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## A bibliometric study of the research area of videogames using Dimensions.ai database

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### Abstract

Videogames are a very interesting area of research for fields as diverse as computer science, health, psychology or even social sciences. Every year a growing number of articles are published in different topics inside this field, so it is very convenient to study the different bibliometric data in order to consolidate the research efforts.

Thus, the aim of this work is to conduct a study on the distribution of articles related to videogames in the different fields of research, as well as to measure their interest over time, to identify the sources, countries and authors with the highest scientific production. In order to carry out this analysis, the information system Dimensions.ai has been considered, since it covers a large number of documents and allows for easy downloading and analysis of datasets.

According to the study, three countries are the most prolific in this area: USA, Canada and UK. The obtained results also indicate that the fields with the highest number of publications are Information and Computer Sciences, Medical and Health Sciences, and Psychology and Cognitive Sciences, in this order. With regard to the impact of the publications, differences between the number of citations, and the number of Altmetric Attention Score, have been found.

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### 1. Introduction

The evaluation of research has always been relevant for orienting research support, rationalising research organisations, increasing productivity, or focusing on specific fields [1].

Videogames have been studied in many scientific and varied fields, such as education [2], artificial intelligence [3], psychology [4] or health [5], among others. That is the reason why we are addressing in this work a bibliometric study on this research area. But previously, we must take into account that there are works which use the term “games” in general, instead the broader term “videogames”. For instance in [6] an analysis of co-words

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and co-venues was made, from a selection of 48 core game journals and conferences, instead searching by term, detecting the appearance of 7 sub-communities. However, as its authors mention, in this work it has been possible to obviate works in interdisciplinary sources. Even so, its results are representative, although in a period prior to our study (2000–2014).

Usually, bibliometric studies of videogames in more specific fields, such as digital humanities, are more frequent. In this particular field, bibliometric studies have been carried out related to gamification in education [7], or in the field of “serious games” using that particular query [8]. There are even studies in the field of medicine, for example the work [9] to study video game addiction.

Finally, there are also surveys and reviews of more specific fields related to Computer Science, such as Affective Computing [10] or even in much more specific areas, such as the RTS (Real-Time Strategy) videogames within the computational intelligence [11].

The main objective of this work is to identify the most relevant sources, countries and fields of research in the area of videogames. To perform this, we provide a descriptive analysis of this area, and offer a methodology to perform this analysis by using a specific database. Most prolific countries, authors, affiliations and journals are shown, and an overview of the impact in citations and Altmetrics in the different fields of research is presented.

We have used the Dimensions.ai database to obtain the dataset. This database has been chosen because it provides a large corpus of more than 90 million publications and more than 4 billion references. Moreover, it offers a complete API to perform queries using their own DSL (Domain Specific Language) query language. Moreover, it is freely available for academic purposes. We have previously used this database in [12], where it was used to measure the impact in citations of the international relationships of a specific region of Spain.

The rest of the paper is structured as follows: first, the methodology used to obtain the dataset is described. Then, the analysis and obtained results are discussed in Section 3, and finally, the conclusions and future work are addressed in Section 4.

## 2. Methodology and corpus

This section describes the steps followed to obtain the dataset of articles in the field of videogames. We are following a methodology similar to the one presented in [1], where a quantitative study of a specific field was conducted. In this work, we have performed a query containing the concepts “videogames” and “video-games”. We deliberately left out the concept “games” or “gamification”, to avoid obtaining papers related with game theory, sports or other type of games (such as Chess). The period selected is from 2013 to 2018, to give last year papers time to be cited.

The data is sourced from Dimensions.ai, an inter-linked research information system provided by Digital Science (<https://www.dimensions.ai>). We have chosen this system because of the huge amount of data it provides, including the number of citations per publication, but also because it offers an API to perform queries using a specific DSL (Domain Specific Language). These queries, similar to SQL, can be executed from any programming language, and obtain a batch of specific results in JSON, thus facilitating processing and analysis. In our case the query and analysis has been performed using Python, as we did in our previous work [12].

The parameters of the query are:

- Date range: from 2013 to 2018.
- Only publications of type “article” are used.
- The query was performed on 23th July 2019.

The resulting query is as follows:

```
search publications in title_abstract_only for "(video-games OR videogames)"
  where year in [2013:2018] and type="article"
return publications[all+concepts+times_cited]
```

A corpus of 7133 documents was retrieved. It is important to note that the search only took into account the terms “videogames”, “video games” or “video-games”. If we widen the search to include the more generic term “games” then it goes from 7133 documents to 68384 documents, including, for instance references to the study

of classic games such as chess or poker, widely considered in the field of computer science, as well as sports or economic theory.

