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Inquiry-based Learning in the Remote Learning Sphere

An Education 4.0 response to the emergency remote teaching challenges

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An Education 4.0 response to the emergency remote teaching challenges

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Resumo

O termo 4.0 foi apresentado na "Hannover Fair" (Alemanha) no ano de 2011, como um conceito transfigurador das operações na Indústria, Educação e Informação. Lançando o olhar sob o ensino atual, a aceleração do processo de integração da tecnologia foi uma consequência inevitável dos condicionalismos associados à recente situação pandémica. Surge assim a oportunidade de aprofundar o estudo da harmonização da transformação digital na educação aos desafios impostos pelo ensino remoto de emergência.

Este estudo propõe-se a analisar as consequências da transição abrupta para um sistema totalmente online, articulando soluções de "Inquiry-based Learning" ao conceito de "platformização" da educação. Este propósito obriga a avaliar alternativas inovadoras para responder à redução dos níveis de comunicação, motivação e retenção de conhecimento, através da conceção de uma plataforma digital institucional para partilha/consumo de vídeos entre alunos.

Este estudo utiliza uma abordagem de triangulação de dados quantitativos e qualitativos para gerar assunções sobre as perceções dos alunos relativamente ao ensino remoto, IBL e "platformização" da educação. A amostra é composta por 18 alunos do ensino superior portugueses, para possibilitar a concretização de um estudo mais aprofundado e detalhado.

Os resultados confirmam a queda dos níveis de comunicação, motivação e retenção de conhecimento em regime remoto, apontando benefícios inerentes à pesquisa autónoma/colaborativa, acompanhada por inferências positivas sobre a plataforma digital conceptualizada para contrariar o isolamento académico.

Palavras-chave: Educação 4.0; Digital Transformação digital; Inquiry-based Learning; Platformização; Communicação; Retenção do conhecimento; Engagement.

Contagem de Palavras: 9988 palavras

Abstract

The term 4.0 was presented at the "Hannover Fair" (Germany) in 2011, as a transfiguring concept of Industry, Education, and Information operations. Currently, looking at education, the acceleration of the technology integration process is an inevitable consequence of the constraints associated with the recent pandemic situation. Thus, the opportunity arises to deepen the study of the harmonization of digital transformation in education to the challenges posed by emergency remote teaching.

This study aims to measure and characterize the consequences of the abrupt transition to a fully online system, articulating "Inquiry-based Learning (IBL)" solutions to the emerging concept of "platformization" of education. This purpose forces us to evaluate innovative alternatives to respond to the reduction in levels of communication, personalization, engagement, and knowledge retention, namely through the conceptualization of an institutional digital platform for sharing/consumption of explanatory videos.

This study uses a triangulation approach of quantitative and qualitative data to generate assumptions about students' perceptions of remote learning, IBL and the "platformization" of education. The sample is composed of 18 Portuguese higher education students, to allow for a more in-depth and detailed study.

Results confirm the drop in the levels of communication, engagement, and knowledge retention in the remote regime, highlighting benefits inherent to autonomous/collaborative research, supported by positive inferences on the conceptualized digital platform in order to counteract academic isolation.

Keywords: Education 4.0; Digital Transformation; Inquiry-based Learning; Platformization; Student communication; Knowledge Retention; Engagement.

Word Count: 9988 words

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1. Introduction

Moving forward, Education is witnessing a shift from monolithic paradigms to modular models capable of absorbing constant changes and promoting real and updated curricular value. Knowing how to progress, where to step and defining an integrated curricular planning strategy based on a long-term vision that makes use of technological progress, becomes a reality to which public and private educational institutions cannot turn a blind eye. The recent pandemic context has accelerated the need to create a digital environment favourable to conducting remote classes, forcing the readjustment of multiple aspects of education.

The interest in the topic of technology integration in Education and "computer-assisted instruction (CAI)" as a means of enhancing knowledge retention dates back to Gaston (1988) whose study revealed positive student attitudes toward CAI integration. Active and collaborative learning were characterized in Johnson, D.W. & Johnson (1975) and Phillips (1988) as a vehicle capable of leading to "increased learning and retention of materials" leading to "higher student grades".

These studies were followed by the contributions of Cohen (1994), Johnson et al. (1990), Qin et al. (1995) and Slavin (1990), which added the need to review the teacher's role, to support the interaction between learners. These studies made considerations about the need to form a heterogeneous composition of groups to combine skills and achieve superior results. The emerging paradigm of "computer-supported collaborative learning (CSCL)" introduced by Koschmann (1996) defined the subsequent course in research on educational digital progress.

Research on collaborative learning and inquiry through computerized systems has increased since the beginning of the 21st century. Lipponen (2002) explored Koschmann's (1996) findings allowed to explore the foundations of the

CSCL, reinforcing the asynchronous stimulus of critical thinking, the adjustment to the pace and availability of learning and the possibility of researching and storing information resulting from the computerized study. Dede (2007) postulated a reshaping of education in the context "of a knowledge-based economy", which requires the expansion of new interactive methods of pedagogy, driven by the increased use of technology by students "outside the academic settings", a reality that feeds the emerging concept of "platformization of education". Cornali & Cavaletto (2020) characterize "educational digital platform" as "an integrated set of interactive online services that provides the teachers and learners", tools/resources to "support and enhance educational delivery and management.", eliminating physical barriers and distances. Tolmayer & BedE' (2019) point to "educational platformization" as a current trend for the transition of learning to digital platforms for study and exchange of insights and feedback that accompany the general "platformization" of services (streaming, transportation and communication) (van Dijck et al., 2018).

In fact, in the last decade, platforms such as Edmodo (Alqahtani, 2019; Halil, 2020; Iskandar et al., 2019), Yipiyap, Packback (Butcher et al., 2020; Chowdhry, 2017), GitHub (Zagalsky et al., 2015), WeChat Mobile Learning (Lei & Liu, 2020) and Flipgrid (Stoszkowski & Collins, 2021) "are increasingly woven into formal classroom learning" (Nichols & LeBlanc, 2020), opening opportunities to enhance engagement and quality feedback. These solutions respond to a growing preference to consume shorter content due to the progressive reduction of student attention span (García-Bullé, 2019; Yusuf et al., 2020).

However, recent research conclusions often point to parallel and inconsistent results regarding the level of communication and engagement resulting from the transition of teaching to an exclusive online typology. There are no cohesive results concerning the articulation of collaborative Inquiry-based Learning (IBL) with digital solutions capable of enhancing knowledge retention levels to

respond to the emergency remote teaching environment. It is also possible to identify some gaps in terms of a qualitative approach to the students' inferences at this stage, to understand how physical and social inhibitions imposed by the pandemic are perceived and may be circumvented through innovative digital platforms.

This study's contribution suggests an understanding of how to promote student knowledge retention and the development of soft skills at a distance through the harmonization of digital transformation (DT) with IBL pedagogies, in higher education. In this sense, it is crucial to understand how the constraints of the emergency remote learning regime influenced students' perceptions of online teaching and self-efficacy. Hence, the study aims to acknowledge how IBL mechanisms can help to mitigate the constraints of emergency remote teaching, namely through the "platformization" of learning. A concept of an institutional platform for uploading explanatory video content between students and reviewed by teachers is also conceived and explored.

From this standpoint, the research question explored in this study stands as follows: "How can higher education institutions harmonize digital transformation features as a means to mitigate students' academic isolation, in contexts of emergency remote teaching?". The answer to the research problem will be outlined by analyzing three objectives: 1) Comprehend how the vicissitudes of remote teaching conditioned students' perceptions of online learning; 2) Assess students' perceived utility in exploring Inquiry-based Learning methods; 3) Exploration of the use of didactic and collaborative teaching platforms in a remote context.

The study structure will follow the classical approach, with a brief contextualization and literary review, methodology and the presentation of results with a subsequent discussion and conclusion of findings.

2. Literature Review

Framing Education to the Needs of the Industry 4.0

Himmetoglu et al. (2021) portray Education 4.0 as a set of "new features that together reshape the educational reality from now on".

Creativity, collaboration, communication, and critical thinking are crucial skills that can never be automated or replaced and, therefore, should be increasingly cultivated and encouraged among the new generations (Keser & Semerci, 2019). Education 4.0 must lead and follow this call. There is now the urge to skill up faster than ever before, at such a rapid pace that individuals must keep constantly dipping into education throughout their careers (Fiona Anson, 2021). As Morris (2019) proposes, Education 4.0 is a request to the sector to rethink its paradigm, constituting an opportunity to formulate from basis what modern education must look like.

The fourth generation of education is based on a flexible and personalized learning experience (Lorenzo et al., 2021) that promotes project-based learning in collaborative contexts (Fisk, 2017). The student is the main element of the pedagogical system that must emphasize deep learning and meaningful retention of knowledge. Changes to the structure for sharing and consuming didactic materials force a rethinking of the roles of student and teacher, in a context of uncertainty and unpredictability resulting from rapid technological advances and social environments (Bonfield et al., 2020).

2.1. Vicissitudes of Remote Learning

2.1.1. Didactic Benefits

As discussed, technological advances make it possible to shorten distances between teachers and students. The clearest form of this reality lies in the possibility of carrying out a remote transmission of information/materials between teachers and learners. Computers, tablets or smartphones (Kukulska-Hulme, 2016). These devices, in addition to creating routines of technological dexterity in the younger generations for several years, began to be part of everyone's academic life, especially over the last decade. (Gallardo-Echenique et al., 2015). The learning value of viewing content face-to-face or remotely and synchronously or asynchronously is becoming increasingly similar. The video class format admits both modalities, granting flexible communication (Raja & Nagasubramani, 2018) and possibly allowing students to rewatch recorded classes multiple times, at their own pace and according to their availability, which has positive effects on the level of "note-taking, in-depth understanding (…) and assessment preparation" (Aristovnik et al., 2020; Chen et al., 2021; Milligan & Littlejohn, 2014; N. P. Morris et al., 2019).

In this context, the importance of a community chat/forum cannot be overlooked as a vehicle to encourage communication before and after class. The efficient management of this type of platform through a digital course manager gives the student greater security regarding the resolution of multiple problems via platform or email (Taylor et al., 2020).

2.1.2. Knowledge Retention

In fact, both student motivation and commitment throughout the semester contribute positively to their ability to retain knowledge. Knowledge retention can be characterized as the "construction and consequential transition of knowledge, through a process of recalling previously absorbed information in a meaningful way" (Al Shebab, 2020). It is up to the student to develop their ability to self-regulate, and to remain focused and attentive, even without the social

pressure of being physically in the conventional classroom environment. The concept of academic self-regulation or self-efficacy refers to students' "monitoring, controlling, and regulating" of "their cognitive activities and actual behaviour", which includes managing their schedule and commitment to learning (Pintrich, 1999).

The growing research on the pedagogical consequences of stimulating learner self-efficacy converges on the positive correlation between this concept and the quality of performance and academic results (Hayat et al., 2020; Klassen & Klassen, 2018). Förster et al. (2022) point to the value of viewing explanatory videos before the remote class, to formulate pertinent doubts, better assimilate the contents and improve performance in the short term (tests and exams) and retain taught materials for longer periods, noting that timing is key.

2.1.3. Abrupt Teaching Transition

In current times, approaching the transition of learning to a remote regime means, inevitably, understanding the impact of the Covid-19 pandemic on a global scale. When we analyze recent literature on this unforeseen transition, we understand that, during the last two years, it tended to be complex for educational institutions to take full advantage of the online class regime (Faize & Nawaz, 2020). In the space of a few months, it was necessary to restructure the planning of classes in the most seamless way possible. However, the abrupt and unexpected transition to a fully online teaching regime brought about a conjuncture of factors that conditioned students' perception of remote learning to this day. Numerous recent studies indicate that given the emergence of this shift in teaching and assessment parameters, student satisfaction with the education experience has been significantly compromised (Chen et al., 2021; El Firdoussi et al., 2020; Patricia Aguilera-Hermida, 2020; M. Shin & Hickey, 2021; Unger & Meiran, 2020).

Teachers ended up having several constraints to manage simultaneously. The students' difficulties in adapting immediately became a direct issue for teachers who, by themselves, already struggle with unforeseen difficulties (Bergdahl & Nouri, 2020). Forcibly, "tolerance" needed to become a keyword at a time when each individual, whether teacher or learner, had his or her own rhythm of technical adjustment (Katz et al., 2021; M. Shin & Hickey, 2021) and psychological/emotional adaptation (Copeland et al., 2021; Potyrała et al., 2021; Sahu, 2020), that depended not only on the quality of connection while accessing online classes (El Firdoussi et al., 2020) but also (and mainly) on the readiness of communication with the rest of the academic community.

In this regard, responsive communication/feedback (Mukhtar et al., 2020), the establishment of comprehensive expectations through an adjustment of deadlines to remote learning, previous experience with online learning platforms (Alnusairat et al., 2021), mental availability/self-efficacy/resilience (Koob et al., 2021) and internet connectivity (Katz et al., 2021), fundamentally constitute are key engagement drivers during distance regime.

