

# Analysis of Trends in Adaptive Learning Using Google Trends and Bibliometric

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## ABSTRACT

Adaptive learning was an interesting topic amid the many choices of 21st-century learning strategies. The development of research and topics related to adaptive learning is believed to grow rapidly in line with the diverse needs of the students. However, trends and research developments related to adaptive learning still need to be identified and analyzed to see the researchers' interest in the topic. This study aims to analyze the development of adaptive learning within a decade. The researchers employ data visualization techniques by using Google trend and bibliometric data. A total of 8475 browsing history indices and 2829 documents were involved in the analysis process. Research findings show that adaptive learning has grown rapidly in the past decade as indicated by the increasing interest of researchers and search results related to adaptive learning. The findings of this study are expected to be a reference for research focusing on adaptive learning.

**Keywords:** *adaptive learning, google trends, bibliometric, data visualization.*

## 1. INTRODUCTION

21st-century learning is currently an interesting topic to talk about. The needs of students are very diverse, so a more personalized learning strategy is strongly needed. Many previous studies have discussed the development of learning strategies addressing the needs of today's students. However, an analysis is still needed on how a topic on learning strategies is widely discussed within a decade. The learning strategy that is currently believed to be able to adapt and meet the needs of students is called adaptive learning, and the discussion of search trends and research on such a topic is interesting as it allows us to know how far this learning strategy has been developed.

The learning environment in adaptive learning presents personalized information to students [1]; thus, it can adapt to the students' learning needs. The development of adaptive learning provides an efficient and effective learning experience by adapting learning content according to individual abilities and preferences [2]. The impact of implementing adaptive learning for three decades has been proven to increase effectiveness and success in learning.

Research on adaptive learning uses a systematic review approach integrating strategic search process

which employs publication trends, research focus, adaptive strategies, and technology [3]. The characteristics of the research present the pattern of publication, the descriptive characteristics of the research, and the instructional context. Therefore, adaptive learning needs to be researched due to the urgency factor to improve the students' learning performance based on their learning styles and cognitive styles [4]. The application of adaptive learning provides feedback based on the learners' learning path [5]. Another study explains that adaptive learning is a technological solution that promotes access and quality in higher education [6].

Hence, the development of adaptive learning is an interesting topic to discuss because this learning strategy can be adaptive to the development of the 21st century. This study aims to discuss the development of adaptive learning trends with the Google trend analysis approach in a decade. This research is expected to be a study material for the analysis of research trends.

## 2. METHOD

Adaptive learning is an interesting focus amid the rapid development of online learning. The study of

adaptive learning needs to be analyzed in this one-decade period, starting from 2011 to 2021. Discussions related to adaptive learning continue to evolve along with the integration of technology on learning, which has been realized on several online learning platforms. The development of adaptive learning in the present study uses data derived from Google trends analysis and bibliometric analysis. Researchers searched for the keyword "adaptive learning" on Google Trends - one of

the most popular search engines [7] - for the period 2011-August 2021 and obtained as many as 8475 indexes of search history from various countries. The main indicator in keyword search is related to the frequency of searching for a topic, which is divided into two: the total search frequency in a certain period and geographic area. Meanwhile, the bibliometric analysis uses document data obtained from the Google Scholar, Scopus, Pubmed, and Crossref indexers, as shown in Table 1.

**Table 1.** Adaptive learning document on One Decade

Sources	Years										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Crossref	93	125	65	94	71	114	76	85	92	118	67
Google Scholar	70	90	75	62	69	85	91	116	134	118	90
Pubmed	18	27	25	34	39	35	53	67	84	125	122
Scopus	33	26	27	20	21	17	21	16	17	2	
Grand Total	214	268	192	210	200	251	241	284	327	363	279

\* Data were taken until August 14, 2021

Table 1 shows the document data used in this study as a total of 2829 documents, with details of 1000 crossref indexed documents (35.35%), 1000 google scholar indexed documents (35.35%), 629 PubMed indexed documents (22.23%), and 200 Scopus documents ( 7.07%). Documents were collected in the period 2011 - 2021 by using keywords in the title and abstract, namely "adaptive learning". The reason for using bibliometric analysis as one of the methods in this research is that bibliometric analysis presents comprehensive information on adaptive learning research trends and their relevance to other research topics. The bibliometric analysis uses VOSViewer 1.6.17 software to process RIS data, and the entire bibliometric data is presented in the form of RIS data. This study combines data search results from google trends and bibliometric analysis to map the extent to which adaptive learning has developed over a period of a decade. While google trends are used to collect information based on web-based behavior [9],

bibliometric methods can be implemented as scientific methods as an integral part of research evaluation [8]. The method used in this study is visual analytics, where the visualization used can support a descriptive statistical process allowing us to interact with the data analyzed.

