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Abstract

The objective in this article, the realization of a patent mapping on medical education, especially using simulators, since we know that in the teaching of medicine, the development of technical and motor skills in practice is essential, and historically, this training happens with the use of corpses, small animals and later monitoring procedures. With all the advent of technological innovation, financial, cultural and social changes demanded the emergence of new teaching technologies, and through this study, one of the utilities of the technological mapping of the activity can be confirmed through patent documents, which is to obtain the technological evolution of a given subject, in this case: use of models, including simulators in medical education. The temporal evolution of patent documents referring to medical education peaked from 2009 to 2018, and above all, it can be concluded that the latest technologies are models of simulators and there are indications from the United States in exporting this technology to Brazil. recent. From this mapping, it is possible to subsidize technological innovation strategies and assist in the promotion of policies and legislation aimed at stimulating national entrepreneurship and the generation of business opportunities.

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Advances in HealthCare teaching: a patent mapping about the models simulators or not used

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Abstract

The objective in this article, the realization of a patent mapping on medical education, especially using simulators, since we know that in the teaching of medicine, the development of technical and motor skills in practice is essential, and historically, this training happens with the use of corpses, small animals and later monitoring procedures. With all the advent of technological innovation, financial, cultural and social changes demanded the emergence of new teaching technologies, and through this study, one of the utilities of the technological mapping of the activity can be confirmed through patent documents, which is to obtain the technological evolution of a given subject, in this case: use of models, including simulators in medical education. The temporal evolution of patent documents referring to medical education peaked from 2009 to 2018, and above all, it can be concluded that the latest technologies are models of simulators and there are indications from the United States in exporting this technology to Brazil. recent. From this mapping, it is possible to subsidize technological innovation strategies and assist in the promotion of policies and legislation aimed at stimulating national entrepreneurship and the generation of business opportunities.

Keywords: patent documents; patent mapping; health education; anatomy education; educational simulators; medical education;

1. Introduction

In the teaching of medicine it is essential to develop technical and motor skills in practice. Traditionally, this training took place with the use of corpses, small animals and later in the monitoring of procedures. Currently, financial, cultural and social changes have demanded the emergence of new teaching technologies [1].

In addition, In health care education, especially in medical education, a series of innovations and trends in relation to teaching-learning practices point to the use and adoption of innovative methods, thus requiring institutions and teachers to seek new strategies capable of improving the final result of the learning process and offer to the student, necessary subsidies for their training with autonomy [2].

One of the methods that have been used to improve the learning process is the use of simulators, an effective and innovative method that expands the relationship between the theory and practice of the student body in a safe environment, offering better learning and training opportunities, contributing to professional training [3].

With this growing amount of information, effective teaching methodologies need to be developed and used to filter relevant information, facilitating constant professional updating. This is of paramount importance, as it brings benefits to society by reducing the mortality rate in more complex medical procedures. Furthermore, it can decrease operational errors even in simpler procedures [4, 5, 6].

One of the methods that have been used to improve the learning process is the use of simulators, an effective and innovative method that expands the relationship between the theory and practice of the student body in a safe environment, offering better learning and training opportunities, contributing to professional training [3].

In this way, every time that training is obtained, repetitively, the student to evolve it reaching an automatic or associative phase. It now shows a significant improvement in performance and a reduction in attention levels. At this stage he is already able to identify some technical errors. The use of simulators promotes a complement to the cognitive phase, allowing the user to reach more advanced levels of mastery of techniques before using them in real situations [7].

The use of automated pedagogical methodologies with also automatic responses in order to improve self-learning is not a recent concept. It did not start to be used after the development of computerized virtual reality simulators from the 1980s. This concept dates back to 1866 when Pressey made the first patent registration in the United States Patent Office for a Teaching Machine. This equipment was intended to teach speech through a self-learning method. In order to be considered a Teaching Machine, the equipment should have three requirements: present an informative content, provide some way for the user to answer the questions of the machine and that the device could provide a correct or wrong answer to the user [8].

With the use of simulators in educational routines, we noticed that in the last few decades, simulation models have progressed to more interactive platforms. With the emergence of Information and Comunication Technologies (ICTs), changes and progress in traditional teaching methods have been seen.

