Research article

Bibliometric Analysis of Scientific Studies Published on Game Customer Churn Analysis Between 2008 and 2022*

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Abstract: Churn prediction has become a key part of many modern businesses because of the performance advantages it brings. Business intelligence (BI) is the process of transforming data into actionable insights that help a company make better choices. This research includes a bibliometric analysis of works on game analytics, particularly customer churn in gaming business. Our research is mostly focused on identifying the content and goals of studies that have already been published. In game analytics, classification, grouping, and statistical analysis approaches are utilized to acquire insight via the study of studies. Keywords were analyzed in articles, papers, books, and research materials on gaming analytics and customer churn analysis. These difficulties are examined in the assessment section, where performance evaluation measures are more significant in this sector. For bibliometric analysis, the keyword "game churn analysis" was used. Data from Google Scholar, as well as Publish or Perish and Zotero. Year requirements for bibliometric analysis were set between 2008 and 2022. The study data analysis tools include Excel 2019 and Vosviewer. Finally, we analyzed databases, widely used data sets, game titles, metric kinds, indexing databases, countries where studies were published, categories of scientific study, word and author bibliometric maps, and algorithms.

Keywords: Bibliometric Analysis, Churn Analysis, Game Analytics, Game Data Mining, Literature Review

JEL Codes: C10, C49

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1. Introduction

Since the dawn of human existence, games have been a component of daily life and culture. In ancient cultures, there are a variety of game examples to be found. Chess, backgammon, and bills in Egypt, and Patolli in the Aztec Empire, which needed luck and strategy abilities and was played by both commoners and nobility. In Turkish and Greek culture, activities such as voting, hunting, animal wrestling, and archery may be found in Mythology and Dede Korkut Stories (And, 2003). These games, which began as conventional games and evolved over time, have managed to retain their character today.

The game notion has found its way into the literature, with several definitions from scientists working in subjects like philosophy, history, and sociology. A great deal of effort has gone into comprehending and explaining the contents of games, as well as how they relate to one another. It's difficult to give a definite description to a process or structure that is always changing (Ang and Zaphiris, 2008; Avedon and Sutton-Smith, 2015; Cardona-Rivera, Zagal, and Debus, 2020; Costikyan, 2002; Juul, 2001; Kevin Maroney, 2011; Myers and Mertz, 1998; Paddick, 1979; Roohi et al., 2020; Tavinor, 2008; Tekinbaş and Zimmerman, 2003; Whitton, 2014). Because of the game's format, it's an activity that appeals to a variety of audiences at various times. The aim here is to find common elements of definitions, to distinguish problems, and then to present a basic definition of a game, considering previous definitions.

Various scientists from the domains of psychology, physiology, philosophy, history, sociology, and cultural studies have attempted to characterize the evolution and structure of the lean game idea. According to Johan Huizinga, a philosopher and history professor who has contributed to game theory research, human civilization has been familiar with games from ancient times and is based on several primordial behaviors (Huizinga, 2016). It also highlights that the game has particular characteristics, that it is founded on honesty and voluntariness, and that it must take place within a set of rules. In this sense, play is an activity that takes place in a specific location, within the confines of time and will, in accordance with a set of rules, with the agreement of the individual, and away from the realities of modern life, and is an activity that guides social and cultural activities (Crawford, 2003; Huizinga, 2016; Kevin Maroney, 2011).

Every day, devices such as laptops, tablets, smartphones, and PDAs bring a new innovation to our lives. We frequently require and utilize these gadgets when shopping, having fun, chatting, and going about our everyday lives. In comparison to past generations, more time is given to the use of technology as technology advances. Individuals born and nurtured as "Digital Natives," according to Prensky (Prensky, 2001), have a better degree of technical competency than their forefathers. Games, thanks to technological advancements, have become an indispensable part of our lives and are available on a variety of platforms. Considering the number of players and the amount of time spent playing, digital games undoubtedly consume the bulk of time given to technology in this dimension (Tom Wijman, 2015).

Video games differ from their non-electronic ancestors in a variety of ways. The fundamental distinction between computer games and their non-electronic forerunners is that computer games can support and calculate game rules relating player conduct by adding automation and complexity, while also recreating an artificial scenario that yields a measurable score (Juul, 2001). Digital games are also electronic software that generates visual feedback for players through interaction with a user interface or input device like a joystick, controller, keyboard, or motion detection device. A visual display device, such as a television, monitor, touch screen, or virtual reality headset, is used to present this feedback. Digital games, like their non-electronic forerunners, are frequently enhanced by aural feedback supplied through speakers or headphones, as well as other sorts of feedback, such as haptic technologies (Lee et al., 2014). Academic researchers in the field of gaming, (Bergstrom, 2019) stressed that digital games are software that is successful and has great financial returns, and that users dedicate a budget to acquire this software for enjoyment. Another feature that separates digital games from their non-digital counterparts is this.

From their beginnings as a technology commercial product at a scientific fair in the 1950s to the present, video games have grown to become one of the most profitable entertainment enterprises on the planet. In recent years, the broad adoption of mobile technology has transformed industry. We can now observe that even the elderly love to play smartphone games. It has managed to become the greatest revenue-generating area in the entertainment industry today, despite experiencing ups and downs at times (Chikhani, 2015).

This research includes a bibliometric analysis of works on game analytics, particularly customer churn in gaming business. Our research is mostly focused on identifying the content and goals of studies that have already been published. In game analytics, classification, grouping, and statistical analysis approaches are utilized to acquire insight via the study of studies. Information on bibliometric analysis and game customer churn analysis is given in introduction, results of the analysis are given in findings section, and results and recommendations of the study are given in the conclusion section.

2. Business Intelligence (BI)

Business intelligence is a technology method and architecture that converts raw data into useful information, allowing businesses to make more lucrative decisions. In a nutshell, it is a software and service package that converts data into useful information. Business intelligence has a direct influence on strategic, operational, and tactical choices made by firms. By utilizing historical data, Business Intelligence assists in making decisions based on facts rather than hypothetical projections. Organization intelligence solutions show graphs, data, reports, and perform essential analysis to provide extensive information about your business (Burstein, Burstein, and Holsapple, 2008).

The main goals of employing business intelligence apps are to examine the present state of institutions and guarantee that they are able to take timely actions in response to potential dangers. It was created with the goal of separating and clustering data from diverse data sources and storing them in a logical sequence, associating stored data with statistical methods, and reporting essential information to information users at all levels within their authorized scope (Luhn, 1958). Complex information systems are becoming increasingly important as businesses grow more institutionalized. Business intelligence systems are commonly utilized nowadays to gather vast amounts of information needed in order to be as quick as possible and make the best judgments.

