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Research in Computer Science in The Republic of Moldova: A Bibliometric Analysis

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This paper presents results of bibliometric and text-based analysis of Computer Science research output produced by academia from the Republic of Moldova during the 2013-2018 years. The authors have collected data for research output indexed in three databases: Web of Science (WoS), Scopus, and National Bibliometric Instrument (NBI). Data from these databases were collected to obtain important indicators such as total number of research papers and citations, citation impact, h-index, collaboration patterns, top institutions, authors and publication sources. A detailed comparative analysis was performed based on these data. The authors also have performed a text-based analysis on keywords of papers indexed to identify thematic trends for research in Computer Science field. The analytical results present a detailed and useful picture of the status and the competence in Computer Science research in the Republic of Moldova.

Keywords: *visibility of publications; bibliometric analysis; evaluation of research activity; information technology; smart specialization; computer science*

1. Introduction

Information and Communication Technology (ICT) has become an area of utmost importance in all social activities. ICT promotes economic growth as well as technological changes worldwide. Today, Computer Science is one of the most relevant subjects studied in universities, labs, and research institutions. This area of study represents a source of a plethora of new interdisciplinary sub-areas, while society becomes more and more dependent on ICT.

According to the International Data Corporation (IDC), the worldwide expenses for ICT, including those for new technology, will exceed 5.6 Trillion Dollars in 2021; a steady growth in ICT is forecasted until the end of the prognosis period (International Data Corporation 2018).

Until 2021, the new *Third Platform* technologies, including the Internet of Things solutions (IoT), robots and drones, augmented reality headsets, virtual reality (AR/VR) and 3D printers will

encompass almost a quarter (23%) of all expenses. Overall, the expenses in technological solutions on *Third Platform* technologies will represent more than 70% of the worldwide ICT expenses (Technologies.org. 2018).

In Europe, the European Regional Development Fund (ERDF) and The Cohesion Fund allocated over 20 billion euros for ICT in the 2014-2020 funding period. These funds will promote the development of a Digital Single Market with a tremendous growth potential of over 250 billion euros (European Commission 2019).

According to the Ministry of Economy and Infrastructure of the Republic of Moldova, the ICT sector in Moldova has become increasingly attractive for investors, registering in 2017 a 9% growth of the gross added value (highest growth recorded in the last eight years) and contributing by 7% to the GDP (Ministry of Economy and Infrastructure 2018).

Considering the above mentioned, it becomes utterly important to study Moldovan researchers' interest in ICT, through bibliometric study. This will allow to discover the human, institutional, organizational and infrastructure scientific potential for ensuring intelligent/ smart specialization in this area.

Bibliometric analysis is an important method for a better understanding of certain aspects of research results. As a science, bibliometrics represents statistical analysis of books, journals, scientific articles, publications' sources and authors. Analysis of keywords frequency, citations, total number of articles published and by certain authors are key elements for such statistical studies. After the '90s, bibliometrics has been transformed from a simple bibliographic statistics study into a separate and unique area of study (Karanatsiou et al. 2017).

This paper intends to be a bibliometric contribution to the ICT research area in the Republic of Moldova. Considering the multidisciplinary nature of the domain, the research in this area deserves much more attention and is proving that there is a sufficient scientific potential in the Republic of Moldova for the Smart specialization of the country in ICT.

2. Computer Science: research context

The growth rate of the number of scientific papers is determined by the level of science development. Knowledge grows exponentially, and this growth reveals the speed of science and society development (Price 1951).

One of the bibliometric approaches to the analysis of the dynamics of science is tracking of the number of scientific publications in certain areas of study and in a specific period of time. For the analysis of the development level of the specific scientific fields in the world, statistical data has been gathered concerning number of publications in various fields registered in the Scopus database for 30 years (1989-2018) and by authors from the whole world. Based on the gathered data, it was noted that the number of publications in all areas of study has been in constant growth, with the highest number of publications observed in the Medical Field (Cujba 2019). This field has maintained leadership for the last 30 years, followed in 2018 by Engineering and then Computer Science. At the same time, analysing the growth rate of the number of publications in various fields, it becomes obvious that Computer Science has registered the highest growth rate (Figure 1). This is the field where the number of published documents has increased about 13 times over the last 30 years, a 1276% overall growth, or a 43% annual growth to be exact.

The number of publications in Computer Science is expected to outrun the one in the Medical Field in just 3 years (by 2021) (Figure 2).

This forecast shouldn't come as a surprise, as nowadays ICT has entered into all areas of social activity and there is no economic field that would remain competitive without the use of information technologies.

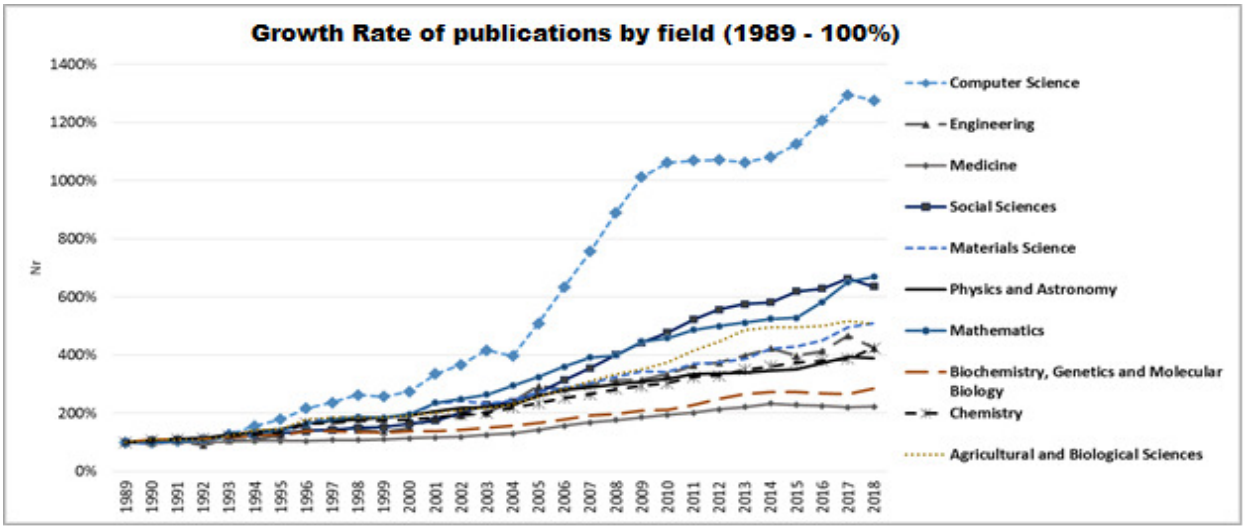

Figure 1. *Growth rate of publications by field (1989 - 100%)* (Cujba 2019)

Computer Science is a relatively new (about 50 years) but a well-established and dynamic area of study. Today, it has become a highly developed, interdisciplinary science with a significant impact on other fields such as physics, mathematics, medicine, library and information science as well as other areas of study.

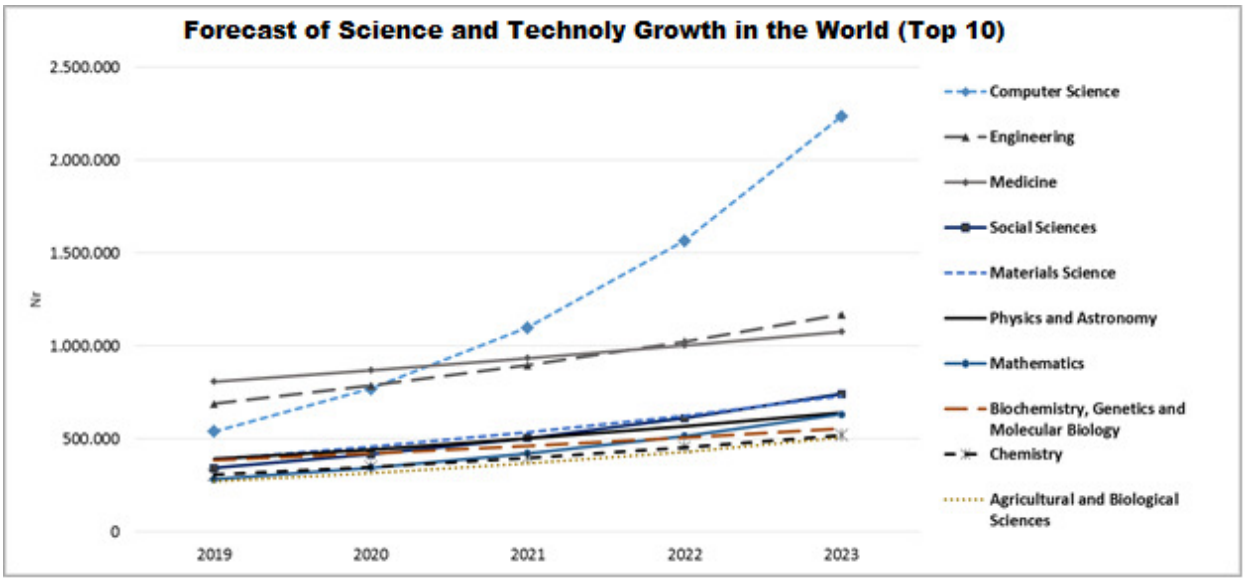

Figure 2. *The forecast of Science and Technology fields growth in the world (Top 10 fields)* (Cujba 2019)

Even though ICT is in an ascending state of development, the number of bibliometric and scientometric studies in the field is relatively small, but there is, however, a certain number of such international research.

There have been published bibliometric studies in Computer Science that compare several countries (i.e.: Fiala 2012, Guan&Ma 2004, Ma et al. 2008, Uddin&Singh 2014, Wainer et al. 2009), or focus on a certain country such as Brazil (Arruda et al. 2009), China (Xie&Willet 2013), India (Gupta et al. 2011, Singh et al. 2015b), Mexico (Uddin et al. 2015) and Malaysia (Bakri&Willet 2011), or emphasizing one of the areas of Computer Science, such as Big Data (Heidari et al. 2017, Singh et al. 2015a), Cloud Computing (Heiling&Voß 2014), Information Retrieval (Mayr and Scharnhorst 2015), or building information modelling (Zhao 2017, Qinghua 2017) etc.

The research paper *"Computer Science in Eastern Europe 1989-2014: A Bibliometric Study"* (Fiala&Willett 2015) focuses on the 15 countries of the former socialist bloc. The research reveals that between 1989 and 2014, these 15 countries (and another 11 with minimal statistical relevance to the study) produced 82,121 publications in Computer Science, with Poland being the most productive country of the region, followed by Russia, Czech Republic, Romania, Hungary and Slovenia. The publication rate grew significantly, but their quality not so much. Hungary and Slovenia are the most influential countries, based on the number of references to their research. The authors have concluded that *Artificial Intelligence* is the most popular area of study in Computer Science, with *Interdisciplinary Applications* being the category with the highest impact.

The authors that collaborate with the post-communist bloc countries are from USA, Germany, Great Britain, France and Canada, the most cited being articles having USA co-authors.

This paper (Fiala&Willett 2015) does not include an analysis of the status of the Republic of Moldova, due to the fact that the number of Moldovan publications has not reached the 1000 threshold needed to be included in the above-mentioned analysis.

The *"Research in Information and Communication Technology in Norway: Bibliometric Analysis"* (Aksnes 2012) encompasses the results of a bibliometric study of the institutions included in the evaluation of the ICT research in Norway and includes institutions and departments, as well as research groups. Likewise, the report contains a macro analysis of the Norwegian research in ICT compared to the international research.

One of the most recent and extensive bibliometric studies, based on approximately 1.9 million works in Computer Science published between 1945 and 2014 that have been indexed in the Web of Science (WoS), covers a period of 70 years (Fiala&Tutoky 2017). The study analyses the quantity as well as the impact of these publications based on the type of documents, language used, field of study, country, institutions and source of publication, as well as the most frequently used keywords, references, and the distribution of the number of references and cites. According to this study, the interdisciplinary research has the biggest impact. Therefore, the evolution of the top keywords frequency over the years is utterly interesting. The top keywords identified by this study emphasizes the evolving interest for research in these 70 years. In the more recent period, there has been evidence of an increased interest in cloud computing, optimization and security.

The recent bibliometric research regarding ICT sector situation, highlights Artificial Intelligence as the most frequent subject. Artificial Intelligence is followed by Theory & Methods and Information Systems, with approximately 26-30% each - out of the entire pool of publications and 20-28% each - out of the entire number of references (Fiala&Tutoky 2017). Based on the number of citations, the most influential subject is Interdisciplinary Applications, with 8 citations per study, while the overall average stands at 5.3.

The study referring to ICT in Moldova could show to what extent the research in Computer Science in the Republic of Moldova is following international trend. This study means to cover the lack of more extensive research in this sense. Hugo Hollanders' Study *"Mapping of Economic, Innovative and Scientific Potential in the Republic of Moldova"* (Hollanders 2017) refers as well to scientific research publications in ICT of Moldovan authors. Based on this study results, directions of smart specialization in Moldova were identified, one of them being ICT sector. Our research strives to analyse and advocate the choosing of ICT as smart specialization for our country.

3. Scope and objectives of the study

The main scope of this study is the evaluation of the research performance in Computer Science in the Republic of Moldova between 2013 and 2018, through the prism of Moldovan authors scientific publications.

The specific objectives of this study:

- Examining the dynamics of national and international publications in Computer Science between 2013-2018;
- Examining the distribution of publications in ICT by scientific field;
- Identifying top ICT researchers and top ICT research institutions from the Republic of Moldova, with the main goal to ensure smart specialization in this research area;
- Analysing publication collaborations of Moldovan authors in the Computer Science field.

4. Methodology

For this bibliometric research, the authors used the comparative method of data analysis from two international databases (WoS and Scopus), as well as one national database - the National Bibliometric Instrument (NBI - https://ibn.idsi.md/). This particular method has been used based on the following reasons:

- Some Computer Science experts consider that WoS does not represent an agreed standard (Wainer et al. 2019, p. 536), because there is a significant amount of papers in Computer Science field published in conference materials in addition to those published in specialty journals. WoS does not index conference materials, except for those published in the Springer's Lecture Notes in Computer Science (LNCS) series and those presented within the ASIST conference. There are worldly recognized journals in Computer Science that are not indexed in WoS, such as ACM Journal on Experimental Algorithms, ACM Transactions on Algorithms, Journal of Discrete Algorithms.
- Scopus is a scientific database that offers, perhaps, a better image of the production side of Computer Science, because it indexes the set of ACM (Association of Computer Machinery), IEEE (Institute of Electrical and Electronics Engineers) and Elsevier journals, but also certain ACM and IEEE conferences, as well as the LNCS series, that are being indexed both as a journal and as conferences materials (Wainer et al. 2019, p. 536).
- There have been other studies that tried to compare WoS and Scopus (Chadegani et al. 2013). These researches were focused on comparing coverage, bias in coverage and mostly the difference in the results of citations' analysis. This article uses data sources from WoS and Scopus, aiming to compare the way these two databases index publications in Computer Science with authors from the Republic of Moldova, as well as papers indexed in the national database.

The WoS data were collected on February 8-9 2019 (Web of Science 2019), using an advanced search procedure. The following criteria were used for searching information on computer science publications in the WoS database:

(1) Country affiliation (CU=Moldova);
(2) Period (PY=2013-2018);
(3) Result filtering based on WoS categories (Computer Science Categories Field) [1]
- Computer Science, Artificial Intelligence;
- Computer Science, Cybernetics;
- Computer Science, Hardware & Architecture;
- Computer Science, Information Systems;
- Computer Science, Interdisciplinary Applications;
- Computer Science, Software Engineering;
- Computer Science, Theory & Methods;
- Imaging Science & Photographic Technology;
- Telecommunications;
- Information Science & Library Science.

The data obtained from Scopus database were gathered on February 8-9, 2019 (Scopus 2019), using the simple search option. The query was based on the following criteria:

(1) Country Affiliation (Moldova);
(2) Period 2013-2018;
(3) The obtained results have been filtered based on the research field (Computer Science).

The data obtained from the National Bibliometric Instrument, developed and maintained by the Information Society Development Institute, were collected on February 8-11 2019 (National Bibliometric Instrument 2019). For the NBI data selection, we used the advanced search function of the open resource http://stiu.md/ (Știu.md 2019), as well as the informative panel of NBI. For obtaining the above-mentioned data, the following criteria have been used:

(1) The Science and Technology of Computers. Computers. Data processing (based on the Universal Decimal Classification - UDC);
(2) Period 2013-2018;
(3) The affiliation country of the authors (Moldova).