2.1.4. Social constraints and limitations

Moving off campus aroused in students a sense of greater anxiety and doubt regarding the method by which they would be taught and evaluated (AlAzzam et al., 2021; Patricia Aguilera-Hermida, 2020; Quintiliani et al., 2022). After the shift, there was a general tendency for students to demonstrate lower levels of engagement due to the reduced motivation and lack of a sense of belonging, (Prokes & Housel, 2021). The referenced study also points out that task management and meeting deadlines have become more complex, accompanied by an increase in the amount of homework, greater difficulty in interacting/communicating with colleagues and reduced self-confidence. The evident decline in the capacity for self-regulation, led most learners to

procrastinate, without having incentives to demonstrate committed behaviours. Unpreparedness and anxiety were especially evidenced in moments of evaluation, due to a decreased time to answer each exam question and lack of knowledge regarding the process of submitting the exams, mechanisms of safeguarding academic integrity (such as plagiarism detection) and the aforementioned decrease in knowledge retention (Gamage et al., 2020; Katz et al., 2021; Potyrała et al., 2021).

Wei & Chou's (2020) study points out that, despite the relatively positive perceptions regarding the potential of remote teaching (such as "accessibility, interactivity, adaptability, knowledge acquisition"), there are no perceived advantages while conducting online classes. The face-to-face experience is more externally oriented than the remote regime, which is associated with a more "cognitive or internally" oriented learning, requiring greater individual responsibility from the student to absorb knowledge (Garrison et al., 2004).

It is worth reinforcing that despite the sudden shift in the face of the pandemic constraints, the DT, although appearing to be more distant, was already expected (Castro, 2019; Raja & Nagasubramani, 2018; Saykili, 2019). There were quite successful cases of educational institutions while approaching the pandemic reality, in which the rapid transition did not cause negative effects on students' self-efficacy (Kosycheva & Tikhonova, 2021), or even increased student performance (Maatuk et al., 2021). Moreover, it is important to mention that one cannot "conflate emergency online teaching with well-planned, well-designed and pedagogically effective online teaching that will meet the needs of learners and future employers" (Bonfield et al., 2020; Golden Cynthia, 2020).

Thus, it is possible to ascertain that the current remote higher education panorama can be explained by the level and quality of communication, personalization/adjustment to student individual needs, stimulation of

engagement, degree of knowledge retention, examination challenges and perceptions of satisfaction.

2.2. Integration of Inquiry-based Learning (IBL)

According to Law et al. (2019), the educational experience is divided into three main types of presences: Social Presence (SP), meaning the student's ability to fit into a cohesive academic context that facilitates the formation of personal and productive connections; Cognitive Presence (CP) reflecting student's ability to extract meaning from interactions and individual/collaborative research; Teaching Presence (TP) relating to the quality of teacher guidance within a given research context.

2.2.1. Communication as a Stronghold

Within this scope, the promotion of an active and collaborative learning context plays a fundamental role in the learning experience and knowledge retention, activating higher levels of participation and perceived utility, constituting the fundamental principle of IBL (Tran, 2014; Trowler, 2010; Vázquez-García, 2018). In an IBL approach, the teacher is mostly a guide, empowering the students to ask questions and actively find the answers by themselves (Prayogi et al., 2018; Sandika & Fitrihidajati, 2018; Suárez et al., 2018). Students rely on each other and on various information sources to solve problems and sort out their doubts through research and communication.

According to Callaghan et al. (2020), in group-based projects, students should be encouraged to "establish team roles and provide support for intra-group scheduling to improve overall group function and accountability". Under reduced teacher assistance, students end up enhancing soft skills such as adaptability, autonomy, and time management, while being forced to cope with the resources they are given (Alderman, 2016). Lu, Pang, et al. (2021) and M.-H.

Shin's (2018) studies concluded that when carrying out activities that promote collaborative IBL, the teacher should encourage students to take charge and make use of a deep approach during research/investigation, as this potentializes positive repercussions on learning outcomes, making knowledge absorption more meaningful and lasting (Rajabalee & Santally, 2021).

2.2.2 A Deep Approach.

The deep approach to learning reflects a paradigm of the student's relationship with teaching that primarily promotes real and purposeful absorption/understanding of taught content, as opposed to an exclusive attribution of importance to the final grade itself (Jackson, 2012). The importance of purposeful learning gains emphasis when it is understood that grade performance is, often, the prominent focus of the student during his academic career, which translates into the mechanization of study processes incapable of leading to long-lasting learning (Rust et al., 2005).

Victoria López-Pérez et al. (2011) study allows to discern a strong relationship between three fundamental variables: 1) the "perceived utility of the teaching method", 2) the "motivation generated by the learning process", 3) the "satisfaction derived from this process". The application/replication of knowledge in real scenarios and the formulation of different learning paths, should be stimulated, to enhance engagement and content absorption, consequently giving rise to greater curiosity, satisfaction and motivation to learn (Lu et al., 2021; Yusuf et al., 2020).

Numerous other studies point to a positive relation between IBL, teaching quality, academic achievement and knowledge retention (Hu et al., 2008; Justice et al., 2007; Luis Zafra-Gómez et al., 2014; Shah, 2020). Luis Zafra-Gómez et al. (2014) concluded that through IBL approaches, students' grade averages rose, with a more homogeneous distribution being also ascertained. It is possible to

associate this learning system with an increase in satisfaction and motivation resulting from superior achievement, displayed on tests and final exams (Visser-Wijnveen et al., 2012).

Encompassing the exploration of teaching methods in IBL, the main clusters sorted out by this study are zestfulness in learning, the level of retention of knowledge generated by the learning experience and the consequently perceived satisfaction.

2.3. Harmonizing IBL with Digital Transformation

In this context, it is increasingly feasible to combine the advantages of inquiry-based learning with the potential of Education 4.0. The synergies created by the incorporation of technology into IBL can also offer different solutions to expand and improve the effectiveness of remote deep learning (Chen et al., 2021; Sáiz-Manzanares et al., 2019), through the maturement of critical thinking, thoughtful feedback (Madden et al., 2017) and exploration of educational gamification (Nascimento et al., 2021).

As argued, from an asynchronous prism, active discussion and interaction between student-teacher-materials are fundamental for the development of collaboration and information filtering skills, enabling the creation of a moment and space to reflect and deepen a particular topic or field of knowledge. In fact, there is a positive correlation between student satisfaction with the establishment of collaborative group projects and online learning communities, as shown in Fisher & Baird (2005).

Early in the last decade, Donnelly (2010) studied the benefits of articulating technology with problem-based learning. This study, in addition to supporting the idea that the construction of an online sense of community is highly enhanced by students, also identified that digital platforms/resources (such as video conferencing, discussion boards, chat rooms and podcasts) largely contribute to

proving/reinforce learned content. However, at the time of publication of this study, the technological dexterity and the number of available tools still fell short of current possibilities, demanding, at that time, "that staff and students possess a complex array of different teaching and learning capabilities", which are more commonly evidenced nowadays. The idea that the inclusion of new asynchronous education channels stimulates curiosity and the desire to learn, cultivating a spirit of community when face-to-face interaction declines, is not new (Comer & Lenaghan, 2013; York & Richardson, 2012).

Oproiu's (2015) studies revealed that the use of e-learning institutional platforms in Higher Education (such as Moodle/Blackboard Learning) can "increase the learning motivation and (…) interest of students to develop learning activities in the virtual space". This author pointed out that, in the first academic year, students tend not to be aware of platform features and that it is up to teachers to instil their use. The study also revealed a positive relationship between the use of Moodle with learning autonomy and the creation of an academic friendly environment that is favourable to the immediate reception of feedback.

In moments of remote teaching, Fisher & Baird (2005) used "communities outside the classroom" and "student-created rubrics" to promote not only student self-regulation but also the socialization process, responding to physical distance, pointing to autonomy and motivation as pillars to generate lasting knowledge. In this sense, Fisher & Baird's (2005) strategy stemmed from the realization that students' satisfaction and commitment are boosted when they have the chance to share their "newly acquired knowledge with their classmates", assuming the teacher's role, to share, prove and reinforce their knowledge. Thereby, Hughes & Mikah (2019) established a positive relationship between the number of options for educational channels and the capacity of reaching more students, enhancing knowledge retention.

3. Methodology

3.1. Research Methodology, Strategies and Methods

To be able to define the objectives that this study has proposed, research branched out into a comprehensive study of remote teaching techniques and constraints, the abrupt transition resulting from emergency remote teaching, the skills valued by students in the vision of Industry/Education 4.0, the methods that promote engagement and knowledge retention, Inquiry-based Learning solutions and the "platformization of education". Findings allowed to develop the set objectives, and extract conclusions on the feasibility of a proposed institutional platform for uploading/consuming explanatory videos (student-student).

Recent shifts in education paradigms require an analysis capable of exploring and extracting in detail the student doxology about the current state of teaching and possible solutions to adopt in order to restore enthusiasm to teaching. Thus, based on this detailed research on fundamental concepts of the digitalization of education and subsequent definition of gaps, it was possible to form a set of questions that, after carefully arranged to match the defined objectives, were presented to a selected group of participants.

The sample selection focused on individuals (students) who have experienced the teaching shift during the emergency remote teaching period, resulting from the pandemic context. Eighteen Portuguese students were selected, grouped into three heterogeneous Focus Groups (FG), whose ages are between 21-23 years old (six males and 12 females) with different institutional backgrounds (Católica Porto Business School, Faculdade de Direito da Católica Porto, Nova School of Business and Economics, Instituto Superior de Engenharia do Porto and Instituto Português de Administração de Marketing) and at different moments of their higher study cycle (Bachelor, Postgraduate and Masters). An explanatory

presentation on the concepts discussed was prepared for participants who were not familiar with the concepts studied. The FGs took place through Microsoft Teams, and the three discussions were recorded for later collection, treatment, and categorization of insights.

The modest sample size was derived from the detail of the analysis required by the settings of this study (use of triangulation of results to validate the research), the amount of information collected from each participant and the short period allocated for the collection of information. To complement the understanding of the testimonies, all participants were asked, after each FG, to respond to a survey that included the topics covered in the active discussion, through Google Forms.

3.2. Design Methodology

As mentioned, this study used mixed-methods for empirical evidence extraction, simultaneously combining qualitative and quantitative data, admitting that interactive analysis with both methods enhances "better analytical features" (Curry et al., 2013; Halcomb & Hickman, 2015). Both analyses share themes and topics, “ensuring the unity of the research design and increasing the level of their integration” (Yin, 2006) while minimizing the constraints of each analysis typology (R. B. Johnson & Onwuegbuzie, 2004).

3.2.1. Focus Groups

Focus Groups constitute a complex approach to data collection, which involves close interaction with participants, in which “the heuristic value (..) lies in the kind of interaction that emerges during the debate” (Acocella, 2012). Semi-structured group interviews (Focus Groups) were chosen as a means of extracting qualitative data (Bradford & Cullen, 2012), in an in-depth approach.

This type of analysis requires a reduced number of participants per group and allows for a more organic conversation, capable of promoting free and spontaneous reporting of individual experiences. (Baumbusch, 2010), subjective opinions, opposing ideas and natural deviations from initially programmed topics (Choak, 2012).

Thus, in the three FGs, the same key-questions are addressed, but the different discussions branched out by multiple issues or approach paths. Comprehensive questions were preferred, in the strategic sense of allowing participants to wander through the topics studied, interrupting only with follow-up questions to refocus the conversation.

Conducting semi-structured focus groups also favours the extraction of insights into new ideas and concepts (Adams, 2015), leading to a more grounded idea about the advantages and constraints of the digital institutional platform conceptualized in the present study and presented to the participants.

Appendix 1 contains the base common questions asked to the three focus groups. Distinct follow-up questions naturally varied depending on group responses.

3.2.2. Survey

Responses to the survey reestablish the objective nature of results, to guarantee convergence of the inferences with the established objectives (Stockemer, 2019). A total of 31 questions were defined, 30 of which were mandatory.

Therefore, through the survey, all participants contributed individually to all themes and questions, eliminating the contributions asymmetries on the FGs (Queirós et al., 2017). Unlike in the qualitative approach, these questions were standardized for all three groups (but addressed the same topics and order of themes of the FGs), as in Appendix 2.

3.3. Analysis Methodology

This study's conclusions/findings are mainly based on qualitative data since the amount of information collected through FGs was more significant and detailed.

3.3.1. Focus Groups

To group and categorize the large body of participants' testimonies that resulted from the FGs, the NVIVO program was used, organizing the data into clusters and subclusters, according to relevant recurring themes to form trends and draw conclusions.

