

ANALYSIS OF PATENTS RELATED TO THE METAVERSE IN THE EDUCATIONAL CONTEXT

Camilla de Almeida Menezes

Master's Degree from the Postgraduate Program in Intellectual Property Science (PPGPI),
Federal University of Sergipe (UFS), São Cristóvão -

E-mail: camillalmeida1997@gmail.com

ORCID: <https://orcid.org/0000-0001-9151-4010>

Lattes CV link: <https://lattes.cnpq.br/9934527094235305>

and GOOGLE ACADEMIC: [camilla27@academico.ufs.br](https://scholar.google.com/citations?user=camilla27@academico.ufs.br)

SUMMARY

One of the technologies with the greatest potential today is the Metaverse, but this is not always disseminated and discussed in the educational environment. The application of this technology in the educational field is wide-ranging and offers many possibilities, as it combines a visual universe with the physical world to concatenate with the educational environment, conveying infinite possibilities. With this in mind, the aim of this study was to map and analyze patents related to Metaverse in the educational context. To do this, a search was made for patents in the Espacenet database[®] and the National Institute of Industrial Property. In the analysis of the patents identified, it was observed that there is no protected technology in the INPI on this subject of study, and in the Espacenet database only 64 are related to education, most of these deposits are from the year 2021. The United States has the greatest interest in the area, accounting for 46.8% of the total deposits found. The company with the most patents filed was Samsung[®]. In view of the scenario analyzed, it can be concluded that Metaverse technology applied to education is on the rise in the market and is expanding greatly, with different modes of growth. It is expected that in the coming years there will be an increase in filings and that there will be greater interest in technological development and protection in the area by research institutions.

Keywords: Education. Metaverse. Patent.

1 INTRODUCTION

According to Zhang, Chen, Hu and Youmei (2022), the Metaverse can be understood as a virtual universe beyond the real world. By focusing on simulating the reality of human life, it is becoming increasingly faithful to the spaces and relationships of communication and sociability. In this new environment, it is possible to carry out everyday activities such as: working, shopping, getting to know and appreciating historical centers, taking classes, playing games and socializing in general (Pereira, 2009).

In this perspective, which encompasses new spaces and, consequently, new dynamics in the spheres of human life, using avatars, conceptualized by Schlemmer and Backes (2008) as virtual humans, corroborates the thinking of the aforementioned authors, when they mention this whole universe as embodied, that is, materialized that live experiences in the virtual model.

This realistic format stems from the need to make the attempt at a parallel world coexisting with the physical world vivid. In view of this, it was necessary to modify and perfect high-resolution graphic interfaces, three-dimensional modeled objects and good quality broadband connectivity in order to meet the needs of users in this virtual world (Pereira, 2009).

According to Schlemmer and Backes (2008), this other world with specific properties and rules is not limited to the universe of programming languages, which makes it possible to rethink it in order to apply it to education. Learning in this context, for example, is mixed and inclusive, and is also based on the necessary skills to be developed by the individual immersed in this virtual universe (Zhang, Chen, Hu and Youmei, 2022).

In education, the Metaverse guarantees intrinsic motivation, giving more autonomy to the individual, allowing them to edit and create a personalized digital identity that meets their needs as an educator and user, without being limited by time and location (Souza and Tonelli, 2012). This personalization of the teaching-learning path, already reflected by Bacich (2018) in his studies on active methodologies and personalization of teaching, is necessary, especially when we think of the student as the center of the process, in which the role of the teacher, school culture, space, technology, management, assessment and the increasingly innovative and decentralized learning possibilities need to be rethought.

In this sense, the use of the Metaverse in education can improve and popularize learning tools. Thus, this parallel world to the real human world, for educational purposes, is making great strides. Students immersed in the implementation of a classroom simulator and mobilized

by computer and interaction technologies, learn from intelligent tutors, carry out educational activities, share learning data that allows them to have a variety of increasingly meaningful and real experiences (Zhang, Chen, Hu and YoumeI, 2022).

