

COVID-19 post pandemic, blended learning and artificial intelligence: Is it the school virtualization?

Pós-pandemia de COVID-19, ensino híbrido e inteligência artificial: É a virtualização da escola?

COVID-19 Post-pandémico, educación híbrida e inteligencia artificial: ¿Es la virtualización de la escuela?

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Abstract

The COVID-19 pandemic is a milestone in Brazilian education when one observes the time in which the country's schools are closed due to the social distancing, necessary to cope with the pandemic. It was necessary, therefore, an upload from the physical school to cyberspace, in a sudden and traumatic way. Although it is not possible to generalize the school model that will be established at the post-pandemic moment, it is a fact that physical school, at a time before the pandemic, was being modified by the advent of cyberculture and network education. Therefore, this work aims to evaluate the concepts of blended learning and artificial intelligence in the context of network education, considering cyberspace as the support for virtual school. As a research methodology, we opted for a literature review including the main authors who discuss the themes under analysis and Social Network Analysis (SNA) for Twitter and YouTube under the themes in analysis. It is concluded that, in the post pandemic, it is likely that the physical school complements the virtual school, in a process of synchrony and connection which will not be possible to distinguish one from the other, where network education will guide teaching practices and student's practices also.

Keywords: Blended learning; Network education; Artificial intelligence; Cyber school.

Resumo

A pandemia de COVID-19 é um marco na educação brasileira quando se observa o tempo em que as escolas do país estão fechadas por conta do distanciamento social, necessário para o enfrentamento à pandemia. Foi preciso, portanto, um upload da escola física para o ciberespaço, de forma repentina e traumática. Embora não seja possível generalizar o modelo de escola que se estabelecerá no momento pós-pandêmico, é fato que a escola física, em um momento anterior à pandemia, estava sendo modificada com o advento da cibercultura e da educação em rede. Portanto, este trabalho tem como objetivo avaliar os conceitos de ensino híbrido e inteligência artificial no contexto da educação em rede, considerando o ciberespaço como suporte para a escola virtual. Como metodologia de pesquisa, optou-se por uma revisão da literatura incluindo os principais autores que discutem os temas em análise e a Análise de Redes Sociais (ARS) para o Twitter e o YouTube sob os temas em análise. Conclui-se que, no pós-pandemia, é provável que a escola física complemente a escola virtual, num processo de sincronia e conexão que não será possível distinguir uma da outra, onde a educação em rede norteará as práticas pedagógicas assim como as práticas dos estudantes.

Palavras-chave: Ensino híbrido; Educação em rede; Inteligência artificial; Ciberescola.

Resumen

La pandemia COVID-19 es un hito en la educación brasileña cuando observamos el momento en que las escuelas del país están cerradas debido al distanciamiento social, necesario para enfrentar la pandemia. Por tanto, era necesaria una subida de la escuela física al ciberespacio, de forma repentina y traumática. Si bien no es posible generalizar el modelo de escuela que se establecerá en el momento pospandémico, es un hecho que la escuela física, en un momento previo a la pandemia, se fue modificando con el advenimiento de la cibercultura y la educación en red. Por tanto, este trabajo tiene como objetivo evaluar los conceptos de enseñanza híbrida e inteligencia artificial en el contexto de la educación en red, considerando el ciberespacio como soporte de la escuela virtual. Como metodología de investigación, se optó por una revisión de la literatura que incluye a los principales autores que discuten los temas bajo análisis y Análisis de Redes Sociales (ARS) para Twitter y YouTube bajo los temas bajo análisis. Se concluye que, en la pospandémica, es probable que la escuela física complemente a la escuela virtual, en un proceso de sincronización y conexión que no será posible distinguir una de otra, donde la educación en red guiará las prácticas pedagógicas. y también las prácticas de los estudiantes.

Palabras clave: Enseñanza híbrida; Educación en red; Inteligencia artificial; Escuela cibernética.

1. Introduction

The COVID-19 pandemic suddenly brought to light the importance of discussing the "inclusion of technology" in pedagogical practices, from early childhood education to high school and, why not, at university. However, the question that arises, first, is the understanding one has about technology and education.

