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Unveiling the Digital Health Renaissance: Exploring the Surge of Health Literacy through Bibliometric Analysis in Early Detection of Cervical Cancer

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Abstract: This research aims to conduct a literature study analysis of 400 scientific journals related to health literacy, digital literacy and cervical cancer from 2004 to 2024. The data collection method uses the Publish or Perish (POP) application and VOS Viewer to identify research trends, relationships between topics -topics, as well as dominant keywords in the literature. The results of the analysis show an increase in researchers' interest in health literacy in the digital era, especially in the context of early detection practices for cervical cancer. The findings highlight the development of digital technology in public health education, the use of social media as an educational tool, and the development of technology-based applications to facilitate early detection of cervical cancer. This bibliometric analysis provides in-depth insight into the contribution of research in improving health literacy and supporting the practice of early detection of cervical cancer in the digital era. The implications include the need for more intervention research focused on community empowerment through digital approaches, as well as the development of targeted educational strategies to increase awareness and accessibility of early cervical cancer detection services.

***Keywords*:** Health Literacy, Digital Literacy, Cervical Cancer, Literature Study, Bibliometric Analysis

Introduction:

Increasing health literacy in the digital era is very important in efforts to prevent and early detect serious diseases such as cervical cancer[1]. In this context, bibliometric analysis becomes a useful tool for understanding trends, developments and research contributions in increasing health literacy related to cervical cancer[2]. Health literacy refers to an individual's ability to understand, evaluate, and use health information in making healthy decisions in everyday life[3]. This involves an understanding of health information, skills in evaluating the truth and reliability of health information, and the ability to use that information in managing personal and public health[4].

Digital literacy is an individual's ability to use digital technology, such as computers, the internet, and mobile devices, to access, evaluate, create, and share information[5]. Digital literacy includes an understanding of how to use digital technology, skills in evaluating the reliability of information found online, as well as the ability to actively participate in the digital environment[6].

Cervical cancer is a type of cancer that occurs in the cervix or cervix, which is the lower part of a woman's uterus. This cancer is usually caused by infection with the HPV virus (Human Papillomavirus) and can develop slowly for years without symptoms[7]. However, early detection through a Pap smear or HPV testing can identify precancerous cell changes or cervical cancer at an early stage, allowing for more effective treatment and a higher chance of cure[8].

Increasing health literacy in the digital era has significant implications for the practice of early detection of cervical cancer[9]. However, it is still unclear to what extent research has contributed to increasing health literacy related to cervical cancer in the digital era. Therefore, the problem formulation of this research is: What are the research trends related to health literacy in the digital era in the practice of early detection of cervical cancer?

The aim of this research is to conduct a bibliometric analysis to identify and evaluate research trends related to health literacy in the digital era in the practice of early detection of cervical cancer. This research aims to provide an in-depth understanding of the contribution of research in increasing health literacy related to cervical cancer in the digital era as well as identifying key trends and findings in relevant scientific literature.

Research Method

Bibliometric analysis methods are used to collect, evaluate and analyze scientific literature related to health literacy and early detection of cervical cancer in public databases such as PubMed, Scopus and Google Scholar[10]. Inclusion and exclusion criteria were determined to select relevant articles, and bibliometric data such as number of publications, author collaborations, country of origin, and most commonly used keywords were analyzed. In the research method using library research with the aim of analyzing 400 scientific journals related to health literacy, digital literacy and cervical cancer from 2004 to 2024, as well as using data collection techniques using the Publish or Perish (POP) and VOS Viewer applications, the following are the steps- steps that can be followed:

Identify Research Topics

Determine the focus and scope of your research. For example, do you want to analyze trends in health literacy, digital literacy, or cervical cancer, or the links between the three.

Collection of Scientific Journals

Use scientific databases such as PubMed, Scopus, or Google Scholar to collect scientific journals related to your research topic. Determine inclusion and exclusion criteria to select relevant journals. Be sure to obtain approximately 400 scientific journals that cover the desired time range (2004-2024) and cover relevant topics.

Scientific Journal Analysis

Using applications such as Publish or Perish (POP) to collect and analyze bibliometric data from related journals. Using POP, you can collect information such as number of publications, number of citations, and journal impact factor for each identified article[11].

