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Mapping User Experience Information Overload Problems Across Disciplines

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***Abstract*— User Experience (UX) has been increasing linearly with the systems and digital media. UX concept describes a human factor as an experience with the life cycle of digital technology. UX increases the usability of the product in the industry more than functionality. Interest in UX has produced a huge amount of product and research articles. Moreover, this interdisciplinary topic becomes increased significantly because of the wider applications. However, this benefit become a problem due to the number of publications. The information overload problem is the result of the increasing UX topic. Several researchers solved this problem with qualitative analysis, but it cannot solve the overload problem. In this paper, we purposed bibliometric analysis and research profiling to interpret UX information on the map, with the publications from 1998-2022, a dataset compiled in RIS format to provide article metadata. As a result, the UX information map from the topic with the five clusters. Therefore, to provide information on the topic's coherence, we propose a coupling network. A related topic is shown as a link; a direct link means high coherence between topics. The analysis was carried out using the 5W1H approach (what, where, who, when, why, and how). The results show that UX is indeed an interdisciplinary field, especially with a design approach and user experience. In addition, to determine novice researchers, determining the focus of research can be done by taking into account previous research goals and maps.**

***Keywords*— User experience; information overload; bibliometric analysis; topic coherence.**

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I. INTRODUCTION

Human-Computer Interaction has been increasing since the first era of computer science. The first era is human factors engineering [1]. Humans, as users of the system, are set according to where they work. Part of the problem of the human engineering factors is such as underlying the values of the people and their motivation in the work to be interpreted in the system. The second era is usability and user-friendliness [2]. In the second era, people were more aware of the system's usability than its functionality. The last era is user experience (UX). The concept of UX was mentioned in 1995 [2]. Moreover, the UX concept has increased dramatically since the mobile technology era. UX, the digital industry's main point, has developed into an important factor in delivering products to customers.

UX is always associated with the design and presentation of software [3]. For example, people are aware of what mobile apps look like and how responsible the apps are with the different operating systems. The researcher believed that UX increases the efficiency of organizational products in the industry [4]. Moreover, the industry's development cost may decrease when customers are included in a product. Some methods, such as User Center Design (UCD), integrate the customer with the product. Customers have been considering the functionality of the product meanwhile developer presented it in the designs.

Increasing UX in the industry led the researcher to a vast number of scholarly publications. However, this increase makes an information overload problem. The problems became bigger to the field structure of UX due to the wide area of UX from computer science [5]–[7], social science [8]–

[10], medicine [11]–[15], psychology [16]–[18], mathematic [19]–[22].

Previous researchers have introduced several solutions for information overload problems, such as systematic reviews, literature reviews, primary quantitative and qualitative papers, and grey literature [23]. In addition, these solutions bridge the gap between the transfer of knowledge and exchange activities. However, a qualitative method like a literature review is subjective and involves the risk of biases [24].

Bibliometric analyses have become popular for solving subjective biases in knowledge transfer. Bibliometrics can combine author information, abstract, and keywords. Researchers mostly combined qualitative and quantitative methods with the largest dataset of publications. This method was also popular for mapping UX research. There is a number of advantages to this method. First is represent citing behavior, and the second is mapping-related research. The last is to show engagement in the UX field.

In this paper, our study aims to identify UX from 5W1H (what, where, who, when, why, and how) questions and map the UX field in the wide disciplines area. The results are presented in both descriptive and visual presentations to bring researchers in the quantitative and qualitative methods as a solution for information overload problems. The remaining section of this paper is organized as Materials and Methods, data acquisitions, and the information about proposed methods are given in section 2. Results and Discussion, the obtained results, and discuss how the proposed method solved the problem are given in section 3, and the last is the Conclusion.

II. Materials and Methods

In this paper, we followed the research profiling combined with bibliometric analysis. Research profiling is a popular method empowered by text mining tools that are combined with the science database and search engine.

A. Materials

We used article research from IEEE, Taylor and Francis, ScienceDirect, MDPI, ACM, Mendeley, DOAJ, and Google Scholar with category journals and proceeding articles.