The use of technologies has enabled more meaningful learning, changing the way knowledge is shared between teachers and students in the classroom. These are very different from those students for whom the predominant school model was created. Thus, the use of new ICTs can be an important ally to motivate students in educational processes, such as the construction of learning [9].

Notably, with the use of ICTs and its improvement in computer graphics techniques, augmented reality and virtual reality, it has made the market for simulated environments and simulators of great prominence in several industries, mainly in health and health education. In this way, we aim to observe the behavior of market players regarding their innovation and protection through patent documents [10].

The use of simulators and model training focuses on the technical skill that can be acquired through repetitions of the practice, however it can be lost if the repetitions cease. But these do not replace real situations, but rather allow learning to take place in situations of controlled risk. However, they do not simulate the natural pressures of the medical environment, for example, operating rooms [1].

It was not found any patent mapping article about education in medicine, especially, procedure simulator model, diagnostic simulator model, and, other non-simulator models.

The purpose of this article is to carry out a patent mapping article about education in medicine, especially, procedure simulator model, diagnostic simulator model, and, other non-simulator models.

The focus of this patent mapping on medical education, especially the procedure simulator model, diagnostic simulator model and other non-simulator models, is to perform a patent mapping by activity, as defined by Porter [11], to study how technologies within medical education are changing.

This article is divided into five parts. Next, the concept of patent and the importance of patent documents will be presented. Soon after, the methodology developed to carry out this patent mapping will be presented. Later, the results and speeches will be presented. Finally, the conclusions will be presented.

2. Theoretical Foundation - Patent Documents

According to the INPI [12] patent documents are one of the most complete sources for research, in addition, it is estimated that approximately 70% available as patent documents will not be made available as another source of information.

Regarding their legal nature, patent documents can be divided into: (a) patent application documents (patent document filed with any patent office); and (b) patent (title granted by the State to the holders of the right of the invention during the term of the patent). In addition to the detailed description of the invention, it is necessary to meet the three requirements of patentability: novelty, inventive step and industrial application to obtain a patent [13].

Regarding the deposit, the patent documents can be: (a) priority document - first deposit of the document, normally made in the country of origin of the invention, however it can be done in another country due to the attractiveness of that country's patent process; (b) “same family” documents - deposits made after priority extend protection to other countries in accordance with the Paris Convention [14], this deposit must be made within 12 months of the deposit date. priority document [15].

In order to facilitate access to information (technical and legal) contained in patent documents presented in several languages and without using keywords with uniformity, the international patent classification (IPC)

was created, a hierarchical system of letters and numbers that groups the patent documents by technology [16].

3. Methodology

For this article it was used as methodology the Porter's [11] patent mapping for activity with the folling steps: definition of search criteria, search, summary analysis and data processing.

The search criteria were defined as: (a) territorial limitation = Brazil (BR); (b) database = INPI (free database of coverage only in Brazil); (c) subject limitation = International Patent Classification (IPC) related to the theme - Education in Medicine (IPC = G09B 23/28, G09B 23/30, G09B 23/32 and G09B 23/34 – show on Table 1); (d) time limitation = no time limitation.

Table 1. Description of the classifications (IPC´s) G09B 23/28, G09B 23/30, G09B 23/32, G09B 23/34, belonging to class G09B23

IPC	Descrição
G09B23	Models for scientific, medical, or mathematical purposes, e.g. full-sized device for demonstration purposes
G09B23/28	* for medicine
G09B23/30	** Anatomical models
G09B23/32	*** with moving parts
G09B23/34	*** with removable parts

With the criteria defined above the search was carried out on April 14, 2020. After the search, all documents found had their summary read and were classified into: (a) procedure simulator model, (b) diagnostic simulator model, (c) other non-simulator models, (d) not relevant to the topic.

The documents relevant to the topic (procedure simulator, diagnostic simulator and other non-simulator models) were treated in order to obtain: (i) number of documents deposited per year, (ii) main classifications, (iii) main priority countries, and (iv) main applicants.