In view of the above, advances in the development of technology have a direct impact on education. The Metaverse, a trend already much discussed by the aforementioned scholars, is still a challenge for the educational sphere. Schlemmer and Backes (2008) discuss the need for teachers/researchers to take ownership of this technology in order to understand its nature and provide their students with pedagogical mediation processes that can make the most of the potential of this three-dimensional virtual world.

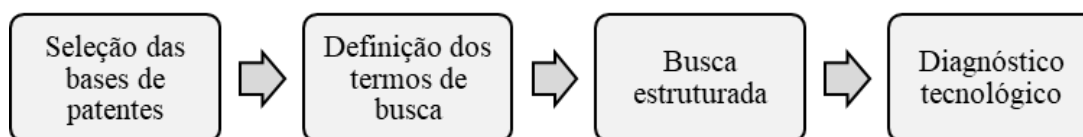
That said, knowing the educational demands and the importance of Metaverse in this context, it is necessary to know the production of technologies that have been developed. Patents are sources of technological information, an important tool for competitiveness and an important indicator for measuring a country's innovation and development (Ferreira, Guimarães and Contador, 2009), while at the same time generating incentives for agents, a financial return from researching the invention and the accumulation of knowledge (Branco, 2011).

With this in mind, the aim of this study was to map and analyze patents related to Metaverse in the educational context. By analyzing the state of the art contained in patent documents, it is possible to verify the technological advances made and help formulate strategic routes for improving existing technologies.

2 METHODS

This is a descriptive, cross-sectional study with a quantitative and documentary approach. This methodological framework results from the description of the object of study and the use of statistical techniques to process the data collected over a given period. The documentary nature comes from the use of primary data made available by institutional bodies that manage industrial property assets. The analysis of the documents supported the technological prospecting of technologies related to Metaverse in the educational context. The main methodological stages used in this study can be seen in Figure 1.

Figure 1 - Methodological steps used in technology scouting



Source: Prepared by the authors (2022)

The patent databases of the National Institute of Industrial Property (INPI) and Espacenet[®] were selected to carry out the technological prospecting. The INPI is the main body responsible for regulating industrial property in Brazil, and its database also includes patent documents protected via the Patent Cooperation Treaty (PCT). The Espacenet database[®] is maintained by the European Patent Office (EPO) and contains more than 140 million patent documents (INPI, 2021; EPO, 2022).

After preliminary reading of scientific articles and patent documents related to the technology of interest, it was possible to define the following search terms for the Espacenet database[®]: *metaverse*, *education*, *classroom*, *school*, *student*, *teach* and *learn*. The same terms in Portuguese were used in the INPI's patent and computer program module, using the "title" and "abstract" fields to retrieve the documents containing the terms in these places. The Boolean operators "AND" and "OR" were also used in both databases, as well as right truncation of the type (*) to retrieve the root records of the terms of interest.

To optimize the retrieval of patent documents, the International Patent Classification (CIP) was used for all searches: G16Y10/55 (Economic sector related to education), G06Q50/20 (Systems or methods specially adapted for the education sector) and G09B (Educational or demonstration apparatus; apparatus for teaching or communicating with the blind, deaf or dumb; models; planetarium; globes; maps; diagrams). Equations (1) and (2) refer to the resulting search expression used at INPI and Espacenet[®], respectively.

$$((\text{metaverse}) \text{ AND } ((\text{educa* OR escola OR aluno* OR ensin* OR aprend*}) \text{ OR } (\text{sala AND de AND aula}))) \quad (1)$$

$$(\text{ftxt} = \text{"metaverse"} \text{ AND } ((\text{cl} =/\text{low "G16Y10/55"} \text{ OR } \text{cl} =/\text{low "G06Q50/20"} \text{ OR } \text{ipc} =/\text{low "G09B"}) \text{ OR } (\text{ftxt} = \text{"education*"} \text{ OR } \text{ftxt} = \text{"classroom"} \text{ OR } \text{ftxt} = \text{"school"} \text{ OR } \text{ftxt} = \text{"student*"} \text{ OR } \text{ftxt} = \text{"teach*"} \text{ OR } \text{ftxt} = \text{"learn*"}))) \quad (2)$$

The searches returned a total of 702 patent documents which, after screening for duplicates and suitability for the scope of the study, were reduced to 64 documents. The data from the eligible documents was exported to spreadsheets in *Microsoft Office Excel* 2019 for

Windows[®] , on which the statistical analyses were carried out. The variables selected for analysis were the annual evolution of patent applications, country of origin, CIPs, applicant profile, main holders and inventors.