B. Method

We used five steps to resolve information problems in the UX field. The First phase is initializing phase of topic identification. The main challenge focused on the research term "user experience, " not actually on user experience in design and Interaction. To eliminate this problem, we purposed data cleaning in step four. The second phase is the selection of information sources. For the selection information process thorough database search of IEEE, Taylor & Francis, ScienceDirect, MDPI, ACM, Mendeley, DOAJ, and Google Scholar was conducted to retrieve and analyze articles from journals and conferences in the range from 1998-2022, as shown in Table 1. The third phase is data retrieval. In this phase, we used a search facility in each website and software Publish or Perish [25]. In MDPI, Taylor & Francis, IEEE, and ScienceDirect we used RIS as a format data for export, for ACM, we used BibTeX, and for others, we used Publish or Perish with RIS data. The fourth phase is data cleaning. In this process, we combined in reference manager Zotero. First, data is imported to Zotero, and we check each article manually for the information provided. This paper needs data such as Item type, Title, Author, Abstract, Publication, Volume, Pages, Date, Journal abbreviation, Language, DOI, ISSN, and URL. Last, we remove an article that is not closely related to the UX in each article. For example, the article [26] in this paper is not related to UX but search engines on websites provide this article as relevant to UX. In this step, we remove 245 articles. The fifth phase is representation and interpretation. In this phase, data is represented as a table and graphics an interpretation as descriptive.

In this paper, we used bibliographic as our dataset that compiles as RIS documents. In the last method of our research, we used interpretation and description. For interpretation, we used bibliographic coupling networks [27]. A coupling network can be constructed for different analyses that we used in these publications. There are several functions of coupling networks such as the interpretation of publications, journals, researchers, and topics. For the bibliographic coupling networks, we follow Equation 1 [27].

$$v_{ij} = \sum_{k=1}^{M} C_{ik}\, C_{jk} \quad (1)$$

Where v_{ij} is a full counting bibliographic matrix between researcher i and j.

III. Result and Discussion

A. Number of Publications

This paper is compiled from several resources from the range 1998-2022 as shown in Table 1. Figure 1 shows the increase in the number of published pieces of literature for articles in journals and proceedings. In this paper, we compared several publications from popular publishers. Slightly increase in publications, reaching up to 300 times in the last 20 years from 2000. Moreover, the number of publications in ScienceDirect reaches the top of other publishers, this number from one keyword. However, ACM reached its temporary peak in 2019. The article from 2014 to 2021 represents half of the total literature from the dataset, and this period is the most productive year for UX. When we talk about the most cited was achieved by the article from IEEE that talked about 5G technology to enhance UX [28].

