A Comparative Analysis of Web Search Query: Informational Vs. Navigational Queries

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Abstract— The search engines are mainly used to retrieve relevant information. Information retrieval researchers show that queries are the basis for providing better search engine performance. The search query is becoming a means for users to search for their needed information. Web search query is one of the common search queries that is widely used in domain areas. However, the main challenge is the absence of a clear understanding of how web search query influences the users' behavior on different web search engines. With the emergence of different types of a web search query, the understanding of user behavior on a web search query guides in improving the performance of many web search engines. Current research focused on using informational queries to search relevance information from a database while ignoring the importance of navigational queries. In this paper, we compared the informational and navigational type of a web search query that is mostly used in academic settings. Specifically, we examine the problems, solutions and techniques used in each of these types. We used a query log to conduct an experiment using BM25 mathematical model. The results indicated that the informational search query performed best because several keywords have been included to properly explain the queries. Also, language vocabularies used in informational queries contributed to better search performance. We believed that the outcomes of our comparisons will guide web search engine developers on the right search query for their web search engines.

Keywords— web search; web search query; informational query; navigational query; information retrieval; search engine.

I. INTRODUCTION

Web search engines provide users with different results that are relevant to their information need. In particular, the web search query is extensively used to submit users request to the web search engines for effective information retrieval. However, there is a still lack of understanding of how the web search can influence users' behaviors [1]. In order to understand this, there is a need to understand how web search query may affect user behavior on a particular search domain. For instance, a user may likely accept the search results if correspond to his web search query intent. Thus necessitate to examining what category of a web search query for every search engine.

Several categories of the web search query have been suggested [1]–[3] to capture user behavior into web search. For instance, Khabsa et al. [2] used a navigational query to represent user behavior based on academic search information. Recently, Holtz et al. [1] used an informational query to show how user behavior on web search query affect

the web search results. In addition to that, Zhang et al. [3] investigate query reformulation to examine how users react to result from the display is not according to their query intent. This assumed that users would not click any irrelevant results. However, these studies do not thoroughly discuss how the web search query can influence user behavior in different search domains. The classification of the web search query strongly relies on the purpose of the web search engines. Previous classification judge that the web search query most includes all infrequent queries such as transactional and connectivity queries. All these can be accommodated in either informational or navigational queries. Specifically, user behavior can be easily understood when representing the web search query based on the objective of the search engine. Other recent studies [4], [5] present that the query intent can be the basis to classify web search query. This inspires us to measure the qualities of informational and navigational queries.

The main intent of most of the web search query papers is to fulfill users need about information searching. Daniel et al.

[6] investigate users' behavior based on their searching information. They estimated the search behavior using the session spend by users taking into consideration a particular task type that users required. Also, their work was carried out in journalism discipline with emphasis on the task topics. In the study [3], the authors' categories of academic search into either informational or navigational query. These searches are used by the academicians to search for information regarding their research activities or publications. There are many types of web search query that now exist. Most of these types fall into either information or navigational query. Our concern is to examine all the web search query based on these two. This is because they are more related to academic search purpose.

Informational query plays a vital role in getting relevant feedback from the user intent for a search [7]. However, many other researchers believe that informational queries cannot yield relevant results because they are influenced by the performance of natural languages. Ryen et al., [7] explain that the query formulated based on natural language has less performance compared to the search query intent questions. They found that better performance can easily be achieved when search intent has been the main focus of a search. This means that query intent can improve search query performance especially when the information query for web search has turn users to require the relevant information.

Furthermore, Erdem et al., [8] maintained that irrelevant results obtain when most of the results do not match the query. They used machine learning representation to indicate some query features that are related to a user query for better performance. This will provide a query suggestion that is mainly relevant to the users' queries. Also, Eugene et al., [9] present that relevancy of the results are determined by the query characteristics and therefore effort has to be made in accommodating such characteristics. They found that the query with relevant features increases the user satisfaction by almost 12.86% and 42% for click and click through document respectively.

In addition to natural language performance, Ido [10] present that the natural language can better improve the performance of voice search rather than the ordinary text search. This work focus on the semantic relationship of a query for web search on a mobile application. Moreover, Adam et al. [8] revealed that searches based on a particular language could increase search performance. They provide this based on their investigation on the users' reasons for using a web search. In addition to that, Mixed-language queries [11] plays crucial roles when formulating query into two or more languages. The controlled vocabulary describes each language content, and searches intent will ensure better results on query reformulation.

Ran et al. [1] establish how knowledge can be predicted from a supervised model throughout search sessions. In order to achieve web search performance prediction, they recognized that learning is an efficient tool to fulfill users' targets. They also showed that knowledge obtained from a search session could provide better performance. Xinyi et al., [8] analysis what academicians are searching for within educational search engines. They used query reformulation to identify the degree of correlations with different topics.