### 3. RESULT AND DISCUSSION

#### 3.1 Google Trend Analysis

Keywords become input data in the search for data on google trends. Google trends make it possible to present data based on keywords that are frequently used in a given period. The development of adaptive learning in this study was observed based on keyword search results on google trends. The results obtained describe how often Internet users search for topics about "adaptive learning" in a period of one decade as shown in Table 2.

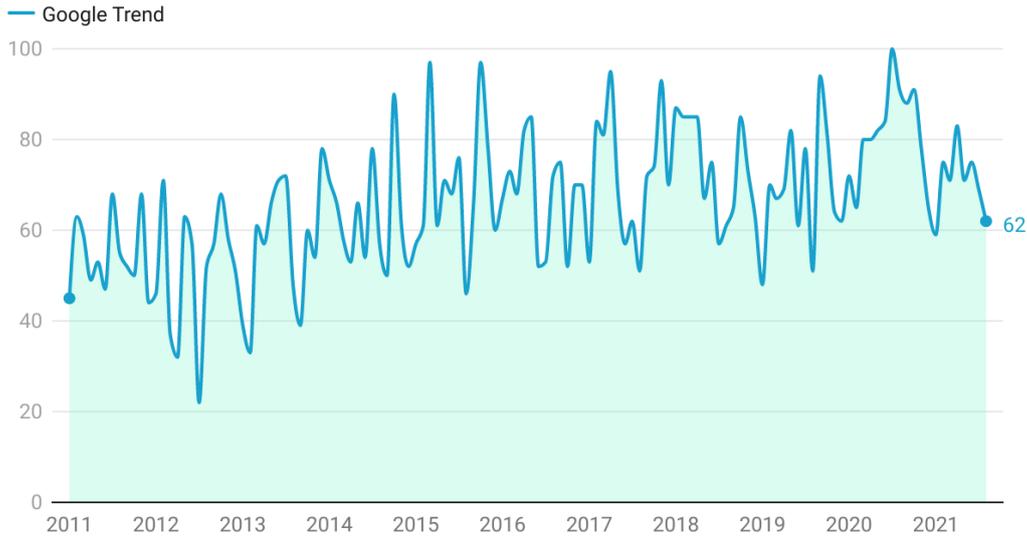
**Table 2.** Search History Data per Year in the Years Period 2011 - 2021

Years	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Search History Data	653	614	678	756	838	819	861	888	827	976	565

\* Data were taken until August 14, 2021

Table 2 shows that "adaptive learning" is one of the topics of interest. The numbers shown in Table 2 do not reflect the number of searches but reflect interest over time, describing the index of interest over time or commonly referred to as popularity over a while. The maximum interest over time ratio is set at 100 in which a

score of 0 - 100 indicates the relative search popularity. During the month, it is estimated that searches for the keyword "adaptive learning" experienced an increasing movement. Internet users' curiosity towards "adaptive learning" obtained through the history of search engine usage can be seen in Figure 1.



**Figure 1** History of keyword research "adaptive learning" in the period 2011-2021

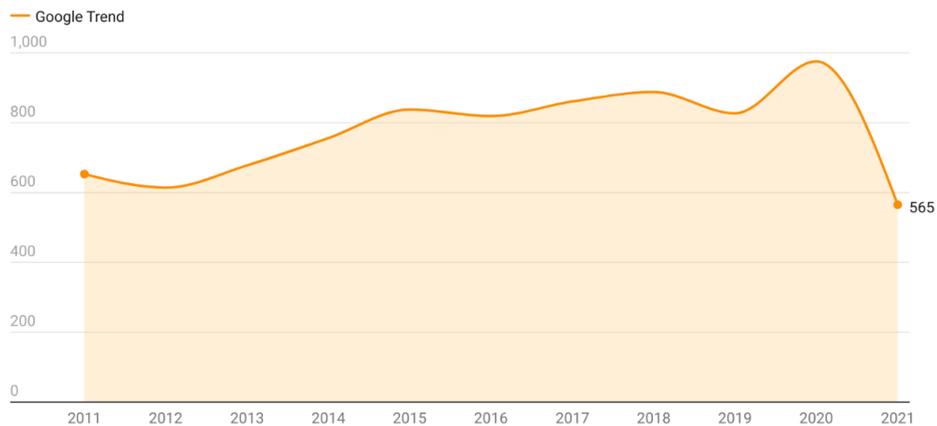
While the development of adaptive learning in the period of 2011-2021 in detail can be seen in Table 3. Table 3 shows that Google trends data in each year increased from 2011 to 2020, and the data in 2021 is taken until August 2021. The data that has been taken

is shown in Figure 2. Previous research stated that many studies use Google trends as an analysis tool to examine how a research topic develops since Google is used to analyze various topics discussed on the internet [10].