Manuel Castells (2019) discusses, since the early 2000s, new forms of socialization considering the advent of the Internet and the creation of what the author calls a networked society. In fact, the internet is the tool that allowed the creation of cyberspace. For Lévy (2010) cyberspace is the new means of communication that arises from the worldwide interconnection of computers. The term specifies not only the material infrastructure of digital communication, but also the oceanic universe of information it houses, as well as the human beings who navigate and feed this universe. Santos (2014) defines cyberspace as the internet enabled by human beings, who produce, authorize and constitute communities and social networks through and with the mediation of digital network technologies. It is observed that, in both definitions, the internet is the crucial element that enables the existence of this virtual environment, in which human beings intertwined with internet access tools, communicate, produce content, share information and interact socially, being this interaction social given in a virtual environment.

The school environment, until the beginning of 2020, had some technological tools, without, however, substantially modifying the pedagogical practices in alignment with the social changes resulting from cyberspace. In fact, the actors involved: students, teachers, managers and family members have long used technological tools and have been present in cyberspace, although students' school activities have changed little in recent years. Considering the sudden closing of schools due to the COVID-19 pandemic, in March 2020 (many schools still remain closed today), it was proposed, worldwide, the use of the internet and technological tools for school activities were maintained. This fact, unprecedented on a global scale (Dhawan, 2020), brought to the discussion the use of cyberspace for the maintenance of classes. In the definition of Lemos (2013), there was an upload from the physical school to cyberspace, and then a cyberplace was established (Wellman, 2001) in this cyberspace, representative of the physical school. In this new environment, teachers, students and managers interacted exclusively in the virtual realm, for a period never before so great. This new need, arising from the health crisis in question, made possible several rearrangements of the schools and a revision, even if hasty, of the pedagogical practices, now outdated in the face of the change so fast that it has occurred. It is also noticed the establishment of network education (Müller & Souza, 2020), driven by network relationships which define cyberspace.

In this challenging context, several proposals involving technology are placed for education. In Brazil, in particular, issues such as blended learning and the use of artificial intelligence are among the novelties, posed to both public and private schools.

Considering the new forms of social relationship, arising from cyberspace and the network relationships provided in this environment, the research question that this paper intends to answer is the following: The school, in the post pandemic, will absorb pedagogical practices that were established during the closing, leading to the virtualization of the school? In order to answer the research question, the aim of this paper is to evaluate the change processes that schools were subjected to in the pandemic period and the consequences of these changes, observing the school's virtualization process in the post pandemic period.

2. School Upload: between (un) certainties and challenges

The use of technological tools in the Brazilian school environment is still precarious, regardless of whether the school belongs to the public or private system. In order to better understand the moment immediately before the pandemic in schools

with regard to the synchrony between technology, pedagogical practices and student practices, it is necessary to look at public policies aimed at education and technology and their impact on school life.

The discussion about the insertion of technology in the Brazilian educational environment began in the 1980s through a program called EDUCOM. This offered training to researchers at universities and to teachers of basic education so that various computational resources available at the time were offered in schools. At that time, few computers were made available in schools and the Internet was not yet popular on the world stage. Ordinance No. 522, of April 9, 1997, of the Ministry of Education and Sport creates the National Program for Informatics in Education (Proinfo) with the purpose of disseminating the pedagogical use of information technology and telecommunications in public elementary schools and medium belonging to the state and municipal systems (Brazil, 1997). It was from this program that the relationship between public schools and technology was significantly modified. Computer labs were installed in schools, aiming at generalized access by Brazilian students. Professionals were trained to assist basic education teachers and they were also offered opportunities for continuing education in technology. Over the years, the lack of maintenance of the equipment and the outdated of the same equipment has made the project obsolete. It is also observed that the relationship of school actors with technology (teachers, managers, students and family) made classes in the computer lab even more outdated. It was observed that, keeping only computers in schools without access to the internet, no longer corresponded to the expectations of insertion of technology in the students' daily lives. In this sense, Decree of the Presidency of the Republic No. 9204, of November 23, 2017, institutes the Connected Education Innovation Program, which replaced ProInfo. The main actions of the program foresee: 'technical support to schools and basic education systems for the elaboration of diagnoses and local plans for the inclusion of innovation and technology in the pedagogical practice of schools; technical, financial support or both to schools and basic education systems for contracting internet access services, implementing infrastructure for distributing the internet signal in schools, acquiring or contracting electronic devices and acquiring digital educational resources or their licenses . In addition, it is planned to offer teacher training courses for the use of technology in the classroom.' (Brazil, 2017). It is important to note, however, that the Connected Education Innovation Program, alone, is not enough to promote internet access for students. Carius (2020) presents the example of a Brazilian rural school, assisted by the Connected Education Innovation Program, which was unable to promote distance education for students during the school closing period due to the COVID-19 pandemic.