5. Results

Between 2013 and 2018, there were 1,524,151 documents identified in the WoS database, that can be classified in the Computer Science categories, with subcategories in the same area of study, as well as other subcategories that are relevant to this study, but are not part of the Computer Science category, such as: Imaging Science & Photographic Technology; Information Science & Library Science; Telecommunications. Out of all international publications in Computer Science found in WoS, 169 (0.011%) belong to the authors from the Republic of Moldova.

The authors found in WoS 3,345 documents published by Moldovan authors between 2013 and 2018, out of which 169 were researches in Computer Science. This represents 5.05% out of the total number of publications coming from the Republic of Moldova in the above-mentioned period.

A similar situation regarding publications by Moldovan authors has been observed in the Scopus database. Between 2013 and 2018 there has been a total of 2,779,218 works in Computer Science published in the Scopus. Those belonging to the Republic of Moldova (225) represent 0.008%. From the total of 2,905 publications by Moldovan authors in this period, the ones referring to Computer Science represent 7.75%.

At the moment of data collection from NBI, there were a total of 69,640 documents found, out of which 48,937 (70.3%) had at least one author from the Republic of Moldova. Likewise, out of the total number of documents (69,640), approximately 57.4% (40,005) were works published between 2013 and 2018, and out of the above-mentioned papers 26,867 (67.2%) belong to authors from Moldova. In the fields - *Computer Science and Technology. Computers. Data Processing* - which are relevant to Computer Science, there were 496 papers (1.86%) published by Moldovan authors in 2013-2018, indexed in NBI.

Therefore, the percentage of publications by Moldovan authors in Computer Science field, in all three databases between 2013 and 2018, is not very high: WoS - 5.05%, Scopus 7.75% and NBI - 1.86%.

The comparative analysis of the indexing dynamics of publications in WoS, Scopus and NBI shows that there were slightly more documents in Computer Science found in the Scopus database (Figure 3). The Scopus indexing dynamics is positive, with the greatest number of published works recorded in 2018 (48 publications).

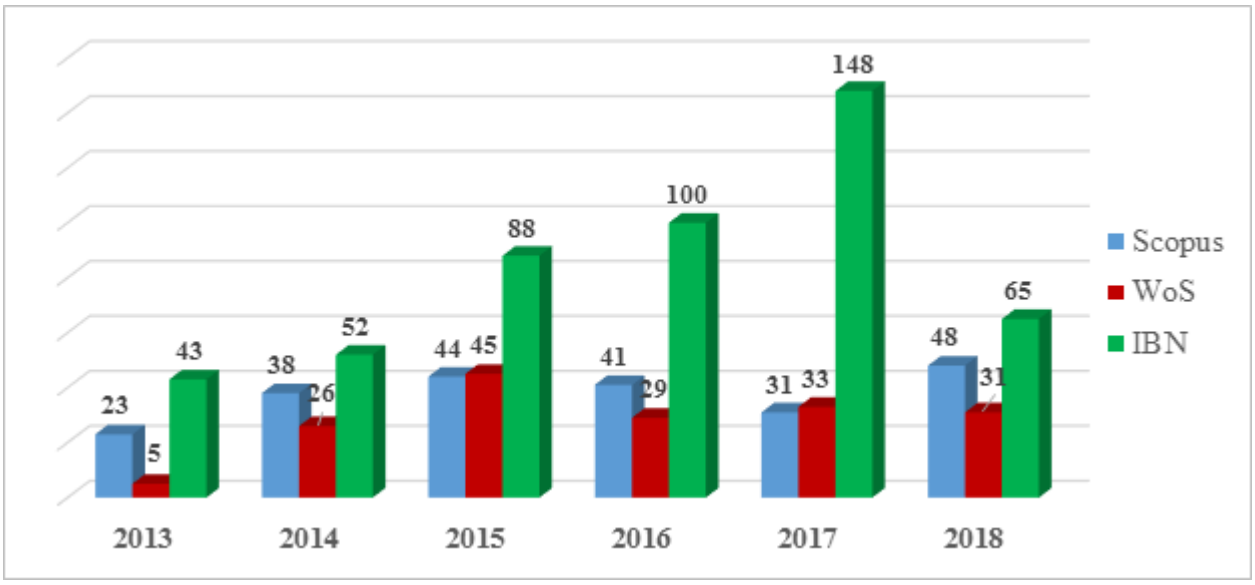

Figure 3. *The dynamics of the publications in Computer Science recorded in WoS, Scopus and NBI*

As far as NBI goes, we can, as well, observe some positive dynamics in documents publication. The relatively small number for 2018 can be explained by the delayed effect of the actual publication process.

We can also note that the growth rate of publications in the Computer Science field in Moldova is mostly positive (Table 1). The number of works in Computer Science published in the WoS database has increased six-fold, Scopus recorded a more than 100% growth, while NBI registered 1.5 times more works in the studied timeframe.

Table 1. *Details regarding publications in Computer Science Field in WoS, Scopus and NBI*

Year	WoS			Scopus			NBI		
	Number of publi-cations	%	Average annual growth rate (%)	Number of publi-cations	%	Average annual growth rate (%)	Number of publi-cations	%	Average annual growth rate (%)
2013	5	3.0	-	23	10.2	-	43	8.7	-
2014	26	15.4	420	38	16.9	65.2	52	10.5	20.9
2015	45	26.6	73.1	44	19.5	15.8	88	17.7	69.2
2016	29	17.2	-35.6	41	18.2	-6.8	100	20.2	13.6
2017	33	19.5	13.8	31	13.8	-24.4	148	29.8	48.0
2018	31	18.3	-6.1	48	21.3	54.8	65	13.1	-56.1
Total	169	100	465.3	225	100	104.6	496	100	95.7

Most of WoS publications in Computer Science with authors from the Republic of Moldova are distributed by following subcategories: Theory & Methods (45%), Artificial Intelligence (26.6%), Interdisciplinary Applications (20.7%), Information Systems (18.3%). Theory & Methods is the most prolific subcategory, with 76 indexed documents (Figure 4). In the studied period, there were no publications by authors from Moldova in Cybernetics. The only paper registered in this subcategory was published in 2011.

Likewise, we can note that some publications in Computer Science are also registered in other

interfering categories such as Applied Mathematics (15.4%), Electronic & Electric Engineering (15.4%).

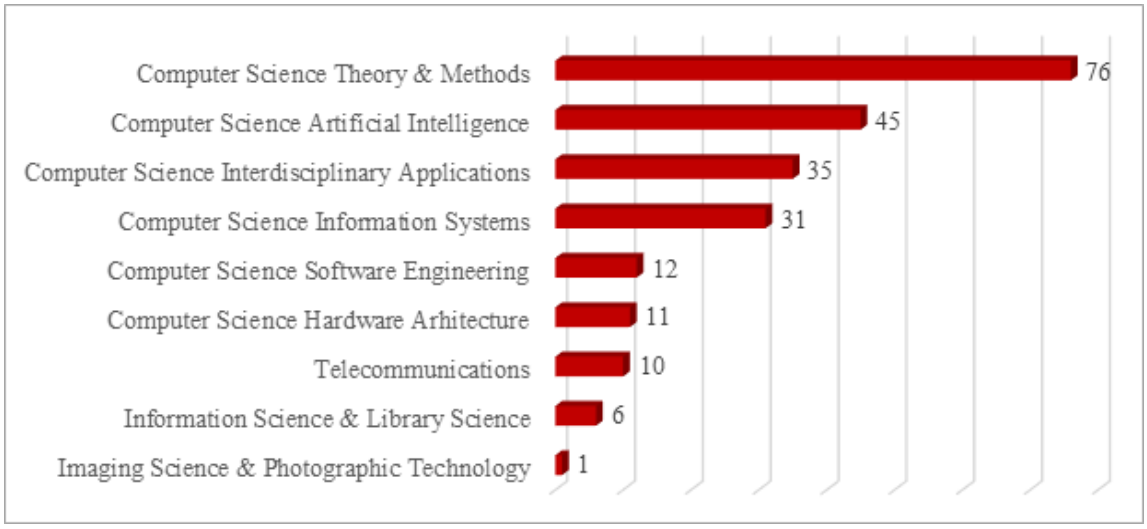

Figure 4. *Distribution of WoS publications in Computer Science by subcategories*

We have to mention that the international articles in Computer Science published by authors from the Republic of Moldova are not very influent. Their most influent works refer to the following subcategories: Theory & Methods - approximately 26% out of the total number of citations; Artificial Intelligence - approximately 12% and Software Engineering - approximately 12%. The highest quotation average per article was recorded in the Engineering Software category and stands at 2.4 references per article, compared to other WoS categories where the referencing average of Moldovan authors is very low. In the study period, the average quotation per article rate is 0.7. According to the WoS data, in 2013-2018, the most cited works published by authors from the Republic of Moldova are grouped in the following categories: Physical Chemistry - 13.4 citations per article; The Science of Interdisciplinary Materials - 11.4 citations per articles; Condensed Matter Physics - 9.9 citations per article.

The analysis of Scopus database papers by category shows that many documents in Computer Science overlap with other exact, applicative and social sciences categories (Figure 5). The biggest percentage is registered by publications in Mathematics (46.2%), Engineering (44.4%), Physics and Astronomy (25.8%), the Materials Science (19.6%). We can ascertain differences in the distribution by category of the publications in WoS and Scopus. At the moment of analysis, there were 26 publications in Mathematics in WoS database vs 104 in Scopus; WoS recorded 34 documents in Engineering, while Scopus registered 100.

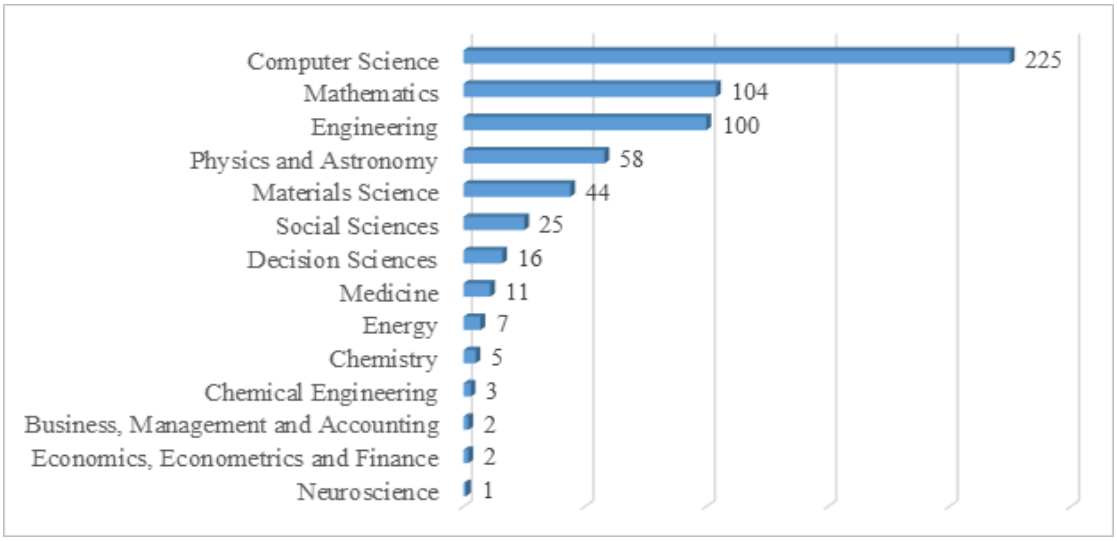

Figure 5. *The distribution of documents by category (Scopus)*

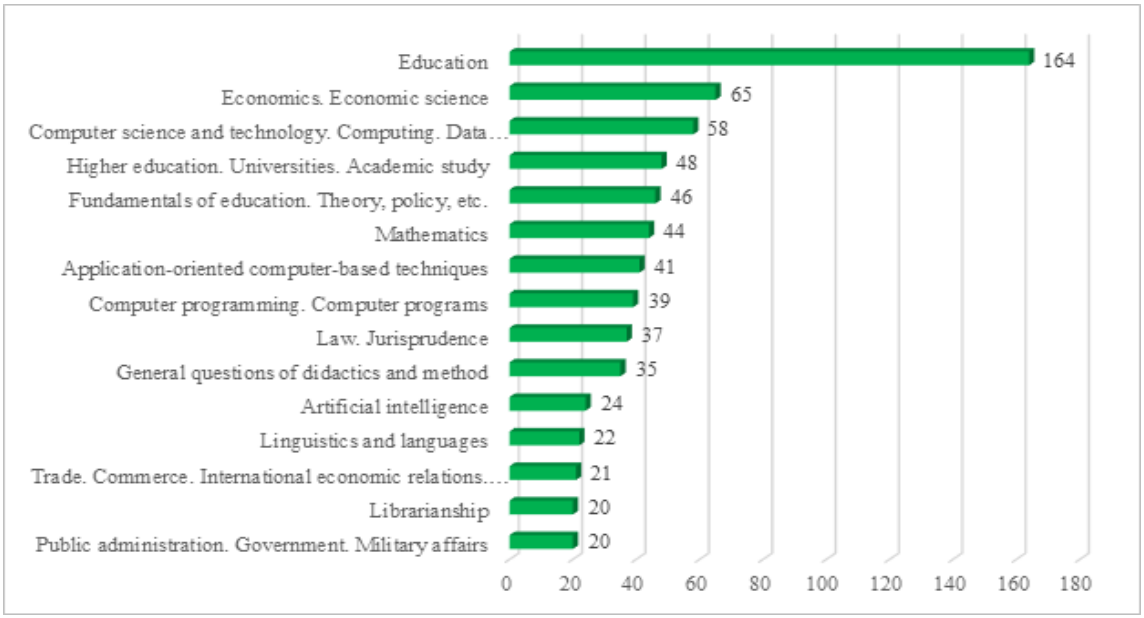

Figure 6. *The distribution of documents in NBI by subcategories of the Universal Decimal Classification (Science and Computer Technology, Data Processing)*

The analysis of the 496 documents registered in NBI by category according to Universal Decimal Classification subcategories, highlights that the Education field recorded the highest number of publications (33.1%), followed by Economics (13.1%) and Economics and Computer Communication (Figure 6). This indicates that the highest number of publications comes from educational institutions rather than from research institutions, but it also highlights the interest for research in applied informatics in the education field.

The selection of a relevant publication type can have a huge effect on the impact and visibility of the published research. Therefore, the analysis of the type of documents used to communicate the research results is of great importance. The Figure 7 presents the distribution of the documents by type.

We identified 5 different types of documents in WoS, the most frequently encountered ones being "Proceedings Paper" (over 53%), "Article" (almost 45%) and "Book Chapter" (almost 15%). The other kinds of documents, such as "Editorials" and "Book reviews" represent a negligible share.

Scopus registers various types of publications, with the most popular ones being "Conference Paper" (62%) and "Articles" (25%). Book chapters represent 9% of all publications and all the other types are insignificant for the research (editorials, articles in press, books and reviews - 4%).

The analysis of the type of documents recorded in NBI shows that the majority of them fit in the Journal Articles category. There are several explanations to this situation. Firstly, NBI records mostly journals and articles from national journals. Secondly, there are very few conference materials registered in NBI, due to the fact that NBI started recording this type of documents only in October 2017.

If we compare the analysis results of the international databases WoS and Scopus with the NBI results, based on document type, a difference in type hierarchy can be observed (Figure 7). Thus, WoS and Scopus placed conference materials on first place, followed by journal articles. We can conclude that at the international level Moldovan researchers disseminate their research results mostly by participating in scientific conferences. There are also very few international journal publications and there is only one Moldovan journal specialized in Computer Science that is accredited and included in WoS database - "Computer Science Journal of Moldova".