3 RESULTS AND DISCUSSION

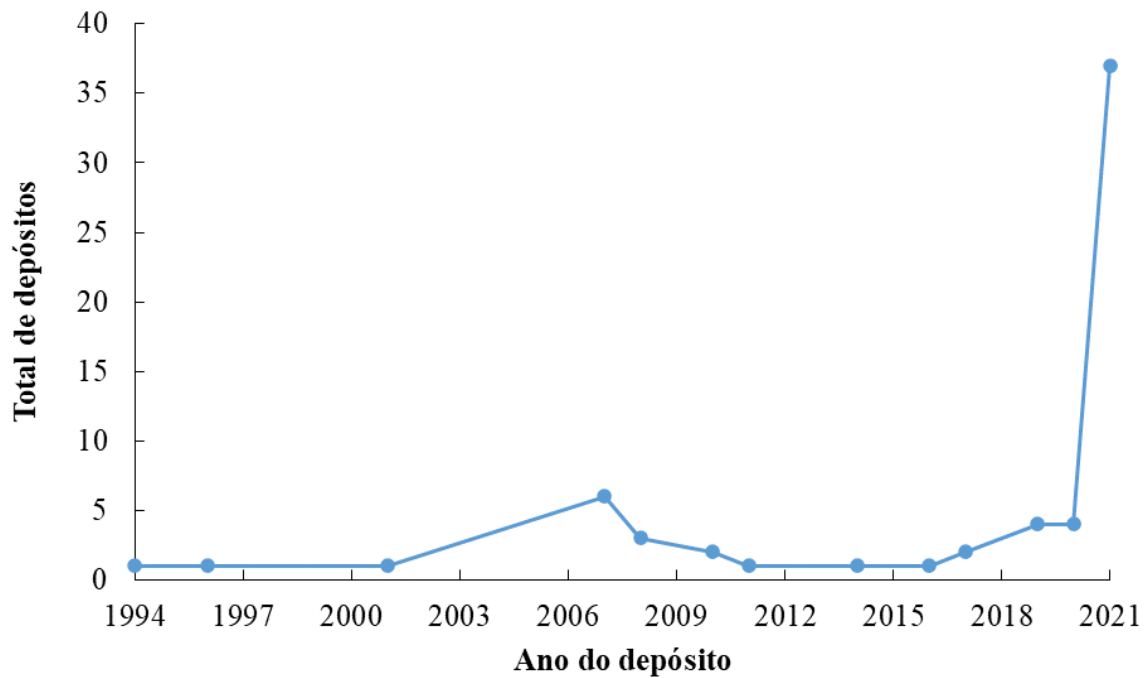
The results obtained from the Espacenet patent and patent application search platform cover 702 patent documents for the scope of this study. This first filter was carried out using the search expression shown above, which required the keywords Metaverse and Education, making it possible to reach the second filter, with 64 documents selected for analysis. This number was achieved using keywords related to education, namely: student with truncation, school and classroom.

Of the documents found, all are applications for invention patents, determining the exclusive right to use the technology (Branco, 2011). It is also worth noting that the patents registered in 2022 are not within the scope of this article, nor was the INPI (National Institute of Industrial Property) deposit found in the country's graph. In addition, of the 64 documents, 37 are awaiting technical examination to check whether they meet the legal requirements of a patent established in specific legislation, 27 patents have been granted, of which 5 have been revoked for non-payment of the annuity.

