; - Relative precision of the drawing tools; - Easy to recognize other users on-screen; - A linking possibility with several plugins; - A previous registration via e-mail is necessary to edit the drawing, you can only visualize the drawing without the registration; -Allows the insertion of images from the web in the drawing.
MODELO https://modelo.io/ **Windows, Mac, IOS, and Android (Web-based)**	Sharing three-dimensional models; presentation; annotation	- Online collaborative 3D viewing, presentation, discussion, and annotation platform; - Noted a high demand for computational resources during the explorations performed. Mostly of students' computers could not be able to be processing it;
MORPHOLIO TRACE https://morpholioapps.com/trace/pt/ **IOS application**	Sketch, drawing, and creation; illustration; representation	- Application with the focus on design and architecture which allows accurate technical drawings; - Several resources for the development of precise drawings, such as pre-configured stencils suitable to the working with scales and color filling adaptable to the areas covered; - Allows to import 3D models for direct interaction with the drawing; - Allows to create a perspective drawing from vanishing points or in a predefined and adjustable scale; - Adjustments of line weights, colors, and palettes;
NOD - Reactions for Google Meet	Browser extension	- Allows you to react or request the speech without interrupting who is speaking at Google Meet conferences.

SPLASHTOP WIRED X DISPLAY https://www.splashtop.com/wiredxdisplay IOS application	Create a PC extension for the mobile phone or tablet screen	- Application that allows the extension of your computer screen to the phone or tablet screen; - Possibility of software interacting with touch or digital pen functionality by cell phone or tablet; - For interaction, it is required to install the application on the mobile device and the computer;
WEB PAINT	Browser application (Google Chrome)	- It allows you to write, add text, comments, or markings on a browser screen, and you can save it later in image format.

Table 1: Tested applications. Source: Authors, 2020.

In the set of tested applications, it was not possible to find anyone that satisfactorily provided means of representation, modeling, and synchronous communication, simultaneously in a free version. However, a solution that proved to be interesting was to associate two or more applications, for example, videoconferencing via Google Meet, for communication, and Miro application, for the construction of collaborative sketches and drawings. In this case, the research explorations involved video calls to collaboratively produce drawings that typically can be developed in teaching environments of architectural design, such as plans, sections, and contour lines.

We also investigated whether the applications would have other features, in addition to the usual basic lines and shapes, that could assist in work sessions during design processes. For example, features of the collaborative design application Miro allowed adding comments and mentioning collaborators that can be stored or resolved asynchronously, if necessary. In this application, it was also possible to add images or screenshots by inserting web links. The images could then be discussed, commented on, and changed in the Miro environment using available drawing resources.

Another exploration involved applications that allow you to extend the screen from personal computers to tablets, as the aim was to use the tablet or other mobile devices like a graphics tablet. This exploration was motivated by the fact that students or teachers of design courses could have an easier time drawing by hand, and this could be done with specific pens of digital design or with the finger, for example.

Explorations using different applications have shown that it is possible to carry out activities that allow the communication and production of graphic and representation pieces synchronously. The tested applications were all used in versions that would have no cost to participants, free software versions were used, or at least some free version was used (in this case it was the version that was explored), or educational versions.

Although the applications explored should not cost participants, the initial survey resulted in a large number of applications, free and paid. The complete list of applications raised, but which have not been tested, corresponds to table 2.