From the Connected Education Innovation Program, there is a concern with internet access as a priority for access to technology. In fact, it is revealed that the internet changes social relations and the school is not immune to these changes. Cyberculture developed in virtual environments brings new realities to the educational context. However, the COVID-19 pandemic modifies the previous scenario since the closure of schools and the proposal, worldwide, to continue school activities remotely, in cyberspace. How to guarantee access to school for students who do not have internet access in their homes? The Connected Education Innovation Program did not foresee the need for individual internet access, although many researchers in the field of sociology already discussed the new perspectives for social relations mediated by the internet in a personalized way. Smartphones were the pioneers in individualizing Internet access, removing the need to be at a computer at a fixed location for access anywhere. Barry Wellman (2001) studies the social changes resulting from personalized communication mediated by technology. For the author, the creation of so-called cyberplaces (places in cyberspace that bring together people with common interests) changes the relationships in the neighborhood, neighborhoods and cities. Considering the concept of cyberplace described by the author, it is understood that schools are virtual communities in this context of remote activities.

According to Libâneo (2018), the school organization is a culture. The way that school works, the relationships that are established on a daily basis, in the classrooms, are built by the members themselves, based on the meanings they give to

their work, the objectives of the school and the decisions that are made. Therefore, for the author, social interactions between school actors is the determinant for the construction of the culture of each school. In this sense, the concept of cyberspace for the school can be seen as the virtual representation of the social interactions of the school organization, promoting school culture in the virtual environment. It is considered, therefore, that the virtual, in one of the perspectives proposed by Lévy (2010), as any 'deterritorialized' entity, which is capable of generating several concrete manifestations at different determined times and places, without however being tied to a particular place or time. It is observed, therefore, that the remote education proposal has in fact made the school flexible, no longer tied to a place or a schedule. Also according to Lévy (2010), cyberspace encourages a style of relationship almost independent of geographical places and the coincidence of time. In fact, the remote teaching proposals have almost completely removed the need for a common geographical place, in many asynchronous proposals, there is also no need for times to coincide, giving a fluid and flexible aspect to teaching.

Some questions are posed in the face of this new scenario: was the school seen as a cyberspace, was it able to establish a 'cyberschool', absorbing elements of cyberculture that were not yet present when the school was a purely physical space? Was it possible to maintain the dialogue between students, teachers, managers and family members in this deterritorialized format? Is the identity of school spaces preserved in cyberschools? Carius (2020) discusses these concepts for university.

As the effective return of face-to-face activities has not yet been possible given the seriousness of the COVID-19 pandemic, many uncertainties hover over the format that the school will adopt in the post pandemic. The experience of geographic flexibility is pleasing to some and to others it is unpleasant. It is believed that many schools will adopt a flexible procedure, with synchronous classes for those who wish to attend from anywhere, but with transmission carried out from the school's physical space, which will be open to those who wish to attend the classes in person. This format has been called, in Brazil, blended learning, like the definition of Horn and Staker (2015), although it is not exactly what is defined as such, as there is no personalization of teaching or the possibility for each student to carry out their activities at their own pace. We will call this proposal flexible teaching, adapted to the geographical space that the student desires, but mediated by a teacher and with a proposal of joint activities for a group of students in the same teaching stage.

