# Gamification for WebSAIL

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#### Abstract

Recent studies reveal that most web search engine users lack appropriate strategies for finding relevant results efficiently and effectively. They eventually miss out on important information, need significantly more time for searching than high search literate users, and overestimate their skills in the domain of web search. In this paper, we introduce the ongoing WebSAIL project (Web Search literacy, Awareness, Interface complexity, and Longterm effects) that tackles these problems. The prime aim is to enhance web search literacy (WSL) by teaching search strategies and basic and advanced concepts of web search engines in the form of a task based application. Users will be introduced to more complex search interfaces (containing more than a single query box) as in some cases these would lead to better results but are hardly used due to the lack of motivation. Furthermore, WebSAIL focuses on long-lasting enhancements: acquired abilities should be sustainable instead of a temporary nature only.

The present project follows two approaches for enhancing WSL: online-tutorials and gamification. After evaluating each method on its own, we will compare the results to answer 1) whether WSL could be enhanced and 2) which approach suited best our goals. Moreover, by evaluating same subjects after a certain period, we 3) will be capable of noticing whether acquired skills remained sustainable. Norbert Fuhr Institute for Information Systems University of Duisburg-Essen, Germany norbert.fuhr@uni-due.de

## 1 Introduction

Since its establishment in 1991, the World Wide Web exceeded the enormous amount of 4 billion indexed web pages<sup>1</sup> that need to be usable and accessible to everyone all over the world. Web search engines help Internet users in satisfying information needs by offering links to web pages that match a search query. Despite of frequent use of web search engines, the majority of users are little or no search literate at all which results in bad or unsatisfied search results. They might not be even aware of better search results as search engines give almost to every query an answer.

Researchers constantly invent new or tweak present algorithms to increase the effectiveness of search engines to satisfy a user's information need as best it can be. Instead of focusing on the system, WebSAIL focuses on the user him/herself to make him/her a better searcher. The following section gives an insight into the characteristics of WSL and gamification.

## 2 Related Work

#### 2.1 Web search literacy

Under the term search literacy, we summarize skills required to satisfy an information need through searching in well-known sources. It is a key concept of information literacy – the ability to know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information. We divide web search literacy into the fields below each of which targeting a specific aspect and thus helps in identifying and characterizing literate users.

Searchability This field encompasses knowledge about the basic functioning of web search engines, i.e., the crawler, indexer, and searcher. Users should be aware of documents that are not indexed and thus not searchable at all. We will teach our users the general aspects of indexing,

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<sup>&</sup>lt;sup>1</sup>http://www.worldwidewebsize.com/ Accessed July 01, 2016.

e.g., linking, anchor texts, access rights, document types, topicality of the index, and language dependency. In summary, users are to be aware of which and why documents are searchable.

- **Linguistic functions** target word normalization (regarding the use of capital and small letters, varieties of spelling), lemmatization, nominal phrases and composites, and synonyms.
- Query language allows users for specifying their information need more precisely to the system. A query language enables the use of, e.g., disjunction, negation, url operators, restrictions related to time, language, or specific document fields like the URL, title, text, or anchors. Furthermore it allows searching for other document types than web, e.g., images, maps, videos, news, or shopping.
- **Ranking** denotes the order in which search results are displayed to the users. But what exactly makes a document appearing at the top position? Users will learn about important concepts like PageRank, user clicks, or diversity to help for a deeper understanding of the construction of result sets.
- Search tactics allow for continuing a search. Bates distinguishes between monitoring tactics to keep the search on track and efficient, file structure tactics to thread one's way though a file structure, search formulation tactics that aim at designing and redesigning a search formulation, and term tactics that help for selecting and revising specific terms within a search formulation [3, 4]. We attempt for teaching users the most relevant search tactics for the web.
- **Stratagems** according to Bates, refer to the selection of the search domain and related operations, i.e., the selection of a web search engine and the application of its specific search features.
- **Strategies** comprise full plans for conducting a search.

Web search engines make it easy to check for facts, but sometimes it is still difficult to find some specific information; users even struggle with finding an answer to a yes-no question [19]. The study by Stark et. al. [17] exposed that Internet users rather tend to overestimate their skills in the domain of web search. A large-scale study focusing on behavioral signals confirms our assumption that users have trouble in difficult search tasks [2]. Teevan analysed Bing search sessions and found about 40% of them contained multiple queries where 25% of queries came from multisession tasks [18]. Half of all search time was spent in sessions lasting more than 30 minutes. Furthermore, about 59% of users returned to search page after their first click. These findings show that there is a need to elaborate on search skills of web search engine users.

One possible approach to increase web search literacy through a task based application is the use of gamification which is presented in the following section.

#### 2.2 Gamification

The concept turned into a hot topic in the past few years as it seems to be a promising approach both in industry and academia to foster user engagement. It is commonly described as "the use of game design elements in non-game contexts" [9]. The idea behind gamification sounds straightforward: rewarding users for completing tasks in a game-like and playful environment with the objective of increasing motivation.