The result indicates little correlation though give direction search behavior of academicians especially about personalization. Also, their work [8] indicate that an informational query is more preferable for academicians rather than a navigational query. This proved that the information query applies to academic search. Another work [8] try to look at what academician are searching for within a well-established web search engines. They do this by focusing on the academicians' search behavior and how experiences react in searching many topics. Understanding the user behavior can significantly improve the performance of the search engine [12].

The implicit feedback is a good technique for measuring similarities [13] of many documents based on user search behavior. The search behavior may be from online purchase history [14]–[16], browsing history [5], [14], search patterns [16]–[18], or even mouse movements [18], [19]. All these prove effective in infer intention for a particular search engine. For instance, Kawasaki and Hasuike [14] show that browsing history can be utilized to provide a recommendation to users in electronic commerce sites. Ghosh, Rath, and Shah [17] present how the complexity of the web search engine can be improved using users search behavior logs. Xie et al., [18] stated that search behavior pattern could reveal users intention within the search environment. These search behavior pattern can see mostly in terms of click time or query reformulations. Kwok [19] also found that a mouse click can easily predict the intention of users in searching needed information. Recently, Zhang et al.,[3] investigated how implicit feedback collected user search behavior can improve the quality of search results. They manipulated the relevant documents obtained from the top rank documents list. However, their investigation does not consider the semantic relationship between various search behaviors which can provide effective search quality.

The navigational query also improves search performance. With an improving amount of information hosted into an individual website, the navigational web search query has turn to be complex in search the user needed information. Some previous works have observed the importance of improving the query to retrieve information within a single web page instead of multiple ones. For instance, Meijia et al. [20] explain that results from multiple websites can significantly affect the performance of the metasearch engine. This assertion supported the use of the navigational query to concentrate on a single web page to improve web search performance. This is because for the user to get personalization search, users' intent must be captured within a single page.

Yogesh and Wang [4] showed that the grouping users based on their intent could easily provide better search results. They found this through experimental studies on the Twitter social network. Madian et al., [2] explained that any search for a particular document such as research paper could be termed as the navigational query. They used machine learning methods to establish how some features related to a query. Authors names of specific papers can be easily identified using language modeling. This will ensure proper web search indexing for academic search engines.

Furthermore, The SPARQL [21] is a good way to structure the query for better search representation. It has

shown effective for describing the keyword search. In addition to that, Ioannis et al. [22] suggest the use of SPARQ to represent the search query. This technique utilizes various unary operators that are based on the navigational query. The RDF graph lower time is taking for the query to accomplish.

The study [3] explain the importance of query reformulation to achieve better search quality performance. This is because the user may decide not to click the documents if found irrelevant based on the titles. Reformulating the querying by simplifying it to simple terms will bring better results. Moreover, Elad et al. [23] explained how web search design could accommodate various search queries. They stated this based on their finding on the investigation on how a document can have multiple clicks by the users.

This revealed that efficient syntax representation is the key to achieving search performance on queries. Ai et al., [24] present how query log used for searching email messages utilizes different query types. They found that searching for information about the organization with a short query is more common in the email search log. In addition to that, Kuzi and Carmel [25] presented how large query logs can improve the effectiveness of email search when the researcher consider query expansion. Santu, Li, and Park [26] used the data obtained from the query search log to identify triggered a query for improving search effectiveness. Zhang and Yang [27] believed that efficiency and effectiveness of search could only be achieved when the search engine kept different sessions without identifying the search users. When predicting the behavior of internet search users, the query log is significant to consider [28]. They explained how the query log how kept the user and search interaction records. GUY [7] use query log analysis for many voices queries to compare how a particular word is similar to a particular query language. Satter et al. [29] used a query log technique to expand the user query in order to represent users needed information. Their approach utilizes both the content of the specific keywords and the search keywords.

The results indicated that 48.6% and 90% had been achieved on precision at 10 and average precision at ten respectively. In terms of document ranking, the study [30] believes that evaluating the behavior of the search user can significantly improve the quality of resume search engines. They show that the demographic characteristics of users cannot be the only basis for improving the document ranking.

Moreover, Zhang et al. [3] show the importance of reformulating a query based on search behavior. They utilize click data as a document containing user search behavior to infer the performance of the search engine. However, the study [31] query reformulation can apply not only text but also to images. The images that contain textual information can be easily reformulated user query to provide better search results.