Trend Analysis and Findings

Use the VOS Viewer application to analyze and visualize research trends from the journals that have been collected. With VOS Viewer, you can create a network map to show the relationships between topics identified in the literature, as well as identify the most commonly used keywords in these journals[12].

Interpretation of Results

After conducting data analysis using POP and VOS Viewer, interpret your results to identify research trends, key findings, and implications of the research results[13]. Examines significant developments in the literature throughout the time span studied. Then the main conclusions from the bibliometric analysis are explained[14].

Writing Research Reports

Present your findings in a systematic and structured research report. Explain the methodology used, key findings, and implications of your research in the context of the existing literature. Include relevant tables, graphs, and network maps to support your findings.

Research Data Metrics

Table 1. Research Data Metrics

Data Metrics	Information
Publication years	2004-2024
Citation years	20
Papers	400
Citations	132347
Cites/year	6617.35
Cites/paper	330.87
Cites/author	58011.33
Papers/author	162.89
Authors/paper	3.28
h-index	174
g-index	362
hI, norm	109
hI, annual	5.45
hA, index	55

Source: *Output* Publish or Perish, 2024

Table 1 presents a number of relevant metrics for research data conducted in the period 2004 to 2024. A total of 400 papers were published during this period, with a total of 132347 citations. On average, each paper received 330.87 citations, and the annual citation rate was 6617.35. Individually, a researcher had an average of 162.89 papers per study and 3.28 authors per paper. In addition, the h-index which reflects the number of articles that have a minimum h number of citations reached a value of 174 which indicates a significant level of impact in this research field. The g-index which measures researcher productivity reached 362.

H-I, norm 109 indicates that this research has a higher impact than the average in its field. H-I, annual of 5.45 shows that there is growth in impact every year. Finally, an hA index of 55 indicates that a number of researchers have had a significant influence in their contribution to this research. Overall, these data reflect the substantial history and impact of research conducted during this time period.

The results of the bibliometric analysis show a significant increase in the number of publications related to health literacy and early detection of cervical cancer in the digital era. Research trends show increasing interest in this topic, with an emphasis on prevention approaches and the use of digital technology in cervical cancer education and detection.

Results and Discussions

This bibliometric analysis, as mentioned previously, aims to analyze existing literature patterns and also explore potential research in the future. To answer this objective, more specific grouping is carried out and results in questions such as "how is the existing literature classified and grouped based on similar themes and topics?", "what are the research trends on these topics from year to year and which articles have the greatest impact on period from 2004 to 2024?", "what collaborations did the authors carry out?", and finally "what topics have potential for future research?". With the help of the VOS Viewer tool, all these questions can be answered precisely and comprehensively.

The first question regarding the classification of existing literature can be answered by utilizing the Network

Visualization feature[15]. The results of this feature analysis are attached in Figure 1 below. There is a complex visualization that shows that topics related to health and information in health care are topics that have high complexity. This indicates that the topic has become a topic that has attracted the attention of researchers.