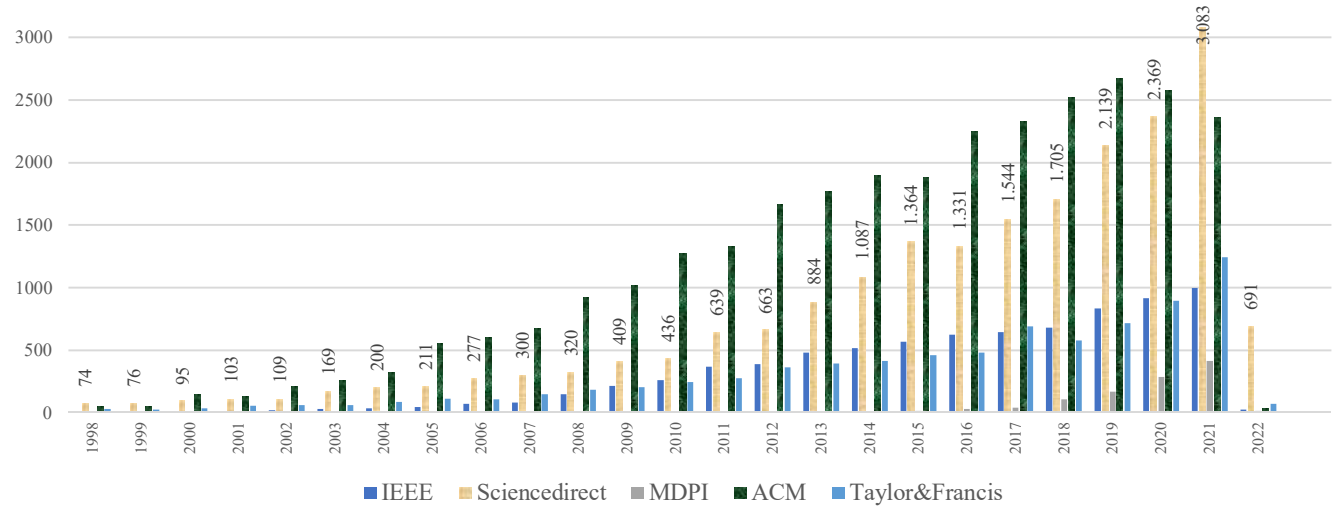

Fig. 1 An annual number of UX publications

TABLE I
THE NUMBER OF PUBLICATIONS AND DATASET RANGE

Source	∑	Range Years
IEEE	10.800	1998-2022
Taylor Francis	10.652	1998-2022
ScienceDirect	31.784	1998-2022
MDPI	3.604	1998-2022
ACM	3.220	1998-2022
Mendeley	117.377	1998-2022
DOAJ	2.416	1998-2022
Google Scholar	475.780	1998-2022

B. *Publication per Subjects*

Table 2 shows the number of the top three subjects in each publisher. The result interprets the "user experience" in each publication. Each publisher has different subjects based on the aim and scope of their journal. The most subject is IEEE with 25 subjects and in this publisher specific in the computer science and engineering category. The most record in IEEE is mobile computing subject with some publications is 1.214 records. Taylor & Francis has 10 subjects wider, from engineering and technology, computer science, humanities, economics, behavioral, information science, art, medicine, health, and communication. ScienceDirect has the same number as Taylor & Francis for the subject with different categories of subjects. ScienceDirect includes mathematics with the lowest number of publications, with 725 records. Same to ScienceDirect and Taylor & Francis, MDPI has 10 subjects. There are interesting subjects in MDPI which we cannot find in another publisher. Chemistry & material, Physical, and Biology. The most record in MDPI is environmental & earth science. The last publisher in our dataset is ACM. This publisher used the subcategory of engineering and computer science with a total of 16 subjects related to UX.

TABLE II
THE NUMBER OF PUBLICATIONS AND DATASET RANGE

Publisher	Top 3 Subjects	# Records	% of ∑
IEEE	Mobile Computing	1.214	11%
	Internet	921	9%
	User Interfaces	735	7%
Taylor Francis	Engineering & Technology	2303	22%
	Computer Science	1843	17%
	Humanities	1164	11%
ScienceDirect	Computer Science	9.139	29%
	Engineering	5.551	17%
	Social Sciences	4.718	15%
MDPI	Environmental & Earth Sciences	694	19%
	Engineering	633	18%
	Computer Science & Mathematics	546	15%
ACM	Interactions	716	22%
	Communications	285	9%
	Human-Computer Interaction	271	8%

C. *Topic and Co-Occurrence Analysis*

Figure 2 shows the co-occurrence analysis of topics in terms of "user experience" and its coupling network (link) in each correlation. This paper used the previous variable for the threshold [24]. For display, the topic was set to five. This keyword indicated how often each keyword appears in the article. Each keyword represented the topic in the UX. The threshold is also relevant to the representation of the network. When we talk about Figure 2, User Experience has a big bubble size, indicating that User Experience is the most popular keyword in the data set. The closet topics are associated with each other in the link, which means both topics have strong relations. Color representation means of the cluster, the individual cluster result from presentation coded according to the keyword.

