

UDC 004.738.52

<https://doi.org/10.35546/kntu2078-4481.2020.3.13>

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SEO: ASPECTS OF IMPLEMENTATION WHEN DEVELOPING AN EDUCATIONAL WEBSITE

A set of basic methodological, organizational measures and software tools has been proposed to increase positions of the educational Web-resource in Google Search Engine and in world rankings. The introduction of the step-by-step SEO-optimization has been demonstrated using the specific example of the existing web resource of the Ukrainian State University of Chemical Technology (USUCT). There have been taken into account bibliometric methods, SEO optimization and web resource optimization.

The analysis of the results of the carried out SEO-optimization showed that with the help of correct basic SEO-settings of the website, without using the commercial advertising, the position of the website rose to the first place in the list of Google Search Engine. The general part of transitions to the website increased due to the expansion of functionality. The introduced methods on the SHI USUCT web resource made it possible to increase the position in the world rating ratings

The results obtained during the study performed will contribute to solving specific practical problems of increasing the ranking of websites in the list of search engines and will be useful for those who plan to carry out activities to promote the educational website in outputs of search engines.

Keywords: website, web resource, SEO-optimization, Google Search Engine, bibliometric methods, SEO optimization and web resource optimization.

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SEO: АСПЕКТЫ ВНЕДРЕНИЯ ПРИ РАЗРАБОТКЕ ОБРАЗОВАТЕЛЬНОГО САЙТА

Создание и функционирование сайта заведения вищого образования – это необходимое условие эффективной коммуникации пользователей и учреждения. Маркетинг продвижения именно образовательных сайтов имеет свои аспекты в отличие от продвижения коммерциальной веб-ресурсов. Особое значение для образовательных сайтов имеет позиция заведения в мировых рейтингах оценки, а не только топ выдачи в списках поисковых систем.

Предложено практической реализации ранее разработанного комплекса основных методических, организационных мероприятий и программных средств для повышения позиций образовательного веб-ресурса в поисковой системе Google и мировых рейтингах. Внедрение пошаговой SEO-оптимизации продемонстрировано на конкретном примере официального веб-ресурса ДВНЗ «Украинский государственный химико-технологический университет» (УГХТУ). Рассмотрены библиометрические методы, SEO-оптимизация и оптимизация веб-ресурса.

Анализ результатов проведенной SEO-оптимизации показал, что с помощью правильных базовых SEO-настройки сайта, без использования коммерческой рекламы, позиция сайта УГХТУ поднялась на первое место в списке выдачи поисковой системы Google. Продemonстрировано, что применены методы и средства позволяют повысить внутреннюю и внешнюю оптимизацию веб-ресурса, оптимизировать веб-сервер, на котором расположен сайт, увеличить скорость загрузки страниц. Основная часть переходов на сайт увеличилась за счет расширения функционала. Внедрение комплекса основных методических, организационных мероприятий и программных средств на веб-ресурса УГХТУ повысило позиции в международных рейтингах.

Результаты, полученные в ходе проведенного исследования, способствовать решению конкретных практических задач повышения рейтинга сайтов высших учебных заведений в списке

поисковых систем и будут полезны тем, кто планирует проводить мероприятия по продвижению образование сайтов в поисковых системах и мировых рейтингах ранжирования учебных заведений.

Ключевые слова: вебсайт, вебресурс, SEO-оптимізація, пошукова система Google, бібліометрические методы, внешняя, внутренняя оптимізація.

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SEO: АСПЕКТИ ВПРОВАДЖЕННЯ ПРИ РОЗРОБЦІ ОСВІТНЬОГО САЙТУ

Створення та функціонування сайту закладу вищої освіти – це необхідна умова ефективної комунікації користувачів та закладу. Маркетинг просування саме освітніх сайтів має свої аспекти на відміну від просування комерційних вебресурсів. Особливе значення для освітніх сайтів має позиція закладу у світових рейтингах оцінювання, а не лише топ видачі у списках пошукових систем.

Запропоновано практичну реалізацію раніше розробленого комплексу основних методичних, організаційних заходів і програмних засобів для підвищення позицій освітнього вебресурсу в пошуковій системі Google і світових рейтингах. Впровадження покрокової SEO-оптимізації продемонстровано на конкретному прикладі офіційного вебресурсу ДВНЗ «Український державний хіміко-технологічний університет» (УДХТУ). Розглянуто бібліометричні методи, SEO-оптимізація та оптимізація вебресурсу.

Аналіз результатів проведеної SEO-оптимізації показав, що за допомогою правильних базових SEO-налаштувань сайту, без використання комерційної реклами, позиція сайту УДХТУ піднялася на перше місце в списку видачі пошукової системи Google. Продемонстровано, що застосовані методи та засоби дають змогу підвищити внутрішню та зовнішню оптимізацію вебресурсу, оптимізувати вебсервер, на якому розташовано сайт, збільшити швидкість завантаження сторінок. Загальна частина переходів на сайт збільшилася за рахунок розширення функціоналу. Впровадження комплексу основних методичних, організаційних заходів та програмних засобів на вебресурсі УДХТУ підвищило позиції в міжнародних рейтингах.

Результати, отримані в ході проведеного дослідження, сприятимуть вирішенню конкретних практичних завдань підвищення рейтингу сайтів закладів вищої освіти в списку пошукових систем і будуть корисні тим, хто планує проводити заходи по просуванню освітніх сайтів в пошукових системах та світових рейтингах оцінювання закладів вищої освіти.

Ключові слова: вебсайт, вебресурс, SEO-оптимізація, пошукова система Google, бібліометричні методи, зовнішня внутрішня оптимізація.