- Business intelligence applications transform data into information, enable organizations to use their resources more efficiently, and increase operational efficiency. It uses analytical tools to achieve all these purposes and thus combines data collection, data storage and information management (Foley and Guillemette, 2010).
- Benefits of business intelligence systems;
- Accelerating decision-making processes and reducing risks,
- Data, graph, map, table, speedometer, etc. using a wide variety of visual and user-interactive component provides effective, understandable and easy data analysis.
- Decision makers can access analyzes on mobile, tablet or computer whenever and whenever they want, thus increasing efficiency of decision-making process,
- To be able to reach forecasts and estimations for future by using statistical methods,
- Access to reliable corporate information through a single environment,
- Increasing corporate business continuity and efficiency (Burstein et al., 2008)

3. Customer Churn Analysis

One of the most crucial concerns for businesses is customer retention. Businesses prioritize preventing customer turnover as part of their Customer Relationship Management (CRM) strategy. Churn analysis algorithms are used by large corporations to predict possible losses before they leave the company. They commonly employ data mining and artificial intelligence approaches that have been popular in recent years to forecast these losses. By employing sophisticated data mining techniques backed by machine learning algorithms, BI apps may give improved consumer insights thanks to developments in machine learning. Despite the fact that it is not a subject that focuses on customer turnover, it can be stated that it is much more crucial for emerging organizations (Butler, 2000).

In recent years, customer churn monitoring has become increasingly popular in the banking, telecommunications, music apps, video platforms, and gaming industries (Gold and Tzuo, 2020). It has assumed its position in the entertainment sector, especially since the gaming industry has been quickly increasing since the beginning of the 2000s. Due to the fast integration of digital games into the business and their large revenue, the relevance of customer relations and customer churn research in the gaming industry has expanded even more. Clients have a large range of service providers from which to pick, creating a challenging and costly environment for obtaining new customers. Customer Relationship Management (CRM) has become one of the most essential long-term concerns in this approach (Ding, Gao, and Chen, 2015).

Figure 1. Tailored strategies for customer churn management

Customer Relationship Management (CRM) has always been a core function for companies, and increasing customer engagement and loyalty to company is one of most challenging tasks. Because of high cost of acquiring new customers, established businesses focus on retaining customers rather than trying to acquire customers. Estimating risk of churn is an important task in customer retention. Each percent increase in accuracy achieved in churn prediction analysis can result in significant potential revenue savings for companies. In other words, a small improvement in customer retention can result in a substantial increase in profits. This is especially true in financial services industry, where customer engagement and loyalty are relatively low, where each customer can contribute substantial profits. In financial services space, a data-driven churn forecasting model is essential to create efficient and effective retention strategies.

Customer forecasting models, which are frequently used in telecom, banking, music and video platforms, are one of the most important factors for success, especially in the form of online and mobile platforms, considering the market and business intelligence problems closely related to game industry today. It is also important in the process of identifying and defining the subscribers to be reserved for company. It's customer churn analysis or loss estimation, and any subscribers, users or players – those leaving service, are often referred to as "churners". A Lost Customer (Churned) is when they stop using or unsubscribe from a service (Gold and Tzuo, 2020).

Innovation can increase customer value or provide better services for customers and markets. In the operations of the IT industries, innovation is the only measure of survival. Successful game companies must update themselves with an innovation focus, respond flexibly and quickly to customers, and continue to innovate products and services so that they are not lost. business model innovation; It is a new innovation that is as important as technical innovation and traditional innovation. It can be said that such marketing models are directly related to business innovation (García, Nebot, and Vellido, 2017). It has been stated that business model innovation means redefining customer value propositions or organizational roles in the value chain. In this respect, business model innovation aims to create added value for customers.

Decision-making phase regarding game development for different platforms (computer, mobile and console, etc.) in game industry is one of important aspects of game development and game marketing. All of these platforms have different features and each has different player groups within itself. In recent years, a great increase has been observed in mobile game market due to increase in number of smart mobile devices with iOS and Android operating systems. In addition, it is obvious that it has a large share in game industry with its appearance in big budget games called AA and AAA on console platform. AA and AAA are term used for business and product budget in game industry. The console market today is shaped by Microsoft (XBox), Sony (Playstation) and Nintendo (Wii). Primary purpose of establishing games on this basis is model of owning game indefinitely by paying a fee each time so that user can play game (Zackariasson and Wilson, 2012). Console devices are not like computers or smart phones, they are devices developed only for playing games. This feature has also been effective in turning consoles towards such a marketing policy.

Figure 2. Bundling cover photos of some AA and AAA games in industry

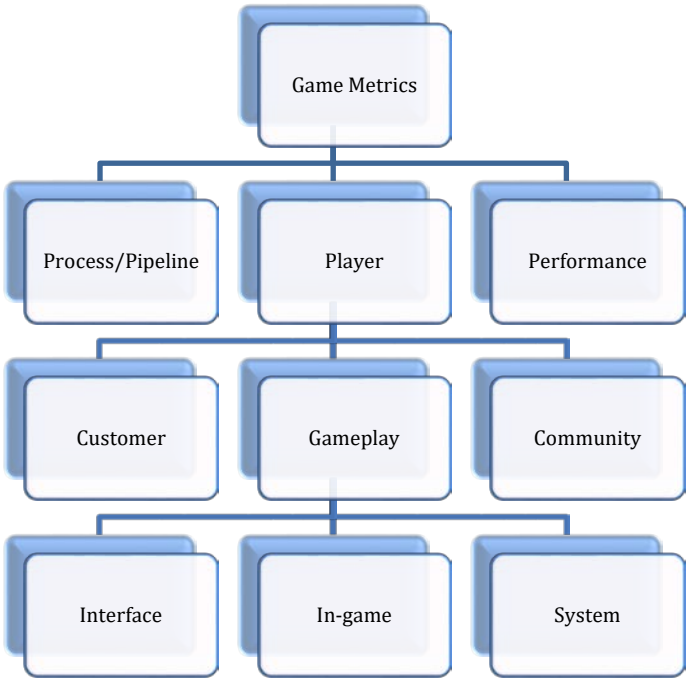
The difficulty of predicting player behavior is a major barrier in game design and development. This necessitates a time-consuming and costly iterative prototype and test design approach. Before investing resources to real-life playtests, research should generate models and tools that allow early assessment of the impact of design decisions. One of the key objectives for player and user modeling (Borbora and Srivastava, 2012; Rothmeier et al., 2021; Vítek, 2020) is to do so. Better models and tools are needed in particular to forecast and optimize crucial business behaviors like player stopping and non-returning to game. Because many current games earn money over time through in-game adverts and sales rather than a single upfront price, churn is high.

Businesses, for example, aim to identify levels with high churn rates and reduce them. However, rather of continually sending out different game level versions to players and watching what occurs, it is more vital to develop predictive churn models that allow designers to undertake initial testing and prototyping. However, there is a scarcity of study on making better use of players' playing time. Free online games give gamers access to games at no cost. A free online gaming firm's revenue is dependent on in-game purchases, much like other free products and services. These earnings allow the company to continue in business.

4. Game Metrics

While examining the scientific texts examined in our study, subgroups of player metrics were examined under three headings: customer, gameplay and community. It is possible to see that there are studies focusing mainly on customer metrics. The figures are given in detail in Findings section.

Figure 3: Hierarchical diagram of game metrics emphasizing user metrics



Source: El-Nasr, Drachen, and Alessandro Canossa, 2013

4.1. Customer Metrics

Customers can download and install a game, then buy any number of virtual products from in-game or out-of-game businesses and shops, using real or virtual cash, over short or extended periods of time. Customers communicate with customer support, send bug reports, assistance requests, complain, and interact with the firm in other ways at the same time. Users can also communicate via forums, whether official or not, or any other type of social interaction site, where data about the users, their play behavior, and how pleased they are with the game can be mined and analyzed. Covers all elements of the customer, such as acquisition and retention costs. Professionals in the marketing and management fields are particularly interested in these measures (El-Nasr et al., 2013).

