

# USE OF CHATBOTS IN E-COMMERCE: A COMPREHENSIVE SYSTEMATIC REVIEW

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## ABSTRACT

The advance of Chatbots nowadays presents a great number of techniques for its subsequent implementation in e-commerce, thus diverting from the traditional user experience that is normally had when making purchases when browsing the Internet. The objective of the research was to know the state of the art about Chatbots and their impact on E-Commerce. A systematic literature review (SLR) was conducted based on B. Kitchenham and S. Charters [76] from 2017 to 2021. The search strategy identified 233 085 papers from digital libraries such as Scopus, IEEE Xplore, Google Scholar, Springer, ACM Digital Library, ProQuest, Taylor & Francis Online and Wiley Online Library. Only 75 papers were selected for review and analysis based on exclusion criteria. The results of the systematic review have focused mostly on recent studies of Chatbots where it offers better implementation techniques for e-commerce; a bibliometric mapping of the extracted studies is also provided.

**Keywords:** Chatbots, E-Commerce, Chatbot Implementation,, Systemetic Literature Review

## 1. INTRODUCTION

The implementation of Chatbots in e-commerce increases customer engagement and technology investments in the business domain have shown a growing interest in exploring conversational agents. This paper addresses this gap with a systematic literature review that explores the following question: what is the role of Chatbots and their implementation in e-commerce? Therefore, we conducted a systematic review with a well-defined methodology to answer different research questions. Therefore, the application of Chatbots evidences the good development for their adoption in e-commerce. Previous studies establish the optimal way to implement them according to the required case, resulting in Chatbots that are able to interact with users.

This study focuses on identifying the state of the art on the implementation of Chatbots and their adoption in e-commerce. The structure of the paper is organized as follows. Section II presents the Background, section III details the review methodology. Section IV presents the results and discussion. Finally, Section V presents the conclusions and future research.

## 2. RELATED WORKS

To the best of our knowledge, there are not many SLRs that focus on the implementation of Chatbots in e-commerce. However, there are some cases of reviews that analyze papers on e-commerce implementation and we should consider important to clearly define the focus and guide the review team during the process of exclusion and analysis of the studies. First B. Gaur [77] conducted a review of the

adoption to e-commerce by implementing Chatbots and discussed about how algorithms allow early detection about user intentions to be obtained within e-commerce platforms. One of the conclusions of this review is that most companies invest large amounts in developing a chatbot tailored to their needs, iteratively. The authors point out that chatbots should focus on interaction throughout the entire buying process, with users.

According to authors A. Rapp, L. Curti, and A. Boldi [83] there is a constant interest in the implementation of Chatbots in e-commerce today to improve the user experience when shopping online. E-commerce is one of the main revenues in the digital economy, which makes of special interest the implementation of Chatbots to improve the adoption of users to online shopping, generating the necessary reliability to make it part of their day to day. According to the authors A. K. Wardhana, R. Ferdiana, and I. Hidayah [81] conclude the review with several recommendations when implementing a chatbot in e-commerce, as well as an appropriate procedure for an optimal development of this.

### 3. RESEARCH METHODOLOGY

The review method has been proposed taking into consideration the guidelines of B. Kitchenham and S. Charters [76] in order to develop the systematic literature review. This review method elaborates research questions, identifies sources of information, search procedure, exclusion criteria, quality assessment, data extraction, and finally synthesizes the data. The systematic review in this paper applies the stages shown in Figure 1.

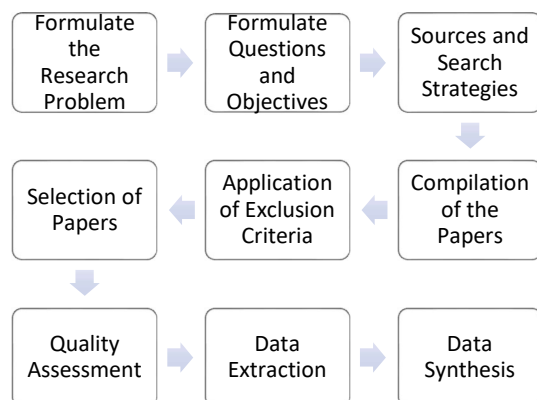


Figure 1: Systematic Literature Review Process

### 3.1 Research Questions and Objectives

In developing an SLR, the research questions (RQs) play a fundamental role in the strategy for searching for, obtaining and analyzing data. When formulating the RQs, the objectives were also determined, which are shown in Table 1.