APP LINK PLATFORM	CATEGORY AND TOOLS	DESCRIPTION (based on information collected)
AUTOCAD https://www.autodesk.com.br **Windows, Mac, IOS, Android, and Web-based**	Technical drawing.	- CAD-type software used mainly for the preparation of technical drawing parts in two dimensions; - Non-collaborative; - Relatively high demand for computational resources.
CANVA https://www.canva.com/ **Windows, Mac, IOS, and Android (Web-based)**	Graphic design; composition.	- Online application for graphic design and image composition; - Non-collaborative; - Used on the development of specific graphic pieces; - Can be used for quick works with an internal library of practical examples.
DISCORD https://discord.com/new **Windows, Mac, IOS, and Android**	Communication and file sharing.	- Application that allows communication between people by creating separate chat rooms (voice or writing); - Possibility of creating isolated rooms for meetings, sectors, or groups; - It allows us to share one or more screens simultaneously; - Has flexibility in the interaction between devices; - It allows exchanging files between users.
DUET DISPLAY https://www.duetdisplay.com/ **Windows, Mac, IOS, and Android**	Creation of a personal computer screen extension for the mobile phone or tablet screen.	- Application that allows the extension of your computer screen to the mobile phone or tablet screen; - Possibility of interacting programs with touch or digital pen functionality by cell phone or tablet; - It's required to install the application on the mobile device and the computer for interaction.
GOOGLE CLASSROOM https://gsuite.google.com/ **Windows, Mac, IOS, and Android (Web-based)**	Communication; repository.	- Google Apps resource for education; - Course content management system and asynchronous communication between students and teachers; - It allows the files exchanging between users; - Allows the organization of activities.
GOOGLE DOCS https://gsuite.google.com/ **Windows, Mac, IOS, and Android**	Development of texts and documents.	- Application that allows the development of a text file collaboratively; - Chat possibility during the manipulation of the file; - Similar to Microsoft Word features; - Automatic saving on the drive connected to Google email.
GOOGLE DRAWING https://gsuite.google.com/ **Windows, Mac, IOS, and Android (Web-based)**	Drawing; diagramming; collaboration; illustration.	- Application that allows the development of drawings and illustrations collaboratively; - Chat possibility during the manipulation of the file; - Automatic saving on the drive connected to Google email.
GOOGLE MEET https://gsuite.google.com/ **Windows, Mac, IOS, and Android (Web-based)**	Communication; presentation.	- Application that allows communication between people by video; - Screen sharing possibility for presentations; - Supports chat during the conferences; - Possibility of creating thematic rooms; - Free until meetings with a maximum of 100 people.
GOOGLE SHEETS https://gsuite.google.com/ **Windows, Mac, IOS, and Android**	Spreadsheets and table development.	- Application that allows the development of spreadsheets and tables in a collaborative way; - Possibility of chat simultaneous to the file manipulation; - Similar to Microsoft Excel features; - Automatic saving on the drive connected to Google email.
GOOGLE SLIDES https://gsuite.google.com/ **Windows, Mac, IOS, and Android**	Development of slides and presentations.	- Application that allows the development of slides and presentations in a collaborative way; - Possibility of chat simultaneous to the file manipulation; - Similar to Microsoft Powerpoint features; - Automatic saving on the drive connected to Google email.
JAMBOARD https://apps.apple.com/br/app/jamboard/id1143591418 **Windows, Mac, IOS, and Android (Web-based)**	Graphics; design; illustrations and diagrams; collaboration.	- G Suite digital board which allows collaboration with teams and classrooms; - You can create a Jam, edit it from your device and share it with others; - Has basic drawing and editing tools; - It allows to export in png and pdf file extensions; - Real-time synchronization of changes.
PROCREATE https://procreate.art/ **IOS application**	Drawings; design and illustrations.	- Application that allows the development of painting and digital illustrations; - Wide range of tools for bringing the experience closer to artistic reality; - Layers functionality to facilitate work organization and fluidity.
REVIT https://www.autodesk.com.br **Windows, Mac, IOS, and Android**	Three-dimensional modeling and collaborative technical drawings.	- BIM-based software for architecture, urbanism, engineering, and design; - Allows to gather the project information in a single three-dimensional model; - Asynchronous collaboration through worksets and local and central models synchronization.
SKETCH UP https://www.sketchup.com/pt-BR **Windows, Mac, IOS, Android, and Web-based**	Three-dimensional modeling.	- Application for the development of accurate three-dimensional; - Importing textures and external images possibility; - Importing external program files for modeling possibility; - Online model sharing area with the possibility of importing third party objects (3D Warehouse); - Currently has online tools for editing and synchronizing 3D models, through the Trimble Connect platform.
SLACK https://slack.com/intl/pt-br/ **Windows, Mac, IOS,**	Communication and file sharing.	- Application that allows communication between people by video; - Screen sharing for presentations possibility; - Support chat during the conferences; - Free with a maximum limit of 100 people