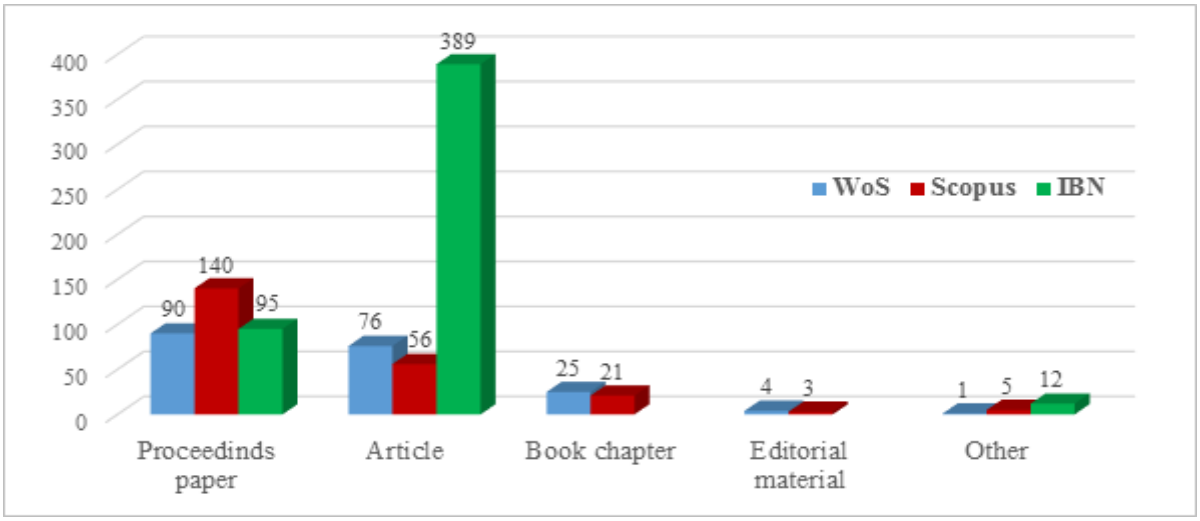

Figure 7. *Distribution of documents by type (WoS, Scopus and NBI)*

Table 2 presents the distribution of documents by type collected from the Web of Science database. Although, there are much more published papers in the Conference Materials section, the number of citations as well as the average number of citations per document is a lot higher in the Journal Articles category. Out of the 169 documents collected from WoS 90 were cited, with a total of 119 citations and an average of 0.7 citations per document.

Table 2. *Document distribution by type (WoS)*

Document Type	Number of Documents	%	Number of Citations	%	Average Number of Citations per Document	h-Index
Proceedings Paper	90	53.3	49	39.2	0.5	4
Articles	76	45.0	70	56.0	0.9	4
Book chapters	25	14.8	6	6.8	0.2	1
Editorials	4	2.4	0		0	0
Book Reviews	1	0.6	0		0	0

Scopus database reveals a similar situation with WoS, where the number of citations as well as the average number of citations per paper is higher in the case of Articles (Table 3). This data suggests that journal articles are used oftener for research documentation.

Table 3. *Document distribution by type (WoS)*

Document Type	Number of Documents	%	Number of Citations	%	Average Number of Citations per Document	h-Index
Conference papers	140	62.2	132	39.8	0.9	5
Articles	56	24.9	181	54.5	3.2	7
Book chapters	21	9.3	0	0	0	0
Editorials	3	1.3	0	0	0	0
Article in press	3	1.3	0	0	0	0
Books	1	0.4	6	1.8	6.0	1
Reviews	1	0.4	13	3.9	13.0	1

The share of references to papers in Computer Science with Moldovan authors in the period under review is not very high and fluctuates from 0% to 1.3% in WoS and from 1.5% to 3.3% in Scopus (Table 4).

Table 4. *Citations distribution by year (WoS & Scopus)*

Year	WoS			Scopus		
	Total Number of Citations to Papers from Moldova	**Total Number of Citations in Computer Science**	**%**	**Total Number of Citations to Papers from Moldova**	**Total Number of Citations in Computer Science**	**%**
2013	145	0	0	182	6	3.3
2014	713	6	0.8	830	13	1.6
2015	1 583	21	1.3	1 840	50	2.7
2016	2 399	18	0.7	3 395	59	1.7
2017	3 557	44	1.2	5 628	87	1.5
2018	4 400	21	0.5	7 211	106	1.5
Total	**12 797**	**110**	**0.9**	**19 086**	**321**	**1.7**

It should be noted that all Moldovan publications for the studied period are cited 12 797 times in WoS and 19 086 times in Scopus, while the percentage of the citations of publications in the Computer Science field constitutes only 0.9% in WoS and 1.7% in Scopus.

It is obvious that the papers in Scopus record a higher number of citations. The distribution of the number of citations by year shows that the highest number of citations in Scopus is registered in 2018 while in WoS in 2017 (Figure 8).

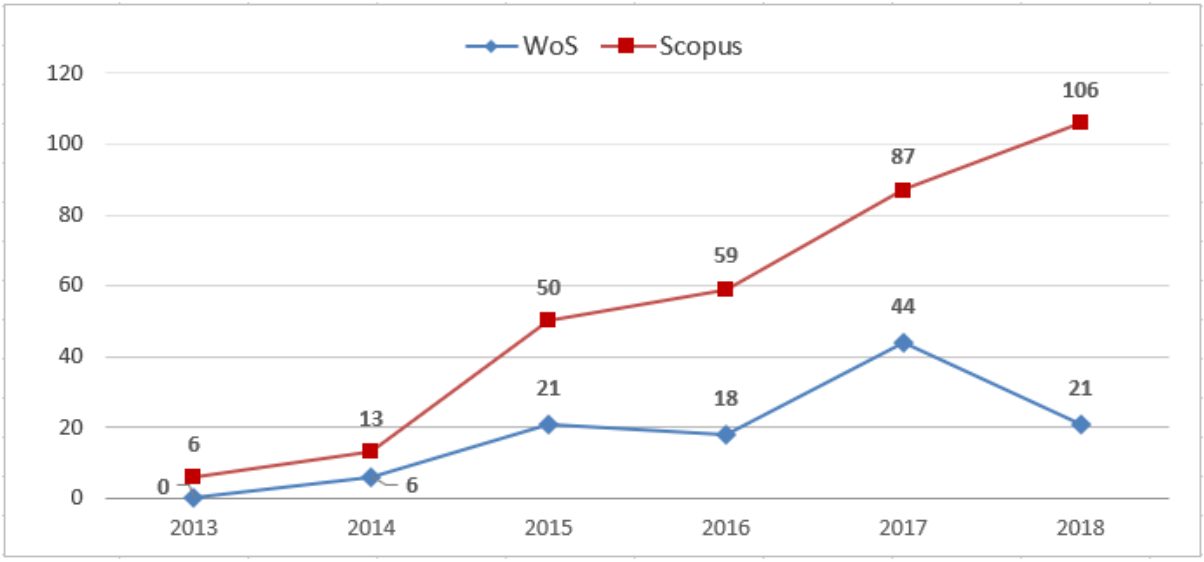

Figure 8. *Citations distribution by year (WoS & Scopus)*

The H-index is calculated for establishing the overall value of research publications in a certain science field. Thus, the H-index for the publications from Scopus is 8, meaning that there are 8 publications in Computer Science, with at least 8 references each. The H-index of Moldovan authors' publications registered in the WoS database in Computer Science field is 7.

In terms of language use, the situation is quite clear. It is well known that WoS is based almost exclusively on publications in English. We can deduct this fact from Table 5, where the percentage of publications in English is 99.4%, and all the recorded references are, as well, to documents

written in English. In fact, the impact of English publications in terms of citations per article is 0.7. We found no publications in Computer Science by Moldovan authors in Romanian language in the WoS database (Figure 9). The impact of publications in languages other than English is negligible, not only for Moldova. This fact is also proven by the research paper *"Computer Science in Eastern Europe 1989-2014: a Bibliometric Study"*, which found that the percentage of works published in English, as well as the number of citations to articles written in English exceeded 99% (Fiala&Willett 2015, p. 4).

Table 5. *Distribution of documents by language (WoS & Scopus)*

Database	Publishing Language of Documents	Number of Documents	%	Number of Citations	%	Average No of Citations per article	h-Index
WoS	English	168	99.4	112	100	0.7	7
	Russian	1	0.6	0	0	0	0
Scopus	English	221	98.2	331	99.7	1.5	8
	Russian	4	1.8	1	0.3	0.2	1

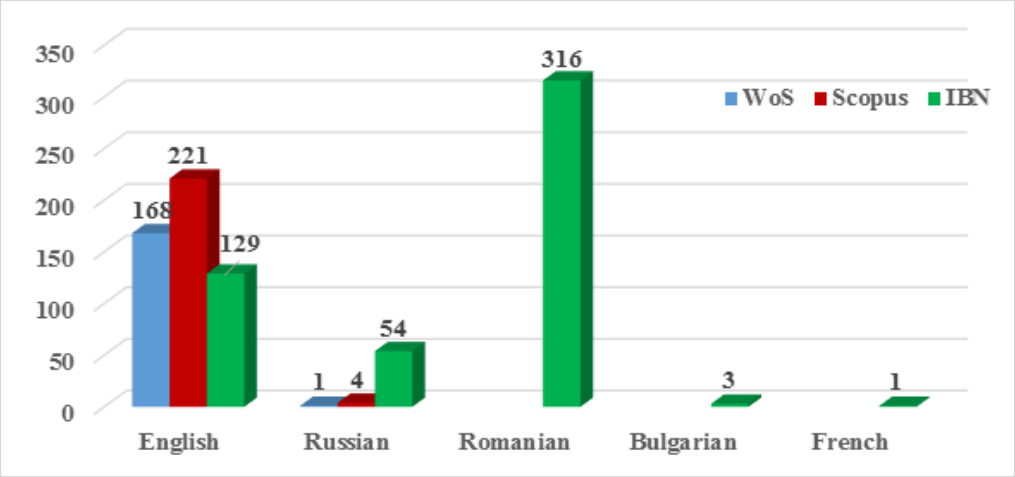

Figure 9. *Documents distributed by language of papers (WoS, Scopus, NBI)*

The result analysis for 2013-2018 of all WoS papers in Computer Science reveals that 98.9% (1,239,827 publications) are in English, followed by 0.3% (3,963 publications) in Spanish. Romanian language is positioned 15th, with 53 publications relevant to this field (0.004%).

Scopus and WoS databases present a very similar situation based on the language the documents are published in. Over 98% of articles in Computer Science are published in English and only 4 articles (1.8%) are in Russian.

The most common languages of papers registered in NBI are Romanian - over 63.7%, English - 26%, and Russian - 10.9% (Figure 9).

Table 6 presents the distribution of the publications in Computer Science in the WoS database by source.

Table 6. *Distribution of documents by publication source (WoS)*

No	Source Title	No	%
1.	Computer Science Journal of Moldova	34	20.1
2.	Lecture Notes in Computer Science	16	9.5
3.	Pareto-Nash-Stackelberg Game and Control Theory. Intelligent Paradigms and Applications	16	9.5
4.	Smart Innovation Systems and Technologies	16	9.5
5.	E Health and Bioengineering Conference	14	8.3
6.	Roedunet International Conference	8	4.7
7.	Proceedings of International Conference on Virtual Learning	7	4.1
8.	Lecture Notes in Educational Technology	6	3.5
9.	User Interface Design of Digital Textbooks, How Screens Affect Learning	6	3.5
10.	CSCS20-2015 (2015 20th International Conference on Control Systems and Computer Science)	5	3.0
11.	EHB 2017 (IEEE 2017 International Conference on E-Health and Bioengineering Conference)	5	3.0
12.	Membrane Computing, CMC 2014	5	3.0
13.	Other Sources	31	18.3

As mentioned above, one of the most important sources for papers with Moldovan authors in the field is *"Computer Science Journal of Moldova"* (34 articles) published by Vladimir Andrunachievici Institute of Mathematics and Computer Science. *"Lecture Notes in Computer Science"* is positioned on the second place, with twice fewer articles (16 articles). "*Lecture Notes in Computer Science"* used to be a leader between 2001-2012, with 38 articles.

We find that about two-thirds of Scopus publications are materials of various conferences. The distribution of documents by source is presented in Table 7. The largest number of documents was published in the *Proceedings of SPIE The International Society for Optical Engineering* (34 documents); *Lecture Notes in Computer Science* (33 papers) that included the *Lecture Notes in Artificial Intelligence* and *Lecture Notes in Bioinformatics*; *Smart Innovation Systems and Technologies* (15 documents).

Table 7. *Distribution of documents by publication source (Scopus)*

No	Source Title	No	%
	Proceedings of SPIE The International Society For Optical Engineering	34	12.6
	Lecture Notes in Computer Science including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	33	12.3
	Smart Innovation Systems and Technologies	15	5.6
	2015 E Health and Bioengineering Conference EHB 2015	9	3.3
	Advances in Intelligent Systems and Computing	8	3.0
	Optical Materials	7	2.6
	Proceedings of the Romanian Academy Series a Mathematics Physics Technical Sciences Information Science	6	2.2
	Theoretical Computer Science	6	2.2
	International Conference Recent Advances in Natural Language Processing RANLP	5	1.9
	Lecture Notes in Educational Technology	5	1.9
	Proceedings 2015 20th International Conference on Control Systems and Computer Science CSCS 2015	5	1.9
	Proceedings Roedunet IEEE International Conference	5	1.9
	Other sources	87	32.3

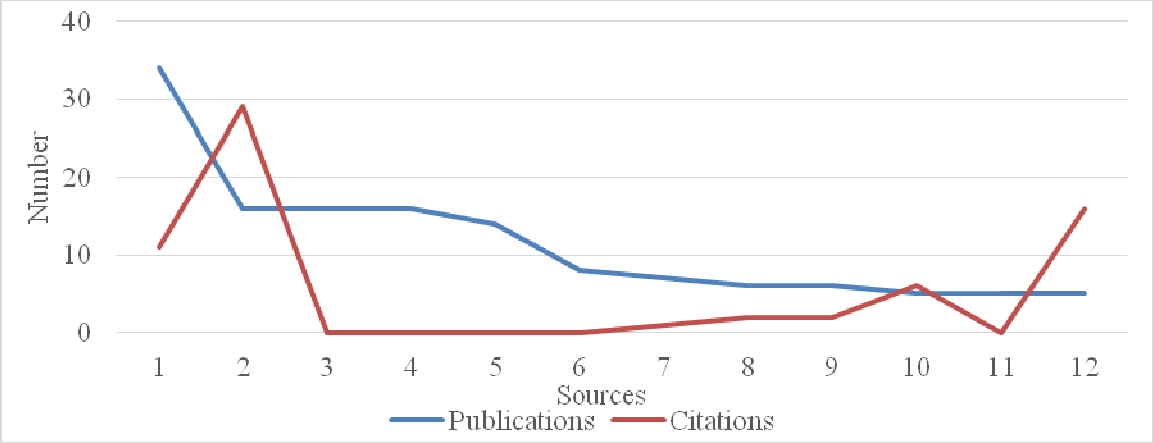

Figure 10. *Number of Publications VS Number of Citations (WoS)*
(Source titles are presented in the Table 6)

The analysis of the total number of publications vs total number of citations for the top sources in Computer Science field shows that the bigger number of publications does not result in the bigger number of citations. Figure 10 presents data from WoS, while Figure 11 shows data from Scopus.

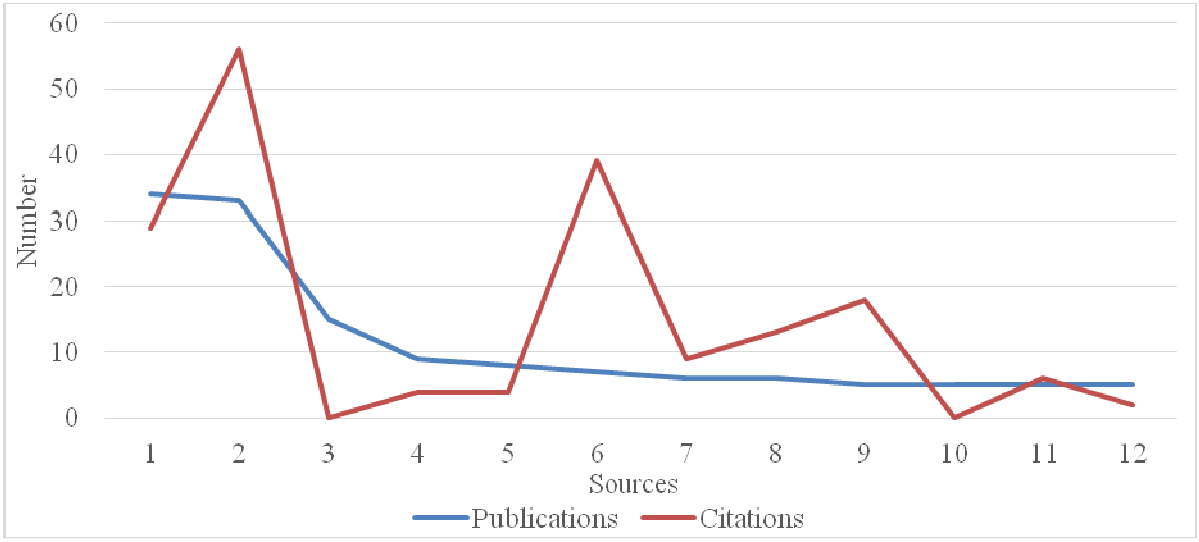

Figure 11. *Number of Publications VS Number of Citations (Scopus)*
(Source titles are presented in the Table 7)

Figure 12 illustrates the distribution of publication sources of articles in the Computer Science field registered in NBI.