Figure 2 shows the evolution of applied technologies over time, allowing us to see that between 1994 and 2021 there was a variation in patent applications. It can be seen that until 2001 the number of patent applications related to the Metaverse and Education remained stable, with only 1 patent being filed each year, a period during which attempts were made to implement three-dimensional interfaces in virtual worlds (Pereira, 2009).

Dwivedi *et. al*, (2022) point to 1992 as the beginning of this discussion on the Metaverse, with the first filing made in 1994 focused on Education and the Metaverse. This invention refers to a method and system for creating animated actors based on real-time behavior, a useful tool for social interaction and the construction of virtual reality educational environments (Kenneth and Athomas, 1994).

Figure 2 - Annual trend in patent filings (1994-2021)



Source: Prepared by the authors based on data from Espacenet (2022)

Since 2003, there has been a significant increase in the number of technologies filed for the scope of this study, reaching a peak in 2017 with the inclusion of 6 patents. This event may be based on the growing investment in public policies for science and technology, especially in the United States and China, which according to the MCTIC¹ (2017) put innovation at the heart of their strategies for resuming growth after the 2008 crisis.

Digging a little deeper to see the roots of the decline in the number of patents filed in 2007, it can be seen that this drop remained stable until 2016. This decrease can be explained by the financial crisis of 2008, marked by a devaluation of the US financial market and a fall in stock markets around the world, as well as the stimulus packages for Information and Communication Technologies (ICT), Science, Research, Development and Innovation (R&D&I) and investment in education and training for schools and teachers (OECD, 2009), in addition, the United States has had the largest number of research projects focused on the Metaverse in the educational context, according to (Tlili *et. al.* 2022).

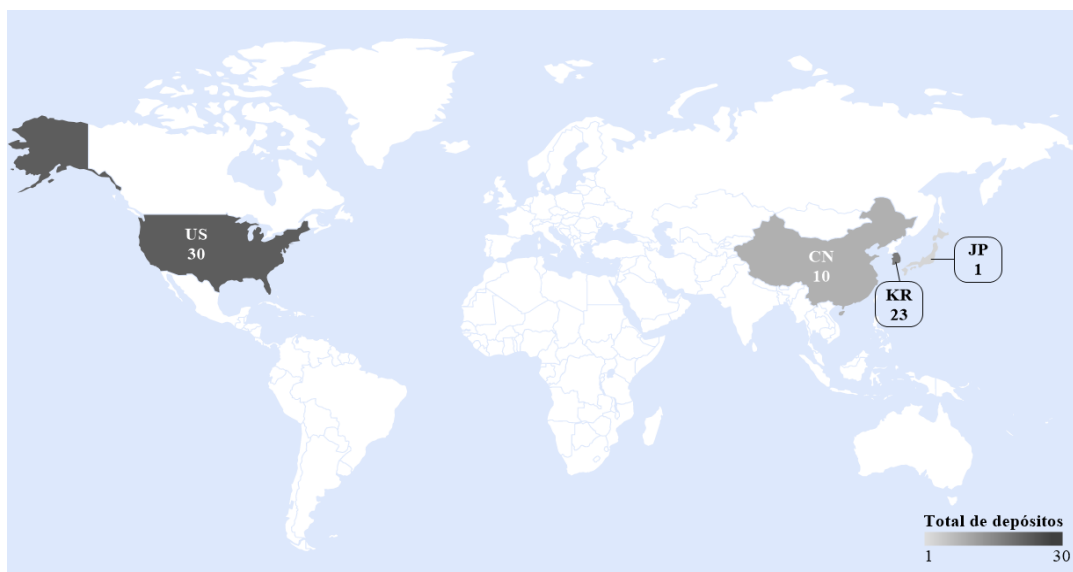
The substantial increase in deposits in 2021 (57.8% of deposits made) can be explained by the investments made in Metaverse technologies, an example of which is Facebook (Tlili *et. al.*, 2022). Another point to be discussed relates to the fact that the COVID-19 pandemic has

¹ The Ministry of Science, Technology, Innovation and Communications is responsible for ensuring and promoting the advancement of science, technology, innovation and communication with a view to sustainable development and improving the quality of life of Brazilian society.

contributed to this significant increase in technologies aimed at the Metaverse and Education, especially in the post-Covid-19 period, due to the popularity of virtual environments (Tlili *et. al*, 2022).

