

A Pedagogical Architecture from a hybrid course in a U.S media course: focused on digital competences*

Arquitetura Pedagógica para um curso híbrido de uma universidade americana: foco nas competências digitais

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Resumo: O objetivo deste artigo é apresentar a construção de uma Arquitetura Pedagógica (AP) para um curso híbrido oferecido pelo *Teachers College da Columbia University* e o mapeamento das competências digitais dos alunos. Este estudo foi realizado por meio da troca de experiências entre a Universidade Federal do Rio Grande do Sul e a Columbia University. A pesquisa, de caráter qualitativo e quantitativo com estudo de caso, foi realizada em duas etapas, na primeira a aplicação de uma AP e acompanhamento dos alunos durante o curso ministrado pela primeira vez de forma híbrida e, na segunda etapa, o mapeamento das competências digitais dos alunos a partir de um modelo brasileiro. Foram utilizados como procedimentos o levantamento bibliográfico, análise documental e aplicação de questionário on-line com os alunos do curso. Como resultado obteve-se uma Arquitetura Pedagógica para o curso híbrido em questão e as competências digitais necessárias aos alunos para acompanhamento do mesmo. Por fim, percebeu-se que este tipo de estudo proporciona soluções inovadoras neste novo campo de atuação, tendo como foco a construção de competências de alunos em diferentes contextos virtuais. Estudos envolvendo cursos híbridos levantam questões importantes sobre o novo perfil dos discentes e suas competências digitais nos processos educacionais.

Palavras-chave: Competências digitais; curso on-line; arquitetura pedagógica.

Abstract: The objective of this article is to construct a Pedagogical Architecture (PA) for a hybrid course offered by Teachers College of Columbia University and the mapping of the students' digital competences. This study was realized through an exchange between the Universidade Federal do Rio Grande do Sul and Columbia University. It is both a qualitative and quantitative study, with a case study that was carried out in two stages. First the PA was applied and the students were monitored during a course which was taught for the first time in a hybrid format. Secondly, the students' digital competences were mapped based on a Brazilian model. A bibliographic survey was conducted, followed by a document analysis, and then an online questionnaire with the course's students was applied. This resulted in a PA for the hybrid course in question and the digital competences necessary for students. It became clear that this type of study presents innovative solutions for this area, focusing on the construction of student competences in different virtual contexts. Studies of hybrid learning environments raise important questions about the new teacher profile and their digital competences in educational processes.

Keywords: Digital competences; online course; pedagogical architecture.

Introduction

This article aims to present a Pedagogical Architecture (PA) for a hybrid course in a U.S. University and the mapping of students' digital competences. To do so, a PA had to be built that could support the online teaching-learning process and as well as the construction of digital competences.

The hypothesis raised in this study is whether the development of a PA contributes to building students' digital competences in a hybrid higher education course. A case study was done to validate this hypothesis and answer the research question. There is no focal problem, since both the PA and the mapping of students' digital competences can be replicated in other contexts of global interest by making specific adaptations according to the needs of the institution and the target audience. The Teachers College⁵ policy regarding hybrid courses is the same as their face-to-face courses. Teachers have complete flexibility, the ability to offer the course either face-to-face, fully online, or in the hybrid format.

The course has been offered face-to-face in previous years by the second and third authors. Fall 2018 was the first time that it was offered in the hybrid format, with a 45 hour workload, 3 credits, and four face-to-face meetings of 7 hours each. The first author observed all class sessions.

A PA that would fit this new hybrid format of the course had to be constructed. Hybrid learning is understood as the blending of face-to-face activities in the classroom with online activities where the student chooses where and how s/he will study. According to BACICH & MORAN (2015) it combines various spaces, times, activities, methodologies, and audiences. With mobility and connectivity, this process is much more defined, broad, and profound: it is a more open and creative ecosystem.

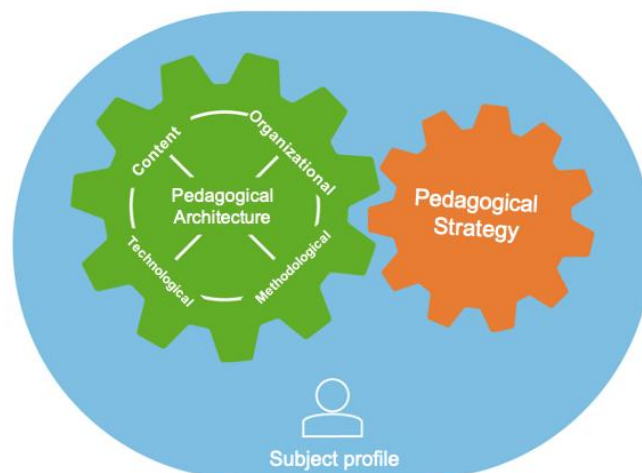
Hence, the following sections will present the necessary elements for the construction of a pedagogical architecture adapted for the course based on the profile of the U.S. online student. Section 3 discusses the Brazilian model of digital competences that served as the foundation for this U.S. case study. Then Section 4 describes the methodology followed by analysis and discussion of the results. Lastly, the basic digital competences for the hybrid course are presented. Final considerations conclude this work.

Elements of the pedagogical architecture for online courses

A Pedagogical Architecture, according to Behar et al. (2019, p.3) "guides the actions that will be developed in distance courses, and also defines who the subjects will be ... and the Pedagogical Strategies (PS) that will be used." Therefore, an AP can be constructed and reconstructed according to the specific needs and the interests, based on the subject profile, in this case a hybrid format with Education graduate students in the United States.

An AP is composed of four aspects: organizational, content, methodological, and technological (which includes application and is called the PS) that are linked to a subject profile, as can be seen in Figure 1 (BEHAR et al, 2019).

⁵ Columbia University's Teachers College has the first and largest Postgraduate program in education in the United States.

Figure 1: Pedagogical Architecture in Distance Learning

Source: Behar et al. (2019)

The four aspects of a PA must be linked with the goal of organizing, guiding, and planning the online work. The PSs serve as the link between the PA, the class activities, and subjects. According to Behar et al. (2019, p.5) PSs are "suggestions for using new digital technologies; applications of complementary activities ranging from simulations, collective text constructions, recommendations and tips, knowledge sharing, and participation in discussions." The four aspects of the Pedagogical Architecture are explained in greater detail below.

Organizational Aspects: These are the foundation of the pedagogical planning/proposal, which include the purposes of the distance teaching-learning process, organization of time and space, as well as the expectations in terms of participants' performance and the rights and duties of each subject.

Content Aspects: Concern the theme proposed and the materials used - learning objects, software, and other learning tools, tests, animations, etc.;

Methodological Aspects: Concern the ways in which technologies are used and how content is developed throughout teaching and learning processes. This encompasses activities, forms of interaction/communication, evaluation procedures, and the organization of all these elements in a didactic learning sequence;

Technological Aspects: These are related to the digital resources and tools used in the online course such as the virtual learning environment (VLE), its functionalities, communication tools such as video and/or teleconferencing, and any other technological resources.

However, there is no set PA pattern because it is built based on the context and subject profiles. In this case, the subjects are online students enrolled in a graduate program in the United States. Silva (2018) argues that online students are made up of a set of subjects constituted by different generations, contexts, and ways of learning through virtual/digital means. Each student will respond in different ways based on their history and experiences learning through technology. Yet, this profile is not necessarily always digitally competent.

Therefore, aspects of the PA help to identify the needs in a given context, as well as the competences required for the subjects. This justifies the importance of **mapping digital competences based on the profile of the online student, and specifically the U.S. student in this case**. In general, competences can be identified through **organizational** aspects, considering those that the student needs to develop in the context of an online course and those that they already have. From here, it is then necessary to develop the **content** that will be addressed, the **methodology**/activities that will be constructed and evaluated and, finally, the technological tools that will be used.

Yet, when transforming the PA of this course from the face-to-face format to the hybrid version, it was necessary to rethink the materials, organization, and digital competences required for students to act in this new environment. Thus, the model of digital competences of Brazilian students was used in order to analyze this PA based on the hybrid learning environment and the specific student profile. The model of digital competences used in this research is presented below.

Model of digital competences - MCompDigEaD⁶

This study developed in the U.S. context used a Brazilian reference for mapping digital competences, which are understood to be knowledge, skills, and attitudes (KSA) linked to the technological domain with the goal of solving problems in digital media, linked to a specific context and subject profile (SILVA, 2018).

The student-focused model of digital competencies, MCompDigEaD, was developed between 2014 and 2018 in NUTED/UFRGS (SILVA, 2018). It is organized based on three digital competences: functional digital literacy, critical digital literacy, and digital fluency. Moreover, it has six technological areas:⁷ introduction of digital technologies, digital communication, network information management, digital health and safety, digital citizenship, creativity and digital content development, as well as fourteen specific skills, detailed through KSAs, with a total of 328 elements.