Similar to the analysis of documents by the NBI domains or the Universal Decimal Classification domains, we observe that the first two positions belong to educational journals. The number of articles in these journals highlights that there is a significant interest in applicative Computer Science research in Education Science. There are only five top sources directly related to Computer Science field:

- Computer *Science Journal of Moldova* (26 articles) and *Akademos* journal (22 articles) - accredited in the *Information Science* field;
- *Intellectus* journal (20 articles) and *Engineering Meridian* journal (18 articles) - accredited in *Engineering Science and Technology* field;
- *Information Technologies, Systems and Networks* Conference materials (22 articles).

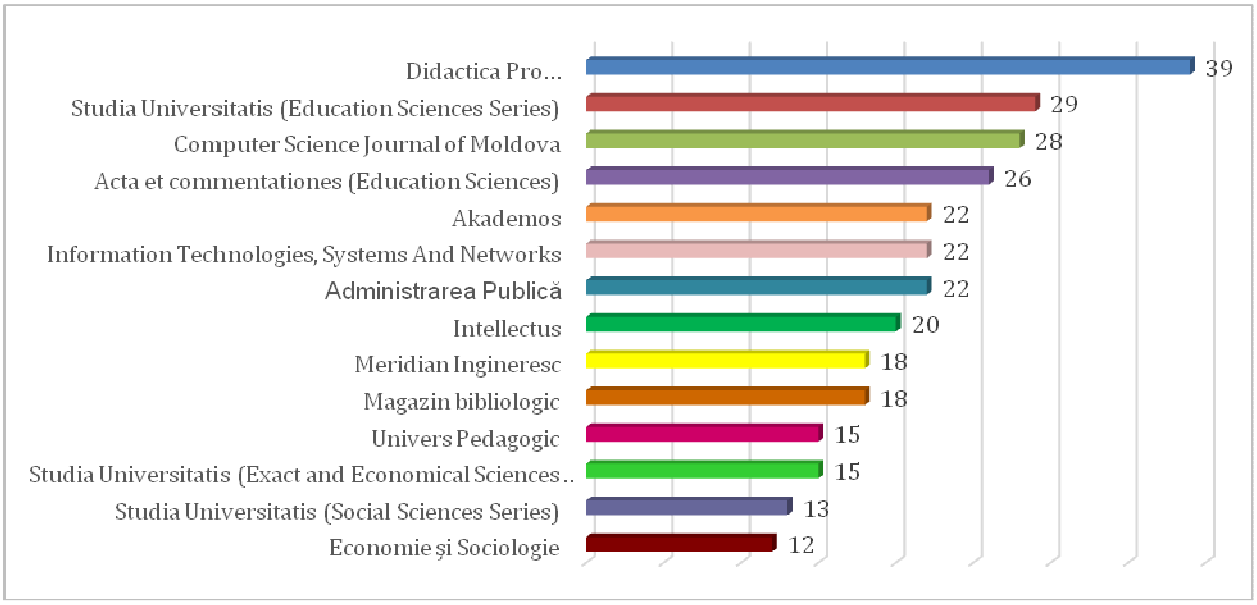

Figure 12. *Document distribution by publication source (NBI)*

A brief analysis of the conference theses recorded in NBI shows that there are papers related to Artificial Intelligence, the Internet of Things, Robotics and other subjects that are relevant to Moldova's Smart specialization.

As mentioned above, the research impact of Moldovan authors' in Computer Science is fairly low, in both number of articles and number of citations per article. Based on bibliometric studies, the top positions belong to China and USA (based on the number of publications), as well as to Great Britain, Switzerland, the Netherlands and Israel (based on the average number of citations per article) (Fiala and Tutoky 2017). One of the goals of our research was to observe the extent to which authors from the Republic of Moldova collaborate with researchers from the most influential countries in Computer Science (Figure 13).

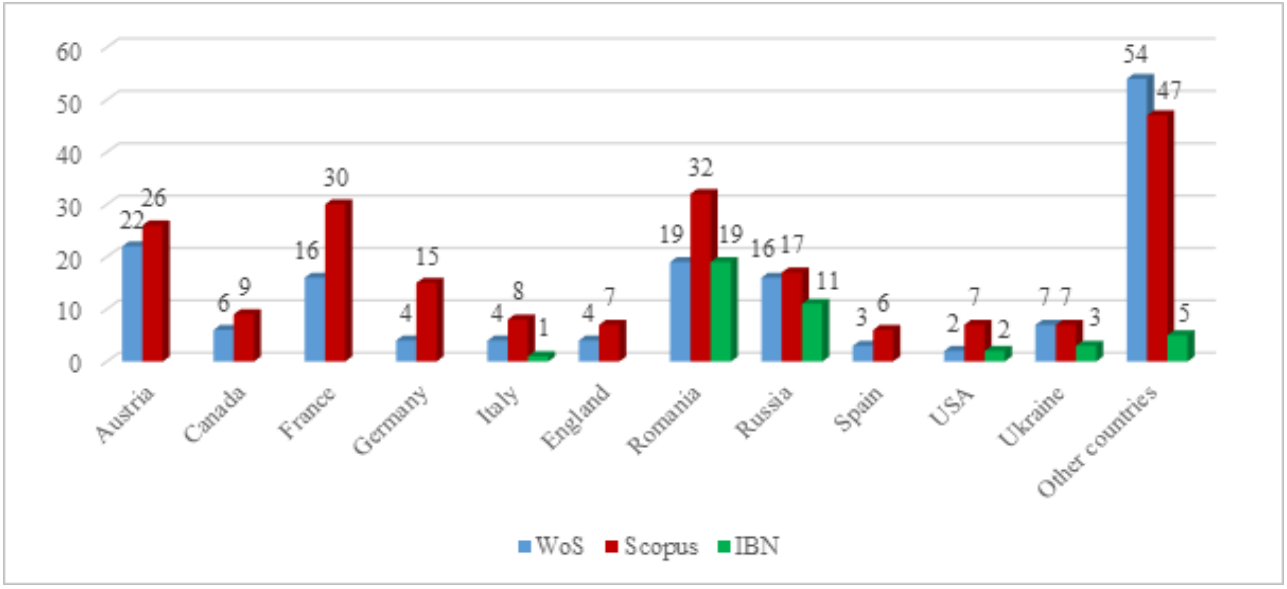

Figure 13. *Publishing collaboration of authors from Moldova in Computer Science in 2013-2018 (WoS, Scopus, NBI)*

We noticed that the collaboration of Moldovan authors with top countries in Computer Science research based on WoS database is minimal. There are only 2 recorded publications written in cooperation with authors from USA and 4 publications - with authors from Great Britain. The

most collaborative publications are written with authors from Austria (22 - 13%); Romania (19 - 11.2%); France (16 - 9.5%), Russia (16 - 9.5%).

Data from Scopus reveals that authors from Moldova prefer to collaborate mostly with the same countries. Thus, according to Scopus, the highest number of co-authoring works are registered with authors from Romania (32 works - 14.2%), France (32 - 13.3%), Austria (26 - 11.6%), Russia (17 - 7.6%) and Germany (15 - 6.7%).

As per data from NBI, Moldovan authors collaborate most frequently with authors from Romania (19 works), Ukraine (3), Israel (4), and USA (2). At the same time the number of publications written in collaboration with authors from abroad is smaller.

At an institutional level (Table 8), according to WoS database in the Computer Science field the leading position belongs to the Academy of Sciences of Moldova (ASM) with one third of documents (33.7%). Other institutions that contribute to publications in Computer Science field are: Technical University of Moldova (17.2%), Moldova State University (16.6%), Vladimir Andrunachievici Institute of Mathematics and Computer Science (8.3%), RENAM (7.1%).

Table 8. *Distribution of papers in Computer Science by Moldovan author affiliation in 2013-2018 (WoS)*

Institution Affiliation	Number of Documents	%	No of Citations	%	Citations per Article	h-index
Academy of Sciences of Moldova (ASM)	57	33.7	78	69.6	1.4	6
Technical University of Moldova (TUM)	29	17.2	13	11.6	0.4	2
Moldova State University (MSU)	28	16.6	5	4.5	0.2	2
Vladimir Andrunachievici Institute of Mathematics and Computer Science (IMCS)	14	8.3	2	1.8	0.1	1
RENAM Association	12	7.1	0	0	0	0
State University of Tiraspol (SUT)	9	5.3	3	2.7	0.3	1
"Ion Creangă" State Pedagogical University of Chisinau (SPU)	8	4.7	3	2.7	0.4	1
University of European Studies of Moldova (UESM)	7	4.1	2	1.8	0.3	1
Academy of Economic Studies of Moldova (AESM)	6	3.6	0	0	0	0
Nicolae Testemitanu State University of Medicine and Pharmacy	6	3.6	0	0	0	0

According to data from WoS, the Academy of Sciences of Moldova has the highest number of citations (69.6%), as well as the highest number of average citations per article - 1.4 (Table 8). Based on article citations data, ASM is followed by TUM (11.6%) and MSU (4.5%).

Scopus shows that at the institutional level the leading position belongs, again, to the Academy of Sciences of Moldova (Table 9). The analysis reveals that almost half (45.3%) of all works belong to this institution. Other affiliations to authors from Moldova with international publications in Computer Science are: Technical University of Moldova (24.4%); Vladimir Andrunachievici Institute of Mathematics and Computer Science (18.2%); Institute of Applied Physics (16.4%); Moldova State University (13.3%).

Table 9. *Distribution of papers in Computer Science by Moldovan author affiliation in 2013-2018 (Scopus)*

Institution Affiliation	Number of Documents	%
Academy of Sciences of Moldova (ASM)	102	45.3
Technical University of Moldova (TUM)	55	24.4
Vladimir Andrunachievici Institute of Mathematics and Computer Science (IMCS)	41	18.2
Institute of Applied Physics (IAPh)	37	16.4
Moldova State University (MSU)	30	13.3
RENAM Association	10	4.4
State University of Tiraspol (SUT)	9	4.0
Academy of Economic Studies of Moldova (AESM)	5	2.2
University of European Studies of Moldova (UESM)	5	2.2

In NBI the authors with the highest number of articles in Computer Science are affiliated to the Moldova State University (87 documents), followed by ones affiliated to the Academy of Economic Studies of Moldova (66 documents), the State University of Tiraspol (41 documents), Vladimir Andrunachievici Institute of Mathematics and Computer Science (37 documents) and the Technical University of Moldova (35 documents) (Figure 14).

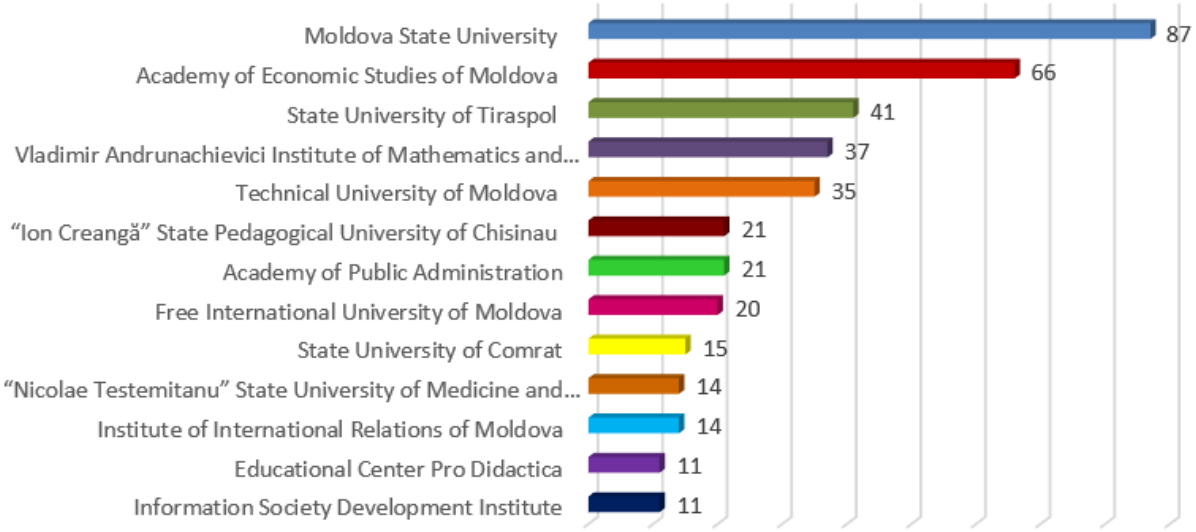

Figure 14. *Distribution of documents by author affiliation (NBI)*

The publications in the Computer Science field from the WoS database were analysed also from the authors' perspective, identifying the most prolific Moldovan authors (Table 10). It was found that the most productive authors are Artiom Ahazov (27 articles, affiliated to IMCS), Valeriu Ungureanu (19 articles, represents MSU), Petru Bogatencov (13 articles, from RENAM), and Svetlana Cojocaru (12 articles, affiliated to IMCS).

Table 10. *Distribution of documents and citations by authors (WoS)*

Author, Institutional Affiliation	Number of Documents	%	Number of Citations	%	Average No of Citations per Article	h-index
Alhazov Artiom, IMCS	27	16.0	55	49.1	2.0	5
Ungureanu Valeriu, MSU	19	11.2	4	3.6	0.2	2
Bogatencov Petru, RENAM	13	7.7	0	0	0	0
Cojocaru Svetlana, IMCS	12	7.1	3	2.7	0.2	1
Secrieru Grigore, RENAM	9	5.3	0	0	0	0
Railean Elena, SUT	8	4.7	2	1.8	0.2	1
Rogozin Iurii, IMCS	6	3.5	6	5.4	1	2
Bobicev Victoria, TUM	5	3.0	6	5.4	1.2	1
Colesnicov Alexandru, IMCS	5	3.0	1	0.9	0.2	1
Malahova Ludmila, IMCS	5	3.0	1	0.9	0.2	1
Iliuha Nicolai, RENAM	5	3.0	0	0	0	0
Burţeva Ludmila, IMCS	4	2.4	0	0	0	0
Cojocaru Victor, ASM	4	2.4	2	1.8	0.5	1

Table 11 presents top authors from Moldova of papers in Computer Science, registered in Scopus database. The top authors with the highest number of publications are Artiom Alhazov (40 articles) from IMCS, with the most citations to his works (28.9%), Valeriu Ungureanu (16 articles) affiliated MSU, 12 articles belong to Petru Bogatencov (RENAM), Victoria Bobicev (TUM) and Mihai Iovu (IAPh).

Table 11. *Distribution of documents and citations by authors (Scopus)*

Author, Institutional Affiliation	Number of Documents	%	Number of Citations	%	Average No of Citations per Article	h-Index
Alhazov Artiom, IMCS	40	17.8	96	28.9	2.4	6
Ungureanu Valeriu, MSU	16	7.1	1	0.3	0.1	1
Bogatencov Petru, RENAM	12	5.3	7	2.1	0.6	1
Bobicev Victoria, TUM	12	5.3	32	9.6	2.7	2
Iovu Mihai, IAPh	12	5.3	9	2.7	0.7	2
Rogozin Iurii, IMCS	10	4.4	35	10.5	3.5	2
Cojocaru Svetlana, IMCS	8	3.6	2	0.6	0.2	1
Secrieru Grigore, RENAM	8	3.6	4	1.2	0.5	1
Lupan Oleg, TUM	7	3.1	11	3.3	1.6	2
Railean Elena, SUT	7	3.1	0	0	0	0

Top authors based on data from NBI is presented in Figure 15. The most publications belong to: Svetlana Cojocaru (14 documents), Elena Badarau (9 documents), Octombrina Moraru (8 documents).