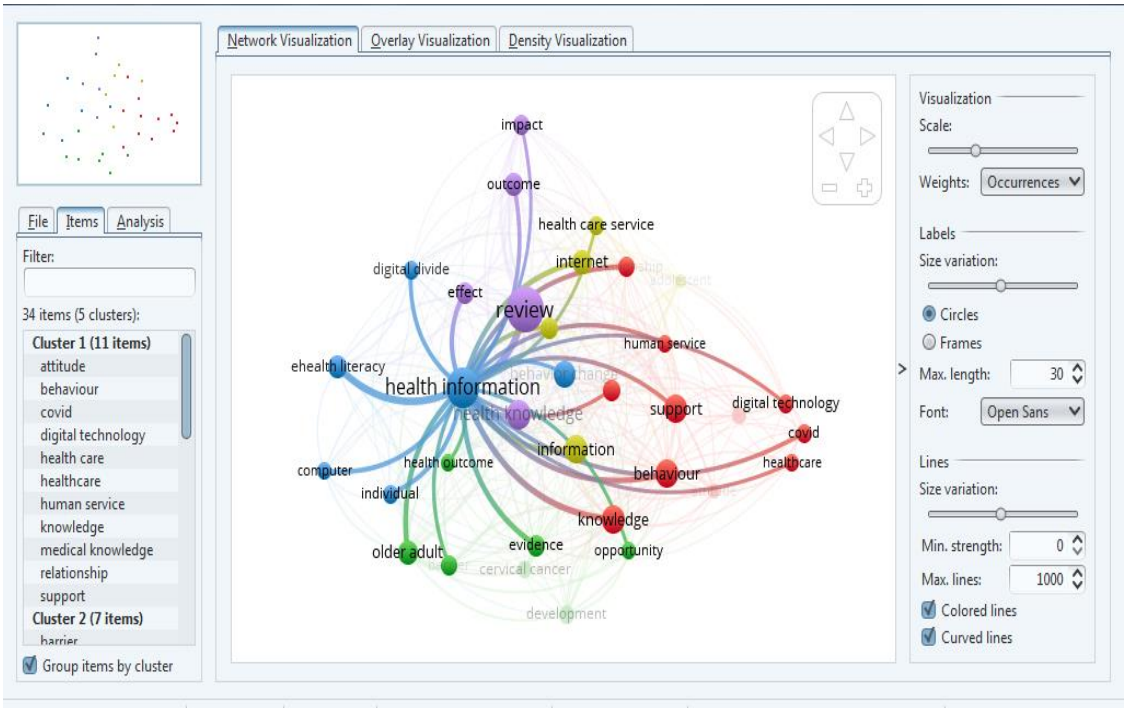

Figure 1. Network Visualization

Figure 1 above shows that there are six different contrasting colors: blue, green, red, yellow, and purple. These colors indicate different groups. Meanwhile, terms that have the same color indicate that these terms are in the same group and have a similar theme or relationship with one another[16]. Thus, the literature on this topic is divided into five groups. The first group is represented in blue with a total of 11 tribes, the second group is represented in green with a composition of 8 tribes, the third group is represented in red with a total of 6 tribes, the fourth group is represented in purple with a composition of 6 tribes, and the fifth group is represented in yellow with 5 tribes. These groups are hereinafter called clusters. Specifically, Table 2 below explains the composition of each cluster with the most relevant terms.

Table 2. Composition of each cluster

Clusters	Cluster Composition
1	attitude, behavior, covid, digital technology, health care, healthcare, human service, knowledge, medical knowledge, relationship, support
2	barrier, cervical cancer, development, evidence, health outcome, older adult, opportunity
3	behavior change, computer, digital divide, e-health literacy, health information, individual
4	adolescent, health care service, information, internet, low health literacy
5	effect, health knowledge, impact, outcome, review

The VOS Viewer output shows 5 clusters where Cluster 1 consists of 11 items: attitude, behavior, covid, digital

technology, health care, healthcare, human service, knowledge, medical knowledge, relationship, support. Cluster 2 consists of 7 items: barrier, cervical cancer, development, evidence, health outcome, older adulthood, opportunity. Cluster 3 consists of 6 items: behavior change, computer, digital divide, e-health literacy, health information, individual. Cluster 4 consists of 5 items: adolescent, health care service, information, internet, low health literacy. Cluster 5 consists of 5 items: effect, health knowledge, impact, outcome, review.