Figure 3 shows that the United States had the highest number of patents involving Metaverse and Education, with 30 filings, equivalent to 46.9%, followed by the Republic of Korea (23 filings - 35%), China (10 filings - 15.6%) and Japan (1 filing - 1.6%). Of this number, 17 (26.6%) filings were made via PCT², demonstrating a particular interest in gaining a competitive advantage in international markets.

Figure 3 - Distribution of patents by country of origin (1994-2021)



Source: Prepared by the authors based on data from Espacenet (2022)

Note: China (CN); United States of America (US); Republic of Korea (KR); Japan (JP).

It was found that the United States' leadership in the number of patent applications related to this technology is justified by the influence of the first signs of the Metaverse appearing in this country, according to Schlemmer and Backes (2018). Another important factor contributing to the US rise in the publication of technologies is the fact that it is one of the largest global economies and the third largest country in terms of technological investment (WIPO, 2021).

From this survey, it can be seen that Asian countries have underperformed compared to the United States, which can be explained by the lack of market sophistication and business

² The Patent Cooperation Treaty (PCT) aims to protect patents in several countries through a single filing.

sophistication that is even further behind, interestingly, because according to the global innovation index, both the Republic of Korea and China are more developed than expected in terms of innovation (WIPO, 2021). In addition, it is important to mention that in Brazil there is a lack of deposits, both by residents and via PCT, the possible reason being investment in technology for the creation of new learning environments, for example.

With regard to CIPs, 237 different codes were identified in the documents analyzed. In various fields, an important search strategy is the use of CIPs, whose purpose is to locate and retrieve information, patent documents that can be located by their specialized classification for any nation. The identification of CIP areas revealed patent applications in Physics (65%) and Electricity (35%). Table 1 shows the most frequent classifications according to the applications found in the search.

Table 1 - CIP codes with the highest frequency of requests

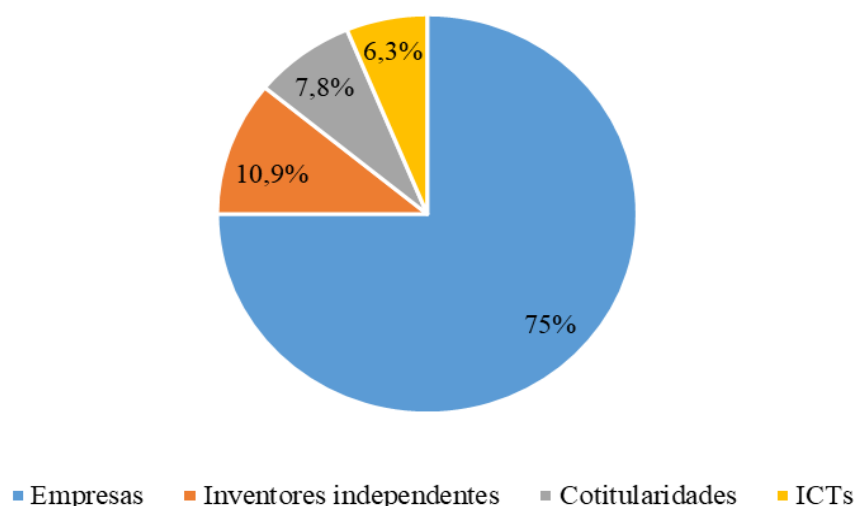
Code	Meaning	N (%)
G06T19/00	Manipulating 3D models or images for computer graphics	10 (15,6)
G06Q50/20	Systems or methods specially adapted for a business sector focused on education	6 (9,4)
G06T13/40	Character animation	6 (9,4)
G06T17/00	3D modeling for computer graphics	6 (9,4)
H04N7/14	Coding systems for two-way operation	5 (7,8)
G06F17/30	Digital computing or data processing equipment or methods specially adapted for natural data manipulation functions	4 (6,3)
G06F3/01	Input arrangements or combined input and output arrangements for interaction between user and computer	4 (6,3)
G06Q50/10	Systems or methods specially adapted for a service-oriented business sector	4 (6,3)
H04L5/00	Arrangements allowing multiple uses of the transmission path	4 (6,3)

Source: Prepared by the authors based on data from Espacenet (2022)

Figure 4 shows the percentage of the analysis of the type of depositor, the majority of which are companies (75%). It can be seen that research institutions are very interested in the

subject when searching for scientific publications, but they are not the main developers of technologies in this field.