Table 1: Research Questions and Objectives.

Research Question	Objective
RQ1: What are the programming languages for developing Chatbots?	Identify which programming languages are most commonly used to develop Chatbots
RQ2: In which areas are Chatbots being applied the most?	Determine which are the areas where Chatbots are being applied the most
RQ3: Which keywords are co-occurring in research on Chatbots and their influence on e-commerce?	Identify which keywords are co-occurring in research on Chatbots and their influence on e-commerce
RQ4: What are the Clusters of Papers whose Conclusions and Discussions are characterized by high Objectivity and low Polarity in research on Chatbots and their influence on e-Commerce?	Determine the Clusters of Papers whose Conclusions and Discussions are characterized by high Objectivity and low Polarity in research on Chatbots and their influence on e-Commerce

### 3.2 Search Sources and Search Strategies

The digital libraries used to find the publications used are: Scopus, Springer, ACM Digital Library, IEEE Xplore, ProQuest, Taylor & Francis Online, Wiley Online Library and Google Scholar.

The search strategy included the search for keywords relevant to the study (Table 2).

Table 2: Search Descriptors and their Synonyms.

Descriptor	Variable
chatbot/ virtual agents/ talkbots/ conversacional agents	Independent
e-commerce / e-business	Dependient
Methodology/ method/ model	Intervener

The searches were carried out using search equations for each source of information, as shown in Table 3.

Table 3: Information sources and search equations.

Source	Search equation
ACM Digital Library	[[All: "chatbot"] OR [All: "virtual agents"] OR [All: "talkbot"] OR [All: "conversational agents"]]] AND [[All: "ecommerce"] OR [All: "ebusiness"] OR [All: "e-business"] OR [All: "e-commerce"] OR [All: b2b] OR [All: "electronic commerce"]] AND [[All: method] OR [All: methodology] OR [All: model]]
Wiley Online Library	("chatbot" OR "virtual agents" OR "talkbot" OR "conversational agents") anywhere and ("eCommerce" OR "eBusiness" OR "e-business" OR "e-commerce" OR b2b OR "electronic commerce") anywhere and (method OR methodology OR model) anywhere
Taylor & Francis Online	[[All: "chatbot"] OR [All: "virtual agents"] OR [All: "talkbot"] OR [All: "conversational agents"]]] AND [All: "ecommerce"] OR [All: "ebusiness"] OR [All: "e-usiness"] OR [All: "e-commerce"] OR [All: b2b] OR [All: "electronic commerce'y]] AND [[All: method] OR [All: methodology] OR [All: model]]
ProQuest	("chatbot" OR "virtual agents" OR "talkbot" OR "conversational agents") and ("eCommerce" OR "eBusiness" OR "e-business" OR "e-commerce" OR b2b OR "electronic commerce") and (method OR methodology OR model)
IEEE Xplore	((All Metadata": Chatbot) AND "All Metadata": Ecommerce) AND "All Metadata":Method OR Methodology OR Model)
Google Scholar	("chatbot" OR "virtual agents" OR "talkbot" OR "conversational agents") and ("eCommerce" OR "eBusiness" OR "e-business" OR "e-commerce" OR b2b OR "electronic commerce") and (method OR methodology OR model)
Scopus	(ALL ( ("chatbot" OR "virtual agents" OR "conversational agents")) AND ALL ( (e-commerce OR "e-business" )) AND ALL ((model OR methodology OR method )))

### 3.3 Identified Studies

At the end of the search for papers, the papers shown in Figure 2 were identified for each source.