3. Artificial Intelligence and its Role in Flexible Teaching

Artificial intelligence can be defined, briefly, as the ability to automate repetitive tasks, through intelligent agents, who perceive the environment and act in order to maximize a result or as the ability to improve human decision making, finding solutions from problems, algorithms developed by humans (Filatro, 2021). Considering, therefore, these perspectives, the introduction of artificial intelligence in education aims to automate repetitive tasks in the area, in the same way that it intends to improve decision making, in several aspects.

At a time before the COVID-19 pandemic, little was said in Brazil about the possible roles that artificial intelligence would play in the educational context. Press reports showed that artificial intelligence was being used to correct tests of undergraduate students enrolled in distance learning courses, as well as there would be, in the near future, the replacement of tutors of undergraduate courses in distance learning by robots driven by artificial intelligence. In the two situations described, it is easy to see that the two objectives described by Filatro (2020) for the use of artificial intelligence are at stake: the substitution by artificial intelligence for repetitive tasks, as is the case of corrections of tests, as well as the capacity making decisions in the case of tutoring. Therefore, this work starts the discussion of artificial intelligence, with regard to the flexibility of teaching in school environments, based on these two functions placed by the author for artificial intelligence.

From the upload of the physical school to cyberspace, it was observed, in Brazil, different ways of monitoring school activities, depending on the age group and the administrative sphere to which the school is inserted. We can explain, in

general, three remote education models implemented in Brazil during the COVID-19 pandemic: the fully synchronous model, the mixed model between synchronous and asynchronous and the fully asynchronous model. The fully synchronous model was adopted mostly by private educational institutions. The face-to-face teaching timesheet is executed, synchronously, through meeting platforms such as Google Meet, Zoom or Microsoft Teams. The mixed model was adopted by the federal education system, as well as by the majority of the Brazilian state education systems (Rodrigues & Carius, 2020). In this format, the face-to-face teaching timetable is also the guiding principle for pedagogical activities. However, the teacher must vary, between different media, the format of linking the contents: through recorded videos, posted material, exercises and, also, use of meeting platforms such as Google Meet, Zoom or Microsoft Teams for synchronous activities with their classes. In this model, the linking of printed material is allowed for students who do not have access to the internet or do not have technological tools to access it. Finally, the fully asynchronous model was adopted by the municipal education systems. In this model, a platform for posting material is chosen, which can also be linked under different media such as videos, texts, exercises or activity proposals. Printed material is also linked to students who do not have access to the platform. The teacher chooses a time to attend students, this activity is not linked to the classroom timetable.

Considering these three scenarios, the autonomy necessary for the student in each of the modalities is discussed and how the insertion of artificial intelligence would modify the pedagogical practices and the role of the teacher. In the exclusively synchronous model, the presence of a teacher interacting with students is the crucial element of pedagogical practice. In this modality, the teacher is observed as the “animator of collective intelligence” of his students, as highlighted by Pierre Lévy (2010). If the use of artificial intelligence were adopted in this format, it would certainly appear in repetitive tasks such as proofreading. In this format, there is little evidence of personalization of teaching, with the industrial teaching model prevailing, in which all students must follow the same pace. If this personalization were a priority, artificial intelligence could be the tool in this approach.

From the reflection on the mixed model between remote synchronous and asynchronous teaching, it is observed that this requires greater autonomy on the part of students. They need to organize their routines so that the asynchronous tasks are carried out, just as they need to be present at the moments of synchronous meetings. In this modality, in addition to the ‘deterritorialization’ of the school, the different times in which students and teachers are working in the pedagogical process stand out. As a consequence of these two aspects, there is a new management of space and time by the actors involved in the process. Despite the lack of valuation of personalization of teaching in this modality, it is possible to observe that the insertion of artificial intelligence tools could contribute to tutoring students in moments of asynchronous activities, stimulating personalization in those moments. The teacher, in this scenario, is the coordinator of the pedagogical activities, managing the students' learning, in a more autonomous way.