### 3. Results and quantitative analysis

This section presents a descriptive analysis of the retrieved data. As previously said, we are describing the same kind of results that the ones presented in [1] for their qualitative analysis: year distribution, affiliations, journals and keywords. However, because the wide extension of the videogames area, we are also describing the fields of research (FOR). The list of the FOR used by Dimensions is based on the Australian and New Zealand Standard Research Classification (ANZSRC) and can be consulted in <https://www.abs.gov.au/ausstats/abs@.nsf/0/6BB427AB9696C225CA2574180004463E>.

As it can be seen in Figure 1, interest in videogames has clearly increased during the considered period, with more than 1000 articles published each year since 2014.

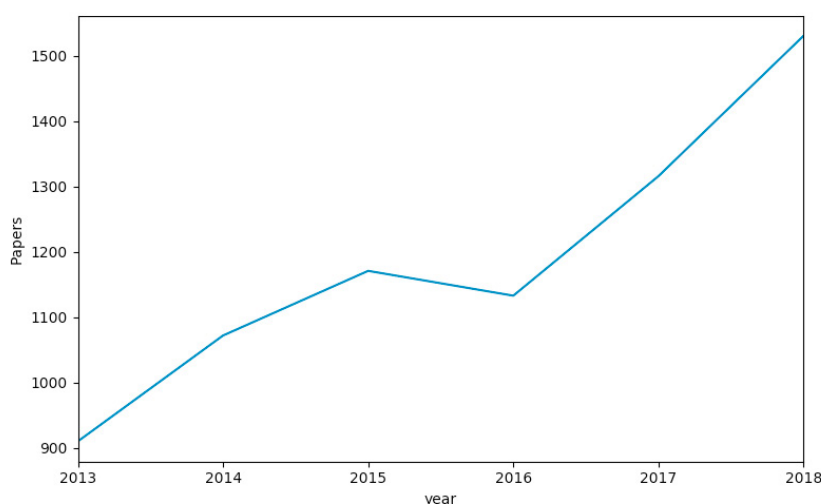


Fig. 1. Number of papers published by year during the 2013-2018 period.

With respect to the countries that contribute the most, according to Table 1, it can be seen that the United States publishes 1 out of every 4 articles in total, followed at a distance by UK, Canada and Spain. However, there is no University that focuses all the research: Table 2 shows how the 10 universities that publish the most are around 40 articles on average, with these universities belonging to the 3 countries that publish the most. In addition, Table 3 shows that the most prolific authors in this area have published in this period a number of papers similar to that of universities in general, possibly indicating that there are only one or two specialised groups in this subject per university.

With respect to the journals where most papers are published (Table 4) it can be seen that those journals are related to health/medicine, and psychology. Surprisingly, there are only two computer science related journals. This may be because the authors publish in general artificial intelligence journals (for example, *Expert Systems with Applications*), rather than those focused on videogames, such as *Entertainment Computing* journal.

This can be seen clearer in Figure 2, where it is observed how the field of research coincides with those of the journal list, being Information and Computing Sciences the field where it is most published, followed by Medical and Health Sciences and Psychology and Cognitive Sciences.

A basic assumption in citation analysis is the more a paper is cited, the most relevant it is [1], so we are showing the average citations per article in Figure 3

With respect to the average impact of each field, there are variations with respect to the previous Figure. For example, the average number of citations for Information and Computing Sciences takes this field to the seventh

Table 1. Top 10 countries and the number of papers published during the period.

Country	Number of Papers
United States	1756
United Kingdom	482
Canada	419
Spain	343
Australia	311
Germany	246
Brazil	220
China	215
Italy	191
Netherlands	190

Table 2. Top 10 Universities and the number of papers published during the period.

University	Number of Papers
The Ohio State University	54
McGill University	51
Nottingham Trent University	49
Michigan State University	47
University of Ottawa	41
University of Toronto	41
Harvard University	39
Yale University	38
University College London	37
University of British Columbia	37

Table 3. Top 10 authors and the number of papers published during the period.

Author	Affiliation	Number of Papers
Mark D. Griffiths	Nottingham Trent University (UK)	43
Christopher J. Ferguson	Stetson University (USA)	32
Brad J. Bushman	The Ohio State University (USA)	23
Tom Baranowski	Baylor College of Medicine (USA)	21
Daphne Bavelier	University of Geneva (Switzerland)	20
Tobias Greitemeyer	University of Innsbruck (Austria)	19
Daniel L. King	University of Adelaide (Australia)	18
Douglas A. Gentile	Iowa State University (USA)	17
Richard Buday	Archimage (United States)	17
Isabela Granic	Radboud University Nijmegen (Netherlands)	16

Table 4. Top 10 journals and the number of papers published during the period.