**Table 3.** Google trends for the period 2011 - August 2021

Years										
2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
653	614	678	756	838	819	861	888	827	976	565

\*data were presented until August 2021



**Figure 2** Google trends data for the period 2011 - August 2021

Keyword searches are taken globally with the aim of not limiting data access from anywhere, and to find out the extent of a country's interest in the topic of adaptive learning which is represented by the value of interest over time. Google Trends can generate data in the form of geographic and temporal patterns based on the keywords searched [11]. Interest over time value is

obtained based on absolute search volume in a certain period in which the score per month is calculated based on the relative average search volume per day. The interest over time value shows the relative popularity of searches compared in various areas. Several countries have an interest in adaptive learning as shown in Table 4.

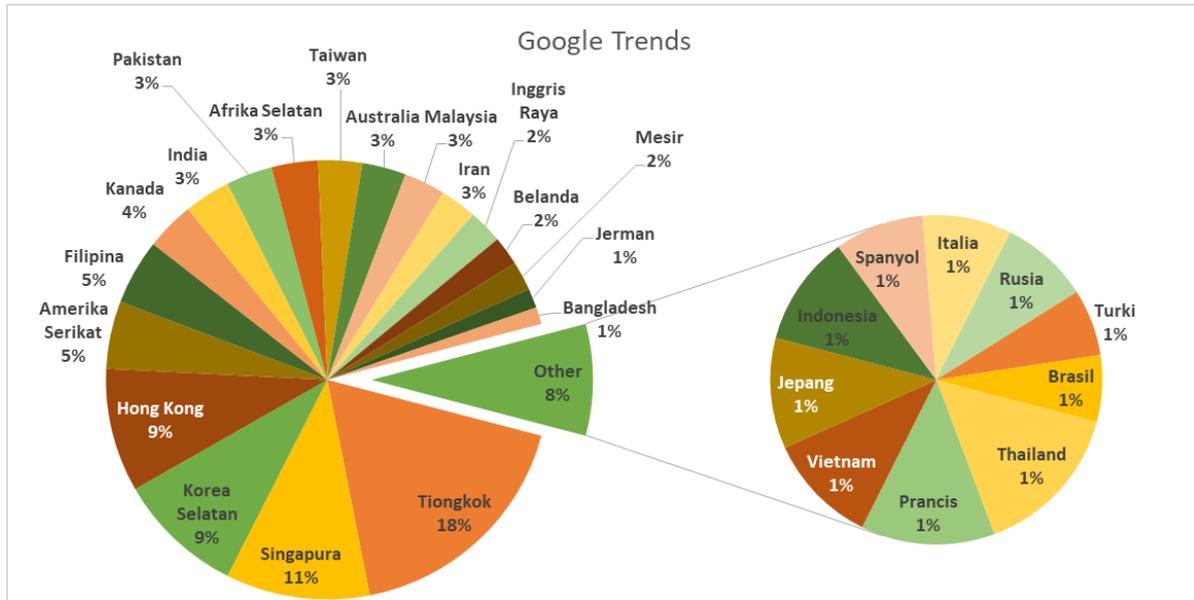
**Table 4.** Value of interest over time per country

Country	The interest over time value	%	Country	The interest over time value	%
China	100	17.83%	Egypt	12	2.14%
Singapore	59	10.52%	German	8	1.43%
South Korea	52	9.27%	Bangladesh	7	1.25%
Hong Kong	51	9.09%	Thailand	7	1.25%
United States of America	28	4.99%	French	6	1.07%
Philippines	27	4.81%	Vietnamese	5	0.89%
Canada	20	3.57%	Japan	5	0.89%
India	19	3.39%	Indonesia	5	0.89%
Pakistan	19	3.39%	Spanish	4	0.71%
South Africa	19	3.39%	Italy	4	0.71%
Taiwan	18	3.21%	Russia	4	0.71%
Australia	18	3.21%	Turkey	3	0.53%
Malaysia	17	3.03%	Brazil	3	0.53%
Iran	15	2.67%	Dutch	12	2.14%
Great Britain	14	2.50%			

\*data were presented until August 2021

Table 4 shows that the highest value of interest over time was obtained by China (100, 17.83%), followed by Singapore (59, 10.52%), South Korea (52, 9.27);

Hong Kong (51, 9.09%); United States (28, 4.99%); Philippines (27, 4.81%); and Canada (20, 3.57%) as presented in Figure 3.