Finally, the fully asynchronous model requires greater autonomy on the part of students and, consequently, greater support on the part of family members. Considering that this model was adopted by the municipal schools, which serves children between five and fifteen years old, there is a mismatch between this modality and the needs of the public to which it was directed. In the face of this antagonism, it was found that this modality did not meet most of the students and their families, leading to learning problems for children. The presence of artificial intelligence in this scenario could improve, through tutored and personalized activities, the use of students from municipal education systems.

4. Research Methodology

In view of the uploading of the physical school to cyberspace and all the changes in the interactions between the actors involved in the virtual environment, in Brazil, three remote teaching modalities stood out, ranging from a fully

synchronous model with greater availability of the teacher to an asynchronous model in which the teacher is a synonym for a tutor, available only for questions from his students.

The proposed research has an exploratory character, given that the topic under analysis is recent and that research in this perspective is still under construction (Gil, 1999).

The choice for Social Network Analysis (SNA) as a methodological procedure is due to the need to verify the breadth of discussions on the proposed theme, at national level. According to Recuero et al. (2018), Social Network Analysis (SNA) consists of a theoretical and methodological set with the aim of understanding social structures and their importance. The methodological basis uses metrics and techniques associated with graph theory, with vertices and edges.

Therefore, when combining Social Network Analysis (SNA) with the themes under evaluation in this work, a quantitative study is observed. For Pereira et al. (2018), 'the quantitative method is characterized by the collection of quantitative or numerical data. These methods generate sets or masses of data that can be analyzed by means of mathematical techniques such as percentages, statistics and probabilities, numerical methods, analytical methods and generation of equations and/or mathematical formulas applicable to any process'.

Recuero (2018) states that the differential in social networking sites, such as Twitter and YouTube, is the ability to build and facilitate the emergence of types of social capital, in the sense of Bourdieu (1983), which are not easy to identify in the physical space. For the present study, in addition to the verification of social capital in cyberspace, it is intended to observe the opinions of actors in cyberspace instead of individual consultation due to the social distance imposed by the pandemic of COVID-19.

Considering the quantitative and qualitative perspective of Social Network Analysis (SNA), in an exploratory way, the present research is characterized as a survey (Gil, 1999), although there is no direct questioning of people, but their speeches are taken. individuals from their public speeches exposed on Twitter and YouTube. The researcher, in this case, places himself as an observer (Lüdke & André, 2013) of the ongoing process, an observation that is virtual through social networks.

5. Results and Discussions

Considering the methodological proposal Social Network Analysis (SNA) from Twitter and YouTube data, some keywords related to education were listed during the period of social distance. The first term used in data collection and analysis was 'online education' on Twitter. The NodeXL Pro 2014 software was used for the construction of graphs, metrics calculations and data import.

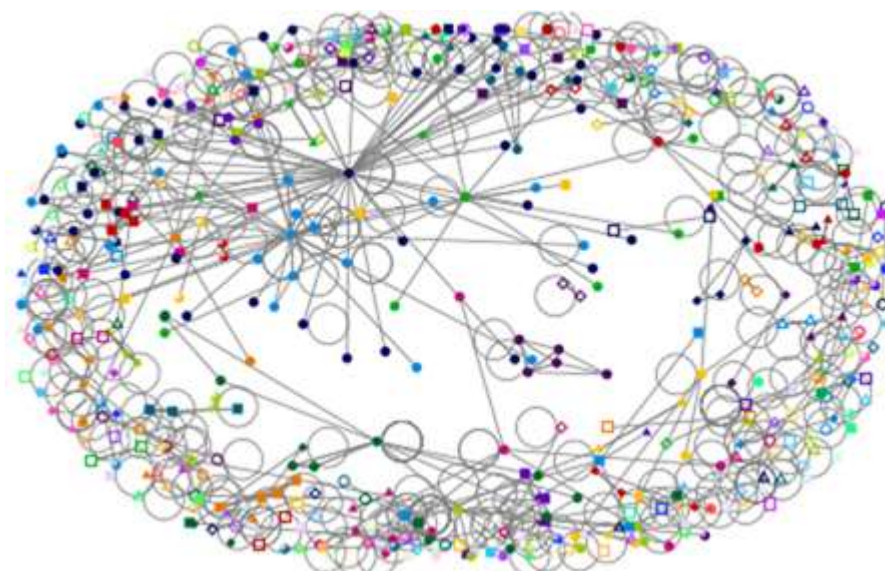
Figure 1 shows the relationships that involved the topic of 'online education' on Twitter.