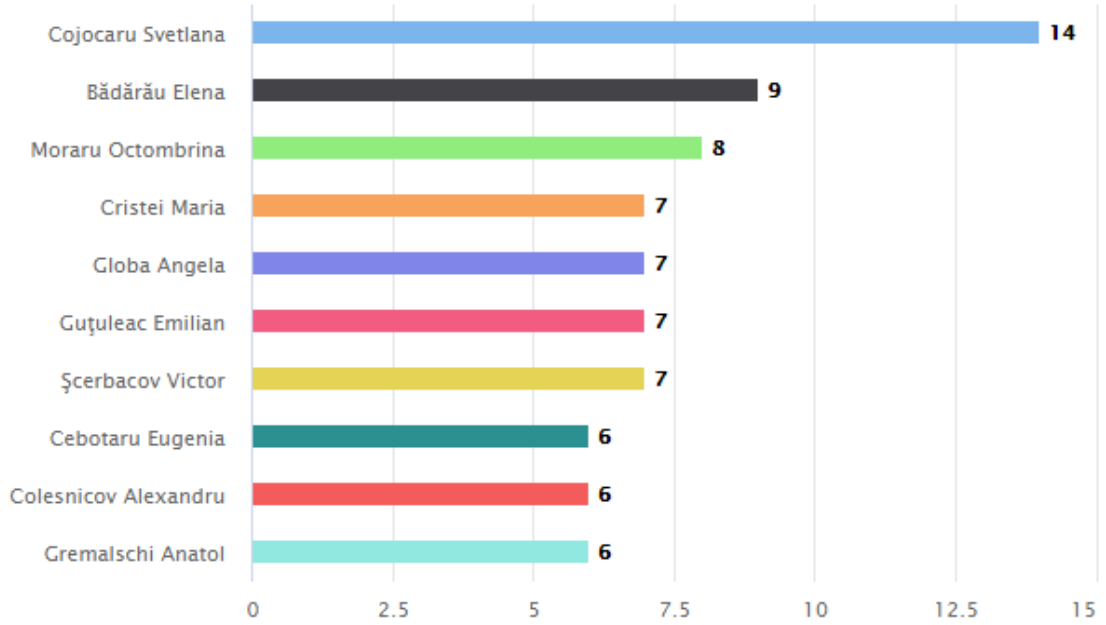

Figure 15. *Top authors with the highest number of publications (NBI)*

Scopus and NBI databases allow for filtering and analysis of results based on keywords. Table 12 unravels the keywords used the most in all Computer Science publications with Moldovan authors. The top keywords found in Scopus are: artificial intelligence (27 publications), nanotechnology (25), P-system (25). NBI presents the following most used keywords: information technology(ies) (35 publications), internet (21) and e-learning (12).

Table 12. *Keyword Frequency in Papers on Computer Science in 2013-2018 (Scopus & NBI)*

Keyword	Number of Records in Scopus	Keyword	Number of Records in IBN
artificial intelligence	27	information technology(ies)	35
nanotechnology	25	Internet	21
P systems	25	e-learning	12
microelectronics	21	evaluation	11
optoelectronic devices	21	information	9
bioinformatics	20	technology	9
computation theory	17	communication	8
computer science	15	education	8
computational completeness	13	security	8
computers	11	software	7

The degree of collaboration between authors represents an important analysis for bibliometric studies. It shows the trend of a single authored model as well as multi-authored researches in the studied period. Some researchers (Maharana&Sethi 2013) consider that the degree of collaboration that is very close to 1 means that the efforts and contribution of some authors are insignificant or negligible.

For determining the degree of collaboration in quantitative terms, we used the following formula suggested by K. Subramanyan (1983).

$$C = \frac{Nm}{Nm + Ns}$$

Where:

C - Degree of Collaboration

Ns - Number of Single authored papers

Nm - Number of Multi authored papers

As shown in the Table 13, the degree of collaboration ***C***, for all publications in Computer Science fields is 0.71 (according to WoS) and 0.8 (according to Scopus). As a result, we can ascertain that the degree of collaboration in the Computer Science field is relatively high 0.71-0.80 and the majority of published documents is predominantly multi authored.

Table 13. *The Degree of Collaboration of authors from Moldova in Computer Science Field (WoS & Scopus)*

Database	Ns	Nm	Ns + Nm	C
WoS	49	120	169	0,71
Scopus	46	179	225	0,8

The data collected from WoS and Scopus, allows us to identify the average contribution of the Moldovan authors to all the published documents in the Computer Science field, as well as the average number of authors per article (Table 14). According to WoS, a total of 572 authors published 169 articles, with an average of 3.38 authors per article and 0.3 publications per author. As per the data originating from Scopus database, a total of 818 authors published 225 articles, with an average of 3.64 authors per article and 0.28 publications per author.

Table 14. *Author productivity (WoS & Scopus)*

Database	Total Number of Articles	Total Number of Authors	Average Number of Authors per Article	Author Productivity
WoS	169	572	3.38	0.3
Scopus	225	818	3.64	0.28

Documents analysis by the type of access, demonstrates that NBI is an open resource that permits access, visualization and download of any registered scientific publication. Figure 16 shows the distribution of documents by type of access, and reveals that 96.2% of all documents have open access. In contrast, only 37 publications in Computer Science (21.9%) belonging to Moldovan authors recorded in WoS in 2013-2018 can be accessed openly. Scopus allows open access to only 7 documents (3.11%) of Moldovan authors from Computer Science domain (Figure 16).

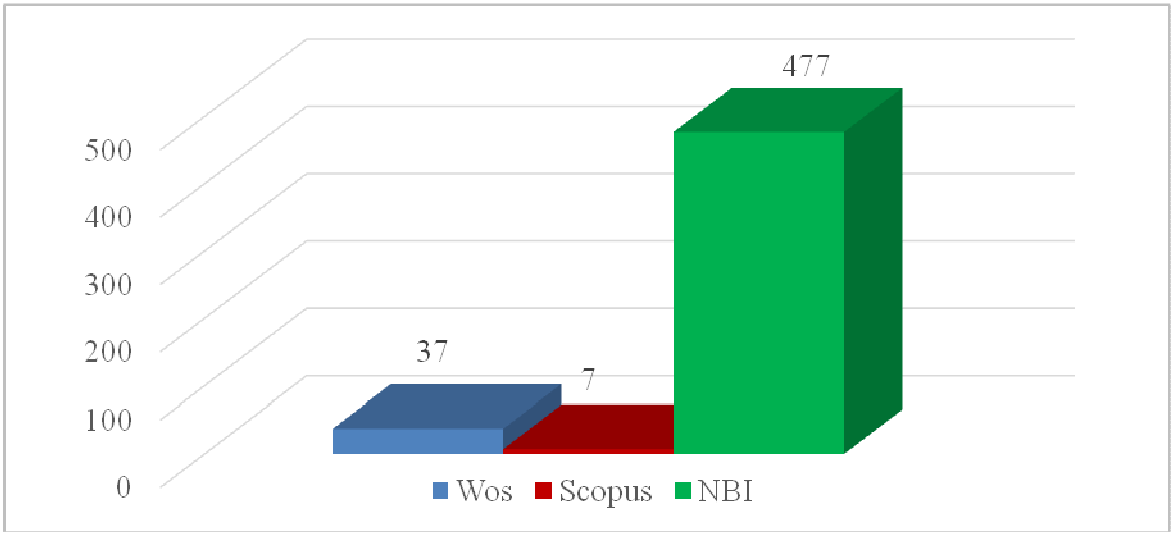

Figure 16. *Documents by type of access*

6. Conclusions

Using data from two international databases (WoS and Scopus) and one national database (NBI), the authors of this paper carried out a study regarding research in Computer Science in the Republic of Moldova. Important parameters such as the total number of published documents in Computer Science, publication growth rate and trends as well as the impact of Computer Science research have been analysed. The authors also took into consideration top institutions and authors from Moldova, as well as scientific conferences and journals.

The study demonstrated that the percentage of Computer Science publications in Moldova between 2013 and 2018 is low - 5% in WoS, 7.7% in Scopus and 1.9% in NBI. Nevertheless, looking at the dynamics of the recorded publications in all three databases, we identified a positive trend, which shows that there is a growing interest in computer science research. The number of publications in this field has increased 6 times according to WoS, over 2.5 times according to Scopus and around 1.5 times based on NBI data.

According to WoS the two most popular subjects in the field, with the highest number of published documents, are *Theory & Methods* (45%) and *Artificial Intelligence* (26.6%). Scopus shows that Computer Science articles mostly overlap with fields such as *Mathematics* (46.2%) and *Engineering* (44.4%). NBI reveals that one third of the publications in Computer Science belong to the *Education* subcategory (33.1%), followed by the Economy subcategory (13.1%). This proves that most of the publications come from the educational institutions and fewer from the research institutes, as well as the high interest in research on the application of computer science in education.

The international articles in Computer Science published by Moldovan authors are not very influential. There were 110 citations of their works recorded in WoS, with an average of 0.65 citations per article, while Scopus database has registered 331 citations of Moldovan research documents, with an average of 1.43 citations per article.

Based on the publication source, according to data from WoS, *Computer Science Journal of Moldova* is the main source were Moldovan academia publish their research in Computer Science (34 published articles). Scopus places *Proceedings of SPIE The International Society for Optical Engineering* on the first place (34 documents), followed by *Lecture Notes in Computer Science* (33 documents). At national level, the two sources with the highest number of publications are the pedagogical journals - *Didactica Pro* (39 articles) and *Studia Universitatis Moldaviae* (29 articles).

According to international databases, the degree of collaboration of authors from Moldova is

relatively high (0.71-0.80). Moldovan authors cooperate with researchers from various countries such as: Romania, France, Austria, Germany etc. However, the number of publications written in collaboration with countries that are considered influential in computer science is minimal.

At an institutional level, the leading position in Computer Science belongs to the Academy of Sciences of Moldova. The other few institutions with a high contribution to the Computer Science field are: Technical University of Moldova, Moldova State University and Vladimir Andrunachievici Institute of Mathematics and Computer Science.

This growing interest for research in Computer Science shows that there is certain human potential that can contribute to the smart specialization of the country in computer science. At an international level, the most prolific authors are Artiom Ahazov, Valeriu Ungureanu, Petru Bogatencov and Svetlana Cojocaru. Nationally, the authors with the highest number of publications in Computer Science are Cojocaru Svetlana, Bădărău Elena and Moraru Octombrina.

The open source policy promoted by a number of research institutions and universities from Moldova showed positive results; hence 96% of all documents published by Moldovan authors in NBI can be openly accessed. Internationally, the percentage of open access research publications is relatively low - 21.9% (WoS) and 2.7% (Scopus).

Note

1. For selecting ICT publications from WoS database, we used criteria mentioned in the *Research in Information and Communication Technology in Norway: Bibliometric analysis* (Aksnes 2012).

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Evaluation and Protection of Library Collections with Heritage Value. Establishing Ante-Digitization and Post-Digitization Measures

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In this article, the authors present, on the basis of the scientific arguments obtained through laboratory experiments, some pertinent aspects regarding: the evaluation and preservation of the digitized collections; presentation of conditions for the digitization of valuable library documents; presentation of ante- and post-digitization measures for library collections that are subject to digitization.
This scientific approach is designed to preserve digitized libraries, collections and documents, being an essential scientific activity that takes place in parallel with the conservation of information from digitized products.

Keywords: *preservation; digitized collections; library documents; ante-digitization measures; post-digitization measures*

1. Argument

Libraries that hold collections of valuable documents must consider digitization as an active way of preserving that avoids the communication of originals, but not as a long-term preservation method, a position shared by most modern library specialists. The preservation of these assets in locked deposits is the detrimental practice of the old book specialist as well as of the manager directly responsible for the integrity and security of the managed documents.

Given the remarkable value of these old and rare, sometimes unique documents, it is nevertheless the fears of the manager, the old book specialist and the library conservator to have reservations to lend the documents for consultation in the reading rooms of the institution under the direct supervision of the specialists. These hesitations are justified up to a certain point. Beyond assuming these fears about ensuring the security and integrity of the documents, one question arises: How are patrimonial documentary assets made known? Only through exhibitions or some thematic presentations? The results are known: this very valuable fund of a library is less well known and researched.

As a consequence, the preservation of the electronic documents has certain advantages for the institutions that have impressive collections, such as libraries and archives. By creating digital substitutes, these institutions preserve their original documents, thus prolonging their physical and informational integrity. Digitization of the heritage documents also means the setting up of the Digital Heritage Library, which includes collections created by the libraries through the

digitization of old and rare collections on organic support to make them known and accessible to a wider and more informed audience. Therefore, the rationale for digitizing the heritage assets in libraries, archives and museums involves multiple objectives, including the preservation of the original.

In summary, digitization transforms analogue data (readable by humans) into digital form (represented by figures and machine readable) and covers all types of documents on different supports: paper, microforms (microfiche, microfilm), photos, video/audio tapes. In a library and archive environment, digitization involves: photographing of analogous items such as books, magazines, maps, correspondence, manuscripts, press collections, etc. which are the subject of rare, unique, extremely fragile collections and then their transfer into a digital environment.

In the literature, the preventive and curative preservation is defined as the set of preventive and curative interventions performed in the libraries, museums and archives, especially in the morphological structure of the documents, for investigation, stopping and eradication of the identified degradation factors. As a rule, curative interventions (treatments) are achieved by using non-invasive, non-polluting techniques and methods, embedded in integrated systems adapted to the degradation factors and levels under investigation. When choosing an intervention system adapted to the morphological particularities of the documents, the emphasis should be placed on the balance between the preventive and the curative intervention system, with a particular emphasis on the preventive methods (Deac 2009).

The digitization of valuable collections in libraries, museums and archives analyzes all types of documents in the cultural institutions and can be achieved from various information-carrier supports: paper; microforms (microfiche, microfilm); photos; video/audio tapes.

In a library environment, digitization involves photographing analogous items such as valuable books, maps, manuscripts, correspondence, etc. which are part of rare, unique, and extremely fragile collections, and then transforming these photos into a digital environment. In the literature and practice on digitizing the paper documents, two technical ways of intervention are known: a way in which the scanning of the document produces digital images (doesn't allow the search in the text) and a way that goes further by transforming the digital images into digital text. The digitization of library documents to obtain the digital image as the ultimate product is the easiest and least costly technical way, being within the reach of each library. Digital images are obtained by photographing each document page, generating thus a copy of the original document in electronic facsimiles (represents a binary language). To facilitate the access to the digital document as a picture, a complete bibliographic description is required. The digital image is processed using an optical character recognition program (software that recognizes the characters optically with a rate of 80-95%). This technique allows the document content to be retrieved as text. Thus, it is possible to search in the text or "document browsing" (operation that allows fast accessing-movement within the information, for example from the contents to a chapter or other) and the easy and direct access of the users (more or less familiar with the domain) to the information.

Briefly, some fundamental aspects of the domains devoted to the protection of documents in libraries, museums and archives have been presented to highlight not only the application domains but also the possible links that can be established in preserving the material support and text of the library and archive documents.

2. Motivations

The evaluation and protection in time of the valuable digitized collections of documents from libraries (archives and museums) represents methodologically, but above all practically, a field of

document protection with recent data requirements and structures, as a result of speeding up the digitization of valuable documents on organic support. The transfer of information from organic support to digital (electronic) support involves the development and use of cutting-edge techniques and methodologies, a modern infrastructure, as well as a flawless training of the specialists involved in this very demanding activity. The need to transfer valuable information on paper support, on the electronic-numeric support by digitizing the library documents is not questioned. The benefits of digitizing valuable library documents are known by all professionals involved in this professional process, be they classical conservators - paper conservators or conservators of digitized information (numerically and electronically).

The main issues that represent motivational imperatives for the development and implementation of the roadmap, for the categorical and unconditional protection needs through preventive and/or curative interventions to preserve valuable documents that are digitized, are listed below:

a. preparation of documents for digitization;
b. development and application of methodologies to investigate the state of conservation and evaluation of the interest scientific parameters of the documents proposed for digitization;
c. choosing pre-digitization and post-digitization intervention systems adapted to the morphological and chemical characteristics of the paper types used (origin and quality of paper, inks and pigments, etc.); investigation and evaluation of the state of preservation of post-digitized documents;
d. development and application of scanning objectives for the documents of a public library.