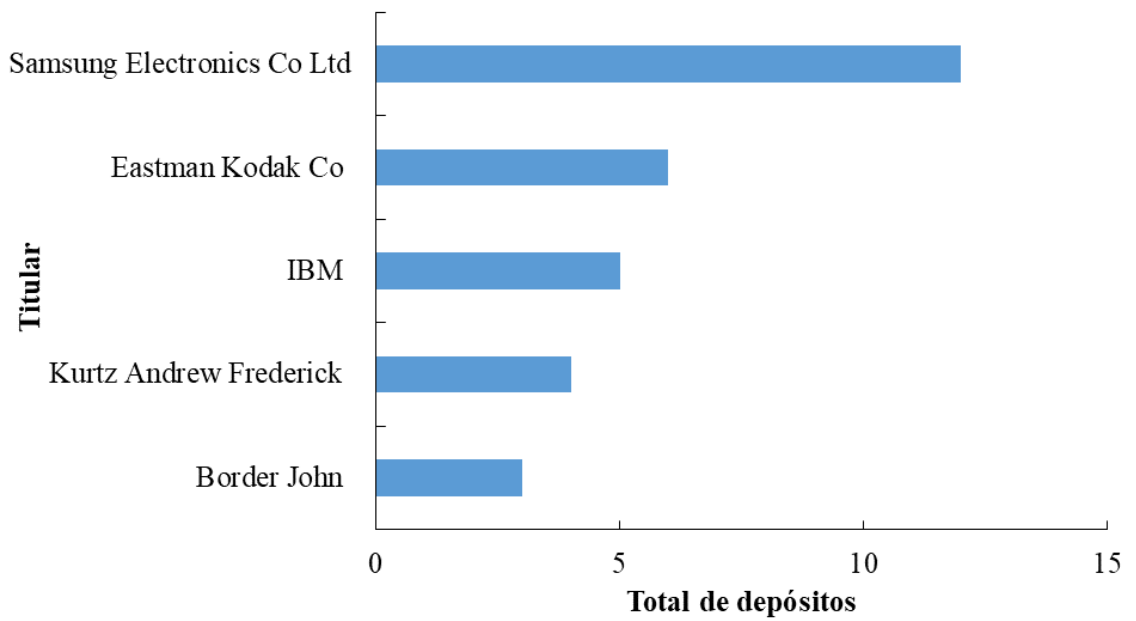
Figure 4 - Percentage of deposits by type of depositor (N = 64)



Source: Prepared by the authors based on data from Espacenet (2022)

When analyzing the holders with the highest number of filings related to the topic studied, we see Samsung Electronics Co Ltd 18.8% of the filings found, this company has an interest in the Metaverse area, with approximately 200 patent filings since 2016, but the vast majority of filings made in the year 2021, another company that appears with 6 filings related to the topic is Eastman Kodak Co, the inventors that also appear in the figure refer to inventors correlated to the Kodak company, both inventors have many patent holdings.