To visualize the graph in Figure 1, the Fruchterman-Reingold algorithm was chosen, which is based on approximation and repulsion forces between the nodes, in order to distribute them in space (Recuero et al., 2018). It is also observed that the graph is indirect.

With regard to node metrics, it appears that the maximum degree found was 44, while the lowest degree found was 1. The Betweenness centrality, which measures how much between groups in the graph a given node is or the number of times that the node in question is a "bridge" between several groups of nodes. The maximum value for this parameter was 861 for a profile that issued the following message: 'You, a student in regular high school, enrolled or graduating from technical vocational education (who completed between 2017 and 2019), take advantage of this opportunity.', from the governor from Bahia, Rui Costa. So it was the governor of Bahia who managed, in this example, to dialogue with the largest number of different groups on the social network on the subject in question. For closeness centrality, which is the parameter that measures

how close a given node is to others in the network, 132 nodes have the maximum value for this property. One of the tweets of one of these nodes on the subject stands out: ‘If your reality allows it, I think it is much better in several ways, I think that online you lose a lot from the exchange of knowledge that only happens in the classroom. I am in remote education (Google Meet) due to the pandemic and, I have already made materials in distance learning. Nothing compares to the face-to-face.’

Figure 1 – Online education on Twitter.



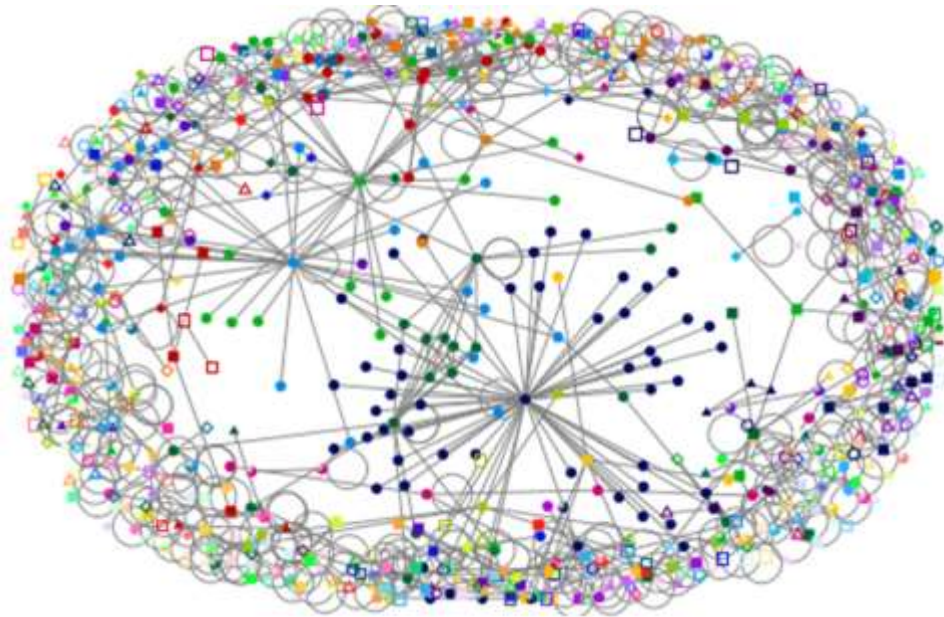
Source: The author (2021).