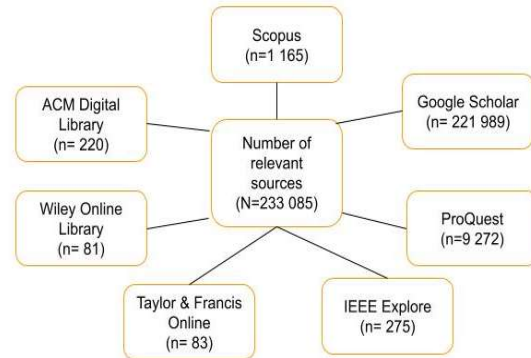


Figure 2: Papers identified by Sources

### 3.4 Exclusion Criteria

Exclusion criteria were used in order to rigorously evaluate the quality of the literature found. The papers were thoroughly reviewed for compliance with the following criteria:

- EC1: The papers are older than 5 years.
- EC2: The papers are not written in English.
- EC3: The full text of the paper is not available.
- EC4: The proposed solution does not apply to e-commerce.
- EC5: The papers do not mention a methodology, model or method.
- EC6: The papers are repeated.
- EC7: The papers were not published in conferences or peer-reviewed journals.
- EC8: The abstracts are not very relevant.

### 3.5 Study Selection

Initially, 233085 papers were obtained that were found in the search performed using keywords relevant to the study conducted.

The selection and filtering phases used are shown in Figure 3. The result of this phase is 81 papers selected for review and analysis.

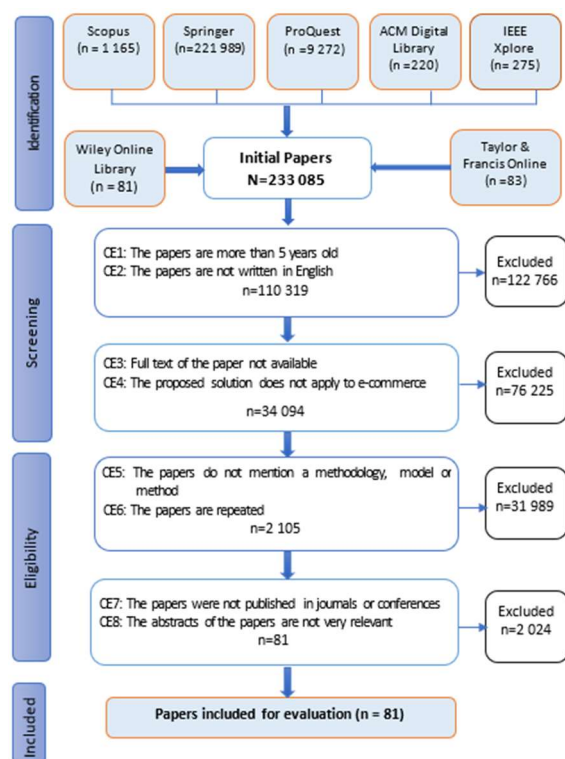


Figure 3: PRISMA flow chart

### 3.6 Quality Assessment

To assess quality, quality assessment (QA) rules were applied to ascertain the final list of papers of items included in this research. QAs were used to assess the quality of the research based on

established research questions. Six QAs were formulated and are shown below:

- QA1. Are the collection instruments referenced?
- QA2. Does the paper consider experimental research?
- QA3. Does the research detail how the sample extraction was done?
- QA4. Does the paper consider pure research?
- QA5. Is the purpose of the research clearly explained?
- QA6. Is the context in which the research was conducted explained?

During this phase, the research quality of the 81 papers selected in the previous stage was evaluated. In order to meet the quality criteria, each study was evaluated independently according to the 6 criteria. For each paper, the full text was read and the evaluation criteria were applied to assess its quality. The initial 81 papers did not meet each of the QAs, at the end of the evaluation we obtained 75 papers that did meet each of the QAs.

### 3.7 Data Extraction Strategies

In this phase, the final list of papers was used to obtain the information required to answer each of the RQs. The information obtained for each paper includes: paper ID, paper title, URL, source, year, country, number of pages, language, publication type, publication name, authors, affiliation, number of citations, abstract, keywords, sample size, etc. The Mendeley tool was used to obtain the data as shown in Figure 4.