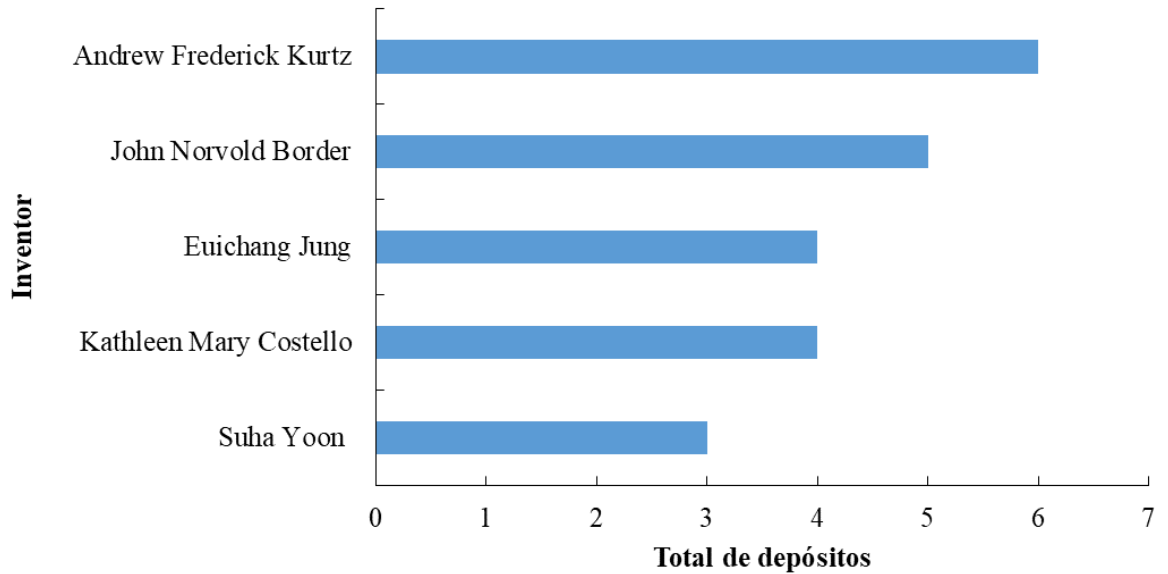
Figure 5 - Holders with the highest number of deposits (1994-2021)



Source: Prepared by the authors based on data from Espacenet (2022)

The main inventor in this area is Kurtz Andrew Frederick, who also has 4 patent applications under study. He is a scientific researcher working in the fields of Optoelectronics, Optics, Computer Vision, Artificial Intelligence and Psychology. The other inventors with more than 3 filings can be seen in Figure 6.

Figure 6 - Inventors with the highest number of deposits (1994-2021)



Source: Prepared by the authors based on data from Espacenet (2022)

Based on the assumption that this article relates the Metaverse to education, some patents were selected to mention what has been created on this subject. The patents were selected based on the keywords used in the search for technologies on Espacenet that met the scope of this study: Metaverse, education, classroom, school, student, teaching and learning. Therefore, 10 patents out of a total of 64 will be described in the following paragraph so that it is possible to understand what technology has been produced on Metaverse and education. These patents involve the creation of a full keyboard with more symbols to help, for example, with language exchange (Kyungsuk, 2020), another patent with a global language service, more precisely a language translation service provider (Gi, 2021), others aimed at sharing information between teacher and student in the classroom (Gyu, 2021), a device to create a virtual classroom space for learning in the Metaverse (Lee, 2021), the Metaverse to aid the learning and sociability of students with disabilities (Rae, 2021), teaching the making of cable heads through the virtual space (Shangde *et. al.*, 2021), the monitoring of the use of the Metaverse as a tool for learning (Gian, 2021). *al*, 2021), monitoring user attention in a computer-simulated environment (Christopher *et. al*, 2016) and user privacy through video communication (Andrew *et. al*, 2017).

All in all, it's important to mention that the number of patents filed for Metaverse and education is increasing. One factor that may have influenced the most recent publications, for example, was COVID-19, with the creation of new teaching and learning environments, as well as resources to help teachers and students during this period of social distancing (Tlili *et. al*,

2022). It is also worth noting that the other patents, i.e. those not included in this figure (10 filings), are concerned with improving access to the virtual world, by increasing broadband, for example, to make it easier for users to immerse themselves in the Metaverse (Pereira, 2009), considered by some scholars to be a continuity of the physical world in which human beings live (Tlili *et. al*, 2022).