The most representative testimonies from each group were selected to illustrate the insights extracted from this discussion. Four main clusters emerged that resulted in the response to the three defined objectives. Thus, the four clusters that emerged from the first testimonies analysis were: 1) Impacts of Technology Integration in Higher Education, 2) Perceptions about Remote Learning, 3) Use of Inquiry-based Learning, 4) Integration of Digital Platforms in an Inquiry-based Learning System

3.3.2. Survey

As mentioned, the interpretation of the surveys is intended to complement the qualitative analysis. The results of the surveys sent by the participants that represent the tendencies of the individuals of each group were first evaluated separately and, later, clustered to obtain an overview of the perceptions. The measurable assessment of the participants' perceptions allowed the translation and graphic visualization of the testimonies.

3.4. Quality Assurance of Research

The complete and robust analysis showed similar response lines between both methods (qualitative and quantitative), adding validity and robustness to the empirical evidence.

The concurrent triangulation methodology helped the constant comparison of results, to verify if the answers collected in the conversational discussion were convergent with the surveys (Creswell & Clark, 2013). According to Noble & Heale (2019), "triangulation is a method used to increase the credibility and validity of research findings" which helps to explain complex behaviours and perspectives "to offer a more balanced explanation to readers". As a result of this method, different justifications for the results were proposed and confirmations were ascertained. In situations in which the individual answers were not clear/imperceptible in the FGs, it was manageable to resort to their direct responses in the surveys. The preparation of topics/questions to be asked in the FGs/Surveys was guided by the central themes highlighted by the recent literature on remote learning/IBL/educational platformization.

4. Results

The joint/mixed analysis of qualitative and quantitative results was distinguished into three over-arching clusters: (1) Perceptions about Remote Learning; (2) Exploration of Inquiry-Based Learning, (3) Harmonizing IBL within the context of digital transition".

4.1. Perceptions about Remote Learning

4.1.1. Communication Level

Physical distance emerged as a considerable constraint in conditioning the quality of communication between colleagues, as we depict in Table 1. This

communication covers both a perspective of studying/carrying out group projects as well as interpersonal and social interaction. All groups pointed to a decrease in the quality of moments destined for didactic communication between colleagues in the sense that most participants report that these moments become less meaningful or memorable, affecting the quality of individual contributions, as expressed in Figure 1.

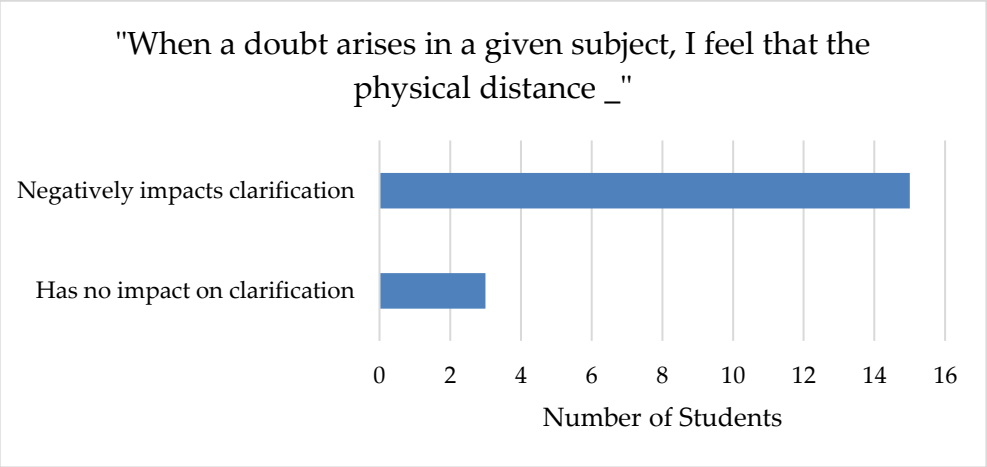

FIGURE 1

Impact of physical distance on doubt clarification

Own source: Survey

Communication with teachers and students after class to clarify doubts was also addressed as a significant loss arising from the transition to the remote regime. The loss of strong social relationships/bonds with colleagues stood out as one of the most relevant aspects in the perception of the quality of remote teaching, affecting it negatively, namely in tasks that involve exchanging ideas and inputs within a group. This trend is aggravated in participants who began their university cycle at a time when the pandemic was already underway, increasing the challenge of developing interpersonal connections with colleagues both for productive purposes/elaboration of group tasks and at a social level.

However, some participants perceive this physical and social distance as a vehicle for promoting greater productivity within groups, leading to them being more attentive to the time spent on each task.

	Key-Idea	Key-Inference
Communication Level	In a remote system, the subject is not taught in a meaningful manner, and you are not able to closely interact to your colleagues. **[LF (FG3)]**	Sense of educational isolation;
	I feel that interaction and communication lose quality, that is, I spend many hours studying online with colleagues, but productivity is often compromised. **[CCa (FG2)]**	Depreciation of communication quality.
	Remotely, there is a loss of a huge set of social skills that can only be developed face-to-face, from the respect for a teacher's authority to the contact with peers. **[SS (FG1)]**	Mismatch of interpersonal skills.
	I end up fulfilling the schedules differently, ending up being more productive at home. **[BC (FG1)]**	Productivity Raise.
Personalization Level	The remote system wasn't very different from the traditional one, just a mere transition to an online regime. The personalization of teaching implies that teachers are more knowledgeable about digital platforms. **[RB (FG3)]**	Digital transformation without personalization.
	With recorded classes the student can decide when he/she wants to attend or review the classes. **[FI (FG3)]**	Higher personalization achieved.
	The recorded lessons are more respectful of the pace at which the student wants to learn. The student can even put the video at a higher speed or stop the video, pull back if he wants to review something. **[BC (FG1)]**	Higher personalization achieved; Individual learning pacing.
Engagement Level	I had teachers with whom I was fully engaged and even preferred online classes. In other subjects where it was harder to focus, because of the comfort and privacy associated with being at home. When there is already a teacher's difficulty in captivating students for a particular subject, the online regime accentuates those difficulties. **[RB (FG3)]**	Deterioration of engagement; Increased procrastination; Higher comfort and privacy.
	In project presentations, comparing online versus in person, the level of attention also changes. There are still many shortcomings when it comes to remote teaching. **[SS (FG1)]**	Difficulties in project presentations.
	One of the problems that I experienced the most with remote teaching was keeping focused during classes. If this system were adopted gradually, it might be easier to adjust to this reality. **[DS (FG2)]**	Deterioration of engagement; Abrupt transition.
Knowledge Retention	It depends a lot on the teacher's method, but generally, it is easier to retain knowledge during a face-to-face class. **[LF (FG3)]**	Easier to retain knowledge while face-to-face.
	Remotely, the notion of authority is lower, because it is easier to get distracted, doing a thousand other things, while in face-to-face classes there is a certain social pressure to pay attention to the teacher. **[AL (FG1)]**	Reduction of class dynamism; Increased distractions; Less social pressure to be attentive.
	In terms of knowledge retention, the opportunity cost of not having face-to-face classes is very high. I find myself having to go back to class recordings or having to always struggle to focus on the teacher in a class. **[DS (FG2)]**	Less learning propensity; Need to rewatch recorded lessons.
Examination Challenges	Most teachers were more concerned with ensuring that we did not copy during exams than with giving us a good evaluation experience from a distance. **[CCo (FG1)]**	Lack of preparation for evaluation moments.
	The problem with online exams emerges when the questions are interrelated. Sometimes you realize you made a mistake, and you can't go back to change that answer or review the exam. If it was introduced gradually, perhaps this problem would not have happened and teachers would be more prepared. **[CCa (FG2)]**	Evaluation constraints; Induced pressure during exams.
	I would prefer if teachers gave students the chance to have more time and be able to consult the materials but making the exam more demanding and conducive to the student applying their knowledge. **[RB (FG3)]**	Examination changes in favour of the student.
	Instead of an exam, some teachers switched the evaluation to projects and that forced us to show more of our knowledge. **[BS (FG2)]**	Rethinking of exam models.
Satisfaction Level	My satisfaction with the course at this stage was below zero. Initially, both students/teachers were not prepared. **[BC (FG1)]**	Compromising sense of unpreparedness.
	In terms of results, I'm better in remote registration exams, but I learned more material and retained that same knowledge in person. **[JF (FG2)]**	Better results but a worse experience.
	It's 50/50. The online final results are better but spending multiple hours in front of a screen is more tiring. When it is face-to-face, it is more dynamic. The best option is a hybrid system. **[DS (FG2)]**	Benefits of hybrid options.
	I would favour face-to-face teaching, for the whole connection, communication and interaction with colleagues and teachers. At the remote level, this is lost. School is more than absorbing information. **[CCa (FG2)]**	Social component; Communication and interaction are essential.

TABLE 1

Student key-ideas and inferences on Remote Learning

Own source: FGs

4.1.2. Level of Teaching Personalization

Participants associate Education 4.0 solely (or in most of its scope) with remote learning, as this is the most concrete evidence of the integration of technology in teaching. The personalization levels sensed by the participants were neutral or negative, a trend that was contradicted by the survey responses, as shown in Figure 2.

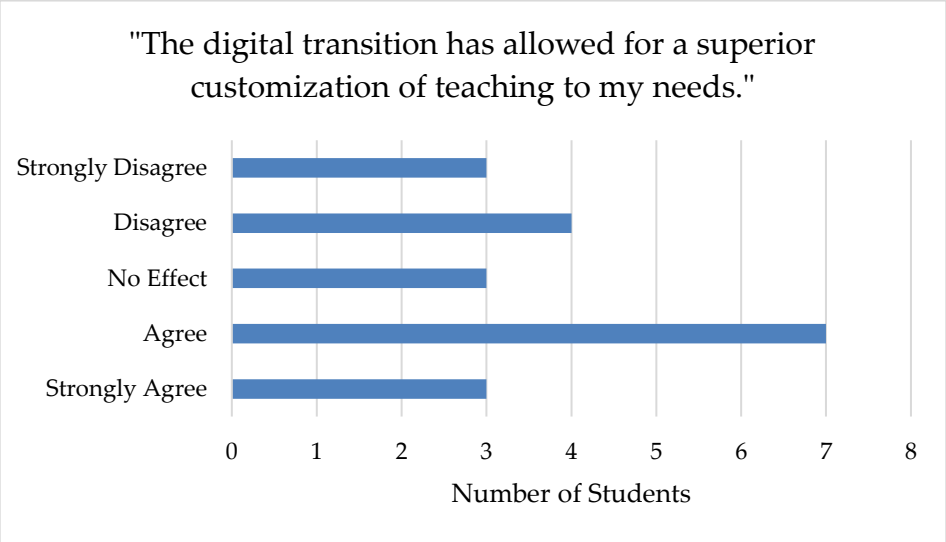

FIGURE 2

Remote customization of the learning experience

Own source: Survey

Regarding personalization/adjustment of teaching to individual needs or difficulties, there were no significant perceived differences from the face-to-face system, which led to unproductive results given the physical distance and student-teacher disconnection. The lack of time to adjust the teachers' new methods and the tools available to track student individual difficulties were identified as the major obstacles. However, the possibility of reviewing recorded classes allowed students to establish their study pace or rewatch an explanation.

4.1.3. Engagement Level

The reality is that students still perceive face-to-face classes as an option that is more reliable, captivating, and memorable. Despite recognizing that there are

now more opportunities to make the learning process more adjusted and personalized, participants tend to find it more difficult to maintain focus in a distance regime, in which the teacher's authority seems to decrease. In fact, the vast majority of testimonies from students revealed that, in addition to being less dynamic, their remote experience makes it less comfortable to ask questions to the teacher.

This trend becomes evident when it is understood that, in the case of some subjects, students prefer to watch recorded classes over a synchronous online regime. Privacy, physical comfort, and multiplicity of distractions emerge as drivers that disturb attention, leading the vast majority of participants to state that their level of engagement has dropped significantly in the remote system. Figure 3 reveals a clear appreciation of face-to-face engagement/motivation to learn, to the detriment of the remote system.