4.2. Community Metrics

Players communicate with one another. This engagement can be either game-related – for example, combat or collaboration through game mechanisms – or social – for example, in-game communication. Interaction between players can take place in-game, out-of-game, or a combination of both. For example, employing a post-to-Facebook tool to send messages bragging about a new piece of equipment. Interaction can take place in-game via chat tools, or outside of the game via live communication (e.g. via Skype) or game forums. These types of exchanges between players are a valuable source of knowledge that may be used in a variety of situations (El-Nasr et al., 2013; Gold and Tzuo, 2020).

4.3. Gameplay Metrics

Any variable relating to the user's real activity as a player - within the game, such as object interaction, object trading, and environment navigation. Gameplay measurements are the most significant for evaluating game design and user experience, yet they are the furthest removed from the typical revenue stream in game production, and hence are often overlooked. Professionals working in design, user research, quality assurance, or any other role where the actual behavior of users is of interest will benefit from these measurements (El-Nasr et al., 2013).

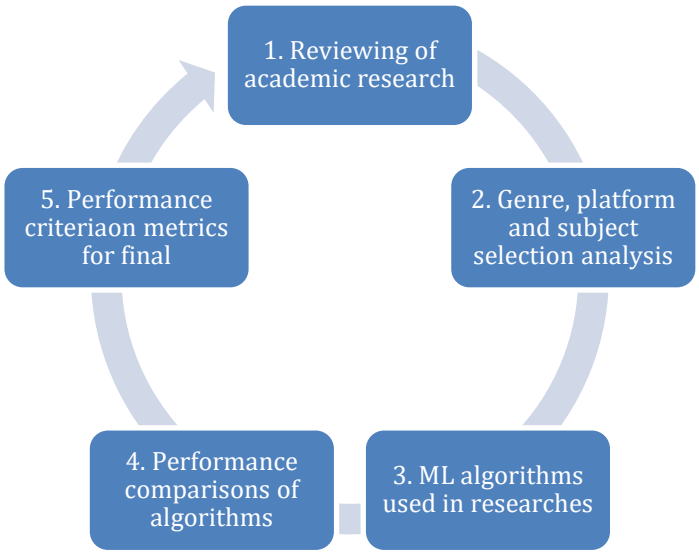
5. Research Method

Bibliometry, which is formed by the combination of the Latin “Biblio” and the Greek “Metri” words, is based on the prospective contribution of scientific content published on a specific subject with numerical data and analysis. In the previous periods, it was also referred to with concepts such as informetrics, librametry, webometrics, scienctometrics (Qiu et al., 2017). To make a general definition, it is to illuminate the processes of science and technology by counting written documents (Hulme, 1923). Today, it is one of the interdisciplinary research fields that is actively used in almost all fields, including fields such as basic sciences, engineering, natural sciences, and life sciences (Glänzel, 2003). In the final analysis, it provides a visual mapping of the most cited studies, the most productive and influential authors, journals, institutions, countries, and the relationship/collaboration between them on a researcher’s research topic(Kurutkan and Orhan, 2018).

The studies gathered as part of the research span the years 2008 to 2022. Academic research on game churn prediction has exploded in recent years. Academic research published during examinations, on the other hand, began in 2007. As a result, investigations done between 2008 and 2022 are included. In 2008, the bulk of society began to actively utilize computers, and more successful and playable games were introduced. 73 academic works (articles, books, papers, compilation pieces, and so on) published in indexed

scanning journals under the term "game churn analysis" are discussed in IEEE and Google Scholar databases. The evaluated papers were searched for answers to the following queries.

Figure 4: Our life-cycle and steps for bibliometric analysis



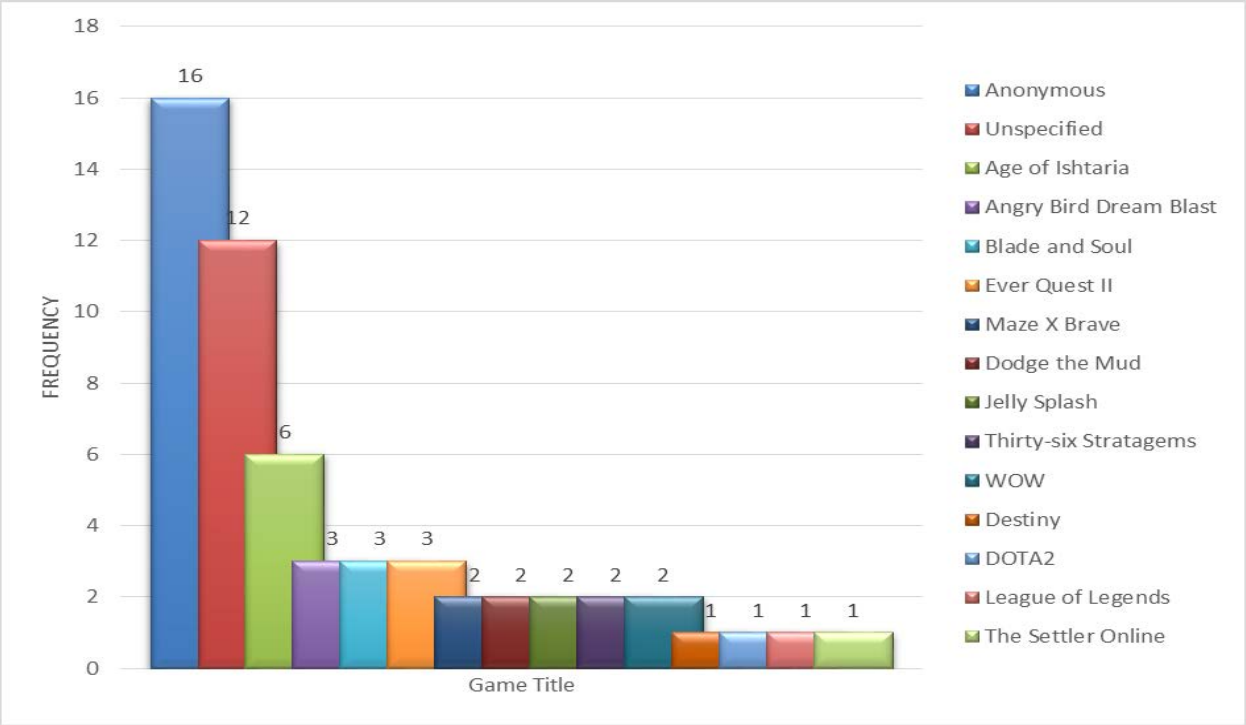
This research is based on a review of the literature on game analytics, namely customer churn analysis in the gaming business. Our research, which is based on specific goals, is largely focused on identifying the substance and goals of investigations. It was attempted to acquire a sense of what classification, clustering, and statistical analysis methods in game analytics are for. Articles, papers, books, and research materials relating to gaming analytics and customer churn analysis were investigated as part of the study. Then it's looked at which metrics stand out in game analytics and which artificial intelligence algorithms are widely employed. Finally, in the assessment part, these problems are discussed, including whether performance evaluation measures are more essential in the area.