Each specific competence has three proficiency levels, 1) Initial, 2) Intermediate and 3) Advanced with examples of use cases. The relationship between the digital and model specific competences can be seen in Table 1, below.

Table 1 – MCompDigEAD

Digital Competences	Specific Digital Competences
1. Functional Digital Literacy	1.1 Use of Desktop and Mobile Devices: This competence is intended to assist the student in the use of the desktop computer, mobile devices and their applications.
	1.2 Network communication resources: This competence is related to the basic network communication that occurs through different tools and

⁶ In Portuguese: MCompDigEaD

⁷ According to Behar et al. (2013, p. 51) the word domain (from the latin dominium) is defined in the scope of art or science, with a territorial extension or sphere of action.

	<p>applications. Its objective is the proper use of different forms of communication. It refers to basic notions necessary in order to adapt communication formats and strategies according to the student's needs. It includes the use of e-mail, instant messaging such as SMS (via a mobile operator) and Whatsapp (an example of an application), social networks (Facebook, Instagram, LinkedIn) and Virtual Learning Environments (VLE).</p>
	<p>1.3 Searching for and treatment information: This competence is linked to accessing and searching for information in a network, as well as the Digital Learning (DL) student's ability to process information. The search is related to the finding information through search engines. Processing of information relates to the basic use of word processing applications, spreadsheets, and presentation editors. These applications are used to perform everyday tasks in a DL course are essential for creating, formatting, and finalizing documents as well as handling information.</p>
	<p>1.4 Ergonomics for desktop and mobile devices: This competence aims to assist in understanding the physical health risks related to the use of technology.</p>
2 Critical Digital Literacy	<p>2.1 Network Interaction and Collaboration Tools: The digital communication competence is focused on network interaction and collaboration is based on the clarity and objectivity of oral, gestures, and written expression. With DL students it is related to the way in which they interact and collaborate with colleagues and teachers, in addition to the use of Netiquette (online behavioral norms).</p>
	<p>2.2 Information evaluation and sharing: Managing information in critical digital literacy is related to a set of strategies that cover the informational needs related to the collection, distribution, and use of information. The student must critically understand and evaluate information as well as sources according to their needs in order to share in an appropriate manner.</p>
	<p>2.3 Organization and Planning: The management of the profile of the virtual student is related to their planning and organization, aiming for autonomous online students. Planning is linked to setting priorities, goals, and objectives. In DL, the conditions necessary for creating situations and applying learning strategies are also considered. Organization is related to the ordering, structuring, and systematization of the student's routine activities. Therefore, it is understood that students must be able to carry out planning and organization to become autonomous in their learning in the virtual space as well as establish cooperative relations where mutual respect prevails.</p>
	<p>2.4 Digital Profile: This competence aims to help the DL student to understand how their data can be managed and published, both in VLEs and social networks. The focus is on understanding how to safely handle information, with respect and responsibility through different digital profiles. How to build, search, create, adapt, and manage these</p>

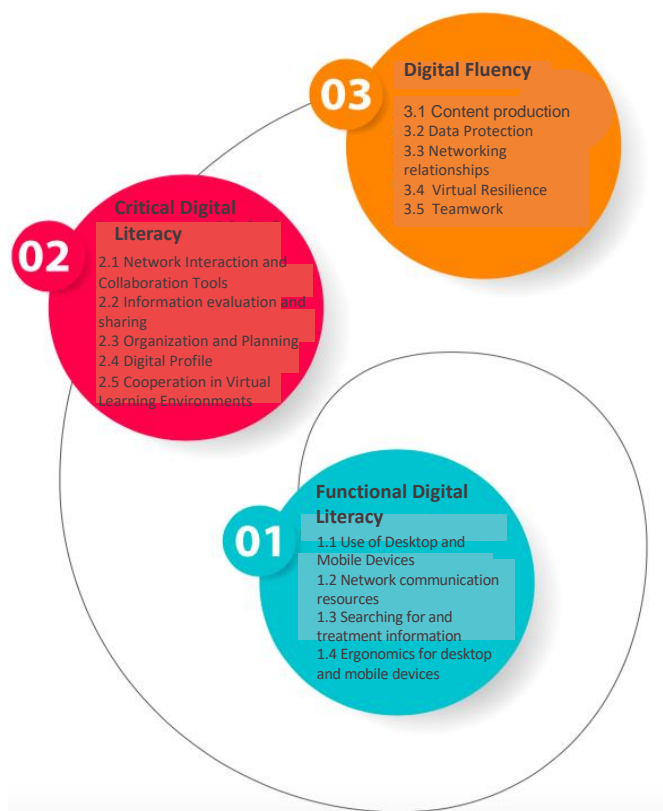
	<p>different profiles, adapting to each environment.</p> <p>2.5 Cooperation in Virtual Learning Environments: Cooperation is related to the processes of understanding common values, the conservation of these values, and reciprocity. Thus, the virtual cooperation competence aims to foster the construction of cooperative relationships, as the basis for the subjects' cognitive, affective, social, and technological development. This competence is primarily linked to teamwork and digital communication.</p>
<p>3. Digital Fluency</p>	<p>3.1 Content production: This is related to the creation and development of the digital content necessary for learning in different formats, with the aim of expressing oneself creatively through digital means for learning. It involves the development and/or integration or rewriting of content by modifying, refining, and combining existing resources as well as the understanding of copyright and licenses applied to the use and construction of content in a network.</p>
	<p>3.2 Data Protection: This competence is related to the understanding of risks and threats, as well as security measures that can be taken. The goal is to understand the protection of personal data, so that the student knows how to protect themselves from fraud, online threats, and cyberbullying.</p>
	<p>3.3 Networking relationships: this competence is related to the student's understanding of the safe and responsible use of the network for their learning. By behaving based on values such as respect, ethics, and honesty in both VLEs and online in general. One must choose the proper content, socialize digitally, and get along in the network.</p>
	<p>3.4 Virtual Resilience: This competence is related to how the subject handles unexpected changes in order to adapt and overcome different obstacles and difficulties. When the subject faces difficulties, their resilience determines how they deal with adversity, such as when faced with situations of risk, stress, pressure, challenge, obstacles, difficulties, or environmental change. Therefore, resilience is not directly related to the successful actions, but to the process of constructing these actions and becoming conscious.</p>
	<p>3.5 Teamwork: Networked teamwork includes intra and interpersonal relationships, which allow the subject to adequately express and communicate their emotions, desires, opinions, and expectations. In addition, it highlights interpersonal behaviors, the ability to interact with other people in a socially acceptable manner, and can thus benefit participants during interactions. These elements can also be complemented from the affective point of view, because the complexity of social relationships also require the ability to perceive and make distinctions in moods, intentions, motivations, and other's emotions. It is primarily linked to the competences of cooperation and resilience.</p>

Source: Created by the authors (2020).

The complete KSA model, containing the three digital and fourteen specific competences along with the proficiency levels and use cases, is not presented here because it is more than 20 pages long. Yet, it can be viewed in its entirety here: <http://nuted.ufrgs.br/MCompDigEAD.pdf>

Finally, it is important to note that the process of building digital competences, according to Figure 2, is a spiral, beginning with the specific competences of functional digital literacy (blue). These are the basis for constructing critical digital literacy (pink) and ultimately digital fluency (orange). The areas in this process are transversal and permeate all competences. According to Machado et al. (2016), in order for the student to reach the level of digital fluency, they must first be functionally and critically digitally literate.

Figure 2 - The Process of constructing the MCompDigEaD



Source: SILVA (2018).

However, these processes are also understood to be interconnected, inseparable, and dependent, because the online student hasn't always developed their digital literacy in all the specific competences and elements necessary for the learning context. Therefore, it is only possible to know the student's level with respect to the Digital Competences (DCs) through an assessment focused on the specific context and course.

Specifically, in this particular study, it should be emphasized that the model had to be adapted to the U.S. context and the students' DCs were identified through a questionnaire identifying those believed to be necessary to the new pedagogical architecture required for the course in the hybrid format.

The methodology is presented below.

Methodology

This article is based on qualitative and quantitative research using a case study. The following two steps and the procedures were performed to collect the data: a bibliographic survey, document analysis, and the application of an online questionnaire with the students enrolled in the course.

The case study was carried out in a U.S course at Teachers College da Columbia University It was taught for the first time in a hybrid format in fall semester, with a workload of 45 hours, 3 credits, and 4 face-to-face meetings lasting 7 hours each. A total of 29 students, between the ages of 24 and 34, participated in the course.

The research stages are described below:

Stage 1) Applying the PA and following up with the students during the hybrid course, using the technological resources developed in Edlab.⁸

This stage aimed to analyze the elements of the PA and PSs organized for the hybrid version of the course. Among the elements, the following stand out: 1) Organizational aspects; 2) Content aspects; 3) Methodological aspects; and 4) Technological aspects. Data was also collected through an online questionnaire addressing the students' profile and experiences.

At the end of this stage a preliminary document was created describing the elements of the PA for the hybrid version of the course.