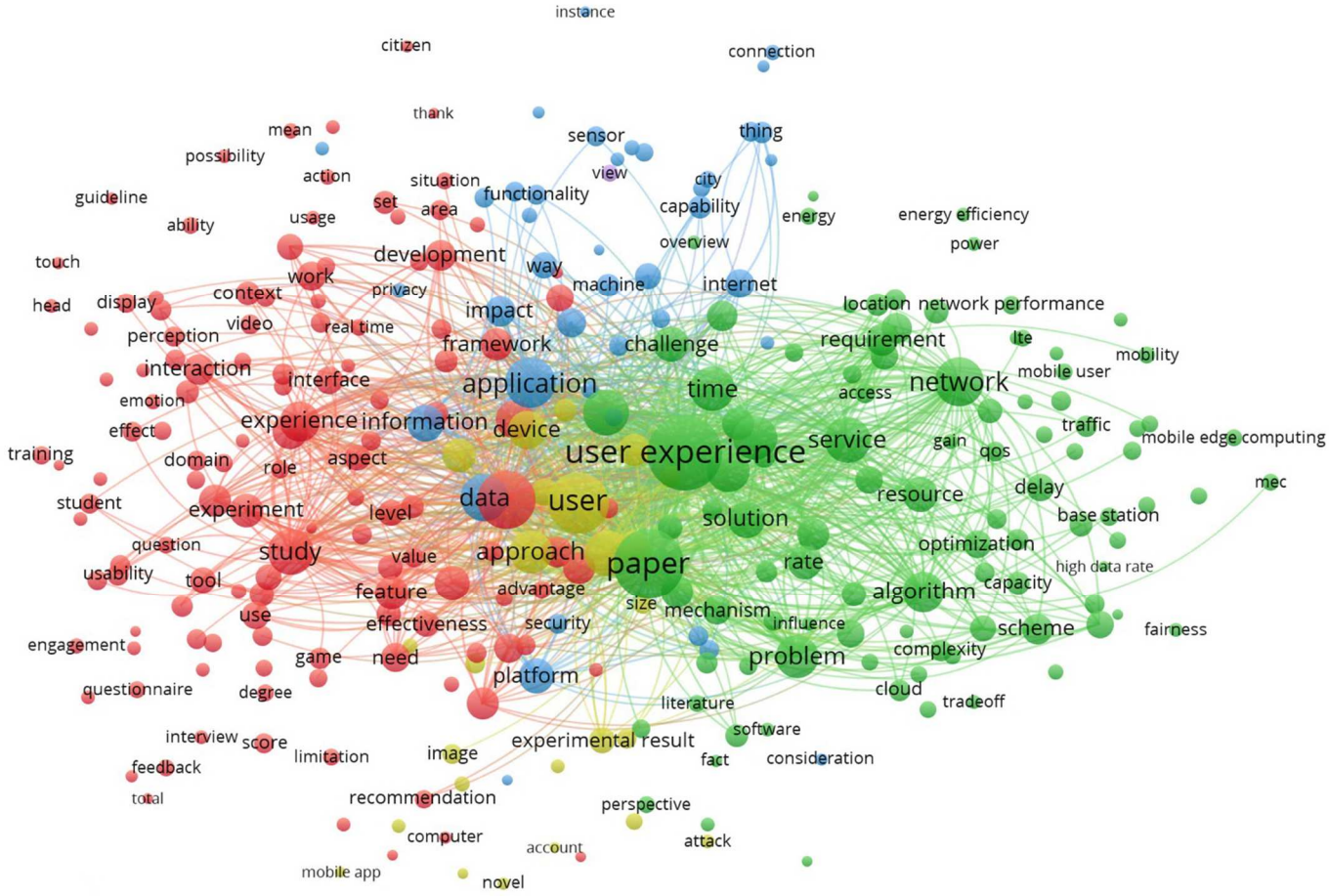

Fig. 2 Maps of Open-Source Publications in Dataset

Each cluster can relate to other clusters based on the link representing a correlation. For example, in Figure 3, we talk about evaluation in data set close related to the experience, study, application, system, user, paper, problem, network, and user experience. With this co-occurrence analysis, information overload problems can solve.

