

Introducing a Gamification Approach for Enhancing Web Search Literacy

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Abstract. Web search engines provide a rich feature set to users that allows efficient satisfaction of information needs. Nevertheless, recent studies show that Internet users do not know how to use Web search engines effectively for satisfying information needs. The overall level of Web search literacy leaves a lot to be desired and most users tend to overestimate their abilities in the domain of Web search. In this paper, we introduce a gamification approach with the aim of promoting search literacy as well as the current state of our prototype application. We present plans for future work to answer whether gamification is a viable means to improve Web search literacy. Our goals include finding indicators to differentiate between low and high literacy users and running long-term user studies to investigate the sustainability of search literacy improvements.

Keywords: gamification, search literacy, Web search

1 Introduction

Search literacy denotes the ability to locate and access desired information with efficiency and effectiveness. It is, therefore, a subset of the much broader concept *information literacy* which also encompasses evaluation, reuse of information, and information synthesis. Instead of putting Web search on a level with information retrieval, we look upon it as a lifelong learning process that we aim to support in order to enable users orienting themselves in modern societies. Users employ Web search engines not only for answering trivial information needs but also trust in the machines and their own abilities when it comes to serious decisions, e.g., health related issues or financial concerns.

In this paper, we draw attention to the problems arising from deficiencies in aforementioned Web search literacy and introduce a potential means that aims at increasing Web search literacy beyond traditional training methods like courses or tutorials. Only few approaches exist in this regard. One notable exception being *A Google a Day*¹ which features a fact finding search quiz. Users are

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¹ <http://www.agoogleaday.com>

encouraged to employ advanced features of the search engine to solve the tasks. While the system includes a scoring system and rewards fast task completion, it lacks key gamification elements like levels, achievement badges, or leaderboards. Users solve tasks themselves and can not compete with other users.

We developed a gamification framework that features different types of tasks (e.g., search and educational) to give users a deeper understanding of the functioning of Web search engines. At the same time, our users are to learn and develop skills that should help them in mastering their daily search tasks efficiently. Furthermore, we plan to use the presented system as a basis for long-term studies. The goal of these studies will be 1) to identify key factors that make a user actually Web search literate, 2) to measure whether Web search literacy was improved and by how much, and 3) to evaluate how sustainable these effects are.

The remainder of this paper is structured as follows: First, we take a closer look at related work regarding search literacy and gamification in Section 2. The gamified application is presented in Section 3, covering game modes and later focusing on the employed game design elements. In Section 4, we draw a conclusion and provide an outlook for future work.

2 Related Work

2.1 Web Search Literacy

A recent study by Stark et al. [1] revealed that Internet users tend to overestimate their capabilities in the domain of Web search. In fact, the overall Web search literacy leaves a lot to be desired and common Web search engine users even have problems with finding answers to yes-no questions [2]. Kogadoga et al. [3] refer to the problems that arise from being low literate based on a study: Participants with deficient Web search skills used to spend significantly more time to complete a search task in comparison to high literate users and were significantly less accurate. The main problem is that users do not know how to use Web search engines effectively for satisfying their information needs [4]. Referring to this, Web search engines offer no feedback for users beyond query completion or expansion that would help them in improving their skills.

In his recent talk at GamifIR'15 [17], Azzopardi raised the idea to make a nature-nurture distinction when it comes to search behaviour. While this is an interesting research approach, we expect nurture to play a considerable role in users' behaviour, allowing for potential improvements by promoting key search skills.

According to Fuhr [5], a Web search literate user needs to know appropriate search tactics and strategies in order to satisfy information needs effectively. Users should be aware of the basic functioning of Web search engines as well as the following key aspects:

Searchability In some cases where users try to find a specific open document in the browser through Web search engines, they fail since not all online resources are indexed. The language used in the search query, Website owner

restrictions (e.g., the robots.txt), the document type, and the recency of Web pages are some of the reasons why resources can not be found.

Linguistic Functions A crucial problem in information retrieval is the language itself since every natural language is both vague and ambiguous. To deal with that problem and to represent a user's information needs as best as possible, Web search engines apply linguistic functions such as word normalization, lemmatization, and phrase identification to search queries and take composites and synonyms into account.

Query Language A specially designed language allows users to express complex information needs and leads to more specific results since the latter are restricted to a limited set. Search operators (e.g., Boolean operators, number ranges, facets, fields, and URL predicates) and search options (e.g., for restricting the time, place, language, and document type of result items) are commonly employed search features.