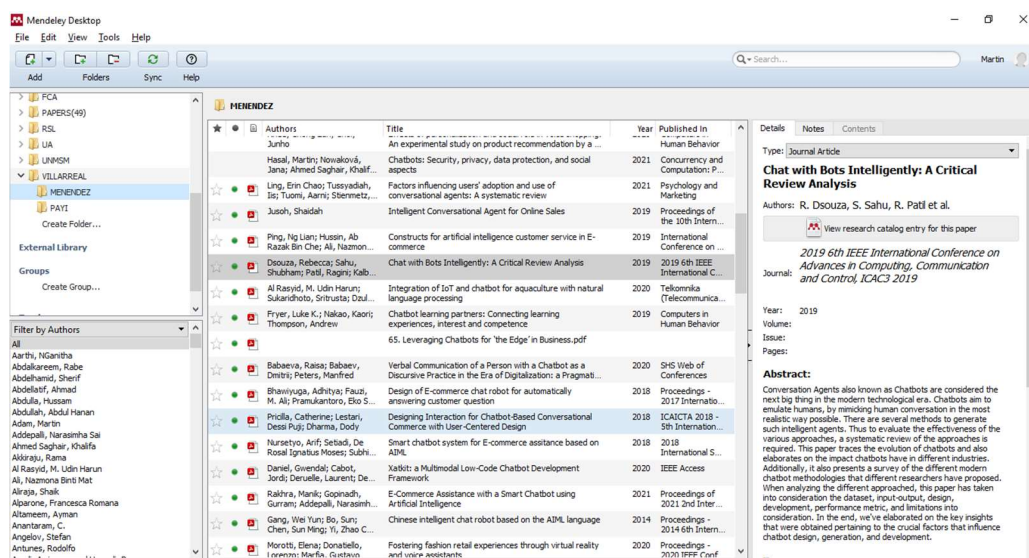


Figure 4: Management of publications with Mendeley

### 3.8 Summary of Findings

The information obtained for research questions RQ1-RQ4 was used to answer them. These answers helped to identify certain tendencies regarding the research topic.

Table 4: Number of papers by publication type and Citation Rank.

Publication Type	<5	>=15	>=5 and <15	Total
Journal	19	6	16	34
Conference	15	3	16	41
<b>Total</b>	<b>34</b>	<b>9</b>	<b>32</b>	<b>75</b>

## 4. RESULTS AND CRITICAL DISCUSSION

### 4.1 General description of the studies

After concluding the process of selection and evaluation of the papers, we obtained 75 papers, which were analyzed in detail in order to answer the RQs. Table 4 shows the papers classified according to the number of citations and type of publication. As can be seen, the most cited papers are those published in journals, accumulating a total of 41 of the 75 papers selected, 6 of which exceed 15 citations per paper.

The selected papers that were published in journals and cited significantly outnumber those from conferences.

As mentioned by the authors [83], they confirm that journal papers are the most used when making citations, due to their structure, and the amount of information provided by them, according to the depth of the analysis conducted.

Table 5 shows the most productive authors by number of citations in the years of the present study.

Table 5: Most productive authors applying the use of Chatbots.

Authors	2017	2018	2019	2020	2021	Total
Ana M. Garcia-Serrano, Paloma Martinez, Josefa Z. Hernandez	31					31
Chiahui Yen, Ming-Chang Chiang			26			26
Adam M., Wessel M., Benlian A.					25	25
Ana Paula Chaves, Marco Aurelio Gerosa				22		22
Ahmad Abdellatif, Diego Costa, Khaled Badran, Rabe Abdalkareem ...				21		21
Lea Müller, Jens Mattke, Christian Maier, Tim Weitzel, Heinrich Graser			17			17
Alexandra Rese, Lena Ganster, Daniel Baier				16		16
Savanur A, Niranjnamurthy M, Amulya M-P., Dayananda					16	16
Siddharth Gupta, Deep Borkar, Chevelyn De Mello, Saurabh Patil	16					16
Muhammad Ashfaq, Jiang Yun, Shubin Yu, Sandra Maria Correia Lou--.				13		13
Ela Elsholz, Jon Chamberlain, Udo Kruschwitz.			13			13
Leung, Chi Hong; Yan Chan, Winslet Ting.				13		13
Ranjan, Alok; Mulakaluri, Narasimham.		13				13
Angelov S., Lazarova M.			12			12
Min Chung Han, Youjeong Kim.				12		12
Cao L.					11	11
Gilles N'Goala, Virainie Pez-Pérard, Isabelle Prim-Allaz.			11			11