Stage 2) Mapping the digital competences of the students in the course based on the questionnaire.

This stage aimed to map the students' digital competences and those necessary for the hybrid course. The data was collected through a questionnaire⁹ organized based on the 14 digital competences from MCompDigEaD. First the group's profile and their experience with online courses was identified, followed by the students' self-assessment with respect to their digital competences. It was based on a Scale from 0 (zero) to 5 (five): 0- Not Applicable (Doesn't apply or demonstrate this competence), 1- Basic (basic knowledge), 2 - Beginner (limited experience), 3- Intermediate (practical application), 4- Advanced (theoretical application), and 5- Specialist (recognized authority). Then, the same digital competences were evaluated with respect to their importance for the course. This was also based on a Scale from 0 (zero) to 5 (five): in this case, 0- unimportant; 1- Low importance; 2- more or less important; 3- important; 4-Very Important; and 5-Essential. As a result, application strategies and information were added to the PA document that had been created in Stage 1, with the basic digital competences necessary for students to take the course in the hybrid format.

Analysis and discussion of the results of the research are presented below.

⁸ EdLab is a unit of the Teachers College library that designs and develops tools and content to support teaching and learning. Multidisciplinary teams from programming, design, and publication collaborate.

⁹ The questioner can be accessed at: <https://docs.google.com/forms/d/10pWTbJZgcCd4bCBT-fWAAUYJf8QGTcPyQ8Pqv619Ubk/edit#responses>

Analysis and discussion of results

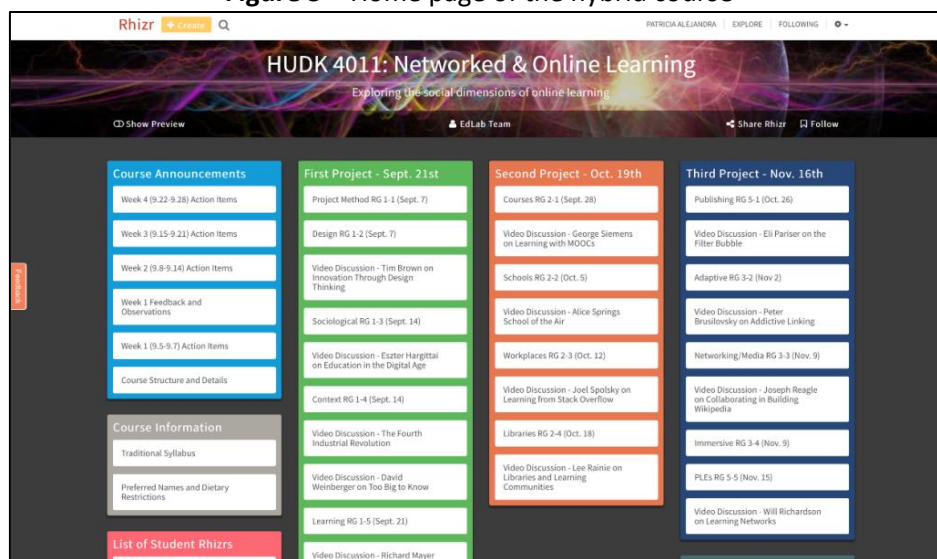
In this section we present the analysis and discussion of the results from the data that was collected. Firstly, there was an analysis of the four aspects which compose the PA and PSs, based on the application of the PA and monitoring of the students in the hybrid course. Then the students' digital competences and those required for the course were mapped. Detailed analysis is presented below.

5.1 Analysis of the elements of the PA of the course

Organizational Aspects

The course was offered in fall semester for Teachers College of Columbia University. It consisted of 45 hours of course work, including 4 face-to-face meetings during the semester of 7 hours each, combining different dynamics for participation, contribution, interaction, and group work. The students received e-mails highlighting assignments every week from the instructors. The course materials were organized weekly through the Rhizr content platform, as can be seen in Figure 3.

Figure 3 – Home page of the hybrid course



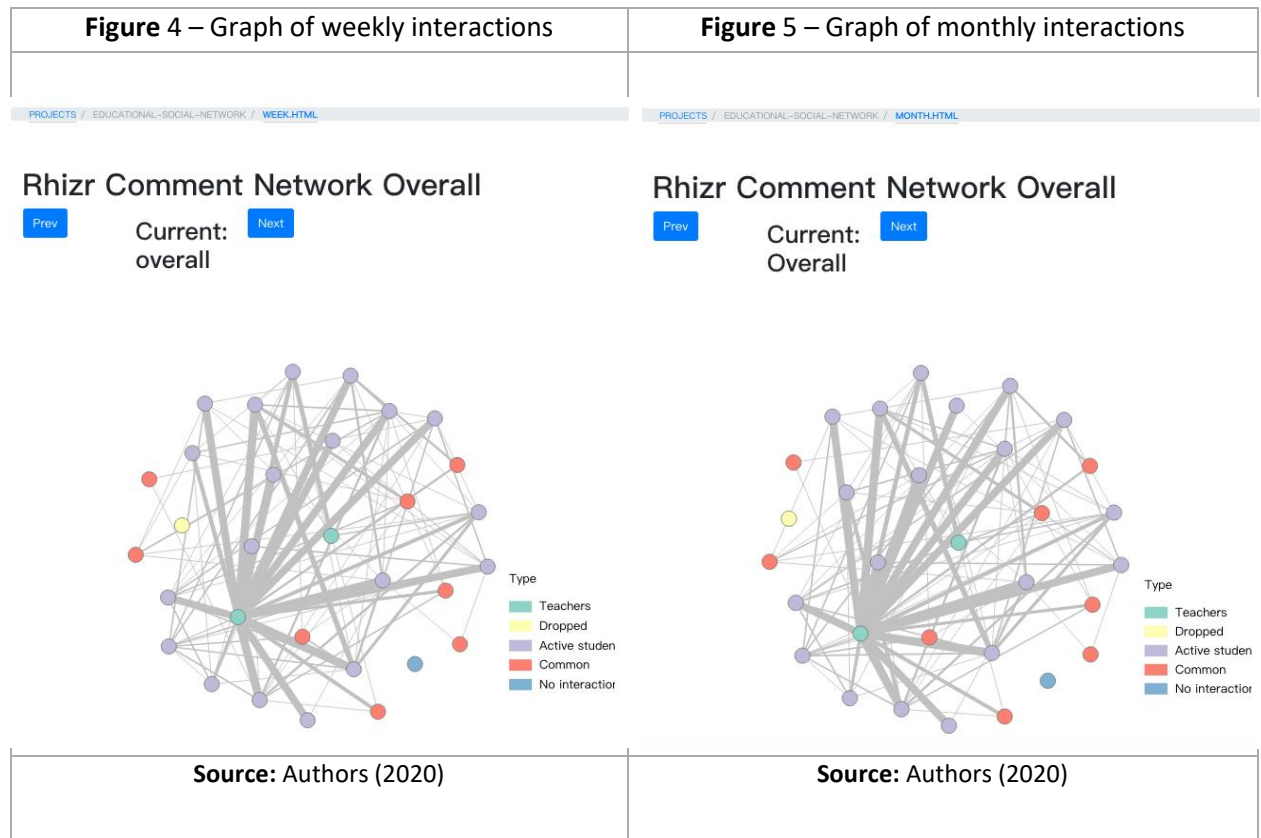
Source: Authors (2020)

Content Aspects

The content of the course was organized in four major sections: learning theories and the social context for learning; online learning based on forms and formats from the offline world, online learning based on original online forms and formats; and designing a comprehensive online learning environment. The course materials were made available through the library e-reserve system, videos for discussion were made available through the library video discussion system, TCR (Teachers College Record).

Methodological Aspects: Activities, interactions, procedures, and evaluation

This course was organized as a set of four design projects; the students were organized into groups to complete these projects, one for each major section of the course. Group membership changed for each of the projects in an effort to have all students work with one another at some point in the semester. Student interactions were monitored through weekly and monthly social mapping, as presented in the graphs shown in Figures 4 and 5 and their respective URLs.



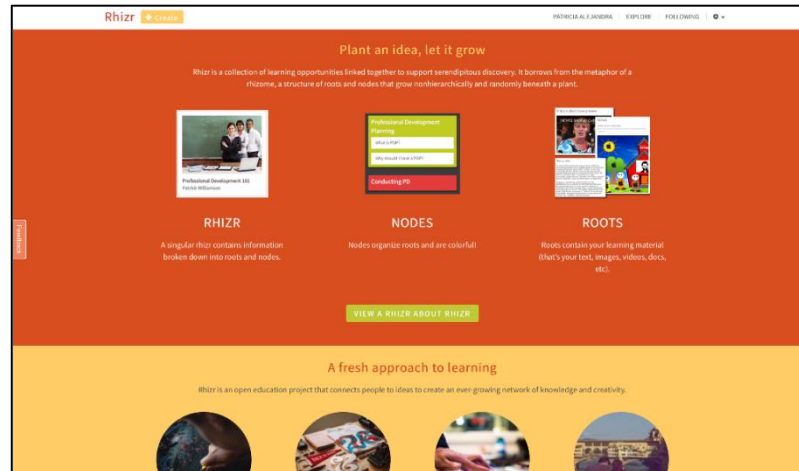
Student performance in the course was assessed based on group and individual presentations during the class sessions on student written journals, and reports that were posted in Rhizrs created and maintained by each student.