Ranking One search query leads to a set of results where the ranking is of utmost importance. Hochstotter et al. [6] found out that users tend to look at items on the first search result page and especially click on the first or second item. Result items below the fold are seldom clicked on. Hence, users have to formulate precise search queries to let search engines produce result sets where the most relevant items are located on the first page and preferably are visible without the need to scroll.

Strategies and Tactics The main goal of Web search engine users is to satisfy their current information need. Complex information needs require a series of search queries. Strategies are plans for performing a complex search whereas tactics denote single operations to advance searches. Bates [7] distinguishes between the following types of tactics: monitoring, file structure, search formulation, and term.

2.2 Gamification

In the book by Zichermann et al. [8] the term gamification is defined as the process of game-thinking and game mechanics to engage users and solve problems. The integration of game mechanics into non-game contexts invokes gameful and ludic experiences to motivate users in solving monotonous tasks or for training users in complex systems. Beyond that, the concept is a viable means to shape users' behavior and to enhance online services with motivational affordances [9]. At its worst, gamification is a "mindless slapping of points, badges and leaderboards [...] onto any boring and irrelevant activity in vain attempt to increase the corporate bottom-line" [15]. When a person performs activities driven by internal rewards, we say she is intrinsically motivated due to the enjoyment of the activity itself. In contrast, users acting based upon extrinsic motivation aim to earn external rewards or to avoid punishments. We focus on enhancing the intrinsic motivation of users since it is known to be associated with the quality of effort that people put into activities [16].

In [10, 11] university courses were gamified with great success. Gamification helped in improving lecture attendance, content understanding, problem solving skills, and general engagement of students. Achievement badges have been used

by Hulinen et al. [12] to reward students for solving interactive tasks. Results show that the students' motivation has been enhanced even when the badges have had no impact on grading. Although there is still a lack of empirical evidence on the side effects of the employed game elements, these findings lead to the conclusion that gamification does not harm the intrinsic motivation at all if gamification is meaningful enough to the user and applied in a user-centered fashion [13]. Nevertheless, gamification designers should take social and contextual factors into account as they may determine whether the employed game elements diminish [14] or even suppress intrinsic motivation.

3 The Gamification Framework

3.1 Game Modes

Following the insights gained by literature review, we developed an application for improving search skills which appears to the user in the form of a game. We introduce the notion of *game mode* which emphasizes the playful character of the framework and summarizes a set of tasks of a specific nature. In total, we developed three game modes each of which aiming at a different aspect of Web search literacy: Quiz, Search Hunt, and Query Tuning.

Quiz The quiz mode features single and multiple choice question answering tasks (see Fig. 1). They allow for a deeper understanding of the functioning of search engines. The main goal of this game mode is to familiarize a user with advanced search engine functionality in a series of tasks. Furthermore, the quiz acts as a means to measure a priori search knowledge.

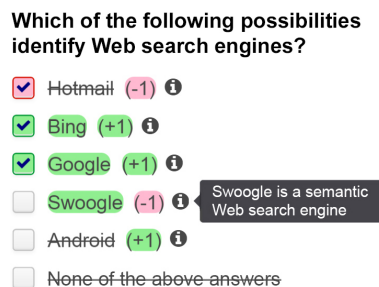


Fig. 1. The demonstration quiz task asks the user to select all items identifying Web search engines. Additional answer related information can be accessed by clicking on the respective information icon.

Search Hunt This mode comprises typical fact finding tasks (see Fig. 2). Users are asked to complete a task by issuing queries to one of the world's leading search engines which is directly included in the game by a proxy solution in order to find the solution being sought. Search hunt primarily trains users to

formulate precise search queries, to identify relevant results, and to find the desired content within the document. Furthermore, it promotes the ability to judge accuracy of results. We exploit the search engine’s rich feature set to provide a complete interface that contains all commonly employed search functions to our users. The interface allows us to train users on how to use specific features and can have more or less importance depending on the task. In addition, tasks will be designed in a way to familiarize users with commonly neglected search engine features and search strategies.

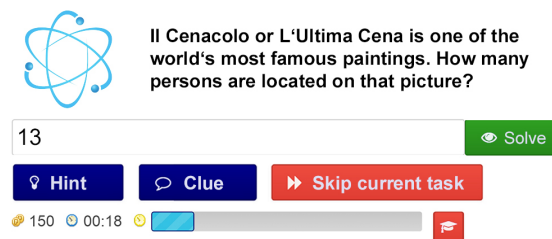


Fig. 2. In this task, users have to formulate a search query and to use certain functions of the search interface in order to find the required image that includes the solution. The task interface as seen in this figure offers hints and clues that users can request in exchange of points as well as a function for skipping the current task if desired. The hint can be a single word or a phrase that provides additional information and the clue reveals the first and the last letter as well as the length of the solution.