Some of the advantages of library document digitization are highlighted without insisting on their quality and impact in different intra- and inter-library situations:

- for the documents of national cultural heritage value of venerable age, digitization creates conditions for keeping, preserving and protection in individual conservation modules, thus prolonging the existence of valuable cultural info assets;
- digitization of documents of national and/or local interest ensures unlimited access to valuable information on various electronic-numerical supports, thus protecting the documents on the paper;
- by digitizing the documents often requested by the general public, that is an information consumer, conditions are created for the redistribution of the copies in cultural institutions with a surplus of documents of public interest to other libraries;
- through the digitization of valuable documents of community interest, the library holding the classical documents (on paper) offers for research the electronic documents under different numerical supports, protecting the classical ones, including through the elaboration of an efficient typo storage system according to the typo-dimensioning of documents in different formats;
- digitization is carried out for scientific purpose, in order to capitalize on the scientific content of the documents, by facilitating the access;
- the digitization of valuable documents is a patrimonial-oriented approach, by storing and preserving the information on several material supports;
- digitization of original documents that are in critical conservation state (fragile, breakable);
digitization of documents on organic media/supports to facilitate the remote access - digital information on the web allows users to quickly search for and retrieve collections anytime, anywhere;
- digitizing valuable documents from libraries, museums and archives encourages and stimulates the multidisciplinary research by increasing the access to valuable information;
- electronic conversion of the written cultural heritage and its promotion at European level.

Digitization offers unique advantages: information can be provided to the remote user; image quality can be fairly good; "full text" search facility; the flexibility of digital content - is reflected in the fact that the information is not as fixed as printed on paper, being easily reformulated; digitization offers the possibility of accessing unique or special collections (which, as a rule, could

only be viewed by one person) to a large number of users, which is the most attractive practical application of the digitization project, since a large audience's access to digital copies of the original materials brings a great service to the library and equally to the users of this institution.

The specialists working in libraries must understand that *digitization not only exploits the existing resources but can bring a new breath to a classic library*. Exposing collections on the Internet and thereby increasing access to these documents is *an effective way of reporting and promoting collections from a virtual, borderless library* (Popovici 2004).

The inconveniences that occur in the digitization of collections of documents in libraries, museums and archives:

a. several inconveniences occur mainly due to the optical character recognition programs that:
- change the original layout of the page;
- generate certain character recognition errors, which involves checking (re-reading) and correcting the text, an often difficult and tedious activity;
- inconveniences of the digital text due to optical character recognition programs that: modify the original layout of the page; do not recognize the characters from non-Latin alphabets, as well as some diacritical signs and manuscript writings.

b. Most inconveniences with regard to the final quality of the digital library document depends on the following factors: the quality of the original document - the printing ink; paper support and contrast that can be degraded over time; scanning/shooting quality;

c. Despite the benefits of the library collection digitization, there are some good reasons to analyze this area more closely: not every document deserves to be digitized; it is a long way to accomplish the objective that all libraries will be fully accessible online, a project which, in the opinion of many specialists, is impossible to achieve; only if collections are carefully evaluated and the documents of local and national interest are digitized, the digital projects can be successful;

d. Digital projects are very expensive; the need for specialized personnel and state-of-the-art technical infrastructure often involves the highest costs in the project:
- it takes a lot of time to train the staff directly involved in running the projects and selecting the items to digitize;
- costs for ongoing digitization and project completion;
- costs for maintaining the digital media to ensure the readings in the future;
- most attempts to recover the cost of digital representation through user charges did not cover the spent financial effort;

e. Digitization is not yet a preservation mode that is based on a stable long-term storage environment; the only long-term acceptable support of storage is the quality paper or microfilm;

f. In many cases, the access to successful digital surrogates encourages the users to consult the original document, fact that generates additional services and costs for phones, letters, reproduction requests for original documents; as such, digitized documents must be of good quality to meet the quality standards imposed by users - consumers of information.

In conclusion, before starting a project of digitizing valuable documents from libraries, museums and archives, it is advisable to know the answer to a series of questions that should explain the whole process:

- what will be the gain by digitizing valuable library, museum or archive documents?;
- if the structure of the document digitization project is known, taking into account the particularities of the institution: the structure, value and the conservation status of the collections of documents: the presence of conservative specialists, as well as a conservation laboratory?;
- how will this project fit in the institution's activities (goals)?;
what costs does this project require, if they are affordable and what are the benefits that can be

gained?
- how will this project fit in the activities of the institution?;
- what will be the impact of the project on the targeted public?
- what are the methods for checking the effectiveness of the project, whether it has been successful or not?;
- whether the legislative, regulatory and normative framework has been established, which serves as the basis for creating management and compliance tools with the legal aspects of digitization, namely: visibility, interoperability, integrity, authenticity, updating and sustainability of information? (ISO 2001a and 2001b)
- what are the methods for verifying the effectiveness of the project, whether it has been successful or not?

3. Contributions on the stage development of a document digitization project in a public library

The digitization of collections involves a series of prerequisites and activities designed to describe the scope, value and importance to justify the effort (Alkhoven 1999). Digitization involves a number of prerequisites: the representativeness of collections; the importance of the user group; conservation reasons.

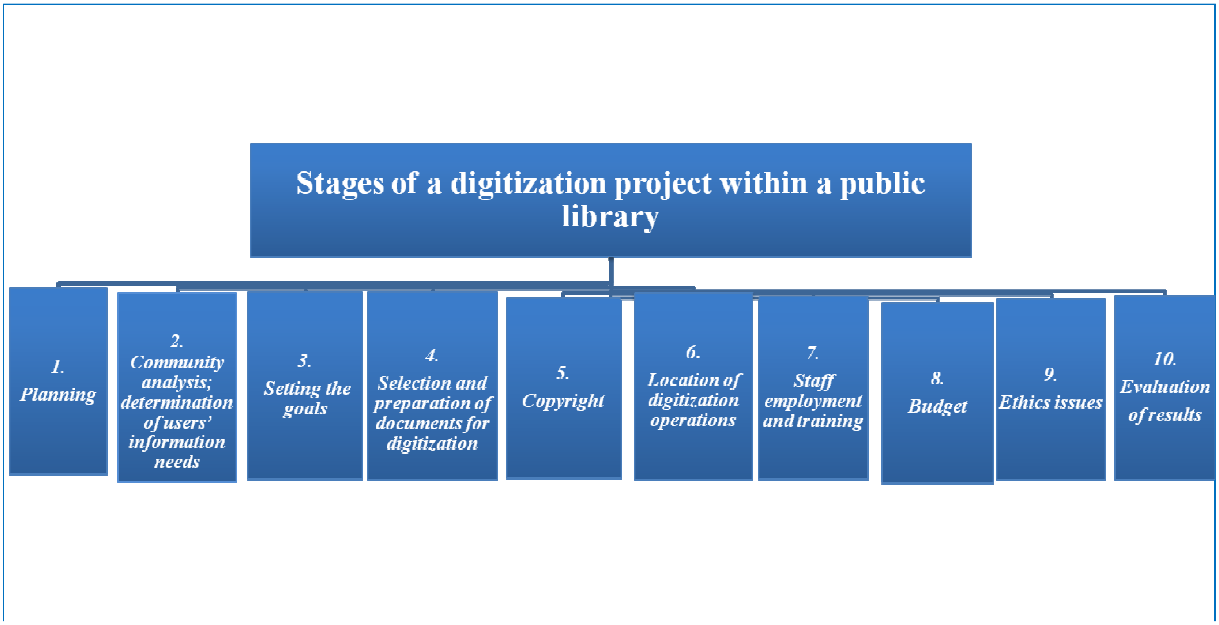

Figure 1

In Table 1 are detailed the main steps of the digitization project at an important public library.

Table 1. *Stages of a digitization project within a public library*

Crt. no.	Stages of project development	Presentation of the digitization project stages
1.	*Planning*	Before starting a digitization project, it is advisable to know the answer to a few questions that are crucial to the success of the project: - what will be gain through digitization? - how will this project fit to the purpose of the institution? - what are the benefits? - what are the ways of determining - quantifying the results of the project - whether it was successful or not?

2.	*Community analysis; determination of users' information needs*	Digitizing the documents in a library involves careful analysis of users and their information needs. Libraries' collections must be structured and thus digitized to meet the needs of users' information. Such an analysis should provide the following data: - who are the users of information? - what are the information needs? - determination of the information behaviour; - meeting the users' information needs by digitizing the collections; - how can information be used from different areas of activity? - how can I transfer the information? - what are the reasons for success or failure to inform? - how will they use this digitized collection? - how will more users access the digitized documents? - what will be the benefits of the institution and users from the use of digitized materials?
3.	*Setting the goals*	The objectives of a digitization project can be of four types: I. Preservation of documents. - Preservation scan refers to documents whose support is outdated and shows deterioration signs. The scanned copy is the copy that can be consulted by users. II. Distribution of documents Distribution scan refers to documents that will be used as part of a broadcast project such as an exhibition or to make the documents accessible to users on the site or remotely. The original documents will be retained, but the consultation will be done according to the scanned copy. In order to facilitate the access to the digitized documents on the Internet, the following aspects should also be considered: - who are the target users and what documents will they request?; - how will they use this digitized collection?; - how will more users access the digitized documents?; - what will be the benefits of the institution and users from the use of the digitized materials? III. Saving Documents - Scanning of the backup documents mainly concerns the documents of vital importance to institutions (essential documents) and requires the keeping of a second copy as a precautionary measure. Usually, this backup copy will be made on a different support and preferably stored in a place other than the originals. The original documents will be kept, but the consultation will be done according to the scanned copy. IV. Substitution of documents The purpose of substitution scanning is to: - reduce the cost of maintaining the premises and collections, as well as of the material resources needed to store the documents; - facilitate the access to and consultation of online documents. Original documents will be removed once they have been digitized and a quality control validated their integrity. These projects must be strictly regulated by laws, regulations and standards that ensure the probative value of documents and their sustainability.

4.	*Selection and preparation of documents for digitization*	The selection of documents from public libraries for their preservation through digitization is determined by various objective factors, including: - the uniqueness of the document; - its cultural, historical and scientific value; - conservation state. The selection of documents intended to be digitized is an essential professional approach and is carried out by a team consisting of: - an expert in preserving library collections, - old book expert librarians. - the IT digitization specialist, directly responsible for the quality of digital surrogates. The documents that are subject to digitization are carefully analyzed and investigated by the conservative specialist who will prepare a pre-digitization preservation file of the document, consisting of: pre-digitization preservation sheet of the document; analysis bulletins on the pH of the information carrier paper support (evolution graph and statistical processing calculus); establishing the bio-pathological diagnosis by microscopy determinations - elaboration of analysis bulletins and other chemical and mechanical analyzes.
5.	*Copyright*	The selection of library documents to be digitized is a topical professional approach, which must firstly take into account the clear understanding of copyright and related rights. In this respect, it must be determined whether the concerned institution has the legal right to digitize items and distribute them online, in compliance with the legal framework. The selection process starts by checking the restrictions imposed by the ownership and the copyright of the documents and digitized materials and continues with the compliance with the value criteria of the documents (in Romania, *Law 8/1996 on copyright and related rights*). The Internet has put new pressure on the legislation to protect the digital material. There are ways in which institutions can protect their digital collections - access can be controlled by requesting passwords.
6.	*Location of digitization operations*	General rules to be followed: specific operations on the digitization of valuable documents will be designed to minimize the duration of transport, handling and digitization, by respecting all specific conservation and security measures for valuable documents. Advantages of digitization at library headquarters: - full control over digitization documents and operations; - protecting documents against transport hazards; - rapid evaluation of the quality of digitized documents and corrections required; - possibly cheaper, but cost is difficult to predict; - specialization of its own personnel, without contractual obligations towards a third party, in case of technical difficulties. Disadvantages of digitization at library headquarters: - costs may increase if technical-material execution difficulties arise in the digitization project; - providing air-conditioned and sanitized spaces for scanning operations; - careful management and supervision within the institution; -security of the technical logistics of the contractor.

6.	*Location of digitization operations*	Benefits of using intermediaries – specialised companies: - no hard drives or software (except those required to display images) must be purchased; - the beneficiary of the project does not provide secure locations for maintaining the technical logistics used for digitization; - the experience and expertise of the service provider can be used; - known costs from the beginning; - the provider has all the interest to use the most modern hard drives and software. Disadvantages of using intermediaries that are digitization service providers: - taking into account the fact that the digitization project will be put into practice by a company outside the library, the careful management and supervision from within is compulsory; - sometimes the norming of the workload evidenced by digitized pages is detrimental to the quality of the digitized images; - automatic browsing of pages (about 2000 pages / hour) represents a risk assumed by the performer, especially when working with fragile documents that easily breaks down on aggressive manipulations; - as such, it is necessary to check all project activities with the help of the quality control grids corresponding to the digitization of documents.
7.	*Staff employment and training*	Digital projects are a new professional approach requiring professional technical knowledge and new skills: - initiation and training of the existing staff in the new technology is a necessity dictated by the new trends in the development of modern libraries; - even if the digitization project will be designed and developed by an external company but also when a specialist is employed to work on the project, the managerial policies of training the existing staff in learning the basic notions and techniques in digitization are essential for all projects that can be developed over time; - the practice of working only with specialists outside of the library is damaging and inevitably leads to compromising the library's commitment to create a modern digital library; - the wisest management policy, with beneficial and sustainable effects, consists in training the library staff's IT specialists, as well as the conservative experts and librarians specialist in protection and old books, to prepare and run through the digitization of valuable collections of documents.
8.	*Budget*	The budget is the necessary financial condition for running the activity programs in any institution. Year-to-year libraries have insufficient funds to run forward-looking projects. Library management needs to set forward investment priorities that bring added value to the professional work of the library, as well as a modern perspective for development. In digital projects, from the allocated budget amount, important costs are distributed to the training and improvement of the staff employed, on which the quality of library services depends to a large extent. A balanced budget for running a digitization project must include the following categories of expenditure: - wages (approximately 50% of the budget allocated for digitization); - expenses for the professional training of the staff; - funds for technical-logistics equipment; - maintenance, license and communication costs; - other unpredicted expenditure in the budget (about 10% of the budget allocated to the project).

9.	*Ethical issues*	Libraries must be responsible not only for the preservation of the original goods but also for the digital goods deriving from the original. There is a problem for the security of the information that the library currently holds. More specifically, how much and what information is made available to the user online. Valuable information is required to be safe.
10.	*Evaluation of results*	The quality assessment of the digital product is done by examining images under the form of digital products. Evaluation of the digital product is sometimes a neglected step in the digitization projects, but quality control is the most important part of the digitization projects that can analyze and promote digital products to the highest standards. Many digital projects are evaluated by the number of digitized items - a criterion that is not relevant to the success achievement, because the digitization of thousands of images means nothing if they are of poor quality, hard to locate in the database or there is a lack of interest from the target audience. In conclusion, the users of digital information are those who ensure the qualitative assessment of digital projects by how long, how they use and the way they use digital products.

4. Conclusions and recommendations

The digitization of valuable documents from libraries, museums and archives highlights the active collaboration of two professional structures with totally different roadmaps, but complementing each other to achieve the digitized support: the team of conservationists, restorers and operators in handling and browsing the documents for scanning and the team of digitizers who, with the help of a book scanner, translates the information from physical format (manuscript, book, press collections, etc.) into an electronic format PDF, TIF, JPG) for easier access to information from multiple locations.

Although the two teams have different training and professional preoccupations they must collaborate, even indirectly, to achieve the final product.

In the digitization process of selected documents, the protection team coordinated by the conservatory specialist for the protection of heritage documents organizes all the activities that ensure the protection of patrimonial assets on paper support in the pre-digitizing, scanning and post-scanning phases, as follows:

- *preparation of documents for scanning* (assessment of conservation status and carrying out treatments for the neutralization ofthe multifactorial degradation factors);
- *handling of documents on the scanner* (during the scanning process, the handling and browsing of documents will be done either directly by the conservator or by coordination in execution);
- *proper operation of the scanning equipment* (the conservator allows the scanning of documents only with high-performance professional equipment).