4. Results and Discussion

There were recovery 162 patent documents using the methodology above, after reading the summary the classified documents are showed on Table 2. The result of 35% not relevant to the topic was not a surprise because the class G09B23, as shown on Table 1, involves other areas such as, dentistry and veterinary; these documents were discarded.

Table 2. Classifications of the recovery patent documents

	Number of patent documents	%
Procedure Simulator Model	39	24%
Diagnostic Simulator Model	26	16%
Other Non-Simulator Models	40	25%
Not Relevant to the Topic	57	35%

The temporal evolution of patent documents on medical education (Figure 1) shows how the tegnologies (procedure simulator model, diagnostic simulator model and other non-simulator models) evolve over time. The non other non-simulator models tecnology (with 40 patent documents) evolutes form 1980 to 2018, with a peak between 2009 and 2011. The procedure simulator model tecnology (with 39 patent documents) evolutes from 1986 to 2018, with a peak between 2012 and 2017. And, the diagnostic simulator model tecnology (with 26 patent documents) evolutes from 1996 to 2018, with a peak between 2012 and 2018. The three technologies have their greatest development at the peak (2009-2018) and those that are at the peak of their development are the technologies of simulation models (procedure and diagnostic). Indicating the current interest in the development of products or processes in the area of education in medicine involving the technologies of simulation models of process and diagnosis, corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The absence of documents in the years 2019 and 2020 is due to the period of confidentiality that the patent document has between its deposit and its publication (the request is only available for consultation after its publication).

The peak between 2009 and 2018, was show in detail on Figure 2, has 77 patent documents with represents 77% of the patent documents on education in medicine. At the peak there is emphasis on the procedure simulator model with 35 patent documents (90% of the procedure simulator model patent documents), indicating that this is a recent tecnology corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The dignostic simulator model has 20 patent documents (78% of the procedure simulator model patent documents), indicating that this is also a recent tecnology corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The other non-simulator model has 22 patent documents (55% of the procedure simulator model patent documents), indicating that it is a technology that has been developing since 1980 and is still present today. Looking at figures 1 and 2, the behavior of each studied technology is verified and from this behavior, new inventions can be expected in all these technologies (procedure simulator model, diagnostic simulator model, and, other non-simulator models).