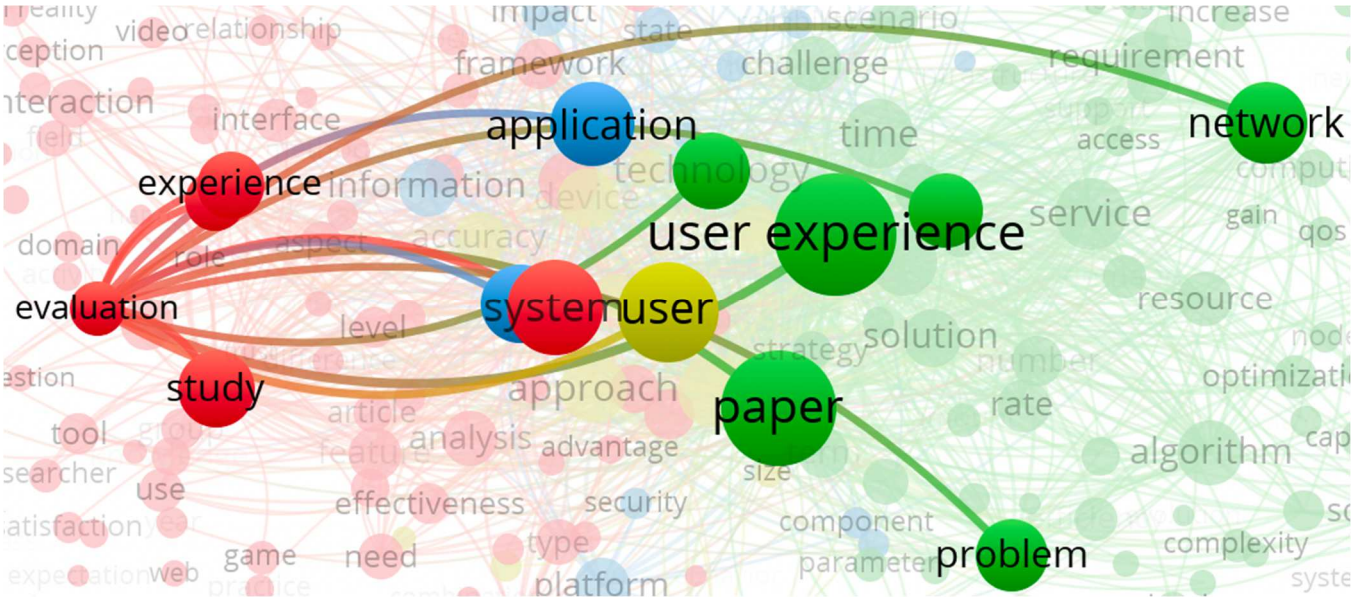

Fig. 3 Example of Related Topics

The researcher knows the related topic based on the link and subject. Table 3 shows the most related keyword in open-source articles on IEEE publisher. Open-source article it's very interesting because with this category people who haven't accessed them can be easy to download them. In this paper, we are not talking about the correlation between close-source and open-source but the correlation between these two-category related in the keywords.

TABLE III
MOST RELATED KEYWORD

Rank.	Topic	Links	Total Link Strength
1	User experience	294	4477
2	Paper	295	3872
3	User	294	2974
4	System	293	2567
5	Application	288	2180
6	Technology	287	1897
7	Study	282	1862
8	Time	281	1661
9	Model	282	1643
10	Approach	287	1611

In this paper, we used five clusters to separate the keywords in the dataset. However, these results are far from other clusters, especially for IEEE dataset cluster number five. Cluster in this dataset based on color, green represents the main cluster user experience, blue color represents the cluster user experience with the application, red color represents the user experience with the system, and yellow color represented the user experience with the user.

Cluster 1: the user experience (green), the focus of this cluster is on the user experience problem and is related to the article in the paper. Close related terms are "paper", "technology", "problem", "solution", and "network". According to the cluster, the closest related term for the user experience is the solution. Moreover, a combination of user experience and solution is commonly in the application cluster and linked to the next cluster.

Cluster 2: the application does not have a central cluster; however, the connection with the third cluster is strong. In this cluster terms, "application" and "approach" are the huge keyword in this cluster. Hence, related topics from the previous and the next cluster are always connected with the blue cluster.

Cluster 3: the evaluation, central of the red cluster is user experience evaluation. Close related terms in this cluster are "experience", "evaluation", "study", and "system". This cluster is very interesting because other clusters correlated with the evaluation. Moreover, cluster 3 have a huge number of independent (non-correlated) bubble, this problem probably happens because of the number of clusters and intercorrelated ones with the main cluster that is evaluated.

Cluster 4: the user, the little cluster located in the center of the other cluster. This cluster is the last one where any keyword is unrelated to other clusters. However, the term "user" makes this cluster the central cluster. Related term in this cluster is "user", "device", "approach", and "experimental" other bubble are too far related to the center of the cluster.

D. Discussion

In the research conducted, the analysis was carried out using the 5W1H approach (what, where, who, when, why, and how). This analysis is used to analyze the problems encountered in the user experience comprehensively. In more detail, the following analysis is carried out.

1) RQ 1: What is the problem?