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Insights on the Use of Facebook in Educational Context - a Systematic Review (2015-2018)

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Despite its overwhelming popularity as the leading social network site in the past few years, the educational value that Facebook provides has not been fully determined, and results are still contradictory. Moreover, systematic reviews about the educational usage of Facebook are still lacking some aspects. This article provides a critical overview of the international studies focusing on Facebook as educational environment, carried out in order to examine if and how this popular social network may contribute to teaching and learning within formal education. The authors conducted a comprehensive search that identified 43 relevant articles, subsequently analysed according to a list of guidelines created especially for this study. Thus, only empirical studies published between 2015 and 2018 in peer reviewed journals have been considered for this review. The studies included present the ways in which Facebook can be used in education, and focuses on the perception of pupils, students and teachers in this respect. Overall, our study found that Facebook is partially implemented in education, depending on the subject taught. Finally we provide suggestions and indications for future research .

Keywords: *Facebook; education; social network sites; students' perception; teachers' perception*

1. Introduction

In recent years many researchers directed their attention towards the implications of Web 2.0 technologies, including the social network sites (SNS), on socialization, psychology, health and the results of learning in different categories of people (McHaney 2011, O'Keeffe&Clarke-Pearson 2011, Valenzuela et al. 2012, Loader et al. 2014). The relationship between education and the use of social networks sites (SNS) showed great interest for researchers in the past 10 years; some of them suggest that SNS became an inadequate distraction for students, because they affect in a negative manner their educational performance (Ivala&Gachago 2012, Jacobsen&Forste 2011); others consider that Facebook, the most popular social network, has received a lot of attention from teachers and researchers, and its popularity made it the number one choice for the teachers interested in using SNS in teaching; it also changed the way in which students are experiencing education (Shaltry et al. 2013). Other research has shown that the use of Facebook has its limitations. Despite the identified assets, Facebook remains a controversial social network especially in terms of privacy and personal data (Chugh&Ruhi 2018). Moreover, students have labelled it as an asocial tool because of the ambiguity that the online communication creates in interpreting certain information. This may lead to conflicts among colleagues (Hope 2016), and, at the same time, some have labelled it as an anti-social tool (Chugh&Ruhi 2018) because students do not socialize, do not relate in the real world, but only in the virtual one.

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There have been identified a series of harmful effects, amongst which we can mention the facilitation of writing and grammatical errors, sharing of misrepresented information perceived as facts, fake-news, exposure to cyber bullying (Aydin 2012), decrease in productivity due to the fact that employees check their Facebook account during work, or even the provision of information that might lead to identity theft.

Despite these negative effects, teachers seem interested in learning how this change in the communication between students and teachers might represent an opportunity for them to create new, innovative methods to enhance learning. The efforts for the integration of SNS in the teaching-learning process and the struggle to understand students' desire to be involved in this process have significantly increased.

Some researchers attest that the online learning tools, give access to educational experiences that are more flexible in time and space than the classroom experience. Moreover, in order to successfully use the online learning tools, teachers must take advantage not only of the increased ability to share content, but they should emphasize the role of interaction (student-student, student-teacher, student-content, teacher-teacher, teacher-content and content-content) (Anderson 2008).

The process of teaching infers more and more the informal learning and the new technologies reorganize the way of thinking. Traditional learning theories become limited in the capacity to explain activities such as online learning or the use multimedia in this process. Alternative theories, such as connectivism (Siemens 2005) try to diminish the differences. This new learning theory explains how Internet technologies have created new opportunities for learning and sharing information across WWW. These technologies include email, wikis, online forums, web browsers, social networks and any other tools, which enable the users to learn and share information with other people. The ability to create connexions between the sources of information is necessary in the personal knowledge development. Learning is a process that is not entirely under the individuals' control; it takes place in different environments in which the main elements are continuously changing.

A positive aspect identified by the studies is the one related to the increased autonomy of students in the process of learning, Facebook giving them a greater control over the profound communication related to learning. Some educational researchers have stressed the need not only to increasingly use Facebook in the classroom, but also the need of a good understanding of the way in which social media could be integrated in teaching in order to ensure both the teachers' and students' comfort (Fewkes&McCabe 2012).

Our study is centred on the identification of research articles, written between 2015 and 2018, in which Facebook is used in educational context. We will focus mainly on the studies that present students', high school students' and teachers' perception on the ways in which Facebook is used in this environment. Another focal point of our research was to explore the reasons for which it is used and the tools preferred (Facebook groups, pages and other tools). The articles identified were also analysed from the point of view of the level of education (secondary, higher education), design and research methods, main research lines developed and findings of these studies. Finally, we will draw some future lines for research.

2. Research methodology

In this section we will present in detail the methodology used in searching the relevant studies about the use of Facebook in educational context. We included studies related to the perception of students and teachers on this type of use. The keywords, search strategy, databases, selection criteria and extraction of data are explained below.

2.1. Eligibility criteria

Taking into consideration the fact that a simple search of the term "Facebook" in Google Scholar produced over 6 million results or that the association of the terms "Facebook" and "education" produces over 3,250,000 results, we considered very useful the elaboration of specific eligibility criteria in order to clearly locate the studies that will be included in our systematic review.

Another aspect is the fact that in the past 8 years we found systematic reviews on the use of Facebook in education, showing a great deal of variety of variables, such as the educational potential of Facebook, educational communication on SNS or Facebook as learning technology enhanced environment. Thus, the search for relevant literature in the area has been limited to studies published between 2015 and 2018, in peer-reviewed journals, written in English, including open access articles.

The articles have been chosen depending on selection criteria previously established. In order to be included in our systematic review, the studies had to be about the use of Facebook in educational context, to include information on the perception of pupils, students and/or teachers regarding the use of Facebook and to contain empirical research.

The studies which refer to other types of social networks, did not present results of empirical studies, didn't contain statistical information, had different types of target audience (adults, children, managers and other), or were not conducted in the mentioned period, have been excluded. Although the papers published in volumes of conferences, abstracts, dissertations and other type of papers could offer information from well documented research, with sustained results, and can present theories and empirical proofs, specialized peer-reviewed journals ensure a better quality of the publications. Moreover, bearing in mind the fact that our study has as main interest the analysis of the state of empirical studies in this field, the articles which had a more theoretical approach or the ones which were not sustained with proofs, have also been excluded. Finally, only articles which presented in a clear manner the research questions, statements and interpretations based upon evidence and theory and also comprised a thorough documentation of all the procedures, have been included in our study.

2.2. Search strategy

The databases in which we conducted the search of the peer-reviewed published articles have been some of the most popular in the academic environment, such as: Science Direct - Freedom Collection Journals, Sage, Eric, Web of Science, Taylor and Francis Journals, and Wiley Online Library. The initial search was done using the following keywords: Facebook, students' perception, teachers' perception, education*; than we used the advance search which allowed us to combine several terms and introduce search criteria, using the Boolean operators (AND - and, OR- or, AND NOT - and not, etc.). We adopted mainly the AND operator which allowed us to find documents comprising the two terms linked in the same paragraph (250 words). The final keywords resulted by narrowing the search based upon the objectives proposed in our review.

For the collection of the corpus of our study we conducted, in the period March-April 2018 an extended search, using the keywords "Facebook AND education*. We limited our search results to articles published between 2015 and 2018, in peer-reviewed journals, in English, including open access articles. In order to receive updates for our search we activated email alerts in the Google Scholar and Science Direct databases. Some of the studies included in our article have been selected using this method.

In order to have a more precise search, in some databases that allow this, we used the possibility to specify the field where we wanted the terms to be searched. Thus, we searched for one or more terms in the fields *Abstract, Title of publication, Subject and Keywords.*

In the databases which allow the search by field, we limited the results to the field Social Sciences,

subject Education. The keywords used were "Facebook", "educational context".

Table 1 comprises information from the initial search: the names of the online databases and the number of articles found in each of these databases.

Table 1. *Databases and number of articles found (initial search)*

Online database	Number of articles
ELSEVIER Science Direct - Science Direct Freedom Collection Journals	4827
SAGE - SAGE Journals - Humanities and Social Science	5898
ERIC	394
Web of Science	8824
Taylor and Francis Journals	16590
Wiley Online Library	9722
Total number of articles found	**46255**

Figure 1, below, comprises the flowchart for the studies included in our systematic review.

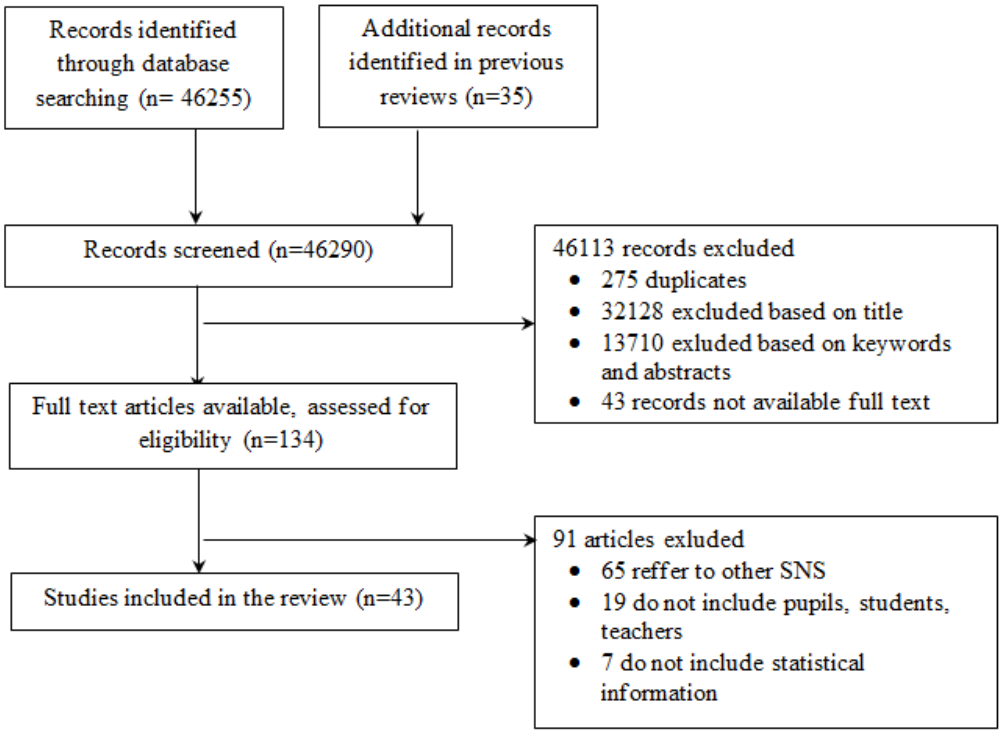

Fig. 1. *Flowchart for the studies included in the systematic review*

In order to ensure the integrity and to avoid the possibility of systematic errors, we repeated the search and then evaluated the data considered adequate for the aim of our study. After critical assessment, some of the articles found were excluded. The number of articles identified in the academic databases was 46,255, as presented in the flowchart above. We added the other 35 found in other reviews and bibliographic lists. After the exclusion of 32,128 articles rejected based upon the title we also eliminated 13710 articles because the keywords and the abstracts were not

consonant with our aims; 275 were duplicates and 43 articles have not been found available in full text. A total of 134 articles have been assessed for eligibility and the articles which fulfilled the criteria and have been analysed full text, was of 43, being included in our review.

The entire circuit of methods used to search the articles included in our review is presented in the diagram below.

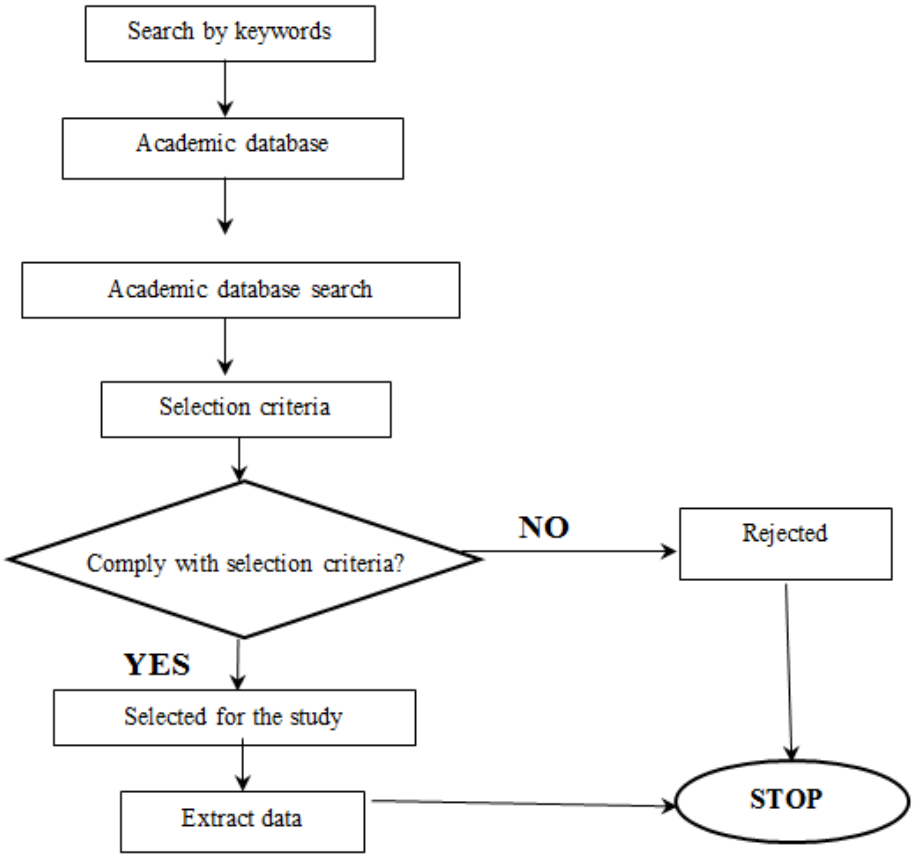

Fig. 2. *Diagram for the methods used for the literature search and selection of relevant articles for the review*

2.3. Types of studies

Our research presents the results of the 43 articles examined, published between January 2015 and April 2018, which refer to the perception of pupils, students and teachers on the use of Facebook in educational context, but also articles which studied the perception, opinions, insights and attitudes expressed by the target audience regarding the use of Facebook in educational context. We also analysed the articles from the point of view of the aim, used methodology, research design and methods, reasons for using Facebook in educational context and why it is mainly used for (sharing of educational content; formal/informal learning environment; group to enhance communication between students and teachers etc.), what affordances are used (groups, pages, other), level of education (secondary or higher education, continuous training). We also took into consideration the distribution of the studies included on each level of education and what properties have been used.

3. Results

From the point of view of the research methods we noticed the prepostency of the quantitative studies (53.5%); also the mixed methodology has been used by researchers in 44.2% of the studies. The majority of quantitative studies collected data through surveys or online questionnaires.

When considering the level of education on which the studies have been conducted on, we can see the largest percentage is the one of the higher education studies (74.5%), followed by the secondary education (20.9%) and the Facebook affordances mainly used in the studies included in our review are the Facebook groups (48.8%).

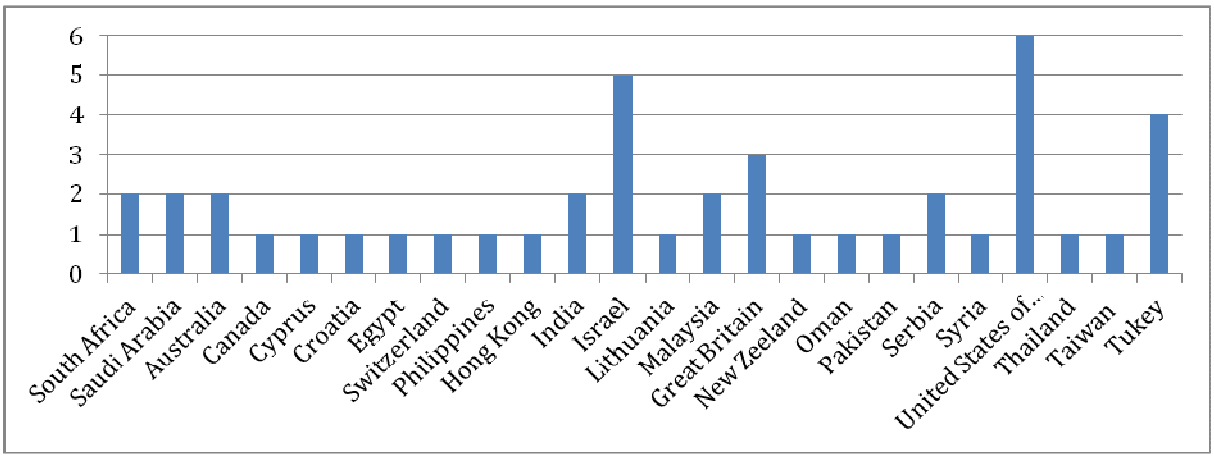

Fig. 3. *Distribution of studies by country*

Figure 3 shows that research on the perception of pupils, students and teachers on the use of Facebook in educational context has drawn the attention of researchers all over the world, as we found studies reported on every continent involving participants from Africa (e.g. South Africa), America (e.g. USA), Asia (e.g. Taiwan, Hong Kong, Thailand), Europe (e.g. Croatia, Switzerland, Lithuania, Great Britain) to Oceania (e.g. Australia).