The most productive authors are Ana M. Garcia-Serrano, Paloma Martinez y Josefa Z. Hernandez with 31 quotes. The other authors are also productive applying the use of chatbot in e-commerce, but in smaller quantities.

According to the author D. Han, X. Song, and Y. Cui [79], emphasizes that authors Ana M. Garcia-Serrano, Paloma Martinez y Josefa Z. Hernandez have been the most productive, providing contributions in the area of Chatbots about the implementation of Chatbots throughout 2017 and their impact on its development.

Likewise, the authors R. Toorajipour, V. Sohrabpour, A. Nazarpour, P. Oghazi, and M. Fischl, [82], highlights in their research that Chiahui Ye has been the most productive author in 2019, in the area of Chatbots implementation.

### 4.2 Answers to the Research Questions

*RQ1: What are the programming languages for developing Chatbots?*

According to the results of the literature review, Table 6 shows that there are five



programming languages for developing Chatbots and implementing them in e-commerce. The most widely used are Python (32%) and Java (25%).

Table 6: Programming language for developing Chatbots.

Programming Language	Reference	Qty. (%)
Python	[2] [5] [20] [23][32] [41] [43] [61] [62] [68] [69] [73] [74]	13 (32)
Java	[9] [12] [15] [26] [28] [40] [49] [64] [67] [70]	10 (25)
C++	[13] [27] [36] [53] [54] [58] [59]	7 (18)
Ruby	[3] [14] [31] [39] [46] [50]	6 (15)
Nodejs	[7] [19] [30] [38]	4 (10)

The use of the Python programming language provides greater impact and adoption in the development of Chatbots for e-commerce, but the other programming languages such as C++ and Ruby are also used to program Chatbots, but to a lesser extent. The least used language for creating Chatbots is Nodejs.

According to authors N. M. Johari and P. N. Nohuddin [78], it is validated that one of these programming languages (Python) is the most used when implementing Chatbots in e-commerce with respect to the others.

According to the authors J. Q. Pérez, T. Daradoumis, and J. M. M. Puig [40] in their systematic review in the field of Chatbots implementation, they found that their development to a greater extent is led by the Java and C++ languages with 42% and 29% respectively.

Likewise, the authors [82], highlight in their research that the implementation of Chatbots currently occurs in the Ruby language to a greater extent, which is not reflected in this table..

RQ2: In which areas are Chatbots being applied the most?

According to the results of the literature review, Table 7 shows that there are 4 areas in which Chatbot use predominates. The most predominant areas are e-Commerce with 41% and Bank Management with 28%.

Table 7: Areas with greater application of Chatbots.

Area	Reference	Qty. (%)
Electronic commerce	[1] [2] [4] [7] [9] [11] [13] [16] [19] [21] [22] [26] [29] [31] [32] [34] [37] [38] [42] [45] [48] [50] [53] [55] [56] [59] [63] [67] [68] [71] [73] [74]	32 (41)
Banking	[3] [8] [13] [15] [18] [23] [29] [34] [35] [37] [39] [41] [45] [47] [49] [52] [56] [58] [63] [64] [66] [69]	22 (28)
Education	[2] [5] [8] [26] [30] [38] [45] [46] [52] [55] [56] [59] [65] [69]	14 (17)
Health	[8] [15] [22] [27] [32] [41] [43] [48] [51] [56] [63]	11 (14)

As can be seen in the table above, the application of Chatbots predominates more in the area of E-Commerce which in turn is necessary to facilitate the use of the web due to the massive amount of users that day after day concur the webs in the field of purchases, instead the other areas such as Banking Management, Education or Health use the Chatbot, but to a lesser extent. The area that uses Chatbots the least is Health due to the fact that customers choose to make phone calls to speed up their appointments and not waste too much time.