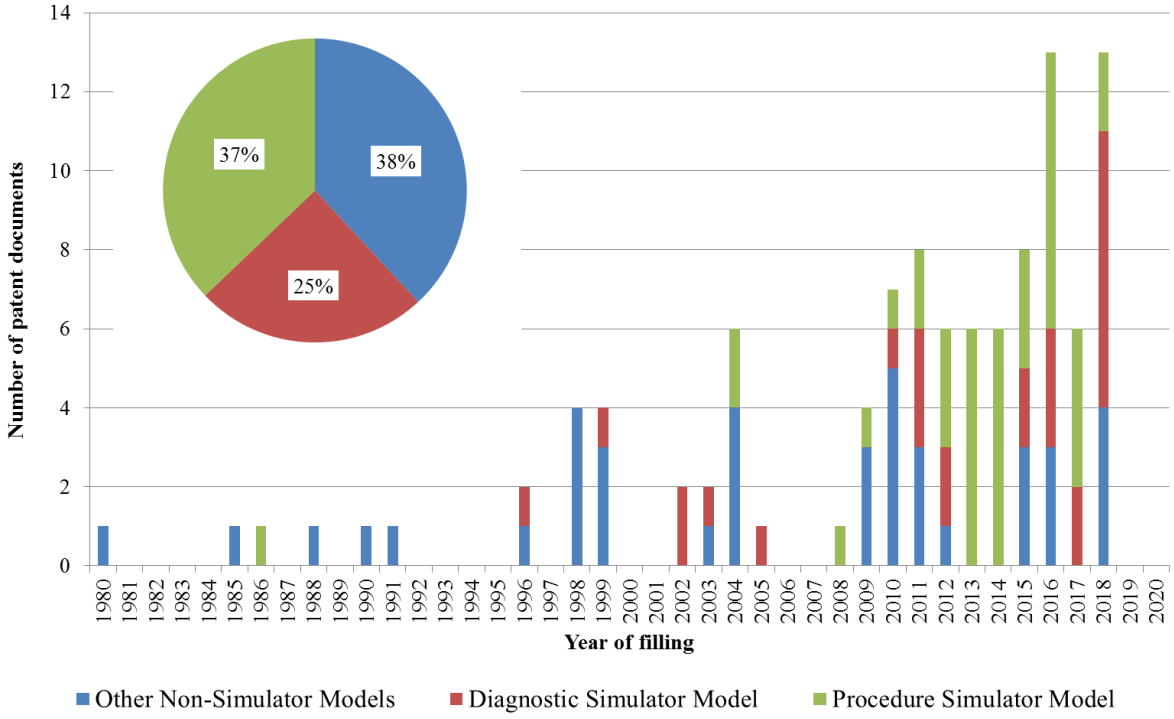

Figure 1. Temporal evolution of patent documents on education in medicine.

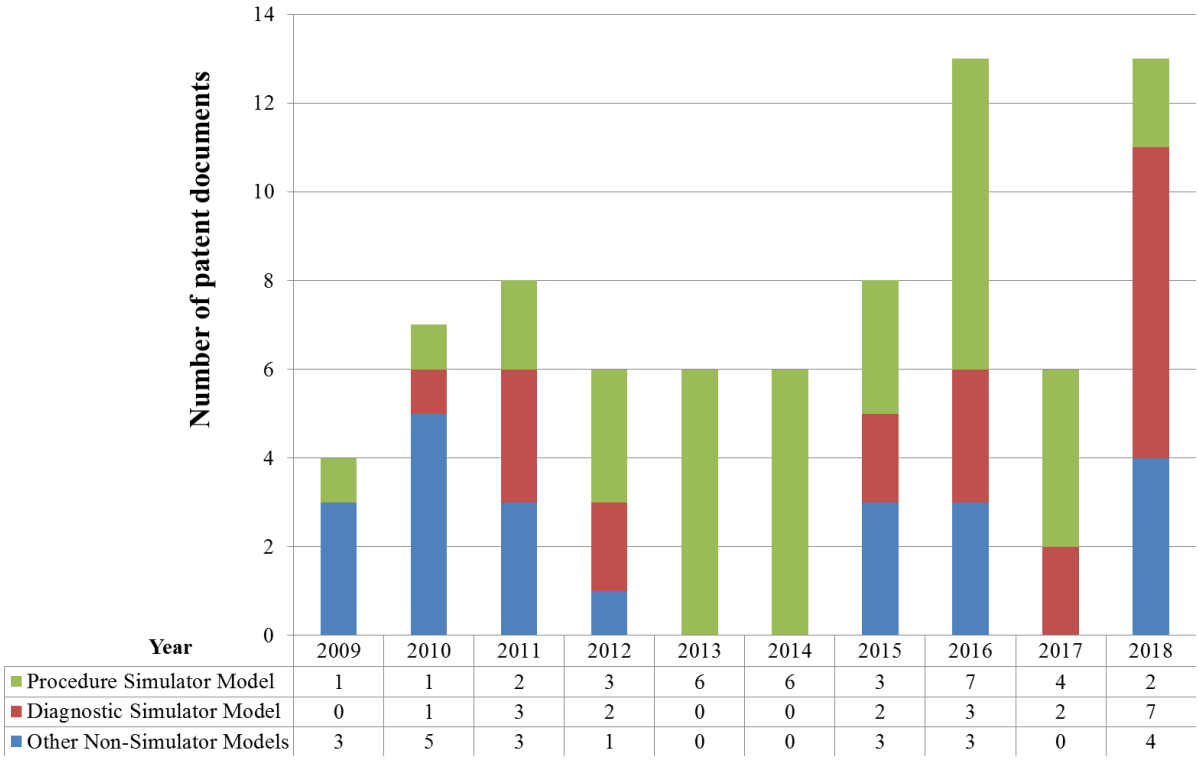

Figure 2. Peak of the temporal evolution of patent documents on education in medicine.