Journal	Number of Papers
Computers in Human Behavior	169
Games for Health Journal	131
PLoS ONE	93
Games and Culture	75
Frontiers in Psychology	75
Cyberpsychology Behavior and Social Networking	62
Psychology of Popular Media Culture	47
Proceedings of the Human Factors and Ergonomics Society	45
Entertainment Computing	40
Multimedia Tools and Applications	40

position. However, it is important to note that it is not fair to make comparisons between the average number of citations per field, due to the differences in people publishing in each one, or even the number of papers published and reference list sizes [13].

One of the advantages of Dimensions.ai is the possibility of controlling the Altmetric Attention Score [14]. The impact on social networks, such as blogs, online newspapers, Twitter, or Facebook can also measure the interest of an article. Figure 4 shows the average impact per altmetrics. As it can be seen, the biggest impact on

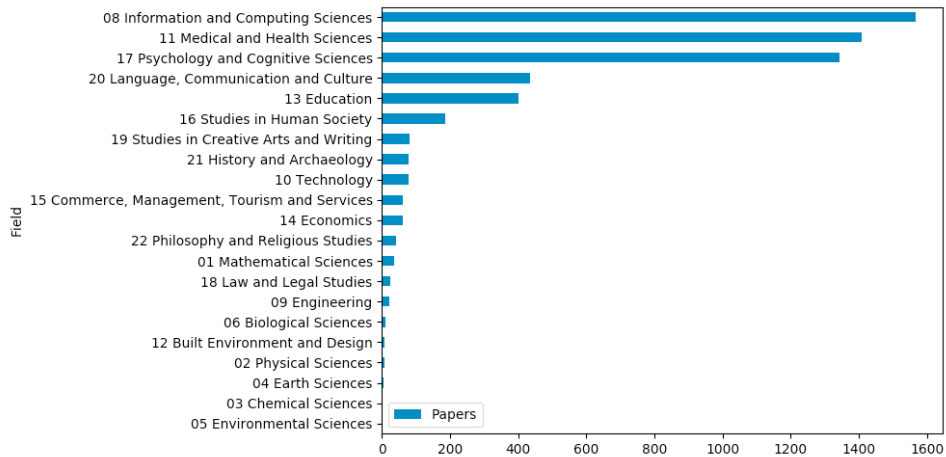


Fig. 2. Number of papers by field of research.

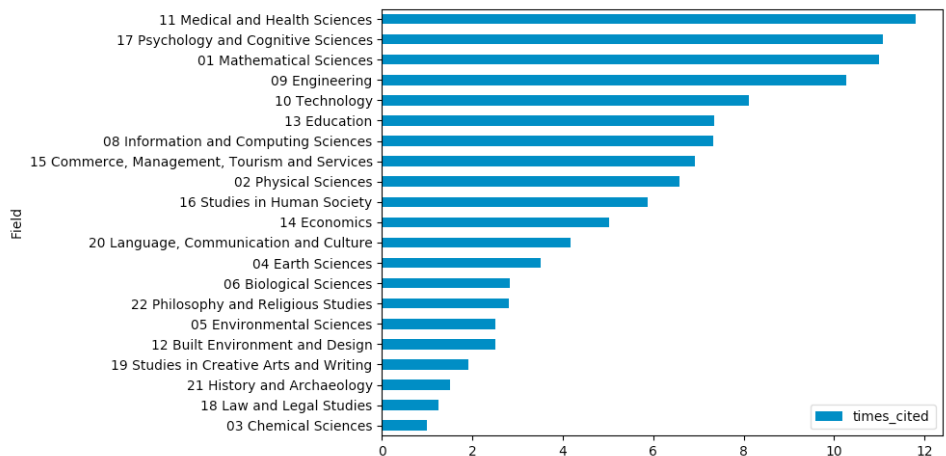


Fig. 3. Citations by field of research.

social networks and other media is in the Physical Sciences field. However, this is because there are only 4 articles in the corpus for this field, and one of them has a metric of 570<sup>1</sup>. Discarding this field, it is Psychology and Health the one which generates the most interest. Surprisingly, being the videogames inherently related with Computer Science and Programming, the Information Sciences field is not even among the first 7 fields with more attention. This can be explained because is the industry and not the academia who are more interested in this field, and as explained in [15], they both do not necessarily attempt to solve the same problems.

Finally, and following the methodology presented in [1], we use a cloud of words to show the terms related with the research area of videogames. Dimensions offer two kinds of terms: the MESH (Medical Subject Headings) and the concepts. The first ones are controlled vocabulary thesaurus used for indexing articles for PubMed, while the former are calculated by Dimensions’ algorithm from text from all papers (not only the indexed by PubMed).