- *Q1. What types of studies have been carried out in churn analysis studies on gaming and how are subject distributions?*
- *Q2. What kind of algorithms have been used on which kind of game data and which of these algorithms are performing?*
- *Q3. Which metrics are more prominent in performance evaluation section?*
- *Q4. What is research demographic information between 2008-2022?*
- *Q5. What are often encountered problems in researches?*

6. Findings

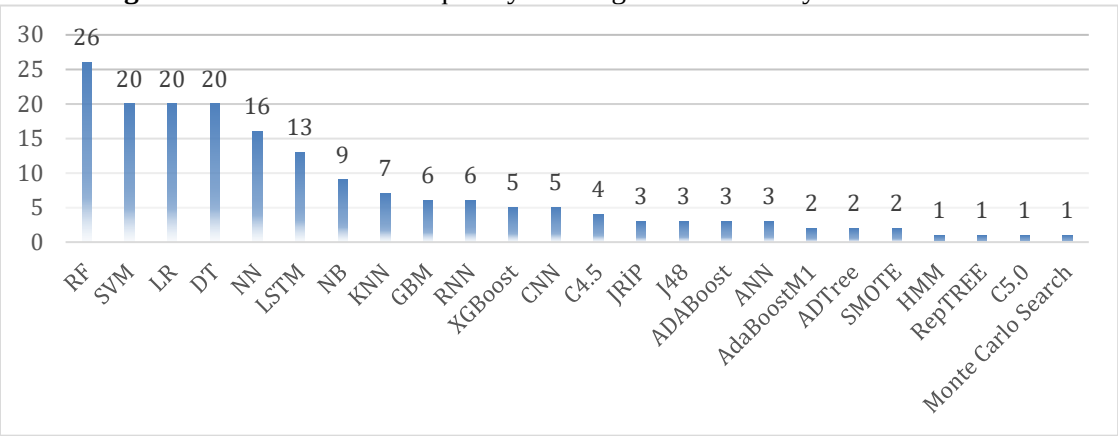
From 2008 to 2022, the terms "game churn prediction" and "game data mining" were chosen. In this regard, the dataset used in 73 papers was assessed based on the type of game, the purpose of the research, the methods usually utilized, and the quantity and structural aspects.

Figure 5: Distribution of data used in researches by game title



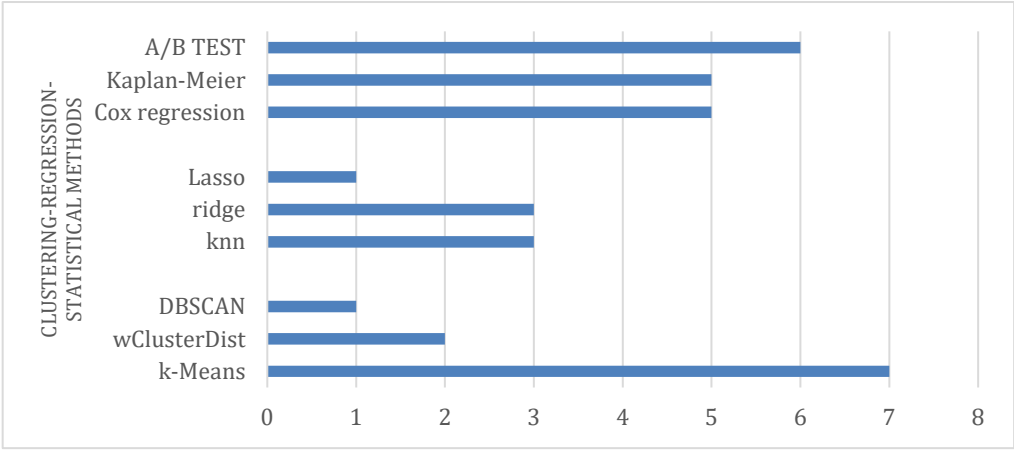
As demonstrated in Figure 5, firms have given academics titles of games to create machine learning models in published studies. We say that MMORPG and mobile game data are among the most popular games whose names can be published in studies. Main issue is that "data" is the most fundamental requirement for customer churn analysis in games. Game data is not disclosed publicly due to ethical and sharing agreements between corporations. In addition, titles of games and datasets utilized in majority (n=16) of studies were not made available. Upcoming group (n=12) is unspecified. This is a group that does not post any game-related material in this area. Researchers only talk about general structure of data, but do not share any details about content, data detail, type and number of records. Games like Age of Ishtaria (n=6) and Angry Bird Dream Blast, Blade and Soul (n=3) are followed by anonymous and undefined groups. Those games listed above are datasets that have been utilized in several studies. It has been offered to researchers for the development of models in more than one study. As a result, it is possible to discuss data scarcity. The graphs that follow provide detailed information on data limitations.

Figure 6: Distribution of frequently used algorithms in analyze - classification



One of the most intriguing aspects of bibliometric analysis is the methods utilized. Previous algorithms' tree-based models have been shown to be effective in predicting consumer turnover in games. The most popular method, as seen in Figure 6, is Random Forest (n=26). After that, the algorithms Support Vector Machine, Logistic Regression, and Decision Tree (n=20) are used. Tree-based models and neural network models are the most common. When we look into ensemble approaches, we can see that they aren't utilized very often statistically, but they do function well on mobile gaming data in recent studies. Although these algorithms emerge statistically, it would be incorrect to assert that a machine learning algorithm performs well on every topic, therefore researchers may experiment with multiple methods based on data. However, as a result of our study, algorithms like SVM and LR are commonly utilized in classification tasks alongside tree-based models (most used problem approach in research).

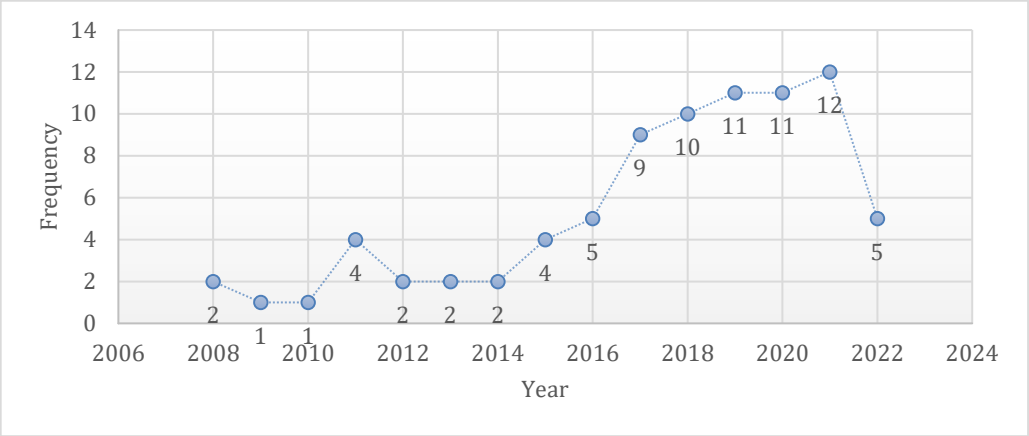
Figure 7: Distribution of frequently used algorithms in analyze – clustering, regression, and statistical methods