The largest number of studies involved participants in the Unites States, according to the results of research conducted by Hew (2011). Israel is on the second position and Turkey on the third, despite the trends mentioned by Hew, who reported Great Britain on the second position after the United States. This indicates that the researchers in Israel became more and more interested on the perception of the actors involved in education (pupils, students and teachers) on the use of Facebook in educational context. The increase in the number of studies conducted in Israel is vindicated by the educational policies adopted by the Israeli Ministry of Education in 2011 regarding the interdiction of student - teacher communication via social networks sites. Although initially it was mentioned that "the usage of SNS for interaction between teachers and students is forbidden" (Israeli Ministry of Education 2011), after approximately one year and a half the regulation was revised, emphasizing the benefits of SNS and allowing a restricted communication via SNS. Many countries all over the world have debates on the interdiction of teacher-students SNS mediated communication. Even some regions in the United States and Australia have restricted this type of communication between students and teachers (Queensland Department of Education, Training and Employment 2016). On the other hand, other countries, like Ireland, preferred to warn about the potential damage of student-teacher relationship via SNS. The Teaching Council, the institution that regulates the profession, has published an updated version of the Code of Professional Conduct for Teachers, according to which teachers are required to "ensure that any communication with the pupils/students, colleagues, parents, school management and other is appropriate, including communication via electronic media, such as e-mail, texting and social networking sites" (The Teaching Council 2012). The fact that communication via SNS

is being discussed by policymakers and regulators reflects the tremendous impact of this issue.

In time, intriguing questions regarding the teacher-student communication via SNS and of its effects on the real life relationship have come up (Manca&Ranieri 2017). Even the term used by many SNS to describe the connection between users "friends", can challenge the normal student-teacher hierarchy, because, traditionally the teachers have a certain degree of influence over the students even when their relationship evolves. With all these changes in the informational era, the role of teachers is in a permanent transmutation. The communication via SNS plays a major role in this mutation, extending the aim and the locations in which the teachers and students/ pupils communicate, even more than the online platforms such as the well-known learning management systems.

Table 2. *Studies on the perception of pupils, students and teachers about the use of Facebook in educational contexts*

Perception of	No. of studies	Percentage
Pupils	6	13.6%
Students	36	83.7%
Teachers	8	18.2%

3.1. Pupils' perception

The manner in which pupils react to the use of Facebook as a tool in education has been explored by six of the studies included in our review. Four of these studies have been conducted in Israel, 1 in Turkey and 1 in India.

The studies conducted by Forkosh-Baruch and Hershkovitz in 2015 and in 2017 respectively, in Israel reflect their preoccupation with the relationship and communication between pupils and teachers via Facebook. In 2013 the two researchers have conducted an exploratory qualitative study on eleven pupils aged between 13 and 18, from Israeli schools. In the first study selected by us the researchers included pupils (N=587) as well as teachers (N=160) in order to extract the differences between the ones *willing to connect* with their students/teachers via Facebook and those who *do not wish to connect*; in the second study the authors examine the associations between the students-teachers relationship and the student-teachers communication mediated by Facebook.

Both studies have been conducted on a school population aged between 12 and 19 years old and focus on the attitudes regarding the policies which forbid the teacher-student communication via SNS and the attitudes regarding Facebook in the learning process. The authors identified significant differences between three groups of students: the ones willing to connect with their teachers on Facebook, the ones already connected to one of the teachers on Facebook, and the group of students not connected to the teachers, but willing to do it. The most popular mean of communication between students and teachers is within the Facebook groups. The students, as well as the teachers consider the groups an appropriate mean of communication because they offer an easy way to communicate with more people at the same time, having also a high degree of privacy and a good separation between the discussions on learning and personal activities. Another result of these studies shows a better degree of closeness to the teachers of the students *willing to connect,* in comparison to the ones *not willing to connect*. Both studies can give a support for the policymakers to regulate student- teacher communication via SNS.

In the following study Rap and Blonder (2017) evaluated the degree in which students use the SNS in general and their attitudes towards the presence of an environment/ group on a SNS for teaching

chemistry. The results show that the active Facebook group for teaching chemistry has been perceived in general as an experience which contributes to the learning process. The study results present a positive correlation between the activities for learning chemistry in groups and the students' attitudes towards the use of Facebook groups for teaching and learning chemistry.

Amandeep Dhir (2016) shows in his study that Facebook adolescent users consider it a good tool for discussions, materials sharing and exchange of ideas and other educational interests with their friends, but also with the teachers, and these functions lead to an intensive Facebook use.

Foreign languages learning moved out of the classroom walls long time ago; in fact, for the most part, learning foreign languages happens outside, in informal activities. The informal learning, through ICT represents an important alternative to practise and use the languages; that is why it shouldn't be neglected. Any informal learning experience is perceived as a link or a bridge between social media and educational content. They offer many opportunities for pupils and students to connect with educational content in formal learning locations. Some teachers are too rigid and limited regarding the idea of learning outside of the classroom. Certainly, learning will always need a formal location for the dissemination of information. Nevertheless, learning processed outside the classroom through the use of technologies, the negotiation of the sense, the construction of knowledge and social and interpersonal interaction, the creation of relationships - are equally important. Selwyn confirms that the IT technologies, the computer and other ICT elements allow children and young people to have access to a greater variety of activities and experiences that can sustain learning, many of these not happening in a traditional educational framework. In fact, many of these could be considered "educational" according to the conventional meaning of the term.

A very recent study done by Levent Çetinkaya (2018) evaluates the effects of Facebook and WhatsApp on the success of learning English vocabulary and analyses the opinions of pupils on the implementation process. The research proved that WhatsApp was more efficient than Facebook in this experiment, and the pupils wish to continue using it in their courses and also to use it in other subjects taught in school.

3.2. Students' perception

This category of studies includes 32 articles, representing the most extensive part of our study.

Some of the benefits of Facebook used in educational context can be found in the recent studies analysed. Milosevic et al. (2015) and Sobaih et al. (2016) observed in their studies that the students perceive the use of SNS as beneficial in terms of involvement, improvement of abilities and expertise on the content of courses. Akcaoglu (2016) emphasises the intercommunion of the students and teachers and their colleagues, through the use of Facebook. On the other hand, other studies identified reluctance to the idea of becoming "friend" with the faculty members for more than half of the participants in the study (Alkhateeb 2015).

In his research about the perception of students on the educational use of a Facebook group, Chen (2012) showed that students consider the Facebook group a mean to improve communication between teachers and students; it also provides a rich multimedia content to enhance the educational experience. Students showed openness to the possibility to extend the Facebook group to other courses too, like several other studies mention; they prefer a voluntary participation, not imposed by the teachers. The authors emphasize the fact that probably when they indicated positive reactions to the introduction of SNS in the courses, the students did not take into consideration the time, effort and privacy issues associated to that. Another question raised was about giving grades or marks which could motivate the students to be more involved in the activity of the Facebook group.

In studying the advantages and challenges of the use of Facebook for sharing students' homework

and projects, Cheng (2016) ascertains that they are more reluctant to the invasion of their private socialising space by the teachers. Most of the students involved in this study didn't embrace the idea of being contacted by the teachers or faculty members on the Facebook with the purpose of teaching or promoting different matters and administrative issues.

A number of studies refer to the benefits and qualities or particularities offered by Facebook including collaboration, sharing of resources, knowledge and ideas, increase in the level of communication with the colleagues and teachers (Ciampa et al. 2016, Connolly et al. 2018, Dickie&Meier 2015, Dhir et al. 2016). Dickie and Meier (2015) in their study *The Facebook Tutor: Networking Education,* make remarks on the fact that Facebook and other SNS should not be considered an alternative but they should rather represent an additional channel of communication between students and teachers. The administration of the pages or groups should be done by a member of the faculty in order to warrant the maintenance and application of standards and to avoid their faulty use. The authors also make remarks on the education of students on the importance of protection of personal data and privacy. This experimental study points out how teachers in the act of teaching can use the SNS technology without losing the traditional student- teacher relationship. The use of communication via Facebook increases the contact and provides an environment to discuss problems with the entire group in a more rapid, productive and interactive manner, in any class, at any time. In this era of mass education, the higher education institutions should take advantage of the new technologies. This is applicable especially now, when students expect to get in touch with the teachers very quickly. The Facebook tutor, used in a structured and safe manner, could lead toward the meeting of these expectations. A new educational environment to answer the students' needs is the best way to equip them for the technology lead future and it can also have a positive influence on the individual and collective learning.

The study Gettman and Cortijo carried out in 2015 unveils negative attitudes towards the use of Facebook initiated by teachers with academic aim. The participants' comments reflect a resistance towards the use of Facebook in the classroom, in the quantitative appreciation of the level of "comfort", the answers have not been above "neutral". The qualitative results indicate a resistance because of the idea that Facebook was created for social interaction and not educational interaction. There are also some concerns about the fact that the interaction on Facebook with the teachers might surpass some barriers, giving space to discussions about privacy and possible issues in the teacher-student relationship. One of the limitations identified in this study is the fact that the participants in the study were not directly involved in an experiment, but their answers came from the previous experiences or from speculations regarding the experiences that they might have. These issues might lead to irrelevant results, which do not reflect real experiences. The authors suggest for future research to be conducted during the period in which the pupils or students use those technologies.

In India, despite the extensive use of SNS for communication and entertainment, the use in the educational environment seems to be reduced (Bharucha 2018). SNS in the Indian educational system evolve as a communication method and seem to gain some territory in respect of acceptance. The interviewed students said that they want to be connected in a flexible manner and want to attend personalised learning based upon experiences. Students have created study groups on Facebook and sustained that they are extremely useful in sharing information, addressing questions and receiving learning tips. The Indian students expect changes in education in terms of emerging technologies. It is clear that the SNS will never completely replace the traditional Indian education, but they are boost in education and improve the process of learning.

O'Neil and Wels (2016) structured their study on three directions: (i) the manner in which students perceive the use of Facebook, (ii) the manner in which the students feel about certain Facebook elements and (iii) if the different elements have optimized the teaching and learning from their point of view. From the students comments it is clear that they actively initiated the participation

on the Facebook page, but they preferred to be involved in a post-hoc manner, after the others (probably the course coordinators) posted materials on the page. The survey and interviews illustrated a general positive attitude regarding the implementation of Facebook as educational tool. The study confirmed that institutions and teachers should not ignore the evolution of the educational need of the Net Generation any longer; and if those needs will not be met, they could lead to the emergence of irrelevant institutions in this perpetually changing environment.

Pickering (2016) suggests that Facebook can play an important role in sustaining students for their exam preparation or evaluation. Ramadan (2017) pleads for Facebook as a promising pedagogical tool which needs all the attention in the Arab countries. The researcher recommends the integration of Facebook as a learning resource in the Arab universities. The most important functions of Facebook, identified by Pribeanu (2015) in his study on Lithuanian students are communication, learning, information exchange and writing of text messages. Sharma (2015) states that sharing of materials and collaboration are the dominant variables regarding the future use of Facebook in the higher education. The authors suggest the inclusion of Facebook as eLearning tool in the higher education institutions.

3.3. Teachers' perception

Previous studies have shown that the Facebook groups or pages can be more useful in teaching specific subjects. The use of Facebook for certain areas, such as foreign languages, sciences and business has been demonstrated before. Blonder and Rap (2015) showed in their study that the initial opinions of the teachers involved in the study (which were not based upon a real knowledge of Facebook) have been replaced by more realistic ideas when the teachers started to use the Facebook groups for teaching and learning chemistry. The technologic support given to each teacher lead to the development of a greater self-efficiency regarding the use of the group.

The contact between teachers and students takes place in different shapes and manners, and for more than one purpose. Asterhan and Rosenberg (2015) divided them into three categories: academic-educational, psycho-pedagogical and socio-relational.

The groups created on Facebook are considered the most popular mean of communication between students and teachers, the teachers consider that it is an appropriate way to communicate, because it offers an easy communication with more than one person at the same time, with a relatively high level of privacy. At the same time, the Facebook groups where the teachers and students discuss offer a better way of separating the discussions about school from the personal activities (Hershkovitz&Forkosh-Baruch 2017). In the case of group discussions, one of the accountabilities identified by Blonder and Rap (2017) is represented by the availability during the day. The role of the teacher is to help students access important information in a very accessible way, an also, to correct their mistakes done during group discussions.

Summarising the comparison between the teachers *willing to connect* to the ones *not willing to connect*, Forkosh-Baruch et al. (2015) draw a sketch portrait of the teachers *willing to connect* who are younger, have less teaching experience and have more experience in using Facebook than the ones *not willing to connect.* Besides, a great number of teachers in the *willing to connect* category tend to think that Facebook could be used in teaching and that the teacher-student communication on SNS shouldn't be forbidden.

4. Contribution of the study and limitations

Our study brings a contribution to the literature through an analysis and synthesis of studies published from 2015 to March 2018, including observation on the level of education, countries, aims of studies, research methods, Facebook tools used, main results and conclusions of the analysed articles. The main purpose was to identify studies in which authors present the

perceptions of pupils, students and teachers on the use of Facebook in educational context.

The first limitation identified is the fact that most of the studies have been done on cohorts of pupils, students or teachers in only one institution (Alkhateeb 2015, Alm 2017, Amasha 2017, Forkosh-Baruch et al. 2017, Hershkovitz et al. 2015, Balcikanli 2015, Blonder 2015, Liu 2016, Skendžić&Devčić 2017). Larger cohorts with differences in the type of perception have been used only in some of the studies presented in our study (Ali 2017, Anwar et al. 2017, Dhir et al. 2016, Bharucha 2018, Nkhoma et al. 2015, Ramadan 2017). The results would be more extensive and conclusive if they were done on larger cohorts of students and teachers from multiple institutions.

Most of the studies have used quantitative or mixed methodology and included self-reported surveys or online questionnaires, fact that might cause errors or confusions. To conclude we can state that Facebook is used and has a great potential of being used in the classroom as a learning tool. Yet, in order to capitalize Facebook advantages it is necessary to understand the way Net Generation interacts with technology and how they perceive it. Finally, we should not forget that the information and communication technology should be used only if the goals would be met and better results would be achieved.

5. Conclusions and future directions

Our review represents a radiogram and a synopsis of the present research in the area of Facebook used in educational contexts. The articles included show that the perception on the use of Facebook in educational context has drawn the attention of many researchers all over the world. Facebook can be used to improve the teaching and learning processes, especially for certain subjects such as foreign languages or sciences. On the other hand some studies show that Facebook can affect in a negative manner the performances of the pupils/ students.

The SNS, especially Facebook, rapidly replace the traditional ways of communication, such as letters, faxes, e-mail messages and even phone calls. Today, the SNS are used for publicity, votes, promotions and sales, as a news platform and especially for social interaction.

Nevertheless, the potential shown by Facebook as a learning support is acknowledged by many researchers and this justifies future research and investigations. Our research will continue with a quantitative and a qualitative study on the perception of students and teachers regarding the educational use of Facebook. The studies will be conducted in Iasi, on a group of approximately 1000 high school students and teachers.

The role of teachers has changed dramatically and positively in the last decades. There has been a shift from the teacher centred model of education to the student centred model or from the teaching focused model to the learning focused model. The teachers switched the role from one day to the other, changing from the “sage on the stage” into the “guide on the side”.

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ERRATUM

In the article *Information Literacy of Library Science Students at the Faculty of Philosophy, University of Sarajevo* by Lejla Hajdarpašić and Džejla Khattab, published in iss. 1, 2019 of our journal (pp. 8-15, http://www.rrbsi.ro/index.php/rrbsi/article/view/71/29), the authors erroneously referred to the Permeation Components Model (PCM) as *Permutation* Components Model.