The information overload problem is a situation that occurs when there is too much relevant and potential information available, but it becomes a hindrance rather than a help [29]. Information overload occurs not only in the field of user experience but covers all fields. This occurs because of the fast circulation of information and the increasingly advanced development of technology which results in all information being obtained easily and quickly. Information overload is also known as information abundance, infobesity, infoglut, data smog, info pollution, social media fatigue, information stress, reading overload, communication overload, cognitive overload, information violence, and information attack [29].

The problem in user experience starts with the definition of the term itself. This happens because the user experience is defined based on perception, dynamic nature, and complexity. The following are some perspective definitions of user experience.

- According to ISO 9241-110:2018 [27], a person's perceptions and reactions result from using or anticipating a product, system, or service [30].
- Usability focuses on task performance while user experience is concerned with the lived experience [31].
- Context-specific and ephemeral field. Users' perceptions of various product attributes and the feelings they experience before, during, and following product use have been evolving [32].
- The front-iteration procedure for user model creation and data gathering [33].

Although user experience has been widely adopted in industry and academia, there is no consensus on a theoretically defined model of user experience. The challenge of this occurs because the activity's process and evaluation differ based on the approach used. Besides, the perception of the user is based on the quality used, as well as defining the user experience to know the user's emotions before and after using a product or service. This is relevant to the description of the research conducted, where in Figure 2, each researcher has different perceptions based on the selected attributes and the user experience goals.

2) RQ 2: Where was the problem found?

This difference occurs because of the different points of view that practitioners and academics use. Therefore, we often find problems with differences in perceptions in the publication of scientific papers, especially if it is applicable and discusses products or services. The differences in the diversity of definitions of user experience cover the entire development process and services for users [32]. The user experience can cover the entire behavior of users, including how effective a product or service is and how efficiently the product or service can solve user problems. The user experience is an objective measurement; however, user experience is a broad conceptual unit combined with operations so that in a test, it does not show a significant improvement, but it is an experience that is carried out every day by users according to their habits. In contrast to user experience, in which usability is the consensus of many users and is objective.

3) RQ 3: Who found the problem?

Several studies have analyzed the information overload problem from various perspectives, such as that done by Zarour, which combines aspects, dimensions, and measurement methods for a simpler UX approach [32]. In addition, the research conducted by Santoso, although it does not directly show the information overload problem, in Santoso research identify expectations from users related to cultural differences. In addition, in the study he conducted, it was explained that the dimensions of the user experience are very broad [34].

4) RQ 4: When was the problem found?

The context of the user experience is closely related to the purpose of the product or service itself, and from there, the user experience problem becomes a challenge. Moreover, Figure 2 shows that the scope of topics related to user experience is very broad; even when it is separated into five main clusters it is too spacious. In the context of determining the goals of the user experience, it can be seen from several things including [35], [36]:

- User experience is seen from a dynamic concept. User experience is often associated with dynamic concepts such as emotion, experiential, aesthetic, hedonic, and effective. Determining the variables for each of these attributes is very random and depends on the background of the researcher and the interest of the researcher to see from a certain point of view [32], [35], [36].
- User experience is seen from fragmentation and complexity. User experience, in this case, is seen from the concept of the quality of the product or service. For example, when the user experience is seen from the point of view of convenience, efficiency, hedonism, quality improvement, and productivity [32].
- User experience is viewed as an attribute for analysis. Usually, researchers will use user experience to be combined with other processes for comparison [32]. For example, user experience is integrated with Agile to increase productivity, user experience is integrated with user requirements to perform user collaboration.

5) RQ 5: Why this is the problem?

In the previous research, user experience terms were used in a wide range of contexts, for example, the article [26] is not related to the user experience in the context of design or user/human factors but from the website search engine in publisher shown as user experience results. This problem maybe occurs because of the accuracy of the search engine. In the previous explanation, we have discussed that user experience will become a problem when researchers inaccurately define it precisely in a certain context, define points of view and define goals. In this section, we look at the user experience from the point of view of the actors who use the user experience. These perspectives can be grouped into three parts:

- Theoretical. In this case, we describe the user experience and identify several models of user experience. Moreover, it will usually define the life cycle of user experience activities as well as compare several methods.
- Practitioner. Describes the concept of evaluating user experience, represents user experience, and provides real examples of the implementation of user experience using case studies, prototypes, and products.
- Academics. Conducting investigations or building efficient user experience methods for certain cases, studying phenomena from a design, and studying how user experience can affect a condition.