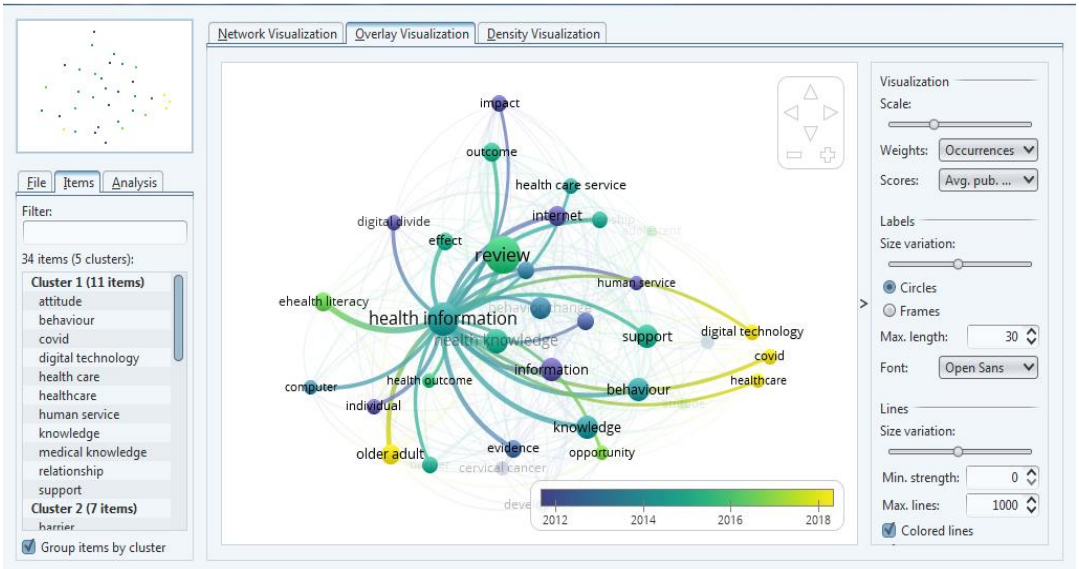

Figure 2. Overlay Visualization

From Figure 2 above we can conclude that terms such as information, internet, individual, and human service have a dark color (purple) which indicates that these terms became a research trend around 2012 to 2014. Meanwhile, terms such as support, behavior, knowledge, and health information emerged and became trends from 2014 to 2016. Terms such as older adults, digital technology, covid, and healthcare are terms that have become research trends in 2018 until now.

These research trends can also be examined by identifying the primary or most influential literature in this field[17]. The indicator of the impact of existing literature is to identify the number of citations so that it can be said that the articles with the highest number of citations are the articles that have had the most impact on scientific developments in the field of health information and care. Table 3 below describes the 5 studies with the highest number of citations spread across various journals and scientific article databases.

Table 3. Highest Number of Citations in Scientific Journals

Citations	Author and Year	Title
1362	Greenhalgh, T (2017)	Beyond Adoption: A New Framework for theorizing and evaluating non-adoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies.
736	Kreps, G.L (2010)	New directions in eHealth communication: opportunities and challenges. *Patient education and counseling*, Elsevier.
138	Friedman, D.B (2009)	African American men's understanding and perceptions about prostate cancer: why multiple dimensions of health literacy are important in cancer communication.
59	Zarcadoolas, C (2011)	The simplicity complex: exploring simplified health messages in a complex world.
50	Organization, World Health (2016)	Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment.

The table above presents a summary of some important scientific work in the field of Health and technology literacy and its impact on health care. A study entitled “Beyond Adoption: A New Framework for Theorizing and Evaluating Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies by [18] stands out with 1362 citations, while other research, such as "New directions in e-Health communication: opportunities and challenges" by [19], African American men's understanding and perceptions about prostate cancer: why multiple dimensions of health literacy are important in cancer communication by [20], "The simplicity complex: exploring simplified health messages in a complex world" by[21], and “Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment” by [22] also provides an important contribution with a large number of citations.

Furthermore, to answer questions related to topics that have not been researched enough to create research gaps and have the potential to become interesting topics in the future, we can use the Density Visualization feature. Figure 3 below shows the results of the analysis with some conditions having a dim color intensity and some having a brighter color intensity. This level of light intensity shows how often the term is used by researchers. The higher the intensity, the more articles use the term and vice versa.