Pengjie et al. [32] present a new web search query approach that utilizes a time series to interpret users intent. They do this by removing certain query features and then use a vector machine to observe the temporal pattern. This will ensure user intents are fully comprehended. Also, The study [33] suggested the use of temporally-based on anchor text to search for information from the achieve. They first find a web search query from archive based on either navigational, temporal or both and then provide relevant results from web archive. This utilizes the anchor text to provide better search quality. Alaa et al., [34] developed a framework to ascertain specific syntax associated with the user query. Each query most has its associated content that web search challenges. They obtained better results in their experiments, but further improvement needs to improve on the classification techniques. Jaspreet [35] believes the machine learning technique can provide a better classification of text on the web search query. Context-aware [36] present a tagging approach that uses parsing within a specific domain. This uses specific syntax to capture related and relevant information.

Like we explained in the previous paragraph, different categories of web search now exist. The description of a particular web search query leads us to categorize as either an informational or navigational query. This helps us to have the basis of our comparative study. As insisted by Xinyi et al., [8] that the query reformulation can justify user behavior. In our study, we do not only focus on a query reformulation but in combination with others. Our work also concentrated on some recent web search query related to user behavior and attempt to classify them into an informational or navigational query or both as these will accommodate other sub-web search query classifications that are now available. For each work, we present the problem focus, problem description, proposed solutions, search query considered, techniques, findings, and limitations.

TABLE I
COMPARISONS OF RELATED WORKS SIZES

Proposed Approach	A Comparisons of Related Works		
	Problem Focus	Search Query considered	Technique
Task Topic in Web Search [6]	User behavior measurements	Navigational	Query log
Academic Search [2]	Query behaviors	Navigational	Query log
Predicting User Knowledge Gain [1]	Understanding web search impact	Informational	Query log
Query Reformulation Patterns [8]	Mixed–language queries	Informational	Query log
Knowledge Gain of Users [5]	User proficiency	Navigational	Query log
Extreme Learning Machine [4]	Search query intent	Informational	Query log
Immediate Require Behavior in Search [3]	Unsatisfied search query results	Informational	Implicit feedback
One Query, Many Clicks [23]	Complex search query	Both Informational and navigational query	Implicit Feedback

In table 1, the paper presents various related works about the web search query. The purpose of this comparison is to present the research problems and their solutions in some of the recently published research papers. We classified the web search query into either informational or navigational queries or both and described how each works with a particular technique. For example, the study [6] explains how the results of the navigational query can be an experiment using a query log while utilizing user behavior in journalisms. It was argued in the paper [11] that the user behavior for a web search query can be easily through query reformulation in different languages. To realize the importance of query reformulation, the study [3] examines how query reformulations could address individual query. All these are meant to improve the performance of a web search query.

Moreover, query log is the primary technique that many research papers used in their works to examine the search query performance. Consequently, the query log has the chance of predicting user behavior for web search query since many users search sessions have been kept for future experiments. Regarding the informational query, we observed that some research works achieved better web search query performance when they classified user search tasks. For example, the study [4] classified the user query based on the extreme learning machine to address search query intent.

Furthermore, various results shown that the performance of search results are the main targets of findings ignored query strategies that can support these claims. Additionally, many proposed solutions considered query classifications and reformulations while forgetting that the query expansion, query suggestions, query answering and many more can also play their roles in improving not only the search results but also addressing user behavior challenges in the web search query.

Web search query problem solution specifically for the user behavior still need to be examined as shown in table 1. Many limitations of the previous works suggest further investigations of proper understanding and implementations. Hence, the performance of the web search query will not be achieved in other search domain. This is because the search requires in the health domain is entirely different from the educational or academic search. However, the problem with these results is that they do not accurately capture how the users try to achieve instead concentrate on what to achieve. Also, their scopes were not fully explain based on user ethics.

This paper provides the following contributions:
- Present a comparison of the informational and navigational web search queries
- Discuss the results of the web search queries comparisons

Other sections of the paper are as follows: section 2 presents the materials and method, section 3 presents the results and discussion, and finally, section 4 presents the conclusion and future work.

II. MATERIALS AND METHODS

The materials and methods used for this paper are explained in this section based on the experiment carried out to obtain the best relevant search results.

A. Materials

To examine the performance of information and navigational queries, we investigate the top five search query results obtained from two different queries. The two queries were represented by unique numbers 0 and 1. The 0 number indicates the informational query while the 1 represented the navigational query. We search for a specific website and information using query ID 1 and 0 respectively.

The Okapi BM25 was also used to obtain the best matching results. This is best on the implicit relevant feedbacks obtained from the query log. The BM25 algorithm can be seen in equation (1) below:

$$Score(D,Q) = \sum_{i=1}^{n} IDF(q_i) \cdot \frac{f(q_i, D) \cdot (k_i + 1)}{f(q_i, D) + k_i \cdot \left(1 - b + b \cdot \frac{|D|}{avgdl}\right)} \quad (1)$$

From equation (1), q_i and D represent the term frequency and its documents respectively. The $|D|$ represents the length of the document. The average length of the document was also represented as the avgdl while they k_i and b represent free parameters. To obtain $IDF(q_i)$, the equation (2) can be used.

$$IDF(q_i) = \log \frac{N - n(q_i) + 0.5}{n(q_i) + 0.5} \quad (2)$$

Where the N represents the total number, and they $n(q_i)$ represent the number of the document.