6) RQ 6: How big is this problem?

Information overload problems in user experience can become very large when novice researchers do not correctly determine the point of view, goals, and perspectives in which the researcher is located. Moreover, when novice researchers see that the citations of several articles that show topics in the user experience are very varied. Table 4 is the most cited article in the IEEE source. However, from this table, we know that the topic it is not only direct to user experience but from the context of the article to increase reliability and human factors in user experience.

TABLE IV
MOST CITED ARTICLE

Rank.	Topic	Citation	Year
1	Microcell networks, Wireless communication, IEEE 802.11 Standards, Energy efficiency, Bandwidth, Millimeter wave technology, MIMO, Mobile communication [28]	5334	2014
2	5G mobile communication, Wireless communication, Computer architecture, Microprocessors, MIMO, Streaming media [37]	1610	2016
3	Paper technology, Bandwidth, Delay, Relays, MIMO, OFDM, Commercialization, Microcell networks, Costs, Throughput [37]	686	2010
4	Wireless LAN, GSM, DSL, Cellular networks, 3G mobile communication, Airports, Modems, Roaming, Packet radio networks, Ground penetrating radar [38]	557	2003
5	Virtual reality, medical treatment, Military computing, Management training, Costs, Public speaking, Conference management, Clinical trials, Application software, Cities and towns [39]	556	2007

Various problems regarding information overload in user experience have been explained in the previous section. The next stage is how researchers can overcome these problems. Researchers must be selective about the information obtained. The popular theory that is relevant to this problem is Miller's theory of 7 (plus or minus 2) [40], [41]. Where the average human is only able to capture 7-chunk of information at a time, this is updated with theory 4 (plus or minus 1) [41], [42], setting limits on information is very important to provide maximum results. Determining the purpose of user experience products and services is also very important so that

researchers can determine the right methods and measurement tools. Using several tools such as VosViewer as used in this research can help to determine the scope of the research or determine the purpose of the user experience and the most important thing is the ability and skills of the researcher to select useful information to support the study or research being conducted.

IV. Conclusion

User experience has become more popular since the system and digital environment increased. The third wave of HCI increases the researcher's interest in studying UX. This concept came from industry and became very popular, increasing the product both in industry and academia. Concept of UX as a method and tool to measure technical performance. UX concept as a method brings industry and researchers to think that human factors more than maintain the user's functional requirement. Moreover, UX brings the concept that the user is a human who uses the system. UX is a tool to measure the system to ensure that system reaches usability, reliability, scalability, and maintainability before and after the system is delivered to the user.

The topic UX has been the main topic when researchers talked about human-computer Interaction. It is spread wider than user and design. From the business, education, and medical in the context of applied application talked about UX. It's become a big problem for researchers because of information overload.

The use of bibliometric analysis and research profiling perhaps helps the researcher to map the information based on the topic related to the UX. The bibliometric analysis of research publications from 1998 to 2022 mapped the research field quantitively. This paper used the 5W1H approach to solve the information overload problem.

Publisher websites as a provider of the research article become the trusted website with their search engine. However, the search term "user experience" give more than an article related to the UX. Moreover, some search engines provide cover, table of contents, and editorial information. Due to the acceleration of the publications of UX, we hope that research in UX going wider and deeper. The interdisciplinary topic in UX makes this field a very popular and interesting topic in the future.

Research limitation, when researchers talk about limitations of their research, the most common is on the dataset. Hence, in this paper, the problem is the data. We used a dataset relevant to the "user experience" term. However, the result depends on the website search engine. Hence, to increase the accuracy of the results, the researcher should use a full paper or document of the article and assign a threshold for the term related to the topic.

This paper comes to solve information overload for the UX. However, this paper has several limitations. First, the source of our dataset is limited to several publishers that maybe not have faced UX in general. Therefore, we used a publisher search engine and selected it manually. The next research can use labeling and coding in qualitative data. Second, our dataset is based on the bibliometric analysis that is limited to title, abstract and limited information. Analysis with the full document can strengthen the finding of bibliometric analysis and research profiling. Third, the number of datasets may create a bias, because the filtering and manual sorting without comparing with other sources and based on the author's opinion.

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