The eigenvector centrality evaluates not only the connections of the nodes that are under evaluation with the indirect connections of this same node. The purpose of this metric is to assess how relevant the node is to the network and, in terms of social capital, this metric is associated with prestige and influence in the network (Recuero et al., 2018). The highest value for this metric in the graph in the Figure 1 is 0.143 for the node of the governor from Bahia, Rui Costa. It is observed, therefore, that the governor has prestige and influence in the network under the topic under analysis. It should be noted that, in addition to highlighting the eigenvector centrality, the same node also has the highest value for PageRank. This metric is a variant of the eigenvector centrality, qualifying incoming and outgoing connections, estimating the importance of a given node in the network if other equally relevant nodes make connections to it. Therefore, the node representing Governor Rui Costa is, yes, relevant in the network.

Considering the network metrics, the clustering coefficient for the network was chosen. According to Recuero et al. (2018), groupability is a measure that expresses the degree of connection between nodes and is calculated based on triads (triplets) of nodes. Therefore, the groupability coefficient expresses exactly the number of closed triads (or sets of three triangles) in relation to the complete number of open or closed triads. Considering this metric, it is observed that several nodes in the graph in Figure 1 reach the maximum value for the clustering coefficient, that is, these nodes are very connected in their “small worlds” or “bubbles”. However, when analyzing the graph as a whole, it is verified that the average clustering coefficient is 0.106, with the minimum value for this parameter being 0 and the maximum value for this parameter 1. Therefore, it is not possible to state that this network is tightly connected to each other, but has several tightly connected groups in their own worlds.

The Figure 2 presents the graph taken from Twitter for the term ‘face-to-face education’.

Figure 2 – Face-to-face education on Twitter.



Source: The author (2021).

For the graph in Figure 2, the Fruchterman-Reingold algorithm was used again, considering the groupings in clusters and as an indirect graph. For this graph, the highest degree recorded for a node is 54, while the lowest degree recorded for a node is 1. Regarding the Betweenness centrality, the highest value for this parameter was 1326, corresponding to the node with the following tweet: 'I prefer the face-to-face classes because of the teaching that is much better. The education:

Figure 3 - Figures from the most cited tweet.



Source: Twitter, 12:16 PM, May, 25th, (2021).

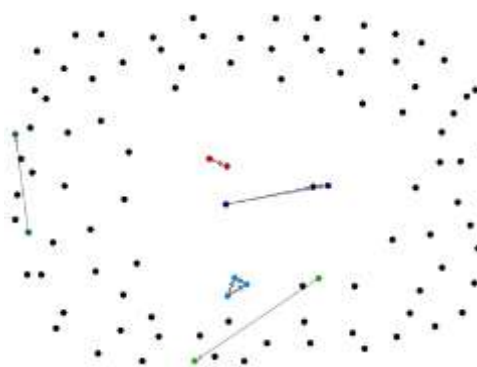
The profile with the best performance among different groups is a profile from UnB (University of Brasília) that links humorous posts about everyday situations at the university and memes. The aforementioned post is a meme, satirizing the importance that certain students give to face-to-face classes. For the degree of proximity (closeness centrality), the maximum value obtained for this parameter was 1, with 208 nodes obtaining this value. That is, these 208 nodes are as close as possible to the other nodes in the network. The minimum value for this parameter was 0, representing the nodes farthest from all others. Among these 208 nodes, he chose a representative tweet for this group: 'With this remote learning thing, every time there is a face-to-face class it's like an event and I love it'. For the eigenvector centrality, again the node that obtained the best performance for this parameter was the one that obtained the highest value for the Betweenness centrality, that is, also when considering the indirect connections for this node, it is the most relevant in the set from the web. Finally, considering the

PageRank parameter, the same node stands out in the network, with the highest value for this parameter. Therefore, the 'UnB sincere' node has a lot of prestige in the network considering the topic of remote classes.

Concluding the analysis, the clustering coefficient was also considered to verify how much the network is connected to itself. The average value obtained for this parameter was 0.046, a value much lower than that obtained in the data search for the term 'online education'. Therefore, there is a much greater dispersion of the speeches in small groups, demonstrating relevant small nodes speaking to their own bubbles.

The third search term used was 'blended education'. On Twitter, this term has no relevance and, therefore, it was not possible to build graphs from this search. For this term, however, a graph was constructed from data extracted from YouTube, from a search in video titles, keywords, descriptions, categories and usernames. Figure 4 presents the result of this research.