\*data were presented until August 2021

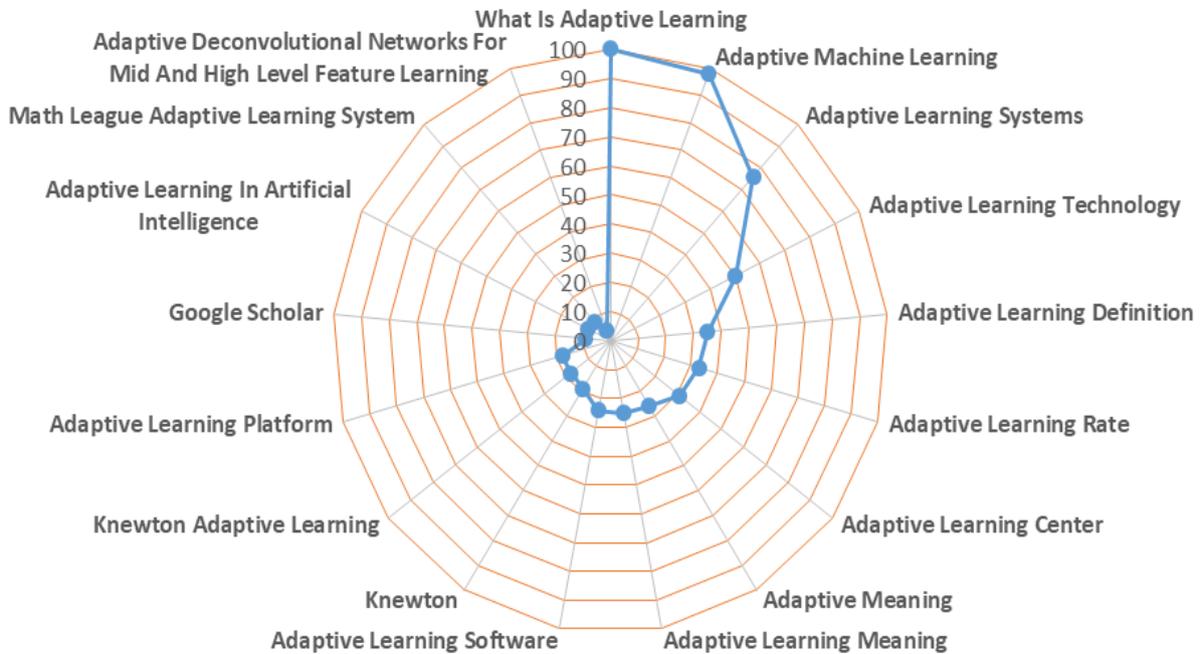
**Figure 3** Distribution of interest over time

Based on Figure 3, it can be seen that the average achievement volume is represented by the interest

overtime value. The topic of adaptive learning is the focus of this research. Indonesia is one of the countries

with a percentage distribution of 0.89%. This result is of course an interesting discussion because Indonesia is known to still have low interest in adaptive learning so it is needed for literacy development and

implementation of online learning. Discussions related to adaptive learning in its development are related to topics as shown in Figure 4.