Technological Aspects: Use of Rhizr, Vialogues, TCR and the interaction map

The main resources of the course were Rhizr, Vialogues, o TCR (Teachers College Record) and the interaction monitoring tool.

Rhizr is a technology that was developed by EdLab as can be seen in Figure 6.

Figure 6: Rhizr Homepage

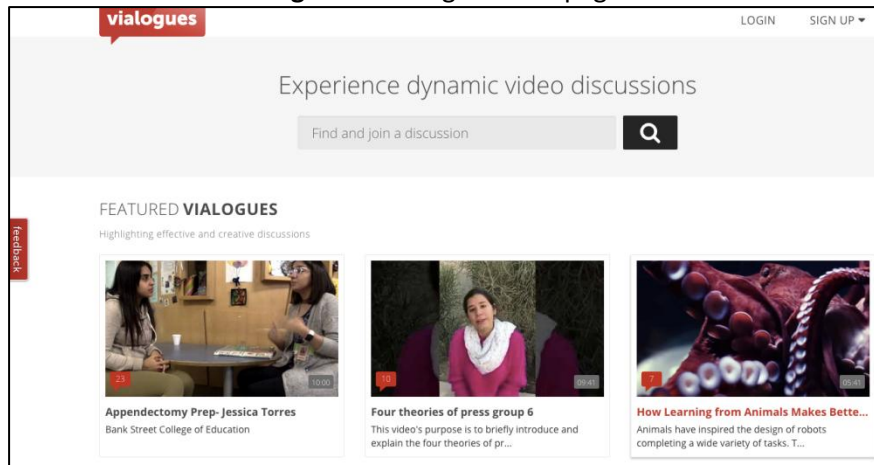


Source: <http://rhizr.com/rz/WgyfgPKf84bgXbrCZ/hudk-4011-networked-on-line-learning>

Rhizr aims to support learning by organizing course content. It is based on the metaphor of a rhizome, a root structure and the nodes that grow in a non-hierarchical and random manner beneath a plant, as previously shown in Figure 6. In addition to a Rhizr for the course, each student in the class created and maintained their own individual rhizr throughout the semester by curating learning content beyond the course reading list and posting journal entries. The content were made available through the library e-reserve system, as books, e-books, scientific articles and videos for discussion were made available through the library video discussion system.

Vialogue is also a technology that was developed by EdLab. It is a discussion platform based on video posts, as can be seen in Figure 7. All videos used in the course were posted on Vialogue for viewing and discussion.

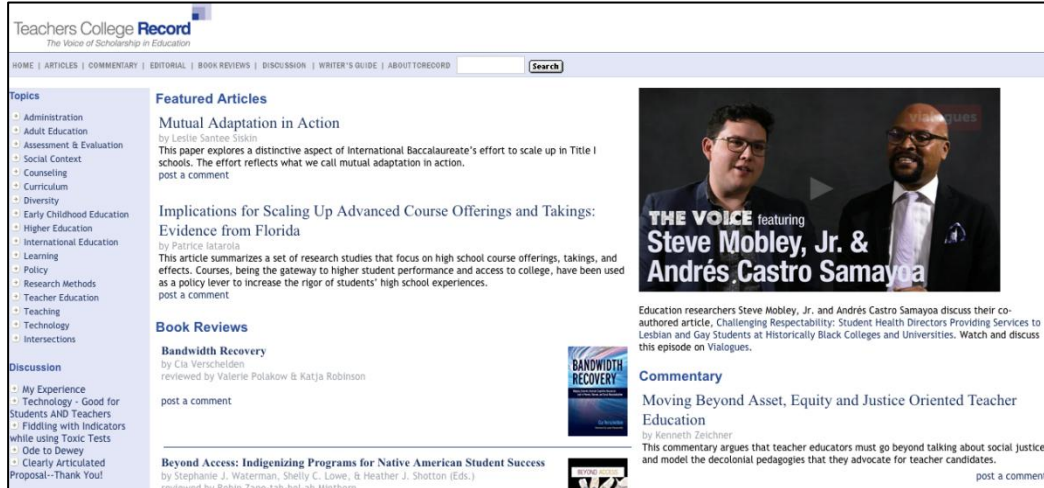
Figure 7: Vialogue Homepage



Source: <https://vialogues.com/>

The Teachers College Record was used by students to access all course readings throughout the semester, as seen in Figure 8 below.

Figure 8 - Teachers College Record Homepage



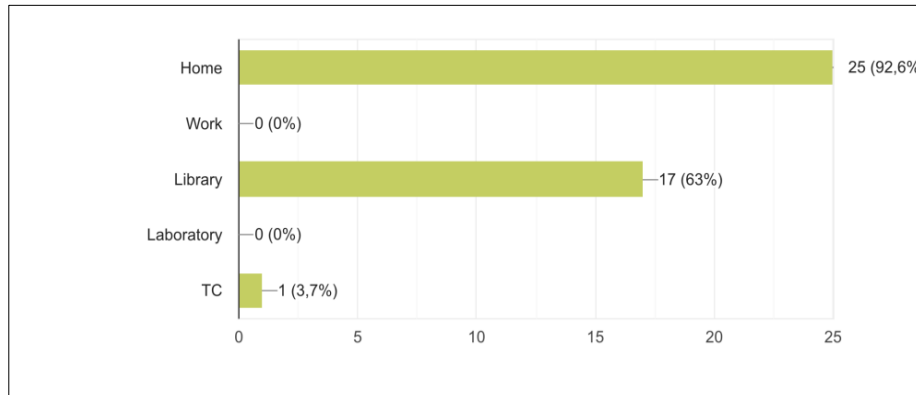
Source: <https://www.tcrecord.org/> (2020)

The tool to map social interactions was used to identify the social exchanges between the students, as seen in the methodological aspects of the course. It was developed in a research project collaboration between UFRGS and Columbia University and was applied specifically in this context of this course.

Student analysis based on PA

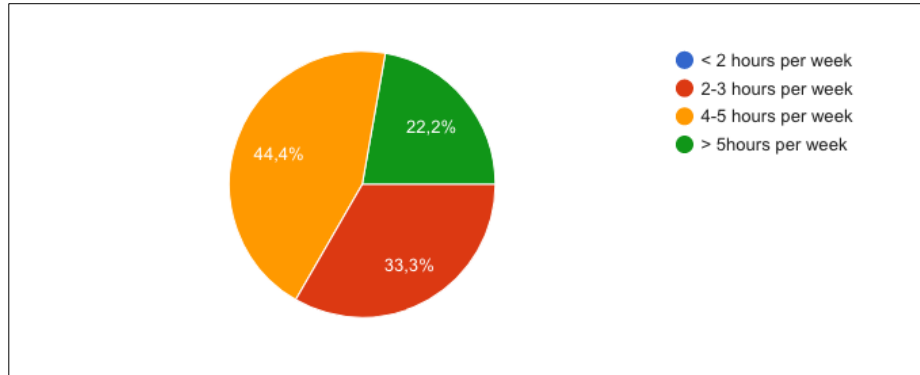
Students' experience while taking the hybrid course was determined through a questionnaire. It revealed that they accessed the course most frequently from home and the university library; students, dedicated between 4 and 5 hours per week to their studies, as illustrated in Figure 9 and 10 below.

Figure 9 – Course access location: Where do usually accesses the course?



Source: Created by the authors based on the research data (2020)

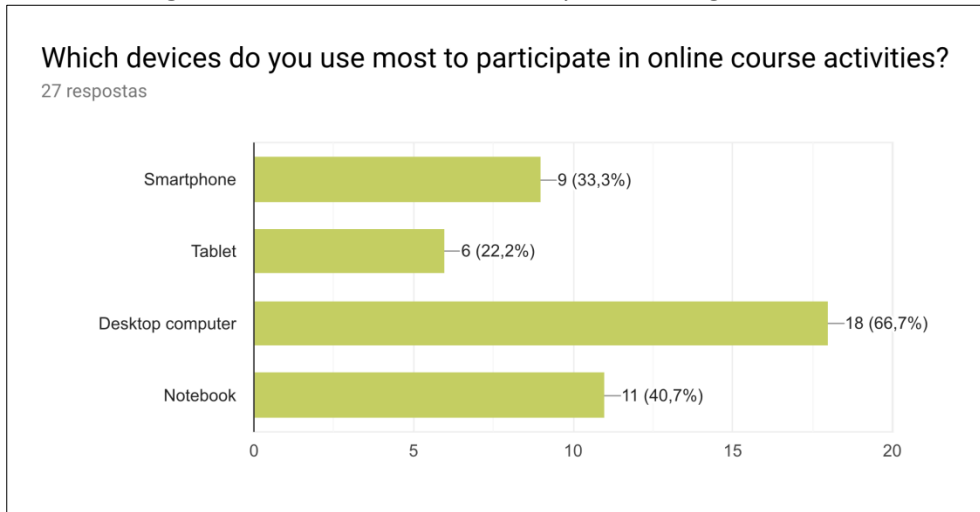
Figure 10 – Time accessing the course: How much time do you devote to course?