Figure 4 – Blended education on YouTube.



Source: The author (2021).

For the graph in Figure 4, again the Fruchterman-Reingold algorithm was used, considering the groupings in clusters and in the direct graph model. For this graph, the highest degree obtained was 2, while the smallest degree was zero. It is observed that most nodes present in this graph are isolated, with a very different characteristic from the graphs in Figures 1 and 2. Therefore, it makes no sense to calculate the Betweenness centrality for this graph. The maximum value for the closeness centrality was 1 for six nodes out of the 100 of the graph in Figure 4, the only nodes that have an edge in Figure 4, except for the three nodes grouped with triangle-shaped edges. An example of record for a node with maximum closeness centrality is: 'Live of opening of the Blended Learning training in school practice.' For the eigenvector centrality, six nodes obtained the best performance, with all others obtaining the worst possible performance. An example description for one of these better performing nodes is: '[CLASS 33] Digital assets and personalization: exploring assets and strategies for equity'. It is observed in the description of this node the understanding of blended learning as an aggregator of digital resources and personalization, in the perspective of the definition by Horn and Staker (2015). For PageRank, three nodes had the best performance on the network, all related to teaching art and movement in a remote or hybrid way. According to this metric, these nodes are the ones with the greatest prestige in the analyzed network.

Finally, analyzing the clustering coefficient of the graph in Figure 4, the highest values for this parameter are obtained by the same three nodes that had the best PageRank performance. The average for the clustering coefficient of this graph was 0.06, that is, a value greater than that of the graph in Figure 2 and lower than the value of the graph in Figure 1. Once again, the network is characterized by high dispersion of nodes, speaking for their own bubbles or alone.

Finally, considering the research with the term 'artificial intelligence in education' on Twitter, it was also not possible to build a relevant graph with posts on the proposed topic. The same happened with YouTube search, using the same key term

for titles, keywords, descriptions, categories and usernames.

6. Conclusion

The forced virtualization of global education due to the COVID-19 pandemic has brought global challenges and complex problems. Previously existing inequalities with regard to access to and use of technological tools and the internet became evident with the need to link online classes. Specifically considering the Brazilian scenario, decentralized decisions by state and municipal governments led to different solutions to the problem. The suspension of face-to-face classes was a consensus and the way in which technology-mediated classes were developed reflected in the interest or not of the online classes model persisting in the country.

Considering the Social Network Analysis for the themes 'online education', 'face-to-face education', 'blended education' and 'artificial intelligence in education', diffuse and little cohesive ideas can be seen, with opinions directed, most of the time, to people who share the same impressions about the first three themes and without relevance for the last one. There are some complaints about the form of online education, other praise and some reinforcements that this way of conducting education is the only one possible at the time of a pandemic, despite the difficulties encountered. As for face-to-face teaching, some publications reveal that there is no difference for some students, while for others face-to-face teaching is extremely important, and only this modality is able to offer quality to the educational process. For blended learning, the YouTube videos conducted the idea that it is a possibility for times after COVID-19, with the concern to give some assistance for teachers in different areas.

In light of this picture, it is clear that technological advances regarding the insertion of computational tools as well as the use of the internet will remain in a post-pandemic scenario. However, the appreciation of social interaction that the school environment provides is still very much remembered by surveyed users, and it is not possible to conceive, a priori, of a fully virtualized school. It can be seen, then, that a combined model, like blended learning, emerges as an alternative to the aspirations of a sector that absorbed, during the pandemic, new pedagogical practices, but which still does not dispense with the relevant social aspects of its activity.

As future works, we point to the need for a discussion between the face-to-face and online dichotomy, which does not seem to be rigid in the way it is currently presented. The perspective that this research brings is the current fluidity between on-site and online teaching, reverberating in the behavior of students, teachers, managers and family members, so that the school environment will no longer be just physical, but an intertwining between technological tools, internet, physical and virtual environment, with contributions from Artificial Intelligence in repetitive tasks.

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