Authors D. Han, X. Song, and Y. Cui [79], emphasize that E-Commerce demands more the use of Chatbot due to the fact that users need an assistant to solve their doubts as soon as possible since the telephone lines are saturated with calls and users present multiple complaints to the company generating lower sales rates in the future causing great economic losses to the company.

Likewise, L. Sanny, A. C. Susastra, C. Roberts, and R. Yusramdaleni [80], point out that the usage factors that trigger user behavior when

choosing a web platform are mostly based on the user's benefit in a short period of time when making their respective queries.

According to the authors [82], they show several areas where Chatbots are used, however 2 stand out from the others due to their large number of applications which are "Health" and "Tourism Industry" with 32 and 25, respectively.

*RQ3: What are the co-occurring keywords in research on Chatbots and their influence on e-Commerce?*

Figure 5 shows that the words "chatbot" and "artificial intelligence" are the 2 keywords with the highest co-occurrence in the selected papers.

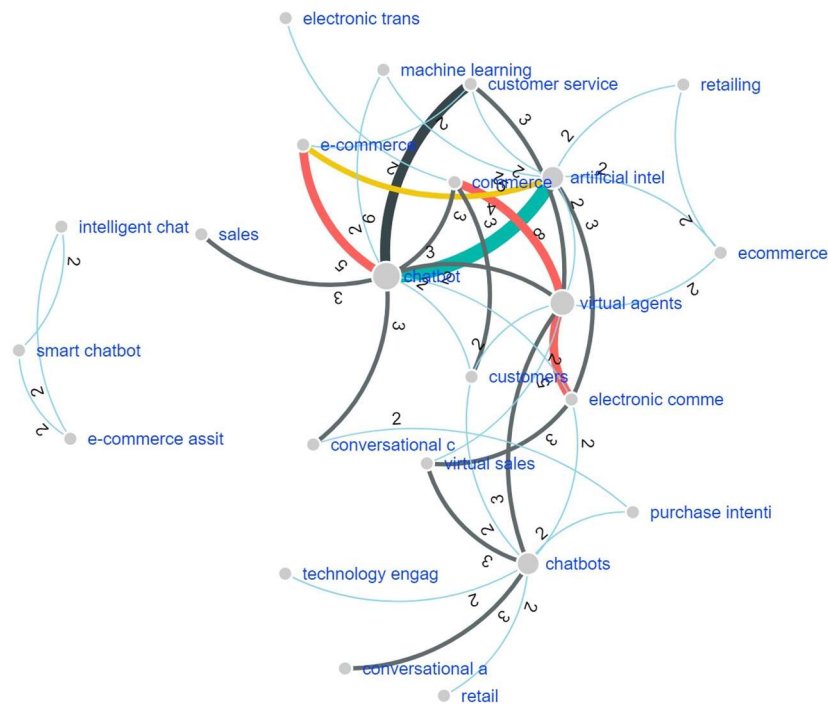


Figure 5: Keyword bibliometric network

The figure shows that there are 3 pairs of keywords: "chatbot-artificial intelligence", "chatbot-customer service" and "chatbot- e-commerce" that occur together more frequently in the reviewed papers on Chatbots and their influence on e-commerce, having 8, 6 and 5 repetitions together respectively.

Authors [79], show in their research that the keywords that frequently co-occur in the research about the influence of Chatbots in e-commerce are "customer service" and "virtual sales".

According to authors [80], in their research confirm that the keywords that frequently co-occur in research on chatbots and their influence on e-commerce are "chatbots" and "electronic commerce" respectively.