Source: Created by the authors based on the research data (2020).

The types of devices most used during the courses were: desktop computer (66.7%), notebook (40.7%), smartphone (33.3%), and tablet (22.2%), according to Figure 11 below.

Figure 11 – Devices most commonly used during the course



Source: Created by the authors based on the research data (2020)

The course’s expectations were clear and objective for the majority of the students who fully agreed with the organizational format, planned activities, interaction, and communication, as well as on the evaluation procedures and pedagogical effectiveness of the course. Students found the readings, Vialogues and Rhizrs materials to all be beneficial for their process. However, they requested improvements as can be seen in the extracts presented in Table 2 below.

Table 2– Extracts from student responses about improvements

“Update all the on-line tools (features too old and not user-friendly)”
“more in personal meeting”
“Think if EdLab's current sources are the best option for us.”
“Add field trips!”
“More real-life projects, less readings, shorter vialogues”

“Have more class sessions”
“I think I would have more in person check-ins. Not necessarily overall full day sessions but”
“regularly standing check in periods.”
“Less readings I think and more videos”
“More feedback on each projects from instructors”
“Should generate more on-line help.”
“less comments on others Rhizrs posts”
“change more group”
“spend more time on the Project”
“More off line class meeting”

Source: Created by the authors based on the research data (2020)

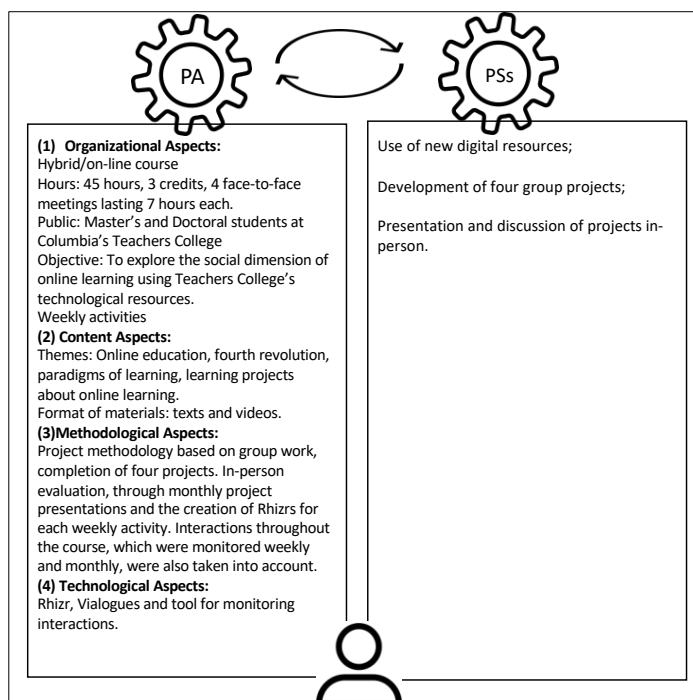
Conclusion of the Pedagogical Architecture Analysis

The pedagogical architecture of the course that was applied for the first time in the hybrid version of the course sought to represent an articulation of the four aspects of the PA and the student profile at the Teachers College da Columbia University.

When comparing the PA data with the students' experience and context, it became clear that the pedagogical aspects of the course were adequate. This can be seen through the activities, content organization, and evaluation procedures. However, modifications were requested primarily related to technological aspects, as can be seen in Table 1. The students accessed the course from different places and devices. They demonstrated their willingness to participate in more activities and virtual meetings yet requested more appropriate tools for these activities. The need to review the content format also became clear, emphasizing the use of videos as well as tools to aid in online interaction and communication. These results demonstrate the importance of offering content in different formats, since often the materials used are not modified when transposing a course from face-to-face to the hybrid format. This is also reflected in the communication and interactions using technological resources. Given that group work was the main pedagogical strategy, the students expected interaction and communication resources so that they could exchange information as well as comment on their colleagues works and receive teacher feedback.

Figure 12 presents a summary of the results based on the analysis and monitoring of the PA, PSs, and the student experiences in the course.

Figure 12 – Synthesis of the results from Stage 1



Source: Created by the authors based on the research data (2020)

Based on the theoretical framework presented, there is no PA model, since it must be linked to the specific subject's profile and context. In this case, multi-generational students, had different ways of being and acting in the online learning process. They also organized their time in distinct ways and accessed the course from different places and devices. All of these issues have to be taken into account when considering requests for changes in the AP. While the changes are relevant, it is not possible to know if the students' lack of digital competences in relation to the use of technologies in the online learning process led them to such conclusions. When transposing a course from the face-to-face to the hybrid format, digital competences are necessary, both of the students as well as those necessary for the course. Therefore, in order to support the PA for this subject profile and their needs during a hybrid course, it is fundamental to investigate digital competences, both of the students and those required for effective course participation.

Thus, analysis of the online questionnaire in order to map competences is presented below. The conclusion of this study will be the presentation of the PA, PSs, and digital competences of the course.

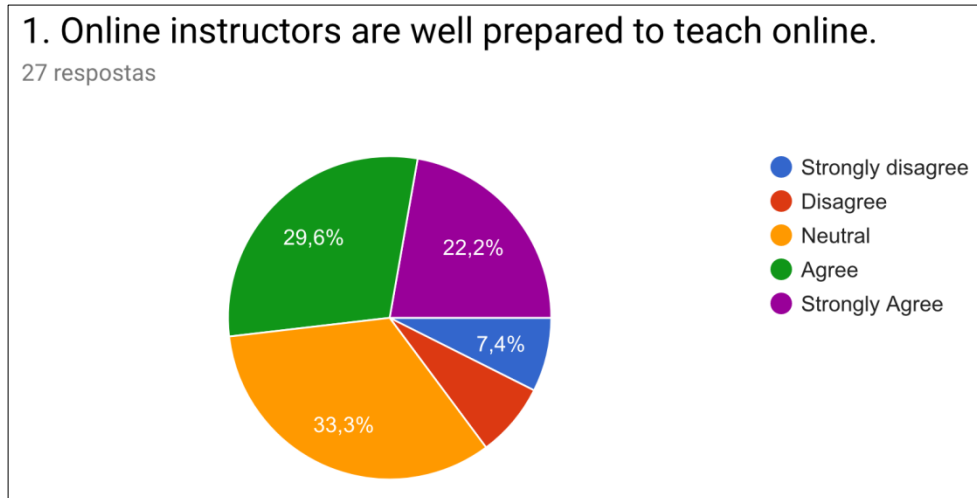
Analysis of the mapping of digital competences for the PA of the course

The mapping of digital competences was carried out based on the analysis of a questionnaire administered to the students and organized in the following categories: 1. Profile of the student group and experience in online courses; 2. Students' digital competences; 3. Digital competences required for the course in the hybrid format.

Group Profile and experience in online courses

The group was made up of 29 students, 90% of which were of Asian origin. The remaining 10% were U.S. citizens and Ukrainians, the majority female, between 24 and 34 years old. They were all Master's and PhD students from the Teachers College da Columbia University with prior experience in online courses, with an average of 2 to 3 previous courses. When questioned about whether the online instructors of the completed courses were well prepared to teach, students were divided in their answers, as seen below.

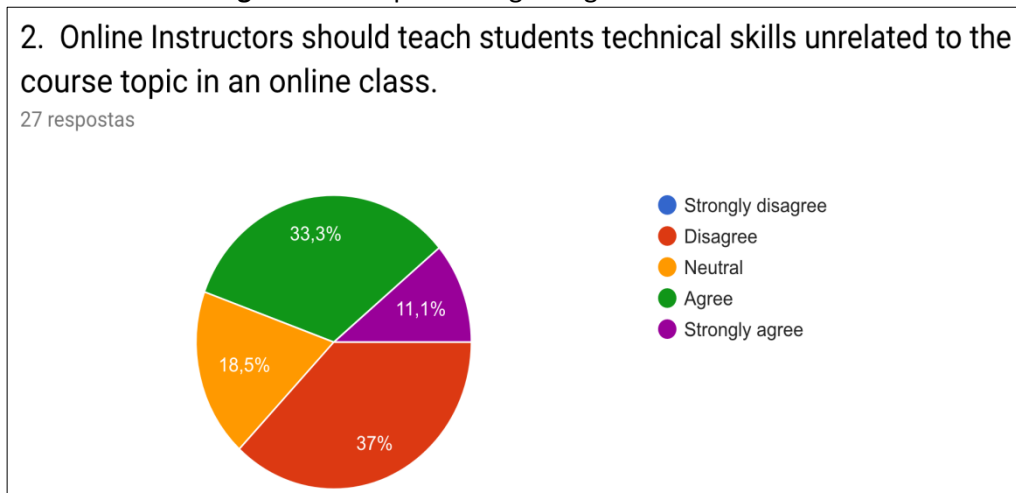
Figure 13 – Responses about instructors



Source: Created by the authors based on the research data (2020)

However, they were divided when asked if instructors should teach technical skills that are not related to course topics, with 37% disagreeing and 33.3% agreeing, a small portion not answering (18.5%), and another 11.1% fully agreeing, according to Figure 14.