Figure 3 shows the priority countries, where the technology was first deposited, usually reflects where the technology was developed. Most documents were deposited directly in Brazil - 67 documents (54%) followed by the United States - 35 documents (28%), with a highly concentrated behavior (86% in the first

two countries). As the focus of the work are teaching tools in medicine that use technologies and innovation through patent documents deposited in Brazil, it was expected that the largest number of documents would have Brazilian priority, the focus of the work, since education as patent documents are regional, however the second place being the United States shows the United States' interest in the Brazilian market, that is, exporting its inventions to Brazil for use in our education and training system.

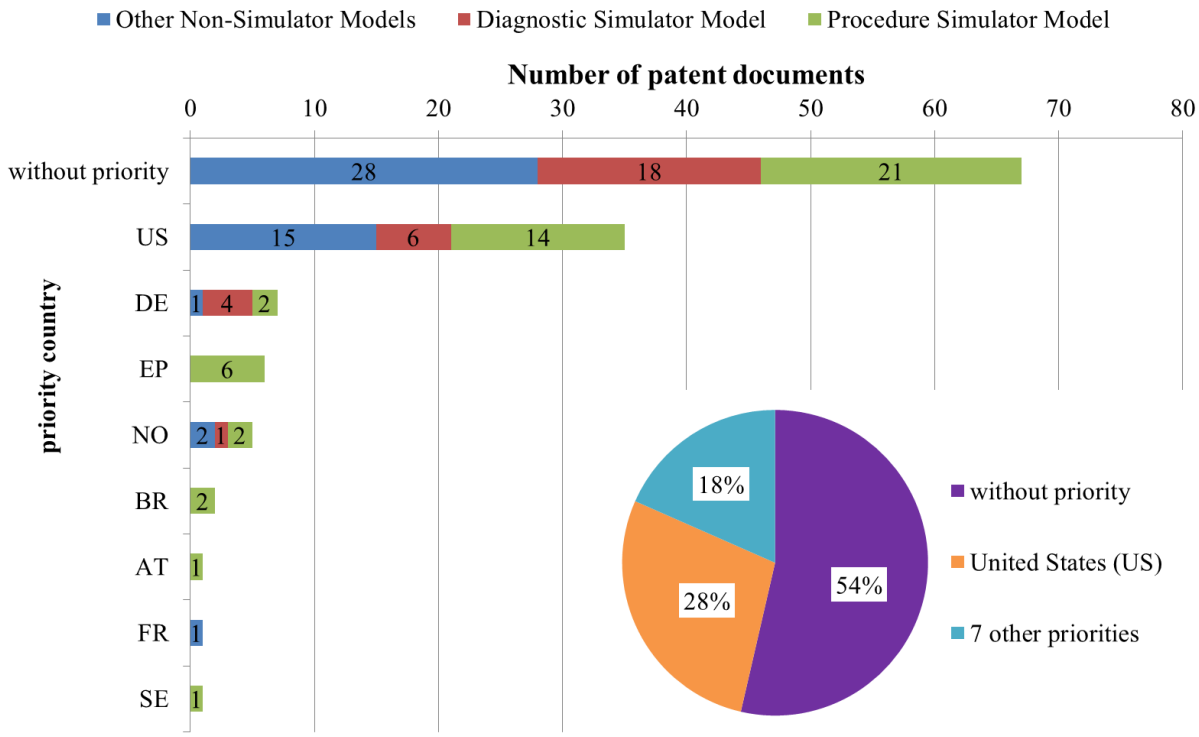

Figure 3. Priority countries evolution of patent documents on education in medicine.

Regarding the applicants, the following analyzes were made: main applicants (Figure 4), distribution of applicants by number of patent documents (Figure 5) and type of applicant (Figure 5). Figure 4 shows the main applicants, those who deposited 3 or more patent documents each, with emphasis on the University of São Paulo - USP with 5 patent documents deposited (3 on process simulator model and 2 on other non-simulator models); followed by companies: Janssen Pharmaceutica with 4 patent documents (all on other non-simulator models); Koninklijke Philips with 4 patent documents (2 on process simulator model, 1 on diagnostic simulator model and 1 on other non-simulator models); and, Laerdal Medical with 4 patent documents (2 on process simulator model, 1 on diagnostic simulator model and 1 on other non-simulator models). Figure 5 shows that the behavior towards the applicant is distributed since the majority of applicants (69 applicants) filed only one patent document, which represents 52% of the total patent documents. Figure 5 also shows that most patent documents deposited in Brazil regarding education in medicine are carried out by individual inventors (physical person with 55%), then there is a balance between companies (legal person with 23%) and universities (22%). Most patent documents are from separate inventors (legal person) is related to the fact that most depositors have only one patent document. The fact that 3 of the 5 main depositors are companies (legal entities) indicates interest by companies to