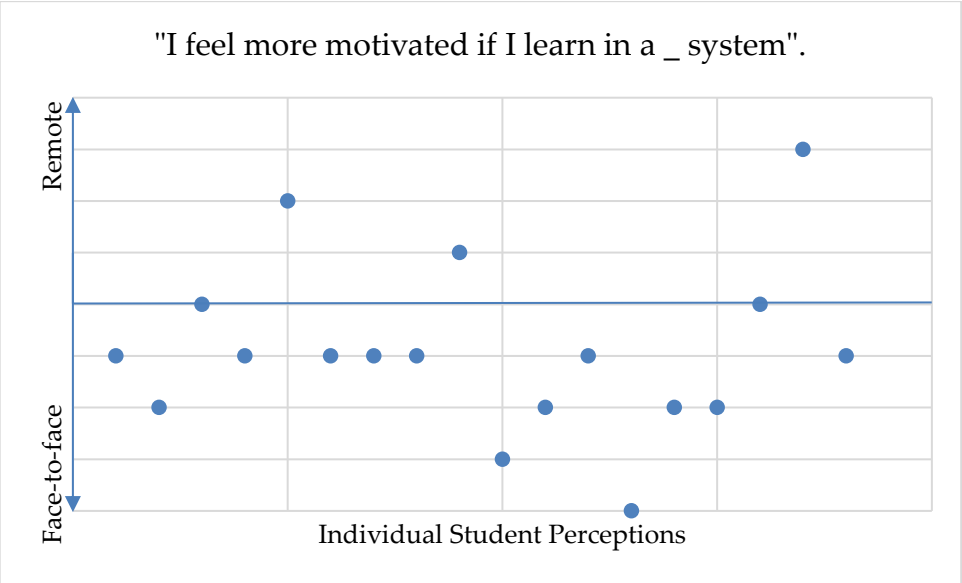

FIGURE 3

Impact of learning system on motivation levels

Own source: Survey

4.1.4. Knowledge Retention

Participants noted that their knowledge retention levels in a remote class derive directly from the possible engagement generated in the activities and explanations conducted by the teacher. Thus, the drastic decrease in their levels of concentration and focus during the online period forced a generalized drop in knowledge retention. Referring that the opportunity cost of not attending a face-to-face class is usually quite high, students also reinforced that they often had to resort to the available recordings of classes to (re)absorb information, which was often very time-consuming.

While in a remote system, a convergent trend towards a preference for consuming shorter and more direct content was evidenced. Also, it was found that students' self-efficacy is a central aspect for them to demonstrate committed behaviour towards achieving their curricular objectives, with students being primarily responsible for it (Figure 4).

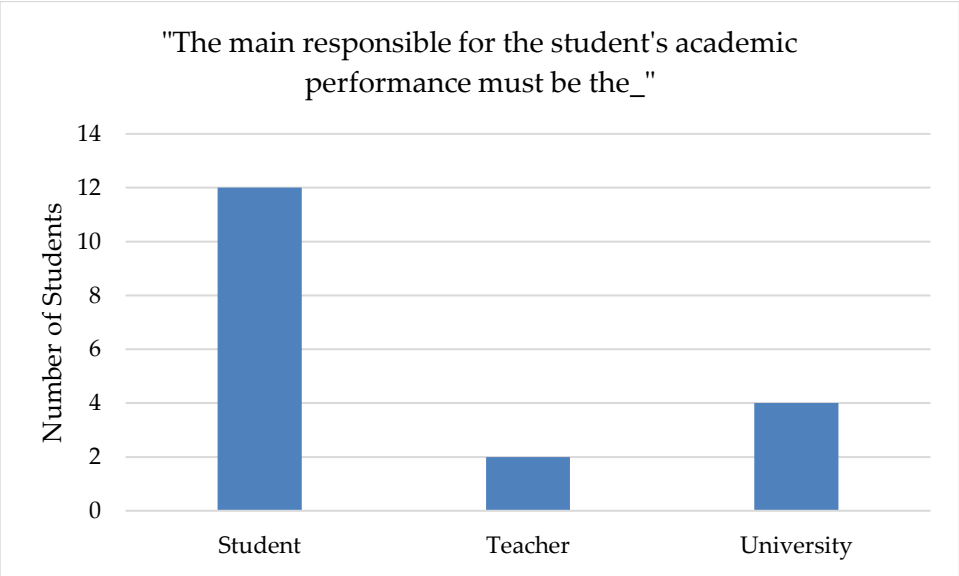

FIGURE 4

Performance accountability

Source: Own source

4.1.5. Examination Challenges

The assessment was the aspect that most concerned the participants. Although the success measured by the average grades is not explained by the type of exam (face-to-face or remote) dictated by a homogeneous distribution of individual perceptions, represented in Figure 5, the overwhelming majority of students report being largely dissatisfied with the remote examination methods.

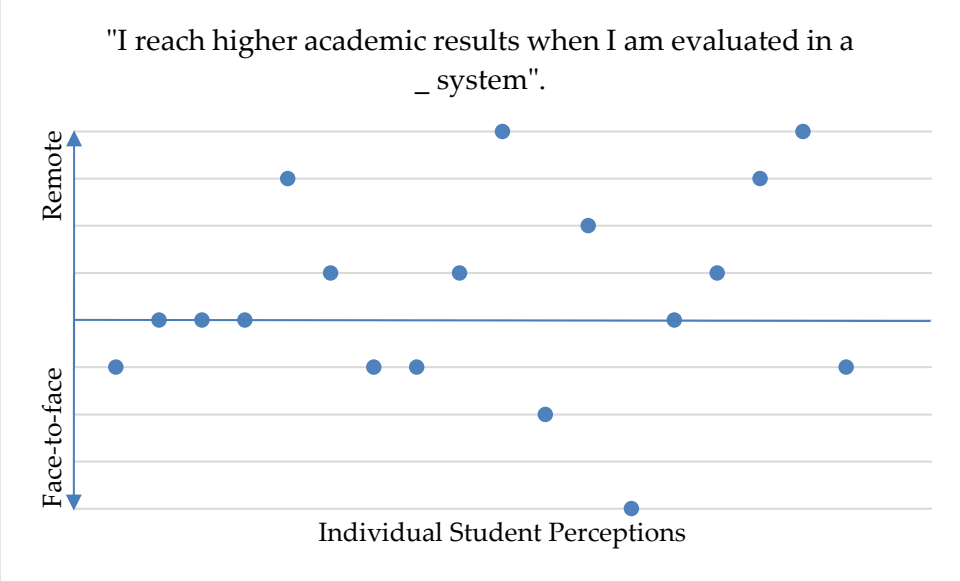

FIGURE 5

Impact of learning system on results

Own source: Survey

This was justified by the lack of time, the impossibility of going back and forth in the exam questions, the "exaggerated fear" of teachers that students would communicate, the difficulty of accessing the examination platforms and the submission of responses. Participants stated that all these constraints do not allow a faithful representation of their preparation and study. While being taught remotely, participants tend to ask for more time/freedom to answer each question at their own pace, not minding having more demanding and complex exams.

4.1.6. Satisfaction Level

Regarding the quantification of learning success in grades, the answers were quite divergent depending on the group of participants under analysis.

FG1 showed a clear preference for face-to-face assessment, noting that in addition to higher grades, this system allows for greater satisfaction with the quality of teaching, pointing to a more faithful translation of their skills.

FG2 preferred a remote evaluation system, pointing out the possibility of consulting content as a significant advantage of this system.

Finally, FG3 participants tended to take a neutral position on this issue, pointing out as relevant factors comfort, lack of peer pressure before the exam and ease of consultation, but also, on the contrary, the greater uncertainty in each response aggravated by the impossibility of revisiting the previous questions to reformulate them and the lack of time to finish the exam.

The survey results, in Figure 6, reveal that the mentioned constraints, associated with emergency remote teaching, still largely condition the level of satisfaction with online learning.

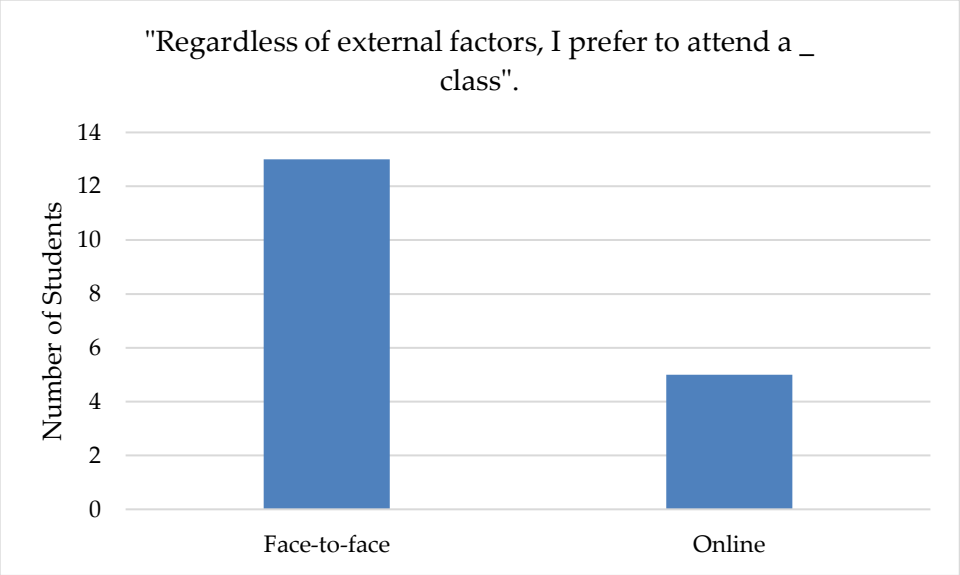

FIGURE 6

Overall student system preference

Own source: Survey

4.2. Exploration of Inquiry-based Learning

4.2.1. Zestfulness in Learning

Regarding collaborative projects, the dynamism facilitated by an Inquiry-based system is very much based on the possibility of bringing together different participants with specific skills and qualities, contributing to improving the final result. In a phase of greater physical and social distance, the importance of learning strategies that enhance communication between colleagues and independent study help to overcome the concentration/focus difficulties mentioned by the participants. The fluidity of communication between colleagues and the ease of adapting to platforms designed for this purpose was the main vehicle for mitigating physical distance (Table 2). Often, the explanation of colleagues was regarded as being more perceptible/comfortable than a teacher's clarification in/after class (Figure 7).

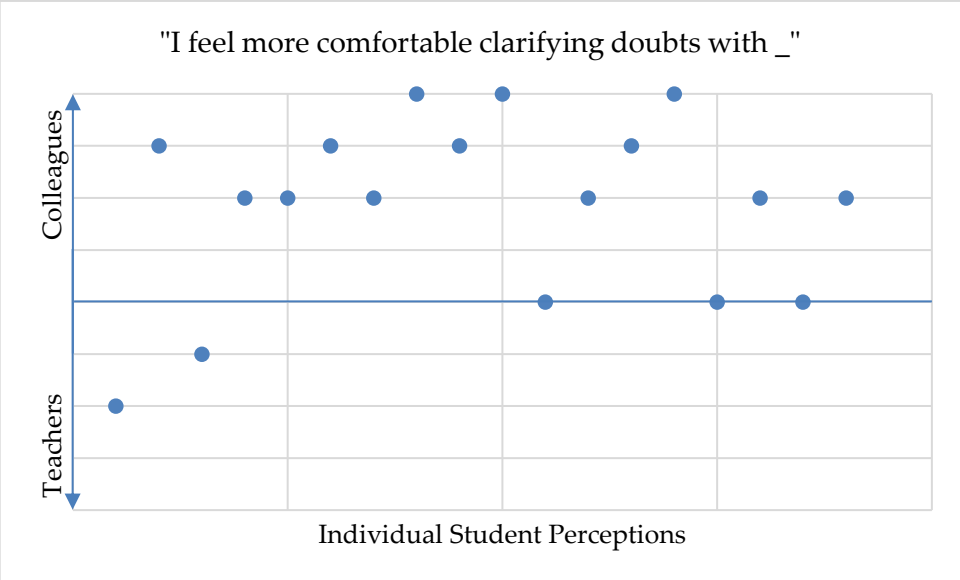

FIGURE 7

Doubts clarification comfort

Own source: Survey

	Key-Idea	Key-Inference
Communication Level	I can ask a colleague the most basic question possible without being afraid of showing ignorance about the subject. I cannot ask unreasonable questions to a teacher. **[JF (FG1)]**	Stress-free and easy communication; Reduced fear of making mistakes.
	Different people master different abilities such as critical thinking, math skills, leadership, among others. Researching in groups ends up pulling people towards you who master other skills. **[AL (FG1)]**	Alignment and combination of skills.
	There is a closer personal relationship if it is a colleague of yours with whom you get along well, communication is more fluid. Teachers also accept questions, but it's always more of a monologue than a dialogue, so it's much easier to have an explanation from a colleague of yours without fear of interrupting him. **[DS (FG2)]**	Communication fluidity; Personalized and comfortable explanation.
	In the job market, what distinguishes two candidates with similar paths are soft skills. The ability to differentiate becomes increasingly important and that's where soft skills come in. Currently, adaptability is increasingly important. **[CGo (FG1)]**	Soft skills as differentiators; Ability to adapt to change.
	I think that soft skills are more independent and unique, relying on each individual to be able to develop and apply them. Group projects end up fostering the ability to plan because you have to establish a strategy to adopt for research, division of tasks and the results you want to achieve, which is not always so actively encouraged otherwise. **[AL (FG1)]**	Fostering the ability to plan; Coordinate efforts; Defining suitable strategies and objectives.
	In a future professional context, you don't do everything from memory, you have to communicate with others, search for information with the help of digital tools. **[DS (FG2)]**	Valuing soft skills over hard skills.
Knowledge Retention	Both in terms of results and knowledge retention, this is the type of learning where I absorb the most. **[FI (FG3)]**	Easier to retain and apply knowledge.
	It forces me to study a topic very well, which can take a long time, but while being actively trying to learn I retain information more easily. In this model, the time spent is synonymous with learning, because even the content that I end up not using is information that I would not learn otherwise. **[SS (FG1)]**	Time spent is synonymous with learning; Higher consumption of materials; Developing self-help and filtering skills.
	If you have to independently search for information and see the contents beforehand in order to be prepared to discuss the matter, you end up retaining more, especially in group work. It benefits students who try to make the most of the classes and clarify doubts. For me it workd out quite well in terms of knowledge retention. **[CCa (FG2)]**	Benefits student initiative; Easier to retain knowledge; Sense of a meaningful class.
	I am a self-taught person and I feel that I learn a lot by investigating and being able to do things at my own pace. I like this type of teaching. **[BE (FG1)]**	Benefits student initiative; Adjusted learning pace.
Satisfaction Level	The truth is that in all the tasks I've had using inquiry-based learning I've always had great success in my grade, and I learned a lot. **[SS (FG1)]**	Positive impact on the grade; Better learning experience.
	The incorporation of inquiry-based learning would be a way to make students more engaged in classes and the subject. **[RB (FG3)]**	Higher student engagement.
	A flipped classroom environment in which the teacher serves merely as a guide turns out to be more interactive and more efficient. I got higher grades in group projects, managing strengths and weaknesses within the group. **[DS (FG2)]**	Higher student engagement with decreased teacher assistance; Positive impact on the grade.