Apart from classification, it is known that clustering, regression and statistical models are used. Sometimes it is necessary to cluster customers/players, while sometimes regression methods can be used to estimate survival time to the company. On the other hand, a prediction can be made by how long game will be played with A/B. While these methods are sometimes used alone, they can sometimes be used to support classification methods. As seen in Figure 7, A/B test was used most frequently in statistical models, while

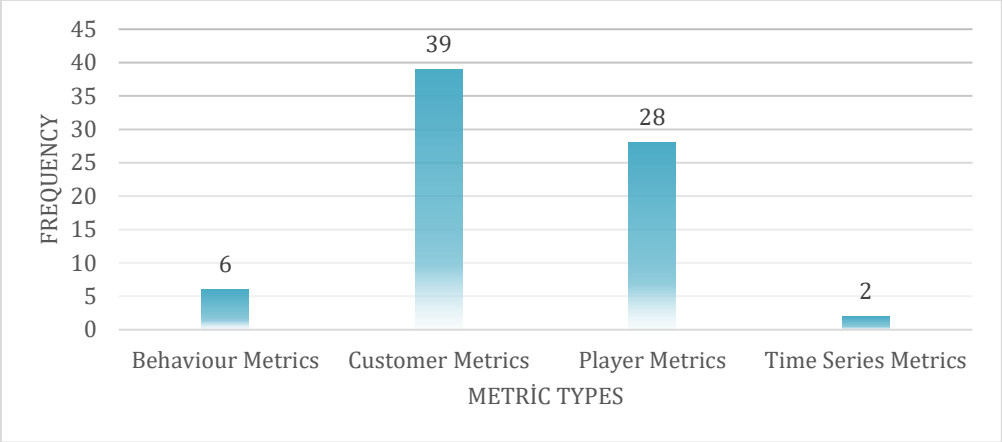
knn and ridge regression were used in regression problems. It is seen that k-means clustering algorithm, which is frequently used in the solution of other problems in clustering analysis, comes to the fore.

Figure 8: Number of published studies on game churn prediction by years



Customer churn analysis has come to fore in academic terms with popularity of Business Intelligence. It has been actively used since 2000, especially in telecom, finance and insurance sectors. In these sectors, this type of analysis gains importance as customers have a fixed membership system. It is very important to predict whether or when customer intends to quit using service. However, due to platform differences and active use of F2P system in gaming industry, it is much more difficult to predict than in other industries. It is very difficult to predict what player is not satisfied with. In this respect, approaches to classification problems have increased after machine learning libraries were made available to public. Significant advances have been made in terms of data mining and artificial intelligence problems. In this respect, studies on game customer churn prediction have been published since 2008. While a few studies were published until 2016, increase in number of studies after 2016 is seen in Figure 8. Game customer churn prediction, which is one of popular topics in recent years, has become an important concept with academic studies on it day by day. It can be said that these studies will increase even more in coming years.

Figure 9: Distribution by metric types analyzed

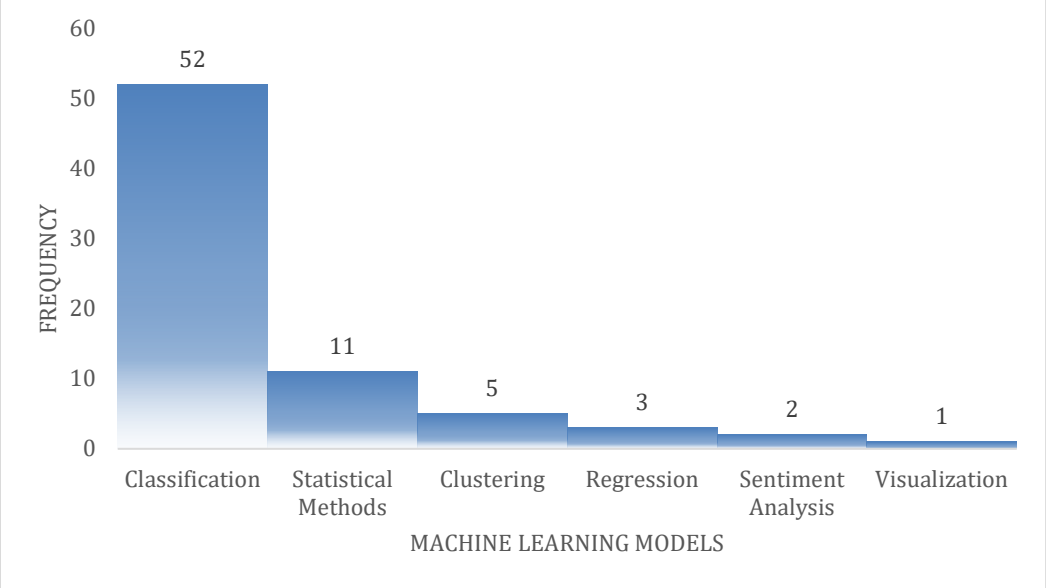


As Drachen (El-Nasr et al., 2013: 7) stated in game customer churn analysis, some metrics come to fore. Especially in recent years, due to rapid income generation in mobile sector, a more customer-oriented approach has been adopted in this field. However, for MMORPG games, which have a payment system in a certain period, a more player approach comes to the fore. Other metrics are behavioral metrics and time series metrics that are exempt from user information. Studies show that it is used less than other metrics.

As can be seen in Figure 9, it's seen that mainly customer and player metrics are processed. Also, it's difficult to understand or predict why customers stop playing games, especially since game variety offered in mobile game section and monetizing method that offers membership system is not used. For many reasons, customer may stop playing game. These reasons are listed below.

- Waste of time and money,
- Cause social isolation,
- Lack of technological devices,
- Weak internet connection,
- Long game intervals,
- Bad game inputs and UI,
- Wage policy
- Many elements can be added, such as the player's wishes.