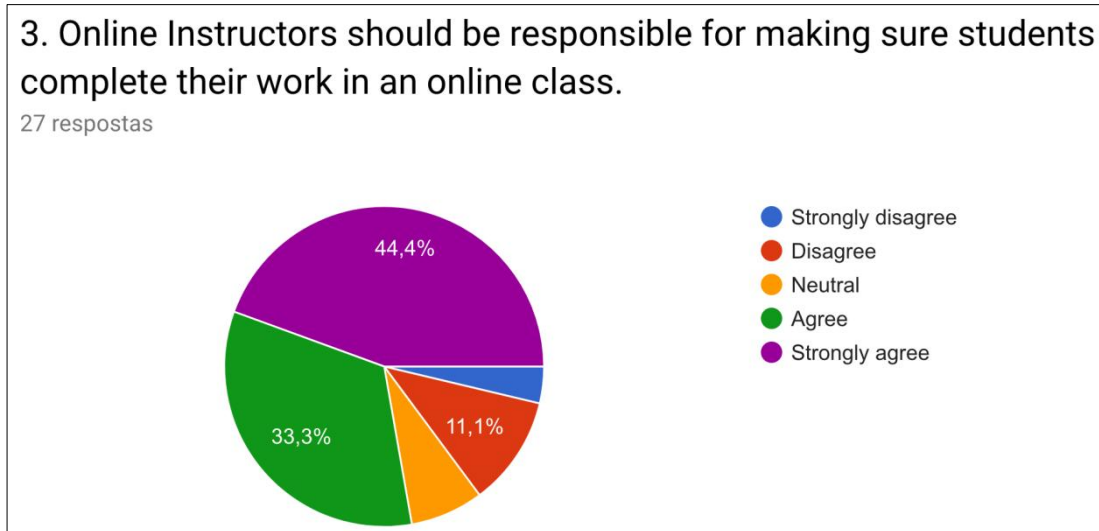
Figure 14 - Responses regarding technical abilities



Source: Created by the authors based on the research data (2020)

However, according to the students, the instructor is the most responsible for ensuring that students complete their activities in an online course, according to Figure 15, 44.4% agreed fully, 33.3% agreed, and a small portion was neutral or didn't agree.

Figure 15 – Responsibility for student activities



Source: Created by the authors based on the research data (2020)

With regard to resources, students agreed that readings are useful, however the majority fully agreed about the usefulness of videos, as shown in Figures 16 and 17 below.

Figure 16 – Usefulness of readings

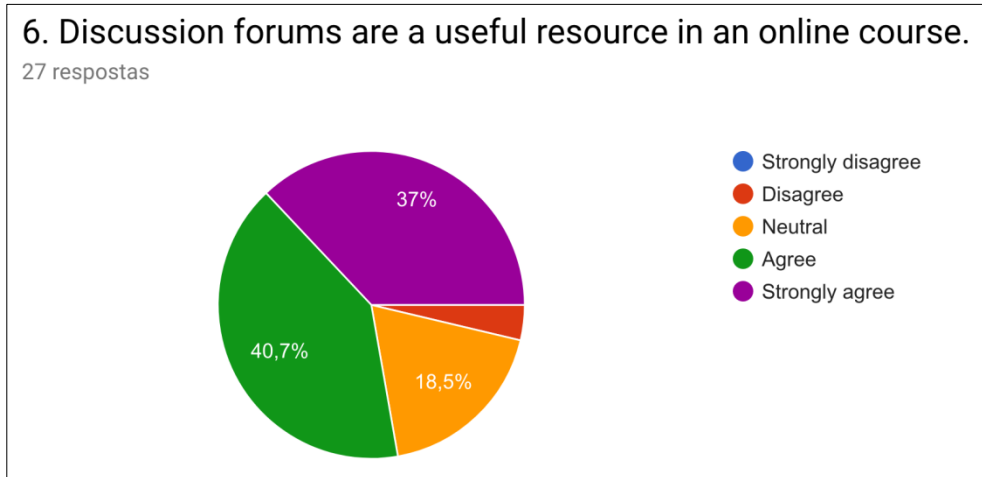
Figure 17 – Usefulness of Videos



Source: Created by the authors based on the research data (2020).

The majority (40.7%) agreed that discussion forums are useful, according to Figure 18.

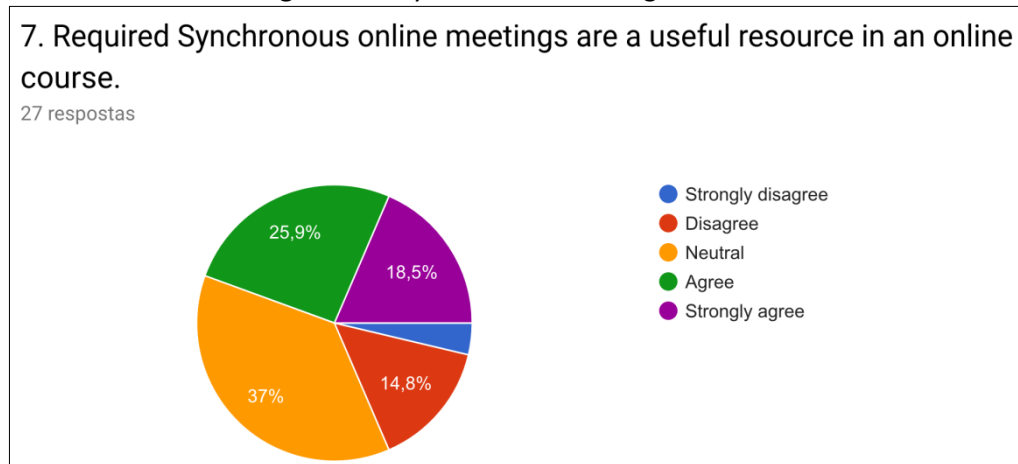
Figure18 –Usefulness of Discussion Forums.



Source: Created by the authors based on the research data (2020).

However, most did not have a clear opinion regarding synchronous meetings, with 37% neutral or indifferent. Nonetheless, 25% agreed with meetings, 18.5% fully agreed, and 14.8% completely disagreed, according to Figure 19.

Figure 19 – Synchronous meetings.



Source: Created by the authors based on the research data (2020).

Lastly, the students pointed out the tools they considered the most important in an online course, which can be seen in Table 3 below:

Table 3 – Extracts of student responses about important tools

“Discussion board and supplemental videos”
“YouTube”
“Zoom”
“Coursera”
“Canvas, slack, pizzara”
“Slides, discussion forums”

"I think discussions when properly designed can be useful"
"Rhizr"
"Google slides/forms"
"I find the use of occasional synchronous meeting in-person or via webcam especially helpful."
"task reminder"
"Flexibility, that everybody could access to the materials based on the schedule."
"Tech support"
"Asynchronous, Self-paced"
"videos, readings"
"live video and discussion session"
"google"
"coursera, rhizr that you can see other people's comments"
"Videos and Quizzes"

Source: Created by the authors based on the research data (2020).

The data analyzed about the group's profile shows that the group as a whole had experience with online courses and made it clear what they believe to be important in relation to content, format of materials, forms of interaction and communication, as well as resources and how to use them. Synchronous meetings were not always found to be important for the whole class, however in order to address specific questions, they are understood to be important with the option of using a camera. Following the group profile, the analysis of the mapping of the students' digital competences was carried out.

Analysis of the mapping of the students' digital competences and those required for the course

The research subjects were presented with the 14 digital competences from MCompDigEAD and their respective descriptions.

Table 4 below shows the students' perceptions based on their self-assessment of their digital competences on a scale of 0 (zero) to 5 (five).¹⁰

Table 4 -Students' perceptions based on their self-assessment of their digital competences

Digital Competences	Specific Digital Competences	Scale						Total	Average
		0	1	2	3	4	5		
1. Functional Digital Literacy	1.1 Use of Desktop and Mobile Devices	1	0	1	4	10	11	27	4,03
	1.2 Network communication resources	0	0	2	7	10	8	27	3,88
	1.3 Searching for and treatment information	0	0	4	6	10	7	27	3,74
	1.4 Ergonomics for desktop and mobile devices	0	2	6	9	10	0	27	3

¹⁰ Scale from 0 (zero) to 5 (five): 0 - Not Applicable (Doesn't apply or demonstrate this competence), 1-Basic (basic knowledge), 2 - Beginner (limited experience), 3- Intermediate (practical application), 4-Advanced (theoretical application), and 5- Specialist (recognized authority).