TABLE 2

Student key-ideas and inferences on IBL

Own source: FGs

Participants stated that clarifying a doubt with a colleague is less subject to scrutiny, and there is no longer any pressure of showing weaknesses to the teacher. Addressing the university's mission of preparing students for the professional context, most participants converged on the idea that, gradually, the importance of developing soft skills in the current competitive context goes beyond learning hard skills, as portrayed in Figure 8.

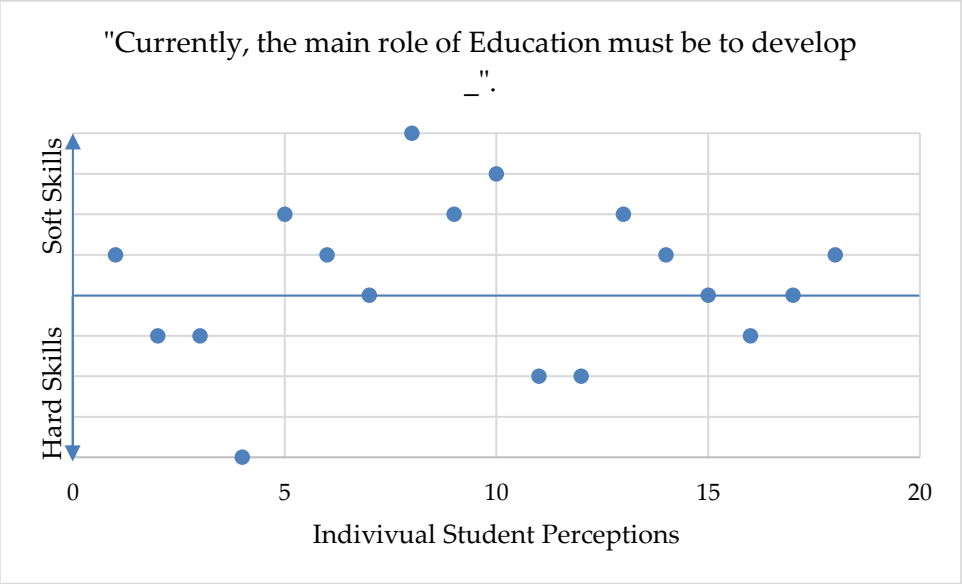

FIGURE 8

Soft skills vs hard skills

Own source: Survey

Being able to reconcile schedules, divide tasks, plan strategies, and define results/goals in advance were highly valued skills. Some participants, having had professional experience in their area of study, highlighted the importance of soft skills as a differentiating element of candidates for a particular job vacancy.

Curricular plans must involve the integration of collaborative projects that promote interpersonal communication, individual or group research and integration of students' feedback, ideas, and inputs (Figure 9).

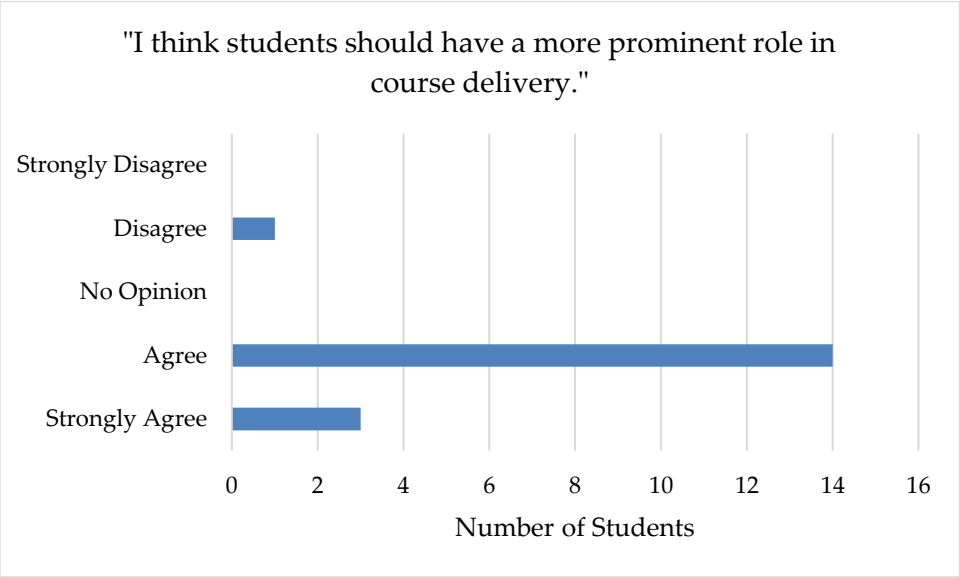

FIGURE 9

Student role in course delivery

Own source: Survey

4.2.2. Level of Knowledge Retention

From the discussion about the level of knowledge retention, the unanimous conclusion emerged that the IBL is the system that most promotes the retention of knowledge, for longer periods, instead of a conventional class. The vast consumption of information and the respective filtering that this model requires, promotes a closer and more meaningful contact with the contents taught. This allows the time spent studying to be translated into real knowledge, being more easily applied at the time of evaluation.

Lower levels of teacher interaction in the student's learning process led to benefits not only in the student's autonomy but also in the levels of knowledge retention, as evidenced in Figure 10 and Figure 11, in which, in addition to being demonstrated that 84% of participants agree that reducing teacher intervention benefits student autonomy skills, it is also clear that 89% extract greater advantages when researching collaboratively.

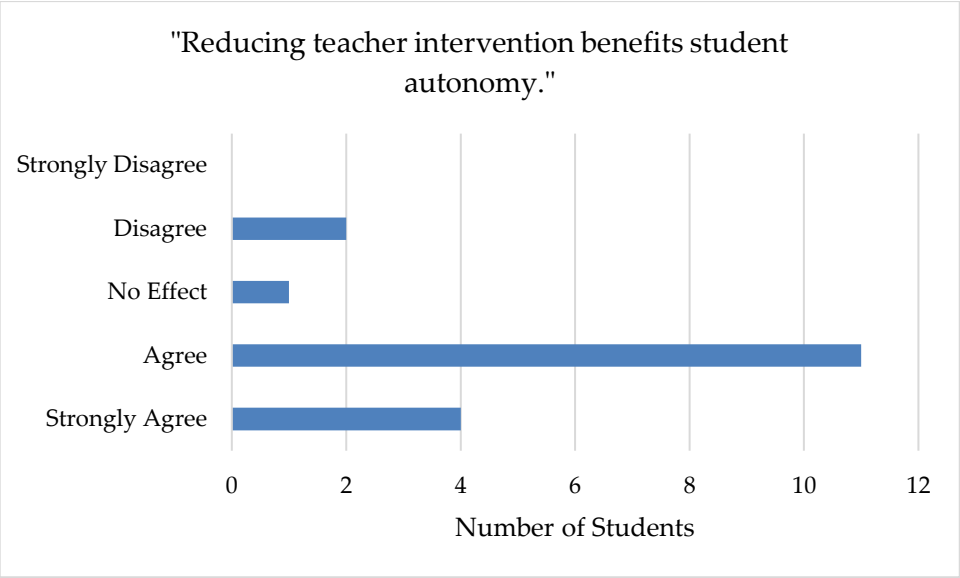

FIGURE 10

Impact of teacher intervention on autonomy

Own Source: Survey

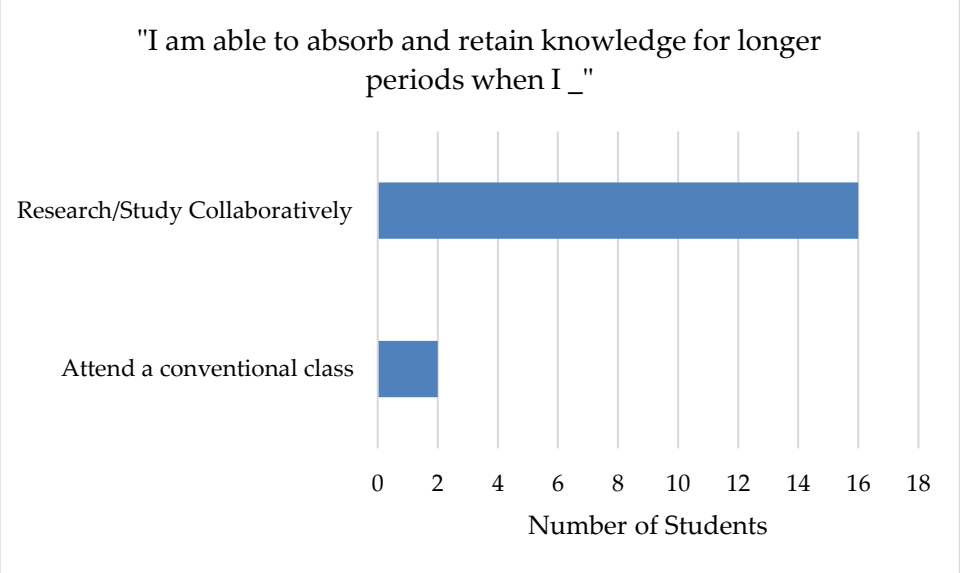

FIGURE 11

Knowledge retention and study typology

Own Source: Survey

However, students did not fail to ascertain that the teacher has the crucial role of guiding their research process, otherwise, they will get lost, not responding as intended. Greater absorption of content before or after the class, allows the learner to formulate more pertinent doubts/questions and ask them to the teacher at a later time. Participants stated that this aspect is maintained and even

dynamized in group projects. Furthermore, this model was considered by the participants as stimulating a more intuitive aspect of learning, that is, it promotes the individual initiative of each student through their desire to learn. It thus represents a more faithful representation of the individual's propensity to generate interest in a subject.

4.2.3. Satisfaction Level

In terms of applying retained knowledge at the time of assessment, participants tended to show an increase in the average level of grades in subjects that used an inquiry-based system during their academic careers. The groups preferred subjects that promote the assessment of competencies through projects, instead of conventional exams, being through this approach that they reach higher results while feeling a faithful transition of their knowledge into the final grade.

Results showed students' enthusiasm for being able to collaborate with colleagues on projects and having the opportunity to get closer to the reality they will face in future professional contexts. Contact with different colleagues in different life stages/backgrounds helps to create a meaningful experience. Also, the success of this system depends on the good functioning of the group, both in terms of communication fluidity and effectively combining skills.

In the survey, all participants (100%) pointed out that the promotion of group research projects should increase.

4.3. Harmonizing IBL within the context of digital transformation

4.3.1. Digital Study Platforms

The collected responses reveal positive impressions concerning digital channels for interaction and communication. The survey showed that 94% of participants responded that adjusting to the new generation of education implies adopting new behaviours regarding the integration of technology (Figure 12) both in the exchange of content and learning resources, as well as in the means of study and research and also at the level of autonomy/predisposition to learn.