Figure 10: Methods used in research

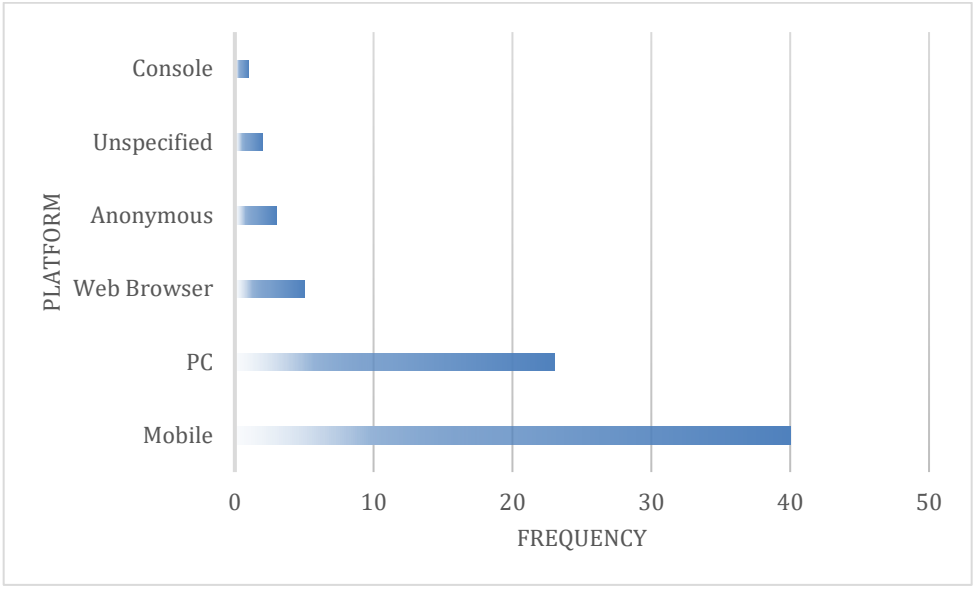


We can roughly define Churn analysis as whole of analytical studies on "a customer", "a product or service", "probability of abandonment". Our aim is to be aware of this situation before customer leaves us (approaching to leave) (even the customer himself may not be aware of this situation) and then to take some preventive actions. In this analysis, which is also considered as a classification problem in field of machine learning; Users' demographic information, past high-level actions, frequency and duration of using service / product they receive, links between actions they take while using service / product, etc. tons of information needs to be collected, processed and evaluated. The fact that cost of acquiring new customers is higher than cost of retaining a customer has made customer abandonment analysis an indispensable part of strategic decision-making and planning process. Customer separation analysis gains even more importance in rapidly growing telecommunication sector, where competitive environment is increasing day by day, customers

change operators easily, and companies lose millions of dollars for this reason. Customer churn analysis provides an opportunity for company to develop various campaigns and policies aimed at increasing loyalty of these customers by predicting customers who are planning to switch to competitor company. In recent years, data mining and artificial intelligence techniques have been used frequently for customer churn prediction.

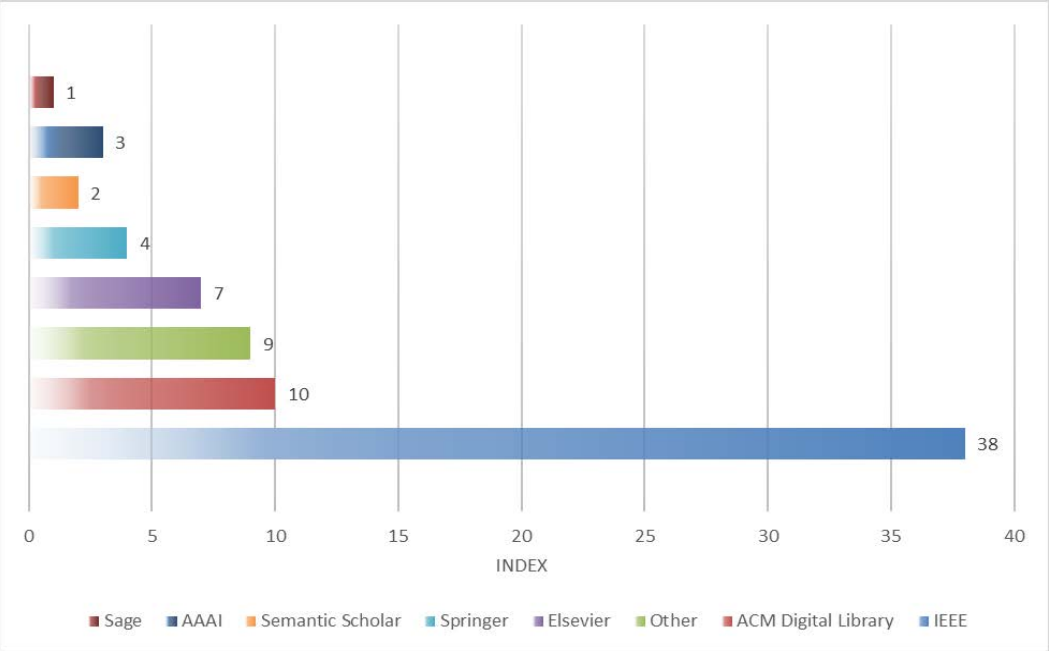
Especially in published researches, it is seen in Figure 10 that classification approach is clearly ahead. It can also be said that statistical methods, clustering and regression approaches are used to support classification. In classification problem, customer is looking for a solution to binary classification problems, either missing or absent. In particular, companies that perform customer churn prediction cannot reach 100% success rate, as in machine learning problems. Due to nature of artificial intelligence, current studies are not suitable for this, but being able to make a prediction or prediction is very important in shaping steps to be taken. It is most frequently used method in studies with classification methods (n=52) and emphasizes importance of classification in this area for future studies.

Figure 11: Genres used in research



Digital games are classified into many categories based on their platform and gameplay features. On a platform-by-platform basis, we assessed publications. The reason for this is that digital game revenue budgets for mobile, PC, and console games differ. The mobile industry has grown in prominence, especially since the widespread usage of smart phones throughout the world. In their published experiments, researchers constructed a model based on mobile gaming data, as shown in Figure 11. Games played on computers and web browsers come in second and third place, respectively, on the mobile platform and on the computer and web browser platforms. Other statistical data shows that anonymous and undefined rates are substantially lower. As a consequence of this research, it is feasible to predict that in future studies, new techniques and algorithms will be tested on mobile data.

Figure 12: Distribution chart by databases



Some databases and publishers were showed in Figure 12. These; IEEE, Springer, WebofScience, Scopus, ACM digital library, AAAI and Sage are some of them. As can be seen in Figure 12, it is seen that majority of studies carried out are in IEEE index. Almost half of 73 publications scanned are scanned on IEEE. This proves compatibility of studies and contents in this field with IEEE format and subject content.