4 FINAL CONSIDERATIONS

The aim of this study was to map and analyze patents related to Metaverse in the educational context. Searches of the Espacenet® database identified 64 patent documents related to the technology of interest. Analysis of the data showed that the main country with the highest number of patent applications related to Metaverse applied to education is the United States. In addition, the applicants with the most occurrences were companies, most notably Samsung® with 12 patent applications.

It was also noted that Metaverse technology applied to education is evolving rapidly, as in 2021 deposits increased by 825% compared to 2020. The inventions are characterized by simulating the physical space of classes and lectures, integrating them with educational platform systems, or creating a method of attendance with avatars representing lecturers and teachers. These are technologies that convert the physical educational environment into virtual reality. The patents studied show that these virtual systems can be implemented effectively in the educational context.

Overall, this study has shown how the analysis of patent documents can be an efficient tool for technological monitoring. Based on the results achieved, it can be seen that although many countries still have a low participation in the patenting of technologies related to the Metaverse in the educational context, this technological field is expanding and has great potential for growth in the coming years.

As a follow-up to this study, it is suggested that further research be carried out to better understand the predominance of companies as applicants and the high representation of the United States in this market. In addition, other contexts for applying Metaverse, as well as other patent databases, could be explored in future work.

REFERENCES

BACICH, Lilian. **Continuing teacher training for the use of active methodologies**. In: BACICH, L.; MORAN, J. M. (eds.). *Active methodologies for innovative education: a theoretical-practical approach*. Porto Alegre: Penso, 2018. p. 129-152.

DWIVEDI, P *et. al*. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. **International Journal of Information Management**, v. 66, October, 2022. Available at: <https://www.sciencedirect.com/science/article/pii/S0268401222000767?via%3Dihub#!>. Accessed on: Nov. 15, 2022.

EPO. **Espacenet patent search**. Available at: <https://www.epo.org/searching-for-patents/technical/espacenet.html>. Acesso on: 15 Nov. 2022.

FERREIRA, A; GUIMARÃES, E; CONTADOR, J. Patent as a competitive instrument and as a source of technological information. **Gest. Prod.**, São Carlos, v. 16, n. 2, p. 209-221, abr.-jun. 2009.

INPI. **Patents**. Available at: <https://www.gov.br/inpi/pt-br/servicos/patentes>. Accessed on: 15 Nov. 2022.

PEREIRA, Itamar de Carvalho. Metaverse: interaction and communication in virtual worlds. Dissertation (Master's in Communication) - Faculty of Communication, University of Brasília. Brasília, 2009.

SCHLEMMER, Eliane; BACKES, Luciana. Metaverses: new spaces for building knowledge. **Revista Diálogo Educacional**, v. 8, n. 24, p. 519-532, 2008. Available at: <http://www.redalyc.org/articulo.oa?id=189116834014>. Accessed on: November 15, 2022.

TLILI *et. al*. Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. **Smart Learning Environments**, July, 2022. Available at: <https://doi.org/10.1186/s40561-022-00205-x>. Accessed on: 15 Nov. 2022.

YANG, Fangfang; REN, Longfei; GU, Chao. A study of college students' intention to use metaverse technology for basketball learning based on UTAUT2. **Heliyon**, v. 8, sept, 2022. Available at: <https://doi.org/10.1016/j.heliyon.2022.e10562>. Accessed on: Nov. 15, 2022.

WIPO. **World Intellectual Property Organization. Patents**. 2021. Available at: https://www.wipo.int/edocs/pubdocs/pt/wipo_pub_gii_2021_exec.pdf. Accessed on: 17 Nov. 2022.

WIPO. **World Intellectual Property Organization. Patents**. Global Innovation Index. Available at: https://www.wipo.int/edocs/pubdocs/pt/wipo_pub_gii_2021_exec.pdf. Accessed on: 19 Nov. 2022.

ZHANG, Xinli; CHEN, Yuchen; HU, Lailin; YOUMEI, Wang. The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics.

Frontiers in Psychology, China, p. 1-18, october. 2022. Available at:
<https://doi.org/10.3389/fpsyg.2022.1016300>. Accessed on: Nov. 14, 2022.