19172 MESH terms and 257994 concepts were extracted from the dataset, and plotted using WordCloud package in Python. Figure 3 shows the MESH terms. As it can be seen, most of the terms are related to health and behaviour studies, showing a clear evidence of control group descriptions (*young adult, children, middle aged,*

<sup>1</sup><https://dimensionsplus.altmetric.com/details/40903684>

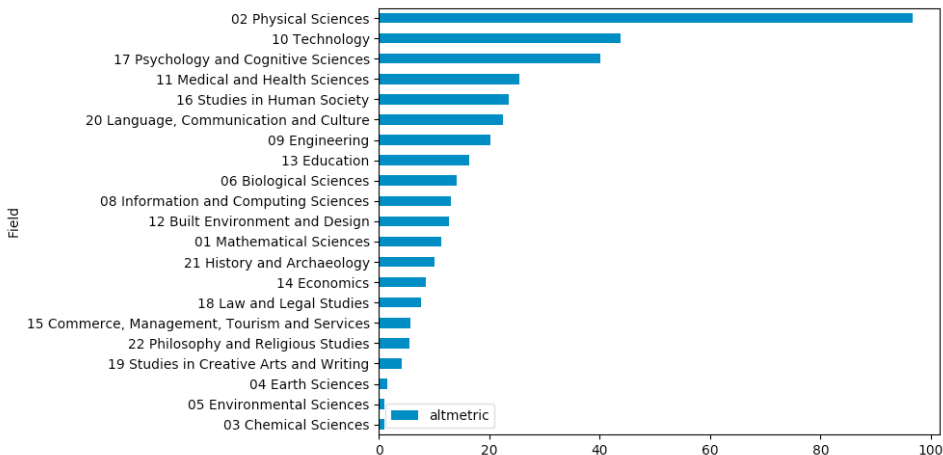


Fig. 4. Altmetrics by field of research.

etc.) and experimental methods (surveys, questionnaires), while the rest of concepts, in less proportion, are related to health issues (*Heart Rate, Body Mass, Exercise*). On the contrary, the cloud tag of the concepts list (Figure 3) shows very general concepts (*result, study, research*), and others also related, but to a lesser extent, to health and psychology. Specific concepts somewhat related to the area of videogames, such as *Artificial Intelligence, Gamification* or *Serious Games*, are not present in the clouds (while they are in the list of concepts from the thesaurus), indicating that this method to extract information from the papers stills needs to be refined.



Fig. 5. Word cloud from the MESH terms obtained from the dataset.

#### 4. Conclusions and remarks

This work presents a bibliometric analysis describing the recent state in the scope of videogames, showing the fields with the most publications, citations and Altmetrics Attention Score (AAS). The Dimensions.ai information system has been considered, obtaining a corpus of 7133 articles in 2013-2018 period. The results show that the fields with more publications in the area are those related to Information Sciences, Health Sciences and Psychology Sciences, being the last two those that receive more AAS and number of citations. The results also show a growing

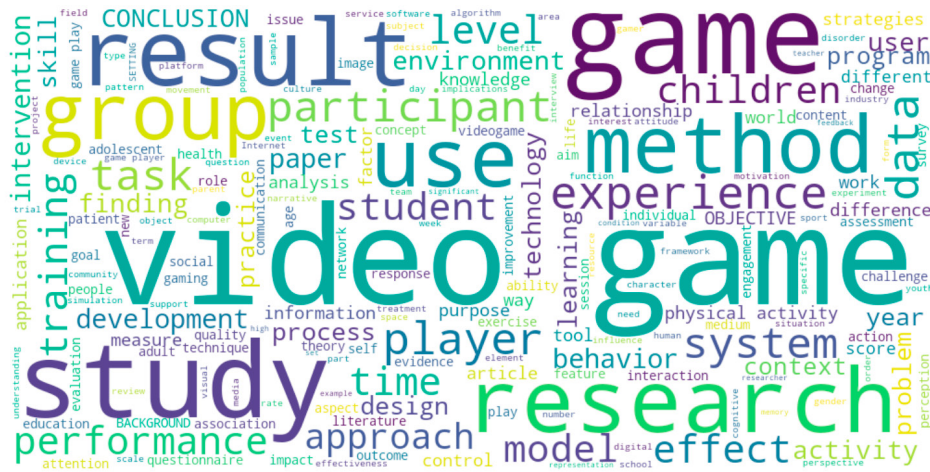


Fig. 6. Word cloud from the concepts terms obtained from the dataset.

interest in this area, with more articles published every year. Moreover, the most relevant authors, affiliations, journals and topics are presented.

The bibliographic search for the term *videogames* clearly inclines towards works related to medicine and psychology, ignoring papers from fields such as computer science, whose authors usually publish using the concept “games” to indistinctly indicate videogames or classic games, such as cards games or chess. In fact, journals such as “IEEE Transaction on Games”, which has 115 publications in Dimensions.ai, did not appear in the top journals described in Table 4.

Future works will deal with larger corpus, or the specific combination of other areas such as, for example, *Artificial Intelligence* or *Rehabilitation* among others. It is also intended to perform a more complete analysis, detecting new communities using co-words and co-venues analysis.

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