Figure 13: Distribution of researchers by country – World map

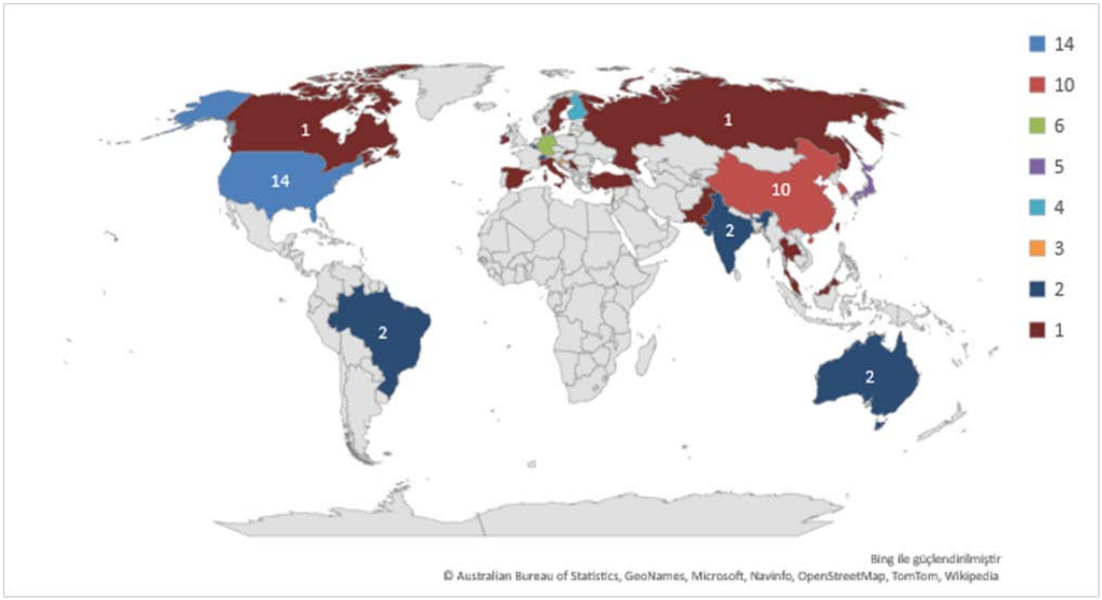
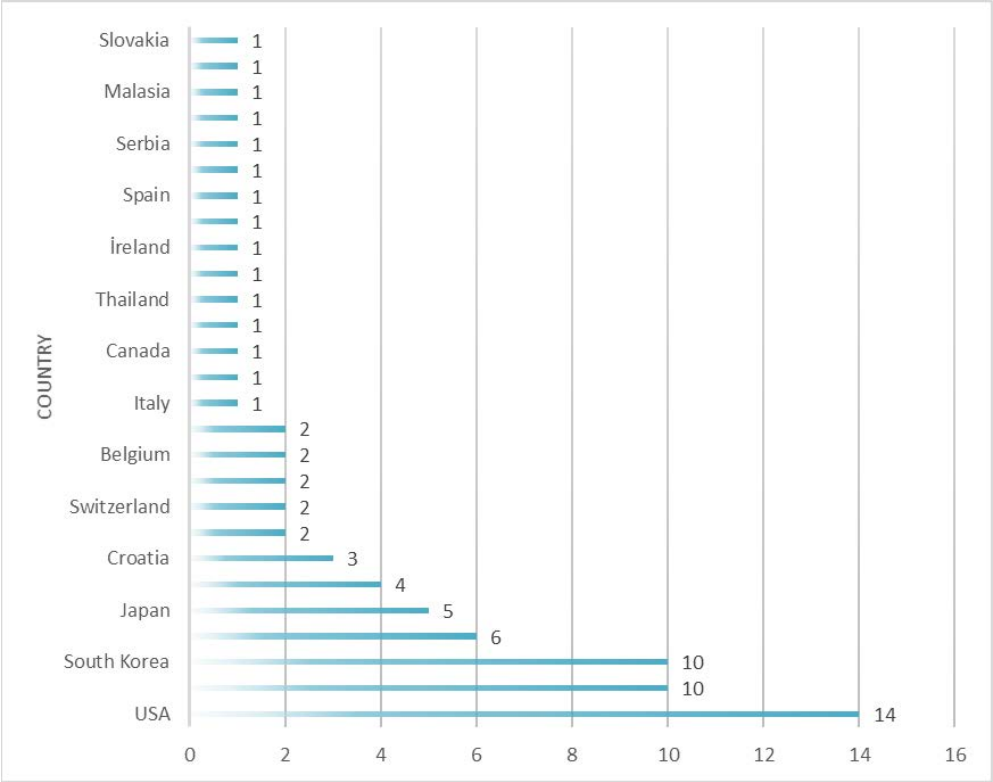


Figure 14: Distribution of researchers by country



As seen in Figures 13 and 14, United States has the most publications. China and South Korea are next in line. The countries that follow them are Germany and Japan. According to data from 2021, China and the United States are the top two nations in the world in terms of academic publications, with 744 thousand and 624 thousand, respectively. The number of scientific publications per capita in China is larger than in the United States, despite the fact that China ranks first in terms of academic publications. On the globe map, Figure 9 depicts the distribution of broadcasting countries. Finland and Croatia are highlighted in this study because they have raised the quantity of scholarly papers on game studies in recent years.

Figure 15: Distribution of published researches by type

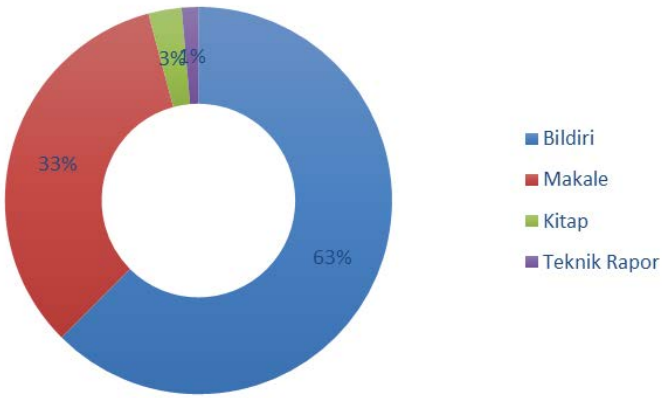


Figure 15 shows the distribution of scientific studies undertaken within the field of study by category. According to the graph, research focusing on paper and article publications came after it. While it's true that scholarly research in this topic are restricted, the low quantity of books is understandable. Because gaming customer churn prediction is a popular topic, it's reasonable to expect a large number of books to be included in this analysis. In this regard, it is anticipated that the publication of book material on this topic would contribute to the literature.