2. Critical Digital Literacy	2.1 Network Interaction and Collaboration Tools	0	0	3	13	6	4	27	3,29
	2.2 Information evaluation and sharing	0	1	3	7	9	5	27	3,29
	2.3 Organization and Planning	0	2	4	8	9	3	27	3,14
	2.4 Digital Profile	0	1	1	11	8	5	27	3,44
	2.5 Cooperation in Virtual Learning Environments	0	1	6	6	7	7	27	3,48
3. Fluência Digital	3.1 Content production	1	1	7	8	6	3	27	2,88
	3.2 Data Protection	0	1	8	12	0	4	27	2,7
	3.3 Networking relationships	0	1	5	6	13	2	27	3,37
	3.4 Virtual Resilience	0	2	2	11	8	4	27	3,37
	3.5 Teamwork	0	0	2	10	9	6	27	3,7
% Total		2,5	3,5	14,2	31	30	18	100%	

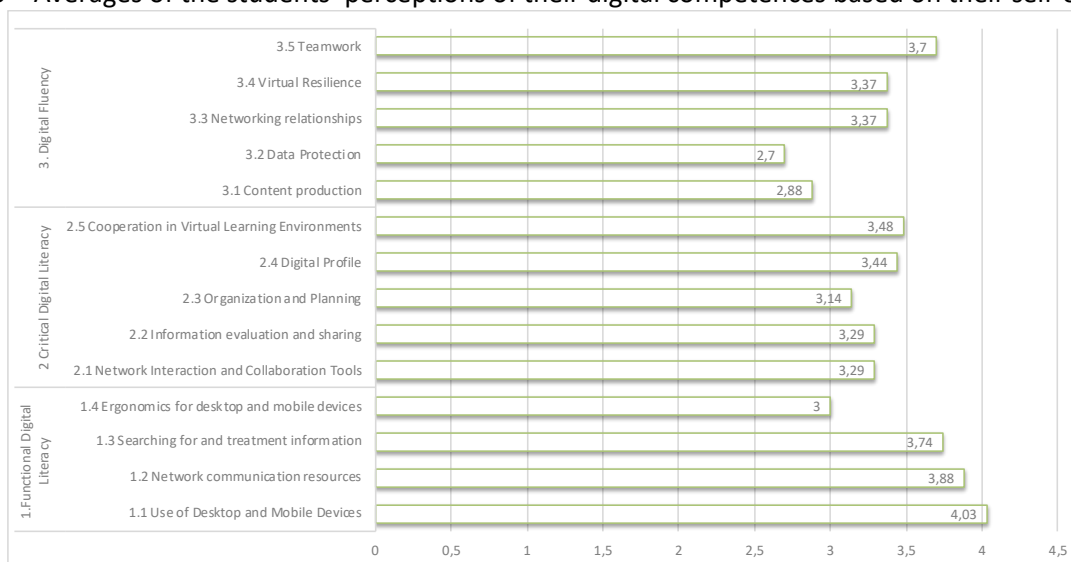
Source: Created by the authors based on the research data (2020).

According to the results of Table 2, 27 of the 29 students enrolled the course answered the self-assessment. Thirty-one percent believed that they were level 3 (intermediate), able to practically apply digital competences. Furthermore, 30% stated they were advanced or level 4, theoretical application.

As can be seen, the competences with the highest averages were: 1.1 Desktop and mobile device use (4.03), 1.2 Network communication resources (3.88), 1.3 Search and processing of information (3.74), and 3.5 Teamwork (3.7). No competence had an average of less than 2.5, the lowest average was attributed to the Data Protection competence 3.2 (2.7).

We now present Figure 20 based on the results of Table 2. It illustrates the average digital competences, organized by Functional Digital Literacy, Critical Digital Literacy, and Digital Fluency.

Figure 20 – Averages of the students' perceptions of their digital competences based on their self-evaluations



Source: Created by the authors based on the research data (2020).

Using a similar scale from 0 to 5,¹¹ students were asked about the importance of each digital competence in the course, as can be seen in Table 5 below.

Table 5 - Students perceptions regarding the importance of digital competences for the course.

Digital Competences	Specific Digital Competences	Scale					Total	Average	
		0	1	2	3	4			5
2. Functional Digital Literacy	1.1 Use of Desktop and Mobile Devices	0	0	0	3	9	15	27	4,07
	1.2 Network communication resources	0	1	0	2	9	15	27	4,59
	1.3 Searching for and treatment information	0	0	0	2	10	15	27	4,48
	1.4 Ergonomics for desktop and mobile devices	0	1	1	5	11	9	27	3,96
2 Critical Digital Literacy	2.1 Network Interaction and Collaboration Tools	0	0	2	4	11	10	27	4,07
	2.2 Information evaluation and sharing	2	0	2	5	8	10	27	3,64
	2.3 Organization and Planning	0	0	1	6	8	12	27	3,77
	2.4 Digital Profile	0	2	2	7	9	7	27	3,59
	2.5 Cooperation in Virtual Learning Environments	0	0	4	4	11	8	27	3,85
3. Digital Fluency	3.1 Content production	0	0	3	3	12	9	27	4
	3.2 Data Protection	0	0	2	1	11	13	27	4,29
	3.3 Networking relationships	0	0	0	6	12	9	27	3,88
	3.4 Virtual Resilience	0	0	1	5	12	9	27	3,7
	3.5 Teamwork	0	0	2	4	8	13	27	4,18
% do Total		0,5	1,0	5,5	15,5	37,5	40	100,0	

Source: Created by the authors based on the research data (2020).

Overall, 40% of the students considered the digital competences to be level 5 (five) essential, 37.5% level 4 (four) very important, 15.5% Level 3 (three) important; 5.5% level 2 (two) more or less important; 1% level 1 (one) low importance; and 0.5% level (0) unimportant.

The competences with the highest averages were: 1.2 Network communication resources (4.59); 1.3 Search and treatment of information (4.48); 3.2 Data Protection (4.29), and 3.5 Teamwork (4.18). There was no competence with an average of less than (3.50), with the lowest average being 2.4, the Digital Profile competence (3.59). Figure 21 below shows the averages of the digital competences for the course.

¹¹ Scale from 0 (zero) to 5 (five): in this case, 0- unimportant; 1- Low importance; 2- more or less important; 3-important; 4-Very Important; and 5-Essential.

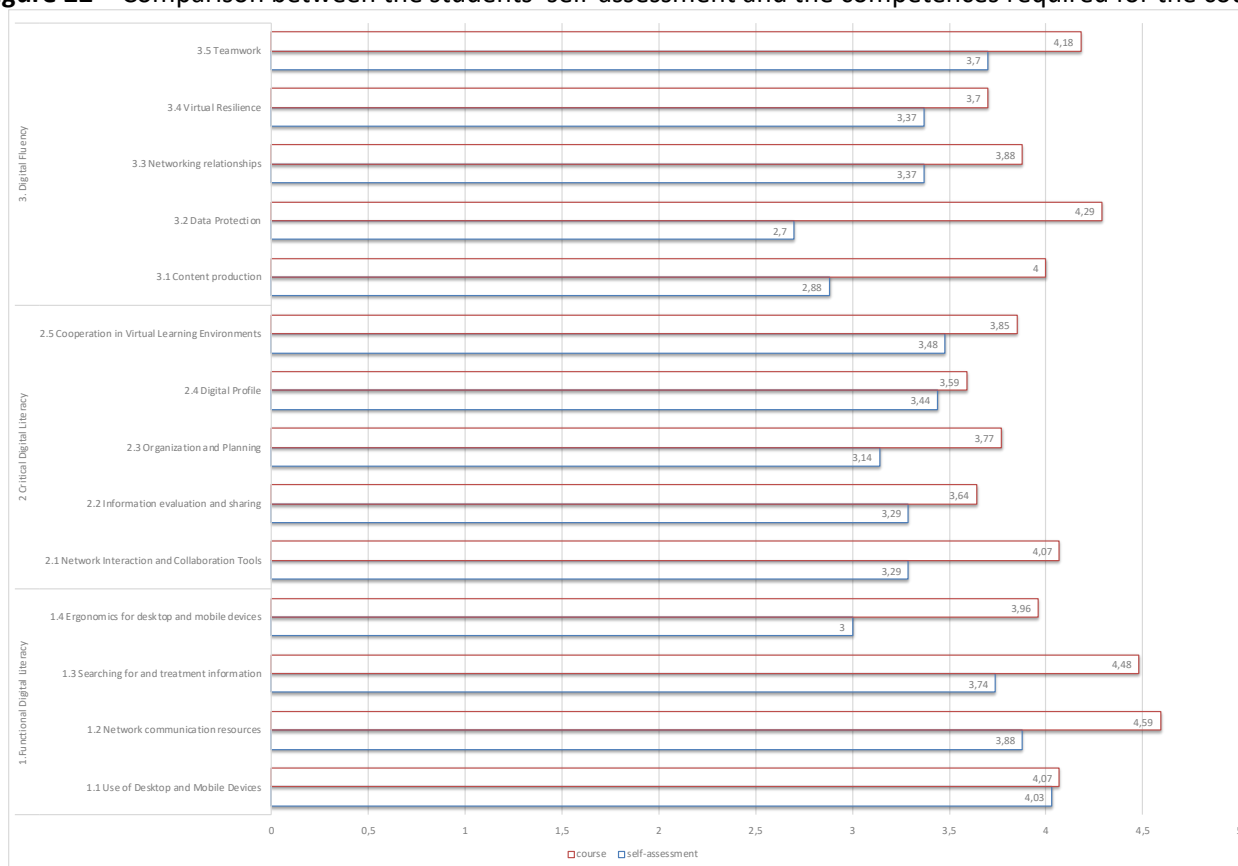
Figure 21 - Averages of the importance of the digital competences for course.