Gamification is most often manifested in the form of points, badges, and leaderboards (also called the PBLs) [9, 7] – game design elements that appear in almost every game. In fact, gamification is much more than PBLs. The key is to focus on deep game mechanics and well constructed elements of strategy to create value and engage the user.

There are plenty of good case studies and examples that confirm the positive impact of gamification [6]; online communities across enterprise, sales, education, lifestyle, health, and financial services have experienced great success. Google, for instance, designed a travel expense system and resulted in 100% employee compliance within six months of its launch [1]. Beat the GMAT, a large online community for students preparing for MBA programs, managed to increase pages-per-visit by 195% and time users spent on site by 370% by following the implementation of gamification techniques like Badgeville's Social Fabric [11]. Another notable enterprise example comes from the SAP community network [5] that regamified its reputation system. Points and levels supported their business goals but were not enough to encourage the behaviors that are beneficial to the community at large. After redesigning their gamification strategies, they managed to increase activity by 400% and community feedback by 96%.

Gamification techniques should primarily refer to the users' (intrinsic) motivation in order to benefit. At its worst, it "is a mindless slapping of points, badges and leaderboards [...] onto any boring and irrelevant activity in a vain attempt to increase the corporate bottom-line [...]" [16]. The fact that subjects' intrinsic desire is reduced is a consequence of shallow constructed gamification design techniques and the improper use of extrinsic rewards. Gamified applications make use of the fact that games are fun [15] and aim therefore to invoke the same psychological experiences as games do [14] in order to keep users motivated. Psychologists have identified three basic elements that support motivation, all of which gamification designers can tweak to their benefit [8]:

- **Autonomy** People gain motivation when they feel in charge for an activity.
- Value Assigning value to an activity increases motivation.
- **Competence** Skills improve when devoting enough time to an activity. The better one gets at one activity, the more likely it is she will continue it.

With this information in mind, tasks can be designed in such a way that they motivate users in solving them to gain experience.

# 3 The WebSAIL Application

The focus of WebSAIL is to design an application featuring different types of tasks each of which targeting at a specific aspect of WSL. Users are confronted with various search engine features they have to use for completing tasks. They gain experience while solving tasks as each task type gives other insights into the function of web search engines, e.g., the result construction. We aim for enabling users to be capable of using acquired skills during their daily searches for improving the quality of search results.

#### 3.1 Task Types

This section gives an overview of the available task types. We gave name to all the types representing the core task respectively.

- **Quiz** includes single and multiple choice questions regarding web search engines for tutoring users. Our goal here is to make the search progress transparent to the user. She should be aware of what happens in the background after entering a query and how result lists are constructed.
- Search Hunt comprises fact finding quiz tasks where a user is asked a question and has to use a search interface in order to find the correct solution. Beside the ability to create good queries, we aim to foster relevance judgements since users have to determine and choose relevant items out of the entire result list in order to find the requested information. In addition, the user should be capable of finding the requested information inside a document. At this point, we use the Bing Search

API<sup>2</sup> and all of its provided search features are integrated into our search interface. They allow us for designing more complex tasks rather than simply searching for websites.

Query Tuning is a new approach for showing users how good they actually are at searching. In each task, an URL and specific information about the document are provided. The goal is to craft a query and rank the URL sought at a good position within the result list. After each query, the user has two options. In case she is satisfied with the achieved position, the user can close the task and continue to the next one. Otherwise she is free to either create a new query or optimize the present one to go for a better position. Thus users can see how changes in their query affect the results step by step which, in our opinion, makes it easier to understand the principle of ranking.

The core application consists of the three task types and can be enhanced by diverse approaches like gamification or online-tutorials for eliciting the desire to solve tasks.

#### 3.2 Goals

Different task types help users in better understanding how web search engines work. By promoting WSL, we strictly speak about users being capable of creating good queries in order to improve the quality of search results. Furthermore, the user should be able to identify relevant items within the result list and find the information sought in the document itself efficiently. Web search engines provide both basic and advanced features like a query language, complex search interfaces, or a dialogue to choose the result type, for restricting the area of inquiry. The WebSAIL tasks will be designed in such a way that they impart knowledge about the domain of web search to support users in gaining experience, developing strategies, and thus becoming better searchers.

Instead of simply solving tasks one by one, we use gamification to turn this monotonous work process into a game. Well designed game mechanics reward users adequately for completing tasks and allow for fostering user engagement. The next section describes how we extended the core application by gamification.

# 4 The gamification approach

Instead of task type, we henceforth use the notion of game mode which emphasizes the ludic character of the application. We took the core application (as described in section 3) and enhanced it by gamification

<sup>&</sup>lt;sup>2</sup>https://datamarket.azure.com/dataset/bing/search

in order to motivate users to solve the given tasks. At this early stage the gamified version comprises the basic game design elements points, level, leaderboards, and rewards in the form of badges. Each task rewards the user with points when solved correctly. In principle, the amount depends on the level of difficulty, the time spent, and applied strategies (that vary from game mode to game mode). Since each game mode hat its individual style of play and strategies that need to be applied, the calculation may vary. Lets consider the query tuning game mode where users have to rank a document at a good position within the result list. The calculation of points can be extended by the attempts the user required to achieve a good rank. A user who needs only one attempt to rank the given URL at the top position would get more points than a user who needs two or more attempts. We believe this encourages users to put more effort into creating one single query instead of trial and error to achieve good results.