Figure 16: Overlay visualization of keywords map

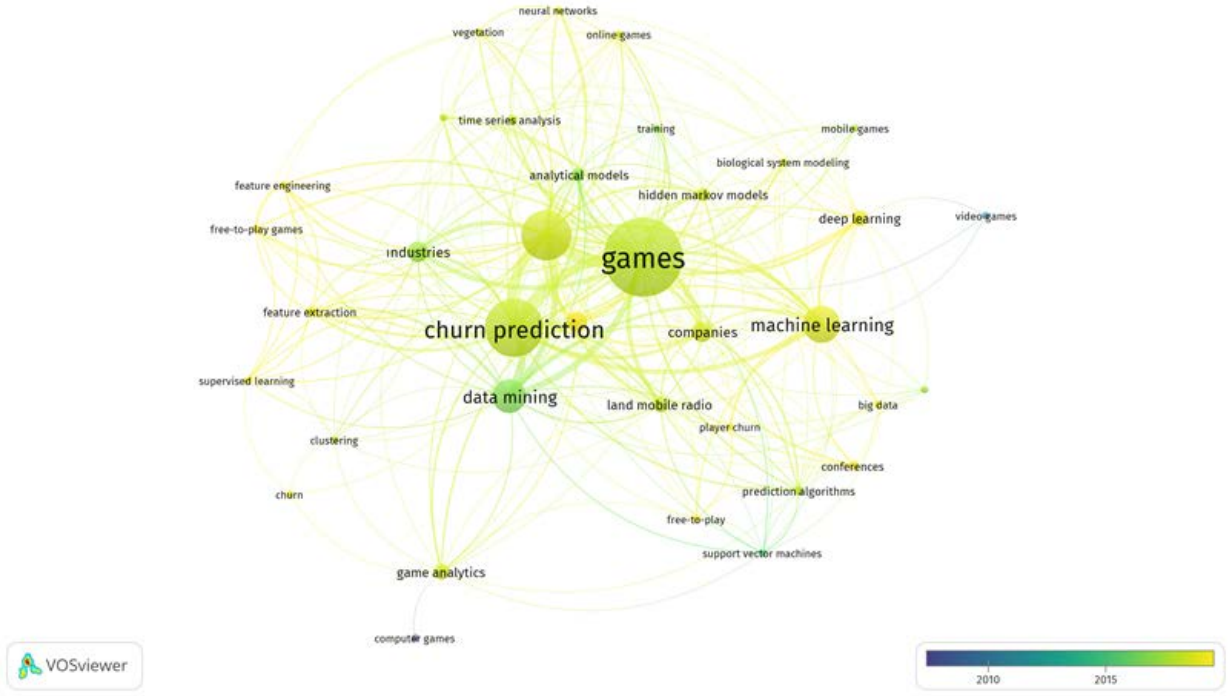
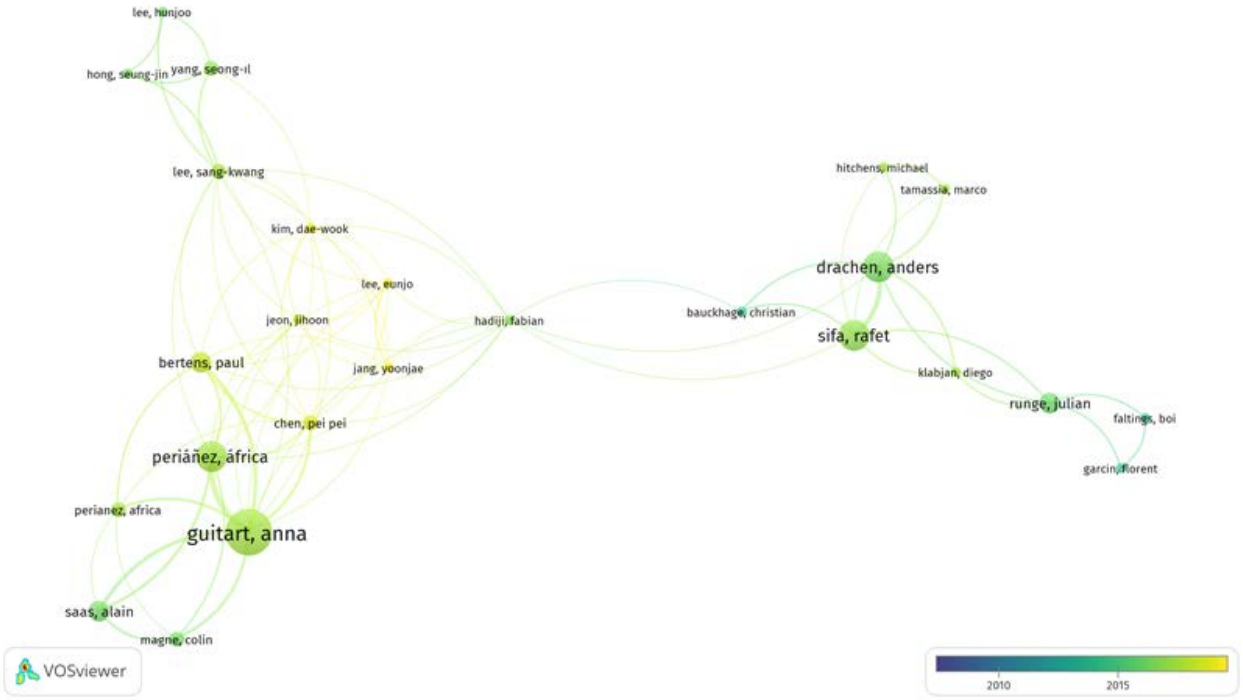


Figure 16 shows a graphic representation of terms utilized in scientific research. The most frequently used and clustered terms in this research are "games," "machine learning," and "customer churn analysis," with ideas including predictive models, data mining, churn customers in games, game analytics, and mobile and computer games dominating following keywords. At the same time, free-to-play is the most dominant keyword in these three clusters. It's easy to see how crucial customer churn prediction is in F2P games from this perspective.

Figure 17: Overlay visualization of author map



Another important part of bibliometric analysis is authors of researchers. These researchers come to fore in customer churn prediction in playground. Especially Guitart (Bertens et al., 2018; Bertens, Guitart, and Perianez, 2017; Lee et al., 2019; Periáñez et al., 2016), Sifa (Bauckhage, Drachen, and Sifa, 2015; Drachen et al., 2016, 2018; Hadiji et al., 2014; Sifa, 2021; Tamassia et al., 2016) and Drachen (Bauckhage et al., 2015; Drachen et al., 2016, 2018; Hadiji et al., 2014; Tamassia et al., 2016) are researchers that contribute to literature in this regard. Again, in this context, Lee (Lee et al., 2014, 2016, 2016, 2019, 2019; Lee, Kim, and Lee, 2017), and Kim (Ahn et al., 2020; Beirne-Smith, Patton, and Kim, 2006; Hwan, Il, and Kang, 2018; Kim et al., 2017; Lee et al., 2019, 2017), who are among researchers in Eastern countries, are among researchers in this field.

7. Result and Discussion

Academics and researchers in the fields of data mining and machine learning believe that there is an issue, particularly in the area of data discovery. Original and up-to-date data is extremely difficult to get by. Current contracts may be formed in corporations to gain access to data from many industries, but these data are not shared with anybody outside of the contract's scope. One of the issues encountered in customer loss analysis is this. Because the data to be gathered represents a company's current and immediate data over a period of time. Managers may be hesitant to make the data public in such circumstances owing to ethical and business standards.

The challenge of gathering data in other areas manifests itself a little more, particularly in the study of gaming customers. Because game development businesses deal with publishers, and publishers don't want their customer/player stats shared with just anybody. When checking at the sites where data is

published (UCI repo or Kaggle), it becomes clear that the uploaded datasets for the game either do not fulfill the standards or do not exist. It would be more rational for academics interested in developing a model on this topic to reach an agreement with a gaming firm to have access to data. Apart from the aforementioned alternatives, researchers may get in-game metrics by using the API in the developer section of the game.

Aside from locating data in gaming customer churn research, another issue is predicting why the player/customer departed. If a mobile tariff is too expensive, can't be used in every place, or if other campaigns are more appealing, an individual can cancel his membership and transfer to another company. It's not difficult to figure out. Or, among the factors that financial businesses claim as churn are the high promotion rate obtained from other banks in the banking sector and the high monthly interest rate of the account. In the gaming sector, however, gamers do not erase data from the system after they register an account to play a game, as they do in the financial and telecommunications industries. The user can play the game by going back to the one he deleted a while ago; but, because he did not deactivate the account, the inactive process continues. One of the issues encountered is being able to foresee this dormant process. Furthermore, another issue with the data acquired is its timeliness. Because the earning models in the gaming sector are always changing, a model built on an older dataset may not achieve the same level of performance in the present time.

As a result, while customer churn analysis is becoming a more prominent topic in gaming, certain challenges that have been found and may be met in future research are discussed. It would be good for anybody conducting study on this topic to think about these difficulties. If we list these issues in substance, it is as follows;

- Finding data
- Access to up-to-date data
- Estimating inactive time
- Data sharing policy of companies

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