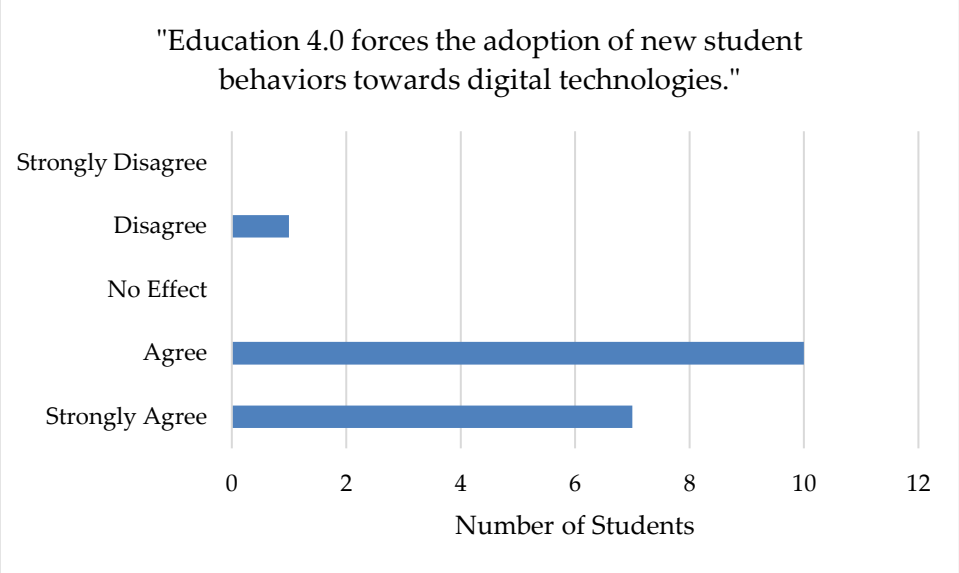

FIGURE 12

Student behaviours towards digital technologies

Own Source: Survey

Participants were motivated to explore new learning channels, stating that there is a positive correlation between the number of communication/study channels and the dynamism of learning.

4.3.2. Institutional Video Platform Concept

In this context, the proposal of the video platform previously presented was exposed to the students, in an attempt to understand their use perceptions/intentions.

In order to fill some of the didactic gaps associated with the impossibility of a face-to-face regime, this study's solution adds DT to the precepts of IBL, with a

view to creating a new channel of study/transmission of information in the form of a video content platform, adopted/ regulated by each higher education institution. This concept-platform intends to allow each student, voluntarily, to upload a short explanatory video (5/10-minutes) covering a particular topic/exercise in the form of a brief presentation. Posteriorly, these videos would be reviewed by the teacher before being available/published in the course online institutional campus/Moodle (Figure 13).

Thus, the option to elaborate and publish videos aims to empower students to stand out in a topic more easily, potentially being rewarded in their final grade while helping colleagues who need to consolidate that subject or exercise, taking advantage of the fact that students tend to master different technological resources in a more agile and intuitive way.

The decision to increase students' grades resulting from the preparation of these videos is optional, depending naturally on the teachers' decision.

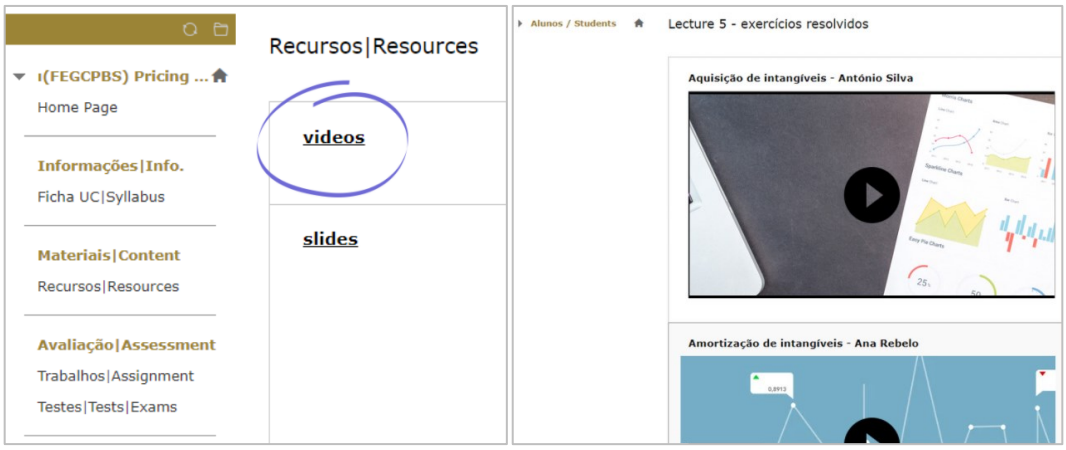

FIGURE 13

Concept example of institutional platform interface through Blackboard Learning

Own source, utilizing Blackboard Learning

4.3.2.1 General Reasons to Use

The students' impressions about the possible integration of this platform into the teaching models (Table 3) tended to be positive, being divided between

enthusiasm and some doubts about the feasibility/implications of such a proposal.

As reported in Figure 14, except for one student, all of the participants reported that they would use this platform to consume content published by colleagues, especially during examination periods.

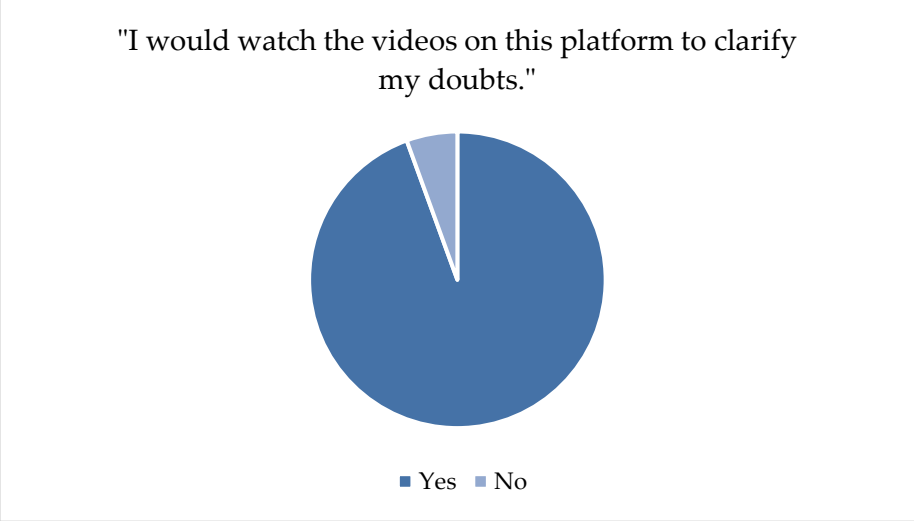

FIGURE 14

Platform acceptance

Own Source: Survey

	Key-Idea	Key-Inference
Study Platforms	Such platforms make teaching more didactic, promoting an articulation of the teacher's explanation with more captivating ways of learning, in a "self-taught way", seeking learning through other channels. **[CGo (FG1)]**	Higher learning dynamism; Stimulation of attention capture.
	The more channels you have for communication, the easier it is to communicate with classmates and teachers. **[DS (FG2)]**	Expanding communication options to promote student communication.
General Impressions of the Platform	This platform can help students who learn faster to lend a helping hand to their colleagues if they are capable of making a good video. **[BE (FG1)]**	Promotion of communication between students,
	During my academic career, I'm quite used to helping to clarify my colleagues' doubts and I don't mind explaining the material, so I would have no problem uploading videos on the platform. **[Cca (FG2)]**	Propensity to publish videos; Mastery of content as an essential factor to publish videos.
	The student, better than the teacher, knows the topics in which other colleagues may have difficulties and how to help them from a different perspective. Several colleagues of mine would make these videos. Some students find it very easy to transmit knowledge, so this channel would be highly enriching. Teachers reviewing the content is very effective in ensuring that the explanation is reliable. This platform allows for greater personalization of learning, as is more dynamic to listen to a colleague's explanation, possibly asking them questions afterwards. **RB (FG3)**	Assistance adjusted to difficulties; Leveraging knowledge synergies; Higher personalization; Greater information security due to full review of content by teachers; Responsive feedback.
	There is an advantage of being able to talk to your colleague if you don't understand the video explanation well, and it's less complex than asking the teacher about that or another subject. **[JL (FG3)]**	Increased interaction between colleagues.
	It would be beneficial to add to other types of content, for example, summaries/exercise answers. **[CGr (FG3)]**	Exploration of other content formats.
	I think the reward is essential to motivate the student, otherwise, few would join. **[SS (FG1)]**	Need for an adequate grade boost.
	Students need a real incentive in their final grades to collaborate. **[FI (FG3)]**	Need for an adequate grade boost.
Social Interaction	Students may be known for making good videos or the opposite, leading them to be bullied. **[Cca (FG2)]**	Possible social pressure/bullying.
	Teachers should give shy students the chance to anonymize their username from the community, so only the teacher would know the name. It would be possible for other students to track that user's videos, but without knowing who it is. **[BS (FG2)]**	Social pressure; Anonymizing the user to prevent bullying.
	I would be more comfortable publishing the videos if they were only available the following year. I wouldn't be enjoying the positive effects of helping colleagues, but as I am shy, it would be very helpful. **[LF (FG3)]**	Social pressure; Uploading for the next year's students.
Teacher's Role	If the video content remains from one year to the next, it forces the teacher to constantly look for more and different exercises. A student who goes through all the information available through different channels should be rewarded. **[AL (FG1)]**	Management of available content; Reward for committed students.
	Teachers should limit the number of exercises per student, so as not to exceed a reasonable number of uploads. **[DS (FG2)]**	Management of available content; Limiting videos per student.
	Maybe at the beginning, it can create a bias in the teacher's subconscious to overestimate the final grade of those who prepare the videos, because it is something new. **[CCa (FG2)]**	Grade weighting difficulties due to its novelty.
	As an additional scope to the teacher's role, the videos can be useful in relieving the burden of clarifying doubts that teachers are currently subjected to. **[SS (FG1)]**	Decreased need for teacher assistance to clarify doubts.

TABLE 3

Student key-ideas and inferences on Digital Learning Platforms

Own source. FGs

The main benefits highlighted by the participants include the increase in communication between students, the development of the autonomy of the student community, the flexibility of learning, the decrease in the number of doubts and the distinction of students with greater aptitude (Table 4).

	Comunication Stimulus	Didactic Flexibility	Students' Autonomy	Clarification Reach	Distinction of Student Merit
Greatly Benefited	3	9	3	9	7
Benefited	11	9	9	9	6
No Effect	4	0	5	0	4
Impaired	0	0	1	0	1
Greatly Impaired	0	0	0	0	0

TABLE 4

Highlighted benefits arising from platform use

Own Source: Survey

Some participants pointed out that the consumption of these explanatory videos can be very useful in the sense of increasing the speed of tackling doubts, containing a more adjusted and personalized speech, if captivating. It was also mentioned that videos would be more useful in courses with standardized answers, as solving a standard exercise allows them to understand how the remaining similar exercises in that category are solved. When asked if they would be willing to make a video for submission on the platform, 39% of the participants stated with certainty that they would not feel motivated to do so on the online campus (Figure 15).

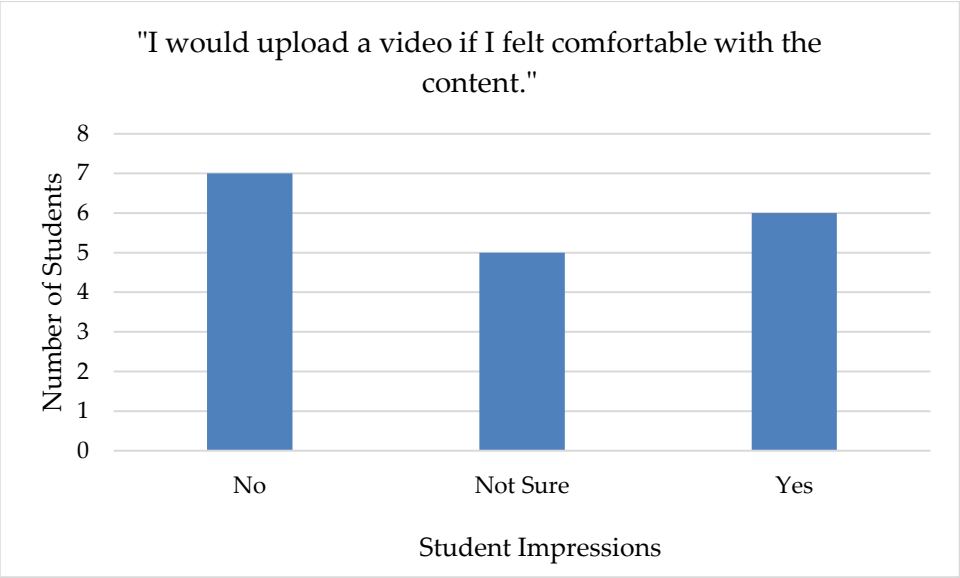

FIGURE 15

Intentions to upload

Own source: Survey

As a justification, there is a lack of interest in raising the grade or the fear of sharing dubious content. However, this idea contrasted with the fact that the content provided was reviewed by the university's own professors, excluding wrong information and relieving the pressure of influencing colleagues to a wrong answer. In this sense, most students agreed that it is safer to use videos previously accepted by the professor than to use explanations with colleagues or tutors outside the university context.

The level of personalization of the learning experience was mentioned as an aspect associated with the platform insofar as it boosts the quality and quantity of the resources available to the student provided by the university, that is, the student knows that he can trust the perspective/explanation of the colleague, because he learned those contents in the same educational institution, performing the same exercises and case studies. From the perspective of the participants, these videos appear as a positive/natural progression from the databases with summaries/exercise resolutions of previous academic years, already available outside the university's control.