develop and commercialize these models, including simulators; considering the total number of patent documents, companies (legal person) represent 23% of the documents.

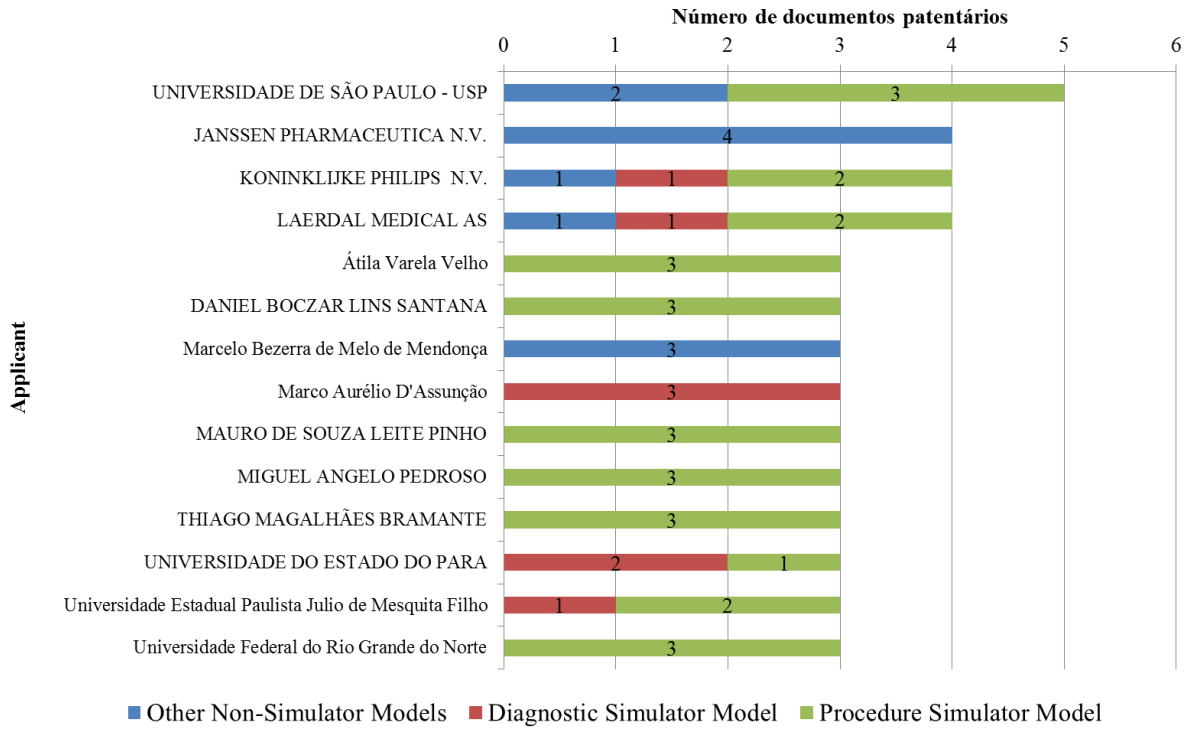

Figure 4. Main applicants of patent documents on education in medicine.