In contrast to the above, the authors [79], demonstrate in their research that the keywords that

frequently present the highest co-occurrence in research based on the influence of Chatbots in e-commerce are "technology engagement" and "machine learning".

*RQ4: What are the Clusters of Papers whose Conclusions and Discussions are characterized by high Objectivity and low Polarity in research on Chatbots and their influence on e-Commerce?*

According to the SLR, we can perceive that the cluster analysis was carried out with the objective of obtaining data that have a certain degree of homogeneity, in order to subsequently allow the analysis of a large amount of data. In other words, this analysis has proved to be a statistical method oriented to classify the papers reviewed and analyzed by means of groups (see Figure 6).

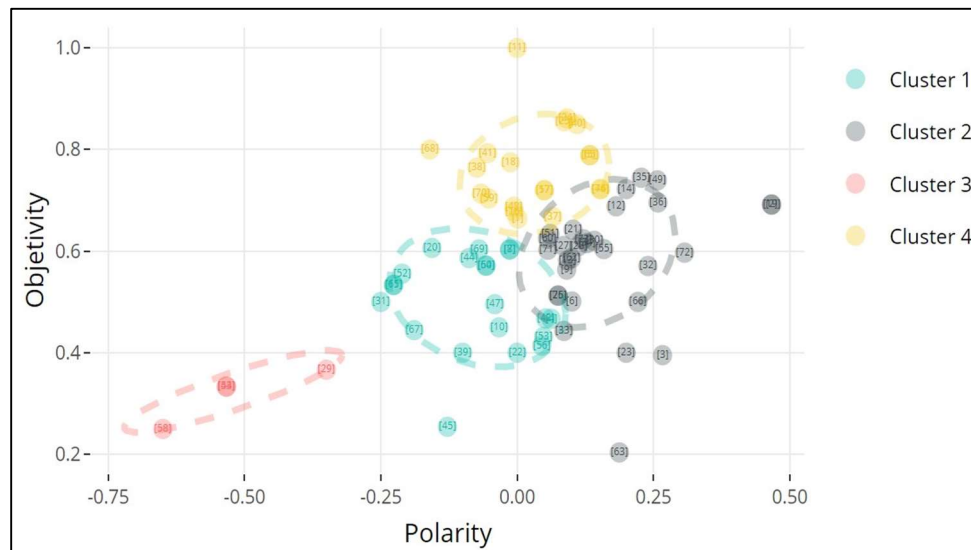


Figure 6: Clustering of papers by the Objectivity and Polarity of their Conclusions and Discussions

In the previous graph it can be seen that there are 4 clusters and that cluster number 4 is the one with the highest objectivity in its Conclusions and Discussions; and it can be seen that cluster number 3 is the one with the lowest polarity and objectivity.

According to what is shown in the graph, the authors A. K. Wardhana, R. Ferdiana, and I. Hidayah [81], agree in their analysis that cluster number 1 touches on the implementation of Chatbots and the way in which they are used by companies mainly to carry out customer service tasks and functions: placing automatic orders, communicating technical incidents, requesting information about a certain product or service, etc. Being the most objective and with the greatest polarity in this systematic review.

Finally, it is appropriate to report some limitations in the present research: only papers published in the last 5 years were considered, and it was not possible to locate enough systematic review articles with which to make a better comparison of the bibliometric network and the cluster generated with the natural language processing tool used.

## 5. CONCLUSIONS

This paper provided a comprehensive statistical and bibliometric analysis on the use and implementation of Chatbots in E-Commerce by extracting data from 75 studies published between the years 2017 and 2021. All the identified studies were papers that were mostly published in Google Scholar, followed by IEEE Xplore. In terms of the area that is having the highest implementation of

Chatbots was found to be e-commerce followed by the banking sector. It is remarkable to see that most of the papers have been produced by India, which shows the growing adoption of Chatbots in e-Commerce. Regarding the most used languages for implementation, it was found that most of them have been developed in Python, followed by Java. Therefore, future research should consider more recent research and published works on Chatbots and their implementation in e-Commerce.

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