The attribution of a reward to students who volunteer to produce videos was one of the central aspects while discussing the feasibility of this platform. In fact, in most cases, only through a small compensation in their final grade, students would feel motivated to submit video content, spend time and expose themselves to the rest of the academic community. All groups insisted that, despite the moral reward that comes from feeling that they are helping their colleagues, they did not consider it possible to stimulate their initiative without a benefit in the grade.

4.3.2.2 Social Interaction Constraints

Recognizing that through the use of this platform there are numerous communicative and didactic advantages, such as the possibility of establishing new contacts in the student community, the creation of a channel that unifies the knowledge base on a certain topic/exercise and the promotion of the use of new IT solutions for learning, the participants also pointed out some constraints of a social nature to the use of this digital solution. In this sense, some participants complained about the possibility that, in certain cases, the submission of videos on the platform could lead to bullying situations, being a focus of social pressure from which some students eventually wanted to move away. Social constraints mainly affect students who are shy/ the target of social exclusion.

For this reason, one participant suggested the possibility of anonymizing the video publications of students who chose to do so (through the use of subtitles in the video, instead of voiceover). Another participant also offered a solution for the videos to be published only in the following year, so that they would not be watched by most colleagues in the same academic year as the submitting student. Students who were more hesitant to publish videos mainly allege a lack of confidence both in their contributions and in the course mates, the lack of previous experience with this type of sharing of resources and procrastination/laziness.

4.3.2.3 Teacher´s Role

From a general perspective, 67% of the participants agreed that the integration of this new channel of learning and clarification of doubts would bring benefits to both students and teachers (Figure 16).

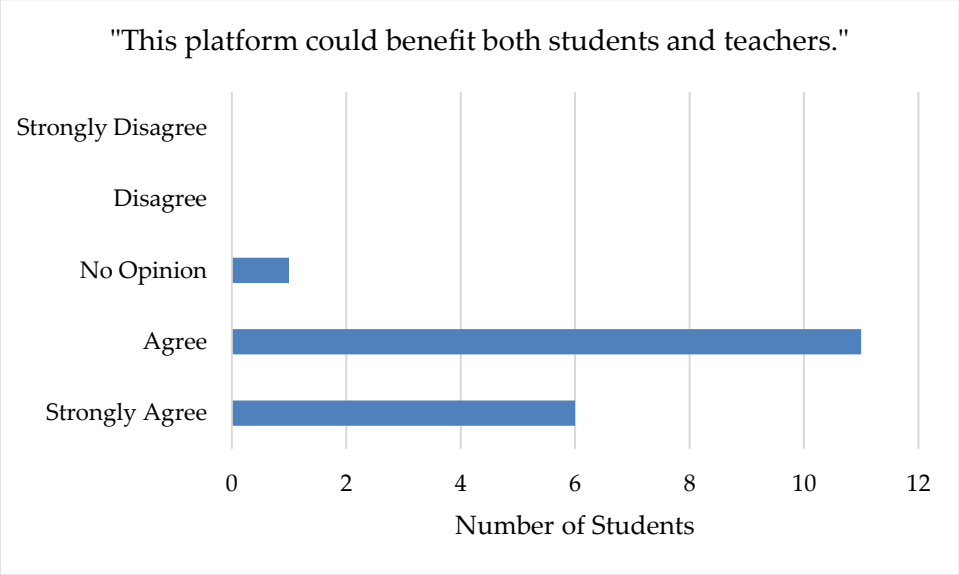

FIGURE 16

Overall platform benefits (Students/Teachers)

Own source: Survey

Some participants mentioned that the load of emails with doubts sent to teachers would decrease, as the students could clarify their doubts through the videos, previously reviewed by these same teachers. Questions were asked about how the teacher would select which video to publish among the different explanations in the same topic/exercise, being agreed that it would be important to establish periods for the acceptance of videos on each topic, giving priority to the first students to send them.

Nevertheless, the "commitment" component of the student's grade would benefit regardless of whether the video (sent to the teacher) was ever posted by the teacher on the online campus platforms or not. The discussion also raised the possibility of defining a limit of videos per topic, or even a limit of videos per student in a semester. Also relevant was the idea of expanding the number of

videos available by keeping students' videos from one school year to the next. In this way, learners would have the possibility to access a larger and more enriching database with the explanation of more topics/exercises in different perspectives/approaches.

It was also suggested, at an initial moment, to familiarize students with the platform, that it would be mandatory to carry out an example of an explanatory video for the platform, focusing on topics assigned by each teacher.

The concern of some participants about the possible reduction of the didactic preponderance of the teacher was also highlighted, mainly by participants reluctant to increase the student's autonomy in their learning process (Figure 17), who pointed to the possibility of these videos becoming a shortcut in the assessment moments.

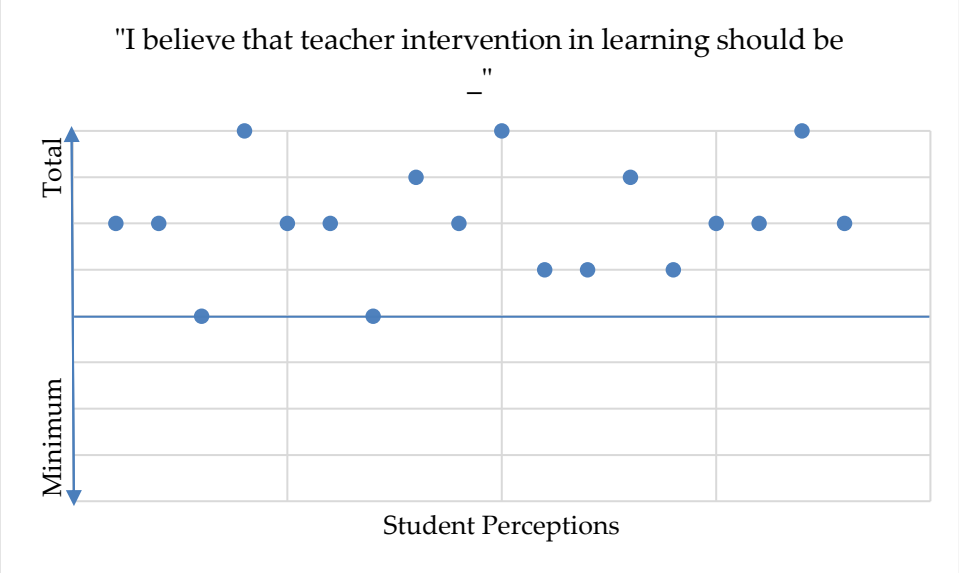

FIGURE 17

Teacher intervention

Own source: Survey

Some participants warned of eventual negative discrimination that would affect students who chose not to make the video, initially creating a bias in the teacher's assessment.

5. Discussion

5.1. Remote Learning

This study aimed to develop a qualitative understanding of how the integration of DT solutions supported by IBL models can benefit students' perceptions of remote learning.

Perceptions of online learning quality were largely compromised by the emergency character of this transition. New challenges to student self-efficacy came from the constraints imposed by the need to adapt quickly. Although no participant reported technical difficulties regarding the quality of internet connection to access online classes, the general tendency of the groups flowed a negative perception given the experience with remote teaching, as expected. The difficulty of adaptation, especially for teachers and their assessment means, is pointed out as the main key that justifies this initial failure, as in Bergdahl & Nouri (2020), mostly evidenced in the transitory phase, which was rushed by the pandemic.

The loss of student-teacher communication quality, the difficulty in maintaining focus and retaining knowledge after class and the obstacles to collaborative study were only partially rescued by the increased comfort, decreased transportation costs and occasional improvement of results in tests and consultation exams. This was highly revealing of the loss in the overall quality of the learning experience, as argued by Wei & Chou (2020).

The degradation of social relationships was widely discussed as a strong conditioning factor leading to the reduction of participants' satisfaction. All groups reported that faced with a fully remote regime, they lost the opportunity of bonding with colleagues/teachers that came from the possibility of, for example, clarifying a doubt right after a class, creating relationships and contacts and experiencing academic activities to the fullest. As in Salta et al. (2022) study,

there was a difference in terms of social interaction and class participation in new non-adapted students compared to those who had already established a personal and productive relationship with the rest of the academic community. This difference was explained, as also defined in Kauffman (2015), by the greater ease of contacting at a distance with colleagues with whom an interpersonal relationship had already been established, both for socialization purposes and for organizing study and collaborating on group projects. The need to promote an environment of productive interaction between students from the beginning of their university studies is vital to lead to superior attainment/retention results in the following academic years (Clery, 2010).

However, participants recognized that Education 4.0 provides teachers with the opportunity to take a digital leap, exploring new resources to improve the learning process, making it more adjusted and personalized (Kurshan, 2016; Turk, 2020; Yusuf et al., 2020; Zacharia et al., 2015), but mentioning that they did not perceive/experience any kind of adjustment to their needs either by teachers or through new mechanisms/platforms, following Wei & Chou (2020) results. Despite relative success in making some classes more interactive, the lack of a personalized response/feedback caused participants to feel a sense of educational isolation, exacerbated by the deterioration of the quality of communication with their peers and teachers.

Confirming the results of previous studies by Aristovnik et al. (2020), Chen et al. (2021), Milligan & Littlejohn (2014) and Morris et al. (2019) recorded classes represented a very advantageous digital feature promoting content absorption valued by less engaged students, mitigating some of the difficulties associated with decreased attention in synchronous classes. The fact that the duration of the classes was maintained highlighted the student's difficulty in engaging for long periods, given the increase in comfort and privacy combined with the reduction of teacher presence and the associated authority that pressures students to not

get distracted. Also, the trend toward decreasing knowledge retention after classes was significantly manifested in all groups of participants, making it clear that the opportunity cost in terms of content absorption of giving up a face-to-face class is very high. This reality converges with the recent bibliography, which, as previously shown, explains the difficulty in transposing the acquired knowledge to the evaluation moments (Gamage et al., 2020). Tests and exams put in clear evidence the students' dissatisfaction with the current remote solutions (Chen et al., 2021). Most participants pointed out that the mechanisms used by teachers to prevent fraud in online tests/exams, such as reducing the time to answer each question and the impossibility of answering the exam in the desired order of questions, contributed to increasing their nervousness/anxiety in these moments.

The increase in distrust between teachers and students during moments of competence assessment in conventional exams was due to the conclusion that students tend to cheat more frequently, as highlighted by (Amzalag et al., 2021). Nevertheless, some students reported that their grade average rose during this period especially when consultation exams were promoted. This type of examination is more in line with the online regime challenges, as students are allowed to access their own resources more easily and freely. In these cases, the remote system is not so limiting, promoting students' perceptions of satisfaction and a reduced likeliness to cheat. This same aspect was previously postulated by Elsalem et al. (2021), whose research revealed not only that students tend to prefer face-to-face exams, but also that levels of dishonesty/misconduct at a distance can be mitigated by rethinking the type/form of assessment, exam structure and fraud prevention systems.

Moreover, the results of the present study align with the perspective of the recent Alharbi et al. (2022) research, which dictated that the level of immediate knowledge retention achieved when attending a face-to-face lecture is

indistinguishable from levels of knowledge retention after viewing recorded asynchronous lectures, at their own pace, which does not happen in the case of synchronous remote classes. However, the results of the present study indicate that students tend to consider this alternative as excessively time-consuming.

5.2. Inquiry-based Learning

New ways of promoting dynamism inside and outside the classroom, in person or remotely, emerge as stimulators of the student's willingness to learn.

This study points to IBL as a vehicle for the absorption and retention of knowledge in a more uncomplicated way, claiming that the reduced/timely teacher intervention is fundamental to stimulate their engagement and critical thinking, in a perspective that supports the concept of "Teaching Presence" of Law et al. (2019) and the previous findings of Alderman (2016). The promotion of a research environment (either individual or collaborative) helps the development of soft skills such as communication and research skills, self-efficacy and learning autonomy, creativity, and even time/task management, adding to the results of Callaghan et al. (2020).

In a time of reduced ability of the student to reach environments prone to deep learning, study and research together emerge as an element capable of granting meaning to information collection. However, the attribution of a major value to the final grade to detriment of the learning process is still noticeable (Rust et al., 2005). It was extracted that, during the fully online regime, collaborative tasks were the exclusive method to establish purposeful contact between colleagues, enhancing learning quality and curiosity to learn/engage.

Investigation/research as a learning model is more recognized by participants as a collaborative rather than an individual system, in a remote regime. The transfer of the knowledge learned to the moments of evaluation becomes more faithful within Inquiry-Based Assessment (IBA) (Hackett, 2021). IBA is a concept

that encompasses any examination model that aims to encourage higher-order reasoning competencies through content assessment by researching or practical application of materials, to enhance knowledge retention and satisfaction. Results expressed that, often, without this research-based learning/evaluation system, participants only realize that a certain subject is interesting while studying for the final exams, which leads them to question why they were not more seriously attentive when the materials were taught in class.