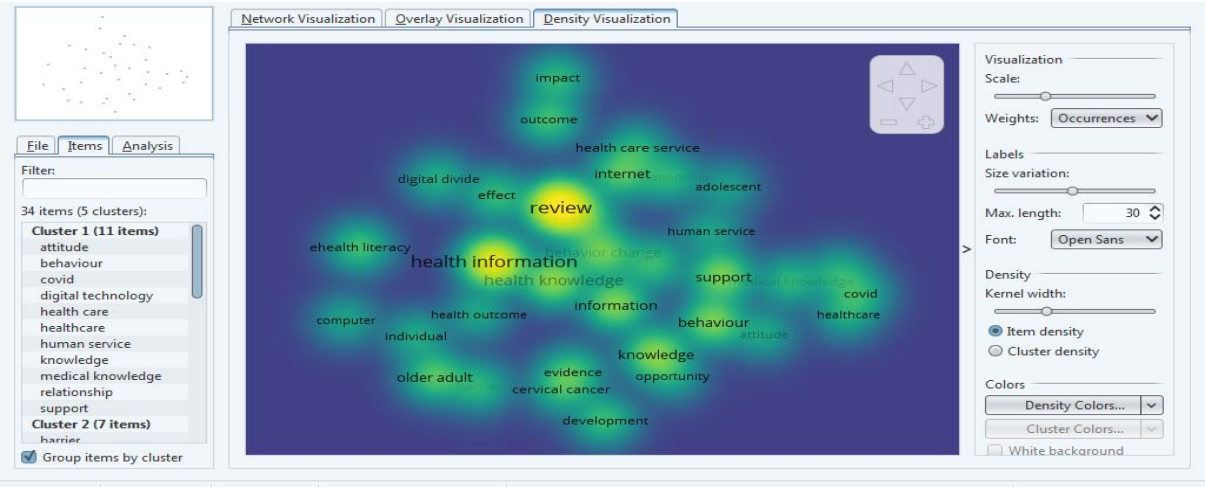

Figure 3. Density Visualization

Based on Figure 3 above, it is known that terms such as digital innovation, planning, finance and performance have a fairly high light intensity compared to other terms. This shows that these terms are used very often in previous studies and have the potential to have high saturation so they are not recommended for use in future research. Meanwhile, terms such as attitude, individual, computer, and health outcomes have a low intensity, indicating that these terms are still rarely used, so they have the potential to become interesting topics for research in the future.

Finally, to find out how collaboration exists between authors, we used network construction based on bibliographic data for each article in the database that we collected. There are several authors who work together and collaborate while other authors still carry out their research individually. Figure 4 below shows the groups of individual authors and those who have collaborated.

Figure 4. Visualization of the Authors' Network

Source: Database Analysis with VOS Viewer, 2024

Figure 4 above shows that there are five groups of authors who have conducted collaborative research. This identification is important for finding key authors as well as for collaborating with each author. This is done with the aim of enriching the discussion and perspectives of research that will later be carried out or published.

Comparison with other Bibliometric Research

Topics regarding bibliometric analysis of health literacy, digital and health care and early detection of cervical cancer have been carried out by several researchers in the past. These studies address the use of bibliometric analysis to understand research trends, the interdisciplinary nature of research, and the increasing importance of Health literacy in health care. The study covers a variety of topics, including attitude, behavior, digital technology, health care, human service, knowledge, medical knowledge, relationships, and support. These studies include those conducted by [23], [24], [25], and [26]. Meanwhile, this article specifically highlights the renewal of health care practices through early detection of cervical cancer, health literacy, and digital literacy which have not previously been achieved by the studies above, so that this research can complement and enrich the literature on this topic.

Conclusion

This research highlights the importance of health literacy in the digital era in health care efforts, especially early detection of cervical cancer. Bibliometric analysis provides valuable insights for researchers, health practitioners, and policy makers to plan and implement effective strategies to improve public health literacy regarding the prevention of these diseases.

Implications

The results of this research have an impact on various aspects. First, it provides an in-depth understanding of health literacy in attitudes and practices in health care. This provides a basis for professionals to develop insight into the influence of health literacy such as knowledge, attitude and behavior, and support in health care. Second, it guides further research, helping researchers identify trends and future research contributions. Third, its contribution to the development of theory and practice of health behavior includes aspects of regulation, technology, ethics and information. Fourth, the results of this research can help health practitioners adapt to developments in digital technology, influencing the way health promotion, implementation of health care, and decision making at the individual and organizational levels. Fifth, motivate interdisciplinary collaboration between researchers in the fields of health, information technology and education. Sixth, its relevance can be applied both globally and locally, helping organizations and practitioners in various countries to understand Health and digital literacy according to local needs. Seventh, it can contribute to the development of education and training curricula for health professionals, ensuring that future generations have relevant knowledge and skills. Eighth, realizing the impact of Health and digital literacy on Health care, which encourages organizations to improve treatment or Health policies and practices. Ninth, open a space for discussion of public policies that support innovation in the health sector and health promotion. Tenth, it provides a basis for organizations to evaluate their readiness to adopt new technologies and adjust their implementation strategies in the health sciences.

This bibliometric analysis provides an in-depth understanding of the contribution of research in increasing health literacy in the digital era regarding cervical cancer. Implications include the need for more intervention research focused on empowering communities in facing the risk of cervical cancer through digital approaches.

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