**Figure 4** The relevance of adaptive learning topics with other topics

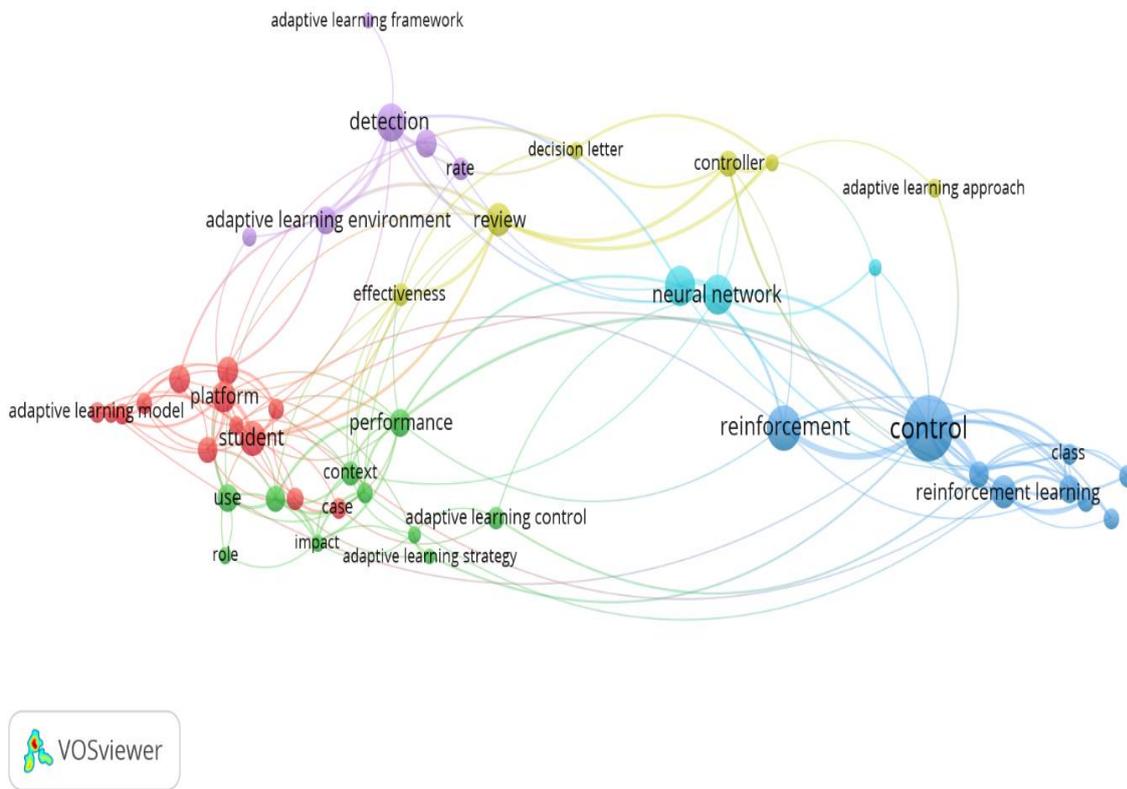
Figure 4 provides a visualization of the relevance of adaptive learning to other topics. Adaptive learning deals with topics such as machine learning, systems, technology, definition, rate, and knewton learning. The topic relevance shows that adaptive learning has become an interesting topic to discuss. Google trends make it possible to predict the development of data by reflecting various factors related to search data [12].

### 3.2 Bibliometric Analysis

The next analysis in this research is bibliometric. The research findings show that adaptive learning has a close relationship with several topics, namely (1) performance; (2) students; (3) neural networks; (4) effectiveness; and (5) controls. The correlation of adaptive learning with several topics becomes interesting because many other topics can be integrated with adaptive learning topics. Bibliometric analysis is currently one of the tools that can be considered for

assessing and analyzing research outcomes and performance [13], [14]. In another study, bibliometric analysis answered the research challenge, namely the lack of a comprehensive summary of the existing literature [15]. Bibliometric analysis can help to identify research trends in the form of impact, topic, and country of origin of the researcher [16]. The graphical analysis combines bibliographic, citation, and co-occurrence data based on the searched keywords, as shown in Figure 5.

The bibliometric analysis approach in this study was deemed appropriate to be used since it can contribute to the literature by examining how a research topic develops [17], [18]. Bibliometric analysis can provide comprehensive insight into research topics and trends, and it can also understand research progress and the characteristics of research publications [19].



**Figure 5** Bibliometric analysis

Figure 5 offers a perspective on the literature review related to adaptive learning. Visual analysis with bibliometrics allows the data interpretation process to be carried out easily. The bibliometric analysis makes it possible to find barriers to literature growth and avenues for further research [20].

**4. CONCLUSION**

Trend analysis and bibliometrics on the development of adaptive learning become an interesting discussion along with the diverse needs of students. A technique is needed to analyze research data and research trends to obtain an initial conclusion. This study uses two data visualization approaches, namely visualization using google trends and bibliometric analysis. Interest in adaptive learning is growing rapidly as can be seen from a large number of values of interest over time in browsing and bibliometric analysis of topics in a decade. The limitation of this study is the limited availability of data on some indexing and use of keywords. It takes some vocabulary to search keywords. Data analysis using google trends and bibliometrics is expected to be an insight and alternative technique for further research.

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