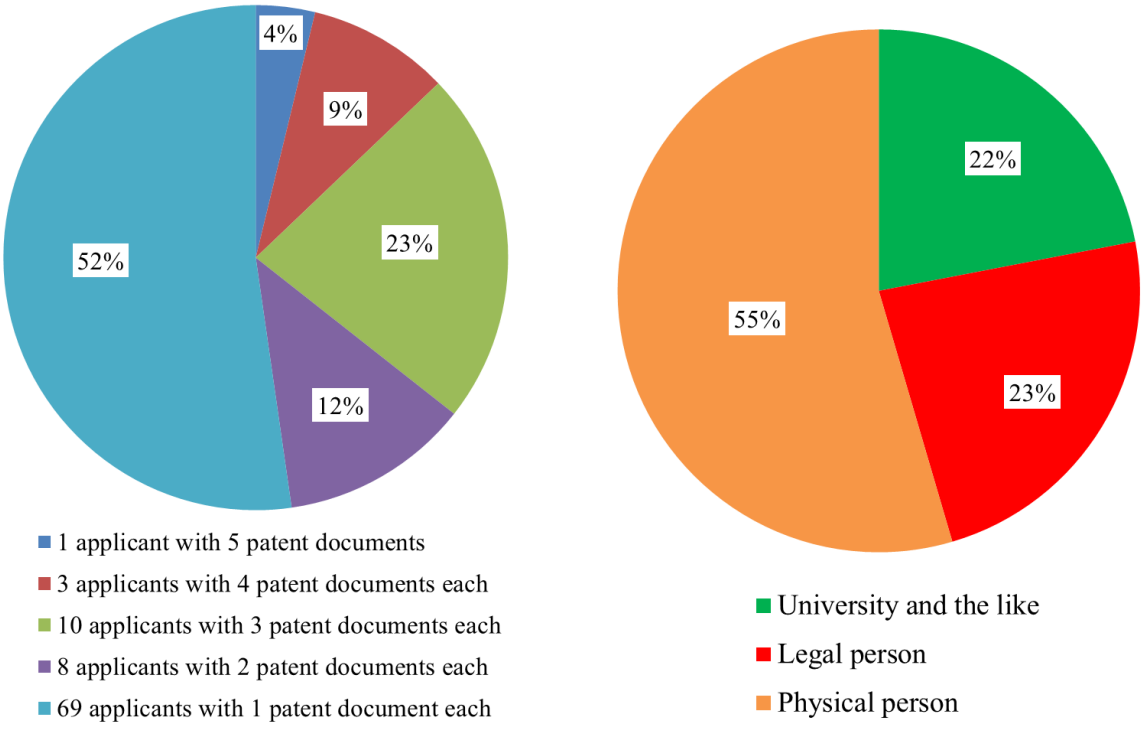

Figure 5. Other information of applicants of patent documents on education in medicine.

5. Conclusion

This article proposes to carry out patent mapping to study how technologies, especially: procedure simulator model, diagnostic simulator model and other non-simulator models, used in medical education are changing.

Through this article, one of the utilities of technological mapping for activity can be confirmed by means of patent documents, which is to obtain the technological evolution of a given subject, in this case: use of models, including simulators in the teaching of medicine. The temporal evolution of patent documents referring to medical education peaked from 2009 to 2018; with respect to technologies: the other non-simulator models are being replaced at the peak by the simulator models (of procedure and diagnosis).

In this work it was possible to detect several models, including simulators, used in the area of medical education; highlighting the procedure simulator model with 39 patent documents, representing 37% of the relevant documents, of these 35 documents are at the peak between 2009 and 2018.

It can be concluded that the latest technologies are simulator models (of procedure and diagnosis), and, and that the other non-simulator models technology continues to develop today. It can also be concluded that the majority of patent documents referring to medical education were first deposited in Brazil and secondly in the United States, indicating that this technology is, for the most part, being developed in Brazil or in the United States; indicating the United States' interest in exporting this technology to Brazil. It was also concluded that most patent documents are made by independent inventors (individuals), who generally deposit a single document; which indicates that it was probably done by a teacher and / or student in order to be used locally. However, the presence of the majority of companies among the first 5 depositors indicates interest on the part of the companies to develop and commercialize these models (including simulators); considering the total number of patent documents, companies (legal person) represent 23% of the documents.

This patent mapping is interesting for those who want to know the state of the art, the history of technologies: procedure simulator model, diagnostic simulator model and other non-simulator models, including the most recent technologies. From this mapping, it is possible to subsidize technological innovation strategies and assist in the promotion of policies and legislation aimed at stimulating national entrepreneurship and the generation of business opportunities.

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