and Android		- Free with a maximum limit of 100 people.
TEAM VIEWER https://www.teamviewer.com/ **Windows, Mac, IOS e Android**	Remote access.	- Software package for remote access, desktop sharing, online conferencing, and transferring files between computers; - Remote access through IP and password; - Low demand for local processing, depending on the quality of the connection; - Chat tool for synchronous communication; - Possibility of using applications and resources of the device accessed; - The free version has a time limit.
THINKERCAD https://www.tinkercad.com/ **Windows, Mac, IOS, and Android (Web-based)**	Conception; three-dimensional modeling; communication; collaboration.	- Online application for 3D modeling and synchronous collaboration; - Intuitive work area; - Ease of three-dimensional modeling; - Synchronous collaboration with other participants; - It has a chat tool for synchronous communication; - Export and import possibilities in several file extensions.
TRELLO https://trello.com/pt-BR **Windows, Mac, IOS, and Android (Web-based)**	Task organization and administration.	- Online synchronous collaboration platform; - Task organization tools, calendars, and schedules; - Specific participants mention the possibility; - Allows notes.
ZOOM https://zoom.us/pt-pt/meetings.html **Windows, Mac, IOS, and Android**	Communication and presentation.	- Application that allows communication between people by video; - Screen sharing for presentations possibility; - Support chat during the conferences; - Free until meetings with a maximum of 100 people for a maximum of 40 min.

Table 2: Non-tested applications. Source: Authors, 2020.

7 Products

According to the third specific objective of the Remote Design Studio project, the Nomads.usp researchers sought to stimulate dialogue about remote design teaching in academic forums both internal and external to the Institute of Architecture and Urbanism - IAU-USP. Such dialogue took place through the dissemination of results and training sessions on the use of applications and websites. In both cases, the participants were able to comment and discuss the data, results, and reflections presented.

The dissemination of research results began between mid-July and August 2020, extending to the present.

i. Presentation of the partial results of the research to Nomads.usp researchers, at the August 2020 general meeting;

ii. Presentation of partial raw data to IAU-USP Architectural Design professors in the format of a Prompt Report. Preliminary data from the questionnaire, tested applications, and reflections on remote education were presented based on the written responses received so far;

iii. Lecture by researcher Mario Vallejo in the conference cycle organized by the Coletivo de Estudiantes de la Sociedad Colombiana de Arquitectos Regional Tolima - CESCA TOLIMA. The conference was attended by professors, some respondents to the questionnaire, and students of Architecture courses in Latin American countries;

iv. Scientific article "Remote online, project teaching: lessons from a pandemic" published at the Arquitextos journal (Portuguese only), discussing the research results. (Tramontano, et al., 2020);

v. Conducting training sessions on the use of computer applications and websites, at IAU-USP, for students and teachers.

The training sessions were held after the exploratory research activities and took place at the institutional level. Three training sessions were held for teachers and trainee graduate students in the Teaching Improvement Program at IAU-USP. The sessions covered the Miro, FormIt, Inkscape programs, as well as Google Meet extensions for browsers. Two other training sessions were also held, but for undergraduate students of the Architecture and Urbanism and Civil Engineering courses within the scope of the courses IAU 0734 - Project III-B and IAU 0412 - Architecture and Urbanism II, which focused solely on the use of the Miro application.

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1 In Brazil, it is usual for the academic year to coincide with the calendar year, divided into 1st semester (from January to June) and 2nd semester (from July to December). Recesses usually occur between mid-December of one year to the end of January of the following year and in July. Because of the pandemic, several institutions had to readjust their calendars so that in some cases the school year no longer coincided with the calendar year.

2 We call computer applications the computational means gathered in the research work, including (but not restricted to) computer programs, video call interfaces, digital platforms, and browser extensions.