Source: Created by the authors based on the research data (2020).

Concluding the mapping of digital competences stage

Comparing the results of the categories from the self-assessment of digital competences with those required for the course, students realized that their levels were lower than the competences necessary for the hybrid course, according to Figure 22.

Figure 22 – Comparison between the students' self-assessment and the competences required for the course

Source: Created by the authors based on the research data (2020).

All the digital competences from the model were found to be relevant, with averages above 3.50, that is, they were determined to be important and/or essential. This result is undoubtedly attributed to the students' own experience, since the majority pointed out that the course in the hybrid format was adequate in relation to organization, activities, and other procedures. However, the technological aspects were found to be in need of review. Technological aspects are extremely important in a hybrid course and are therefore considered to be one of the fundamental elements when articulating the PA, PSs, and the subject profile.

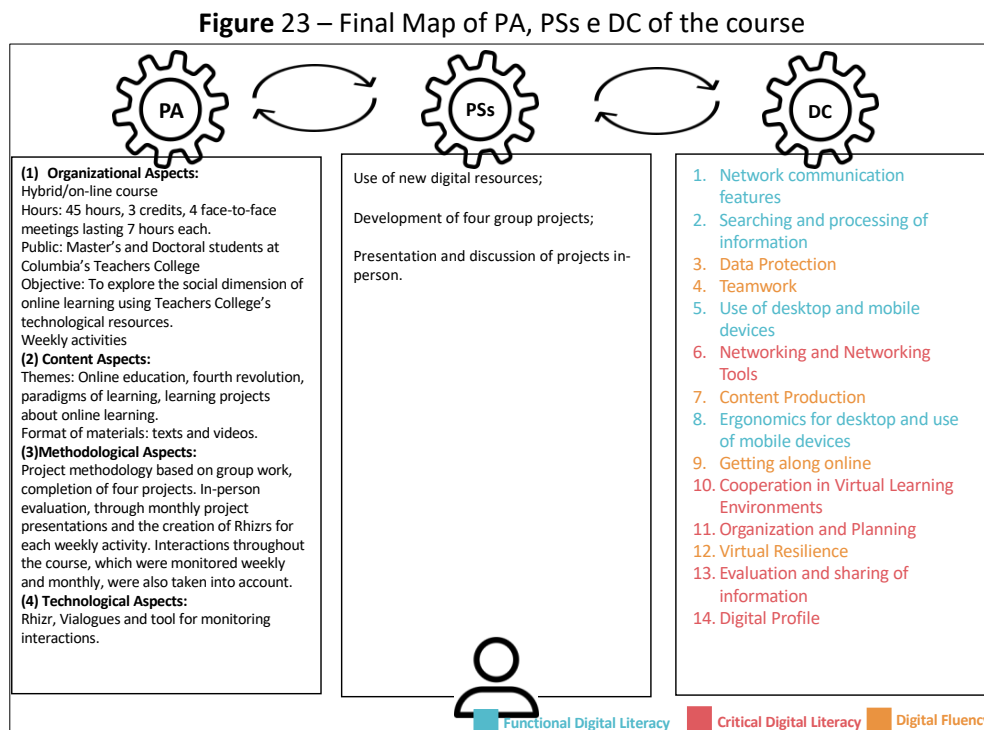
Chart 13 reveals that the competence with the highest discrepancy between the average of the students' profile and that required for the course was: 3.2 Data protection. This belongs to Digital Fluency, and the competence with the closest average between the course and the profile of the students, was 1.1 Use of desktop computer and mobile devices. However, it should be noted that this result is based on the students' perception when they recognized an imbalance between the set of competences necessary for the course compared to their own. However, this is justified since this was the first time this course was applied in a hybrid way, which influences the students' digital competences. It also demonstrates the complexity of learning and teaching using technological resources. Moreover, to a certain extent, the results also reinforce the weight attributed to the development of the Pedagogical Architecture for the hybrid course. It further highlights the need to take into account the digital competences that will be

required for the student to be able to effectively and safely participate in this type of course utilizing digital technologies.

Final considerations

The construction and application of the AP is important work that has practical results in the development of digital competences for hybrid courses. Hence, the results of this research can help in the creation and/or reformulation of the course as well as a discussion of online PA building for hybrid courses based on the digital competences necessary for the online student profile.

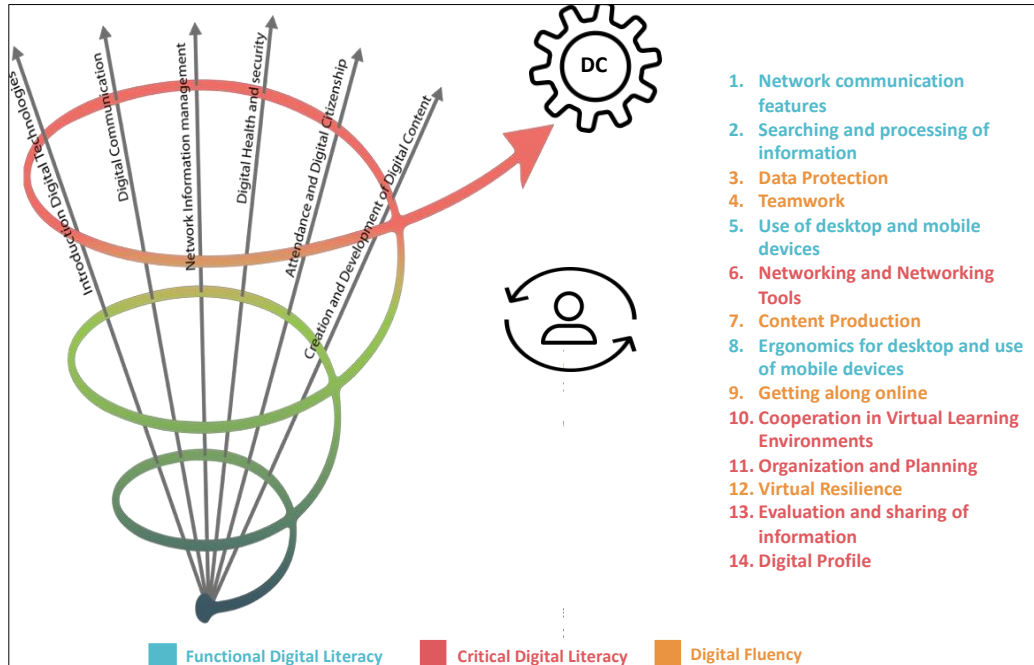
As a final result, Figure 23 presents the Pedagogical Architecture, Approach, Pedagogical Strategies, and Digital Competences organized based on the average importance attributed to them in the course analyzed.



Source: Created by the authors based on the research data (2020).

Thus, the most important Digital Competences for the course's Pedagogical Architecture and Strategies were found between Critical Digital Literacy and Digital Fluency. The most important being the Network Communication Resources competence and the last being the Digital Profile.

The process of building students' competences for this course can be seen in Figure 24.

Figure 24 – The process of building students' digital competences for the course

Source: Created by the authors based on the research data (2020).

Thus, it is understood that each course will have its own particular Pedagogical Architecture, Strategies, as well as Digital Competences, making this a complex process dependent on the subject profile and their distinct competence levels.

The results of this research therefore contribute to reflections on practices related to the transformation of face-to-face courses into hybrid versions, considering the impact of technology in the teaching and learning process. In fact, it contributes to the construction of PA and PSs linked to the development of digital competences for online students.

The implementation of a mapping program of the students' digital competences, considering the needs of this subject profile in hybrid courses, as well as new technological resources focused on interaction and communication is recommended. Furthermore, additional course development and research by and for course instructors additional course development and research by and for course instructors is also suggested in order to better utilize available resources as well as for the development of digital content based on the results of this study.

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