Collaborative projects help to alleviate the negative consequences for the mental state of the students resulting from being physically dislocated, as previously highlighted by Patricia Aguilera-Hermida (2020) and Prokes & Housel (2021). The results of the present study can be combined with the perspective of the recent Alharbi et al. (2022) research, which dictated that the level of immediate knowledge retention achieved when attending a face-to-face lecture is indistinguishable from levels of knowledge retention after viewing recorded lectures. Nevertheless, the results of the present study indicate that, often, the student tends to consider that this alternative is excessively time-consuming.

5.3. Institutional Video Platform Concept

This platform's concept managed to retrieve positive impressions in order to make the online teaching experience more adjusted, personalized and satisfying, strongly suggesting its implementation. Thus, it boosts communication, promoting the establishment of new productive contacts within the academic community, while reducing the constraints associated with the emergence transition. Its pedagogical value lies in helping students who struggle to absorb/retain information synchronously in this remote system.

The enthusiasm for the consumption of these short videos is in line with the trend studied by García-Bullé (2019) that students show a preference for more

focused and direct content, so as not to lose engagement. The unanimity of the participants in consuming these videos naturally contrasts with a smaller number of volunteers to produce them.

Thus, the students' need to feel rewarded cannot be put aside, as mere kindness and altruism are not enough to convince them to develop a video proposal, in most cases. However, valuing the student's "commitment" component in the final grade resulting from the preparation of the videos, although necessary to motivate them, should be optional, depending on each teacher. Also, the teacher's occasional inability to understand whether students are understanding the content, aggravated by the distance caused by the remote regime and lack of interactions to raise doubts, can be mitigated by assigning the role of teacher to the student. (Fisher & Baird, 2005), because they comprehend, more closely, what doubts are coming to their peers, then elaborating videos on those topics/exercises.

There is also a potential increase in dynamism in the remote classroom, as more students become aware of the topics and exercises, after viewing the videos (and possibly contacting those colleagues for further explanations, with less embarrassment). The student who prepares a video also has benefits in his/her own study in terms of knowledge absorption and retention.

Comparing the results of this study with previous Donnelly (2010) research, it is possible to understand that, currently, the concept of an institutional video platform would be more valued by students than the digital solutions proposed at the time of this study. (Table 5).

	Number of students that would use
Institutional Video Platform	12
Discussion Boards	5
Video Conferencing	5
Podcasts	1
Chat Rooms	3

TABLE 5

A comparison of intentions to use the conceptualized platform with Donnelly (2010) suggested digital platforms

Own source: Survey; Donnelly (2010)

5.4. Limitations

The development of this study cannot be concluded without listing two major limitations.

The first is the reduced sample size, (with exclusively Portuguese participants) derived from the need to compare results through a triangulation strategy. Despite being representative, the sample runs the risk of falling short in terms of generalizability. Furthermore, even with representative sample size, it is necessary to understand that students' perceptions of online teaching are not definitive, but rather highly volatile, depending on their self-efficacy, teachers and overall level of satisfaction/grades achieved in a given semester.

Secondly, despite the effort to design a presentation that followed the topics discussed in FGs, providing definitions for the concepts addressed, the lack of knowledge of some participants about concepts such as Education 4.0 and Inquiry-based Learning, gave rise to some doubts and fear of contributing freely. Furthermore, the selection and categorization of testimonies in the NVIVO would benefit if it were elaborated, separately or together with more researchers, due to the subjective nature of the task of grouping individual perceptions.

5.5. Future Research

Follow-up research may focus on analyzing a more representative sample for the present study, in order to understand how digital learning platforms may enable to boost student self-efficacy and knowledge retention in higher education. This derives from the fact that the study of remote learning solutions that foster knowledge retention does not receive the same attention as the study of remote engagement.

It is also useful to deepen the study on the form/value of the reward in the grade required to motivate students to publish videos on the created platform.

Lastly, it may be interesting to extend this approach to other education cycles, such as primary or secondary, and study the levels of knowledge retention and the possibility of adapting the platform conceptualized in this study to these realities. There is also the possibility of carrying out a comparative study between undergraduate and master's students, understanding how the level of maturity or previous relationships/contact with colleagues helps to overcome social and productive difficulties in the context of remote teaching.

6. Conclusion

Fortunately, from a general perspective, students and professors are currently able to share the university campus again, in person, due to the stabilization of the pandemic situation. The adoption of new learning and assessment routines forcedly instilled in the academic and teaching community will not be lightly forgotten in the future. Regardless of the tendentially negative perceptions about a fully remote system, there is a collective awareness that, gradually, online teaching methods have been perfected and we are today more prepared, as a community, to respond to similar challenges.

The uncertainty regarding the type of teaching that we will face in the short/medium term reinforces the relevance of this study. Nevertheless, the results obtained in terms of the exploitation of digital resources are pertinent in different teaching regimes (fully online regime, a hybrid regime or even as an asynchronous complement to face-to-face teaching), leading to the stimulation of communication, engagement, knowledge retention and perceived satisfaction.

Students' Perceptions of Remote Learning
Decreased levels and quality of communication and interaction among peers (and with teachers) leads to a sense of academic isolation.
Decreased levels of engagement and focus, resulting from the degradation of the dynamism of classes and the increase in procrastination led to reduced levels of knowledge retention.
Recorded video classes as a means of personalizing the learning experience, mitigating disparities in self-efficacy during synchronous remote classes.
Distrust between teachers and students during assessment moments caused a negative experience and lack of comprehension regarding the structure of tests/exams, which tended to increase the pressure and anxiety at these moments, but not significantly affecting grades;
Students perceive the possibility of learning in a hybrid regime as the most advantageous learning system.

TABLE 6

Students' perceptions of Remote Learning

Own source

Students' perceived utility arising from Inquiry-based Learning
Research and investigation without the constant intervention of the teacher allows the development of soft skills, which are currently more highly valued than hard skills.
Higher-order thinking skills, critical judgment, fluid communication, and filtering skills are cultivated by individual/collaborative autonomous research.
The levels of knowledge retention resulting from research/investigation are significantly higher in IBL methods.
IBL stimulates individual initiative and engagement, creating a sense of adjusted and meaningful experience, positively influencing the final grade.
IBA (assessment) enhances a more reliable translation of the knowledge absorbed to the final grade, representing the preferred assessment method.

TABLE 7

Student's perceived utility arising from IBL

Own source

Illations on the "platformization" of education and creation of the proposed platform concept
Learning synergies can be achieved through the dynamic use of digital platforms, as the number of different channels is portrayed as proportional to the ease of communicating;
The creation of an institutional video platform for uploading and consuming didactic content, harmonizing DT with IBL, enhances student communication, autonomy and learning flexibility while helping to consolidate and retain knowledge, being the digital platform that most enthuse students, in a way that does not corrupt student self-efficacy;
It is essential that a quantitative benefit in the final grade derives from the preparation of videos to feel motivate students to overcome the fear of being criticized by colleagues (bullying).
Conflicts arose regarding the management and choice of videos and the attribution of an adequate weight that does not harm students who do not produce videos.

TABLE 8

Illations on the "platformization" of education and creation of the proposed platform concept

Own source

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Appendices

Appendix 1

Base discussion topics and questions to guide the qualitative extraction of insights - Focus Groups

1 - Impacts of technology integration in higher education

- What do you understand by Education 4.0?
- To what extent is education today different from what you found at the beginning of your academic life?
- What do you consider to be the main obstacles to the integration of technology in teaching?
- Do you consider that technology is present daily in your academic life? On what tasks?
- What is the importance of using technology in practical activities (face-to-face and remote)?
- Do you feel that technology allows an adjustment of education to the student, that is, greater personalization?
- What are the main changes in examination made possible by technology?

2 - Understanding perceptions about Remote Learning

- What do you understand by remote learning?
- Does the current level of technological advancement allow you to successfully overcome all physical barriers?
- What kinds of benefits arise from distance learning?
- What is the opportunity cost of not having a face-to-face class?

- Of the platforms available for teaching classes remotely, which ones benefit the most from learning?
- How do knowledge retention levels differ at the end of a face-to-face class compared to a remote one?
- In terms of assessment, are your results superior when you learn and are assessed remotely or in person?
- What were the main skills (skills) they developed in the remote learning process?
- Overall, do you feel more satisfied with remote learning than face-to-face learning?

3 - Understand the effects on learning of the use of Inquiry-based learning

- What do you understand by Inquiry-based learning (or, in Portuguese, inquiry-based learning)?
- What do you consider to be the main benefits of inquiry-based learning for the student?
- What skills and competencies do you develop by having less contact with the teacher?
- What do you consider to be the possible limitations associated with this type of learning?
- What is the role of peer-to-peer communication in learning?
- How can a colleague's explanation of a subject be easier to understand?
- How can autonomous (or group) research promote knowledge retention?
- Do you feel that when you learn in this system, your performance is superior?
- Does this translate into overall satisfaction with the discipline?

4 - Harmonizing the integration of digital transformation in an Inquiry-based learning system

- How can technology benefit peer-to-peer communication in the context of study?
- How may the existence of online forums for students (such as Discussion Boards, Chat Rooms, Video Conferencing or even Podcasts) contribute to facilitating the study?
- What types of devices can be most useful to promote access to these platforms?
- What is your opinion about the new concept of digital platform presented in this study?
- Would you use the platform?
- Would you use it more in the sense of consuming content or making videos?
- Do you consider a grade boost deriving from elaborating the videos as necessary to feel motivated to do so?
- What are the advantages and disadvantages that this platform can give rise to?

Appendix 2

Questions posed to participants through Google Forms - Surveys

1 – Education 4.0

1.1. Currently, the main role of education must be to develop _. Soft Skills/Hard Skills. (1-9 answer scale)

1.2. I believe that technological integration in education should be _. Minimal/Total. (1-9 answer scale)

1.3. Technological mastery is especially advantageous in _ projects Individual/Group. (1-9 answer scale)

1.4. As a student, I consider that mastering digital platforms is fundamental to my ability to learn." (Strongly Agree to Strongly Disagree scale)

1.5. I think that technological progress facilitates research and access to information. (Strongly Agree to Strongly Disagree scale)

1.6. The digital transition has allowed for superior customization of teaching to my needs. (Strongly Agree to Strongly Disagree scale)

1.7. During the study, how often do you need to use a technological device? (Constantly to Rarely scale)

1.8. Technology impacts my results in moments of evaluation, in a _ way. (1-9 answer scale)

2 - Remote Learning

2.1. Regardless of external factors, I prefer to attend a _ class. (Face-to-face/Online)

2.2. I think the main advantage of remote learning is _. (Short open answer)

2.3. I believe that the main challenge of remote learning is _. (Short open answer)

2.4. I feel more motivated when I learn in a _ system. Fully F2F/ Fully remote (1-9 answer scale)

2.5. I reach higher academic results when I learn in a _ system. Fully F2F/ Fully remote (1-9 answer scale)

2.6. When a doubt arises in a given exercise, I feel that the physical distance _. (Has no impact on clarification/Negatively impacts clarification)

3 - Inquiry-based Learning

3.1. I think that the student should have a more prominent role in course delivery. (Strongly Agree to Strongly Disagree scale)

3.2. The main responsible for the student's academic performance must be the _. (Student/Teacher/University)

3.3. I believe that teacher intervention in learning should be _. (Minimal/Total)

3.4. I believe that the promotion of group research projects should _. (Increase/Decrease)

3.5. Without the teacher's intervention in learning, students develop autonomous research skills. (Strongly Agree to Strongly Disagree scale)

3.6. What soft skills are developed in collaborative tasks? (Communication/Autonomy/Time-management/Creativity/Filtering/ Others)

3.7. I am able to absorb and retain knowledge for longer periods when I _. (Research or Study Collaboratively/Attend a conventional class)

3.8. I feel more comfortable clarifying a doubt with _. The teacher/A colleague (1-9 answer scale)

4 - Integration of IBL approaches through digital transformation

4.1. In the current context, communication between students would not be possible without the adoption of new behaviours regarding technology. (Strongly Agree to Strongly Disagree scale)

Questions concerning the conceptualized institutional video platform:

4.2. I have the technological dexterity to access and use this platform. (Yes/No)

4.3. I would consume this platform's videos to clarify my doubts. (Yes/Not Sure/No)

4.4. I would upload a video if I felt comfortable with the content. (Yes/Not Sure/No)

4.5. Associate each parameter with a level of change resulting from the use of this platform. [(Communication between students; Didactic Flexibility; Student's Autonomy; Clarification Reach; Distinction of Student Merit) / (Greatly Benefited; Benefited; No Effect; Impaired; Greatly Impaired)]

4.6. This platform could benefit both students and teachers. (Strongly Agree to Strongly Disagree scale)

4.7. From the following digital solutions, which ones would you use in the learning context?

4.8. I might be hesitant to make/publish a video, because _. (Short open answer)