Query Tuning is comprised of precision oriented tasks (see Fig. 3). Users are again required to interact with the search engine but this time to produce a result set that contains a specific site at a top position. Along with the target site and a summary of the content comes a small set of search terms that are not allowed to be used in the query to avoid trivial solutions (e.g., querying for the URL of the site). Users formulate and reformulate queries until either the given site is ranked at the top position or the search performance can not be improved further. Hence, required skills for formulating precise queries are enhanced within a step-by-step refining process. The main goal of this mode is to form the understanding of ranking and to get a feeling how small changes in the query can yield to major differences in the result set.

3.2 Game Design Elements

The core game mechanics of the application consist of points, levels, badges, and leaderboards. Points are received for (partial) successful completion of tasks. The amount is determined by the degree of correctness, the current user level as well as the time needed to complete a task. Points act as the main performance indicator in the application. Levels are used to define the user’s current state and represent a task’s complexity. The next level up can be reached by exceeding

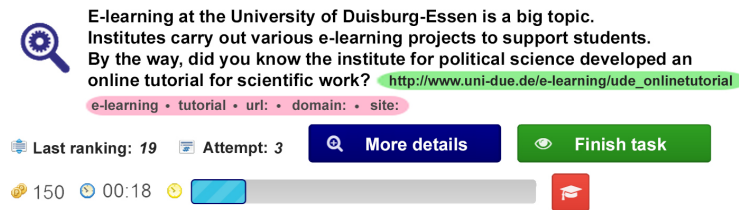


Fig. 3. Users enter a search query in a text field which is forwarded via a search proxy to the connected Web search engine to produce a result set that holds the URL marked in green at a top position. The words marked in red are terms or search operators that must not appear in the search query. A user is free so close the task at any time. Points are calculated based on the last search process: The position of the given Website within the result list and the number of attempts have the biggest impact on scoring.

the corresponding point threshold. Badges are special rewards that are acquired either for reaching a certain state or for various actions. They may come as a surprise and with varying frequency and act as a motivator to explore the application. Furthermore, badges can be used to “show off” individual user skills to other users via a profile page (see Figure 4).



Fig. 4. The user’s profile page comprises game mode related statistics on the left side. The main area gives an overview about the effort achieved in each game mode by displaying the current level, a corresponding level description and the current score in the form of a progress bar respectively. While already collected achievement badges are depicted in color, the application displays all available badges to promote transparency.

Leaderboards are overviews of the top performing players in each game mode and are represented as ordered lists with a points score beside each name to allow simple comparisons and to engage users in competition. Again, these boards act as a motivational means for continuing as well as an instrument along with levels

to indicate that users have more or less status or achievement in the game. Besides the core mechanics, the application features different sound effects to guide users and to introduce events, e.g., the beginning/completion of tasks and the receipt of awards. A comprehensive logging system collects user data in the background. The log data gives an insight into a user's behavior and thus can be used to create user profiles that reveal strategies and techniques being used to solve tasks.

4 Conclusion and Future Work

In this paper, we presented a gamification framework for Web search. The system in its current state features key gamification elements like points, badges, and leaderboards. Furthermore, three different game modes, i.e., types of tasks, are included. The system was tested regarding usability in a small user study ($N = 15$) with great success. The main goal of the system is to improve Web search literacy among general Web search users. We believe that this will allow for more time efficient and effective search sessions, which will lead to a higher task completion rate. To accomplish this goal, we will address various challenges that we are still facing with our prototype:

1. The actual search tasks and quizzes need to be tailored for the goal of improving literacy. Therefore, tasks will be created that are challenging for an average search engine user. Ideally, tasks should promote specific learning goals, e.g., search strategies or search engine features.
2. After a larger collection of tasks has been created, we will run a long-term study with a larger user base. This will not only allow us to tune game balance. The results will also act as a ground truth for future experiments. Observing many users completing the same tasks will allow us to "pool" solution attempts and to generate an ideal solution for every task. Individual users will then be scored by the closeness of their solution to the ideal one.
3. In the end, we will isolate key factors that make a user *Web search literate* and find means to specifically promote these skills in a gamified environment. The secondary goal of the long-term study will be to test the sustainability of literacy improvements. Therefore, we will invite participants to reuse the application with new tasks of similar complexity after a specific time period and compare the outcomes of their endeavors.

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