B. Methods

Our paper uses the query logs method as a benchmark. Author a [1], [6] and [2] shown that query log can be used to investigate the behavior of search users within the specified search query. The L8 Yahoo search query log dataset [37] version 1.0 was used for this experiment. The dataset comprises 1000 regularly search queries issues to Yahoo web search from nine separate languages. In the approved manner, the English version of the dataset was used to obtain the performance results. Each search query in the documents has been represented with a unique identifier (number).

III. RESULTS AND DISCUSSION

This section presents the results and discussion of the comparative analysis of the web search query: information vs. navigational queries.

A. Results

The navigational web search query results are summarized in Table II. It shows the ranking results obtained from the search. We considered the first five ranking results for the experiment. The query Id 0 represented the navigational query. The documents Id are the lists of documents returned from the initial 1000 query provided by the yahoo corpus. There also appeared in the table based on the rankings. The document with id 312 provide the highest results for a navigational query with a total of 15.02 average length of the document. Followed by document Ids 224, 193, 319 and 259. Thus, they have been represented in fig. 1.

The informational web search produces the highest average length of document (avgld) results as compare to the

navigational web search query. Table III summarizes the results of the informational web search query. The query ID 1 represents the informational query which obtained the best results on document ID 231 with 17.63 as an average length of the document, followed by document ID 304 with 15.10.
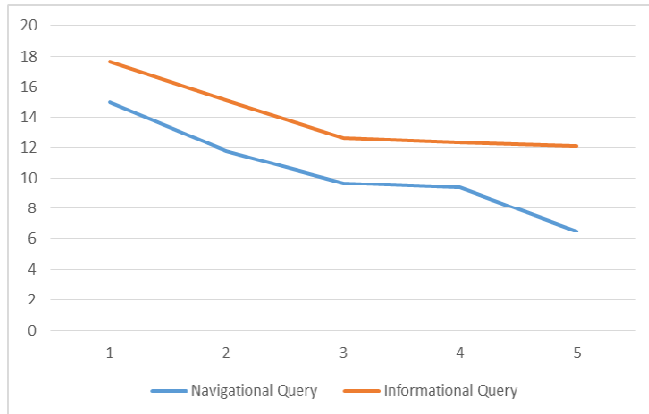

Fig. 1 Average document length of Navigational and Information Queries obtained from the Okapi BM25 mathematic model

B. Discussion

The comprehensible evidence that both information and navigational web search queries provide a convincing web search query results. Although the information query shows a bright performance in contrast to the navigational query. The rationale for this is mainly because the user has the exact term he is looking for.

Probably, the navigational web search query also produces good results. However, it is likely that the query log contains both names of the query such as YouTube and the web search address of the query such as www.youtube.com. Moreover, because queries within the query log have been arranged alphabetically, it may be possible for the search engine to return the first matching query before the actual relevant query.

Another recourse is that the number of query terms within the query log is not sufficient to provide quality results but can serve for prelude results. We reasoned that if it is a query log problem, then a higher query log should be used without arranging them alphabetically. Consequently, the best results of the query can be achieved similar to the informational query.

TABLE II
NAVIGATIONAL QUERY RESULTS

Rank result	BM25-Results of Information Query		
	Query ID	Document ID	The average length of the document (Avgld)
1	0	312	15.02
2	0	224	11.75
3	0	193	9.65
4	0	319	9.36
5	0	259	6.51

The principal result of this analysis is that the informational query provides the best results for a web search query. This advantage was not only to the web search query results but also to other search engines such as

enterprise search, desktop search, federated search and many more. Although the BM25 has been considered for relevant feedback, the results raise the chance that different outcome in most can be obtained when considering other techniques such as wordnet and implicit feedback.

TABLE III
INFORMATIONAL QUERY RESULTS

Rank result	BM25-Results of Navigational Query		
	Query ID	Document ID	The average length of the document
1	1	231	17.63
2	1	304	15.10
3	1	308	12.62
4	1	254	12.34
5	1	307	12.08

IV. CONCLUSIONS

The web search query is an essential aspect in deciding which particular query a search engine could be supported. However, the precise web search query can enable the user to the matching document from the search engine. Several web search queries have presented in many research papers, yet their results to justify the claims. In this paper, we run a comparative analysis for two web search queries to investigate which one can provide the best results on Yahoo query logs. Two web search queries that ware considered are information and navigational queries. The results obtained shows that the informational query can provide the best performance as compared to the navigational query. In the future, we plan to develop the Quran web search engine using an informational web search query. Also, the same experiment will be performed on a different dataset.

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