Another game design element our application features is levels for adjusting the difficulty of tasks and thus promoting advanced users. Levels are bound to game modes and determined by the number of points a user has earned. She starts at level one and advances by reaching predefined thresholds. The difficulty of tasks increases with each level and users gain more experience as more complex strategies need to be developed and applied in order to solve a task.

Progress bars show progress and can encourage users to not only complete, but compete. To add clarity: they aim at extrinsic as well as intrinsic motivated users. Our implementation represents the amount of point the user received during each current game mode respectively and on the other hand the points left to proceed to the next level (see Figure 1).



Figure 1: The representation of a user's current progress in each game mode respectively.

In this regard, we use images representing the game modes and names given to each level that should strengthen the sense of being in a game.

Users are rewarded with badges when reaching certain states or performing defined actions which vary in each game mode. For instance, in query tuning, a user can be rewarded with a badge claiming that she has ranked the provided URL at position one right the first attempt during a task. Moreover, extensions of one badge may exist with increasing difficulty to obtain respectively. There might be an extension of our badge represented through a more imposing icon that claims a user succeeded three times (in three different tasks) in ranking the provided URL at position one the first attempt.

Frederick-Recascino and Schuster-Smith have shown that competition positively motivates some players [12]. It is supported in the form of leaderboards that track a user's progress against others. The drawback is that a shallow constructed leaderboard could result in some users feeling driven to keep up with other users [10] which would reduce intrinsic motivation. As a consequence, the user activity would drop. Leaderboards should always be encouraging, never discouraging. Thus said, our leaderboard does not show the top players unless the current player is among the top 10 players. Instead, the current player based on her amount of points as being smack in the middle of standings, regardless of where she actually ranks. Moreover it can be discouraging if the difference to the next player is considered too great. In this context, generated fake data could help to elicit the desire to continue by apparently reducing distances.

Each user has her own dashboard or profile that displays user statistics for each game mode respectively. It shows the total amount of points achieved, the amount of solved tasks, and average time spent on a task by default. Rather than showing basic statistics only it displays statistics bound to game modes. For instance, in query tuning, we can show the average amount of queries spent on a task.

Besides game mode statistics the profile comprises a badge gallery (see Figure 2) showing all rewards that can be unlocked. Badges that have already been unlocked are marked in color. Conditions that must be fulfilled are revealed by clicking on the corresponding badge. We believe that this motivates some users in spending more time on a task and thus improving or inventing new strategies to unlock all rewards.



Figure 2: The badge gallery in a user's profile. Already unlocked badges are marked in color.

#### 4.1 Usability Evaluation

Before using the gamified application to measure web search literacy, we carried out a usability test with N = 15 participants to test whether the application is capable of motivating users. The application achieved a system usability score (SUS) around 90 which indicates it is highly effective, efficient, and satisfacting. It fosters the ability of users to complete tasks and increases the quality of the output of those tasks. On the other hand, we gained additional information on how to improve game design techniques, e.g., the construction of leaderboards.

## 5 Long-term Goals

Once we finished creating both versions of the Web-SAIL application (online-tutorials and gamification) we will perform a study to identify whether WSL has been enhanced. By comparing the two approaches against each other, we will figure out the one having the bigger impact.

However, the drawback is we will not be able to distinguish whether the acquired skills are long-lasting or of a temporary nature only. We will address this problem by reinviting subjects after a certain period of time who will have to solve tasks of the same complexity once again. The comparison of both the evaluation phases should clarify whether knowledge and strategies gained during the first evaluation phase remained sustainable.

#### 6 Conclusion and Outlook

Studies revealed the lack of good strategies and skills in the domain of web search. Low literate users spend significantly more time than high literate users to solve a search task, discover less relevant documents, and eventually miss out on important information. Due to the lack of motivation and knowledge, complex search interfaces are omitted during search which could eventually lead to better results. In order to head off these problems and to make users better searchers, we started the WebSAIL project. We use online-tutorials and gamification and evaluate both approaches against each other to find the one having the greatest impact.

The core application features three different task types. Solving tasks one by one is considered to be monotonous and boring. Gamification enriches the application with common game design elements in order to foster user engagement and elicit the desire to play, and serves as a powerful motivator to continue. The gamified application achieved during a usability evaluation a SUS score around 90 and thus is very effective for approaching our goals. The next step is to evaluate the two versions on their own to determine whether WSL can actually be enhanced. After a certain period of time, we will reinvite subjects that will have to solve tasks of the same complexity once again in order to determine whether the acquired skills during the first evaluation remained sustainable or were of a temporary nature only.

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