Formulation of the problem

Nowadays higher education institutions (HEIs) face a serious competition at the market of educational services. In addition, the rivalry has recently shifted from the physical space to the virtual environment. Creation and functioning of HEI sites is a necessary condition for effective interaction of users and existence of the educational establishment as a whole. Unlike the traditional scheme for promoting corporate sites, the Internet marketing in higher education is focused not only on positions in search engines, but also on places in the world education ratings such as: QS, THE, ARWU, CWUR, UniRank, Scopus, MosIUR, Webometrics etc. It is possible to rank different HEIs according to various areas of their activity using the information on their websites. Ratings are means of public and world assessment of scientific and educational activities of HEIs. Domestic and world ratings set the goal of a professional approach to creating high-quality and effective sites which should meet the needs of stakeholders: students, teachers and the staff of HEIs, entrants, research societies, employers, graduates as well as public authorities.

Analysis of recent research and publications

The field of information technology is very dynamic, so publications related to the topic of SEO-optimization, in particular, quickly lose their relevance in a short period of time. This is especially true when search engine algorithms are changed and some SEO tools fall into disuse.

Much attention is paid to the study of search engine algorithms in the publications [1-4]. Tools for search engine optimisation and algorithms which it is based on are investigated in the article [5]. The work [6] is devoted to the comparison of different algorithms that affect a search engine. Some of the available solutions to the problem of search engine optimisation with the analysis of their advantages and disadvantages are presented

in [7, 8]. An overview of methods and applications for search engine optimization is given in [9-11]. The article [12] describes the problem of search engine optimisation for a new website of any organization as well as approaches to achieving better results in different search engines.

Usage of automated tools for analysing the availability of educational websites is described in [13]. A search engine optimisation strategy for university websites is proposed in [14-16].

There are many kinds of international rating of universities, the best of which are composed in accordance with the Berlin Principles on Ranking Higher Education Institutions [17]. [18-20] proposes different approaches to strategies for raising the position of HEI in ratings.

The analysis of publications shows the lack of examples of practical realization and implementation of approaches to optimise HEI web resources that have their own specific characteristics. In the works [21, 22] the analysis of rating formation for HEIs in the context of web representation is carried out and the importance of finding the solution is emphasized. It is noted that in Ukraine issues of ranking the activities of HEIs are not given enough attention, while in foreign HEIs these issues are a high priority. As a result, we developed a number of recommendations in the form of a set of basic methodological and organisational measures as well as software means for raising the position of universities on the Internet.

Formulation of research objectives

The purpose of this study is to highlight aspects of implementation of the previously proposed by the authors set of methodological and organisational measures as well as software means that will increase the informational value of educational web resources and, consequently, increase the position of HEIs in the world and search engine ratings.

Statement of the main material

In [21] we described the conditional division of the developed methods into the following groups: bibliometric methods, search engine optimisation (SEO) methods and web resource optimisation methods (Fig. 1). The implementation process for each of them is presented in this paper on the example of creating an official educational site of SHEI Ukrainian State University of Chemical Technology (USUCT).

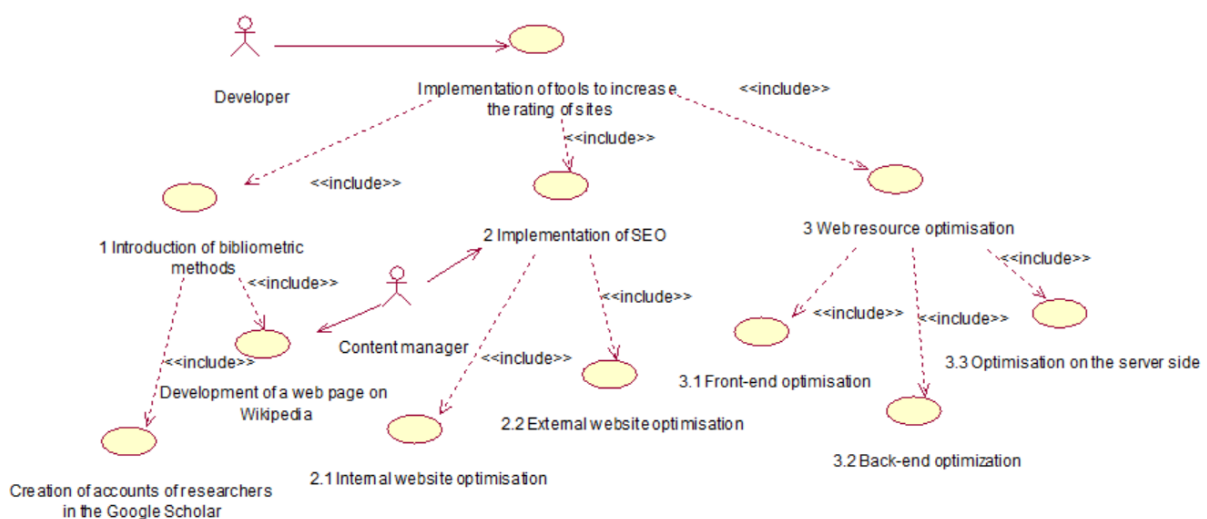


Fig.1. Diagram of precedents for the process of implementing a set of measures and software to raise the position of the website on the Internet

1 Introduction of bibliometric methods on a web resource

We developed a page in Wikipedia for the web resource and filled it with up-to-date information about the history and activities of USUCT as well as fields of student training.

Besides, we took measures to register teachers and scientists in the global Google Scholar database in order to increase the number of accounts of HEI researchers.

Figure 2 illustrates the implementation process for bibliometric methods.

2 Implementation of SEO on a web resource

Implementation of SEO web resource included two areas: internal and external website optimisation (Fig. 2).

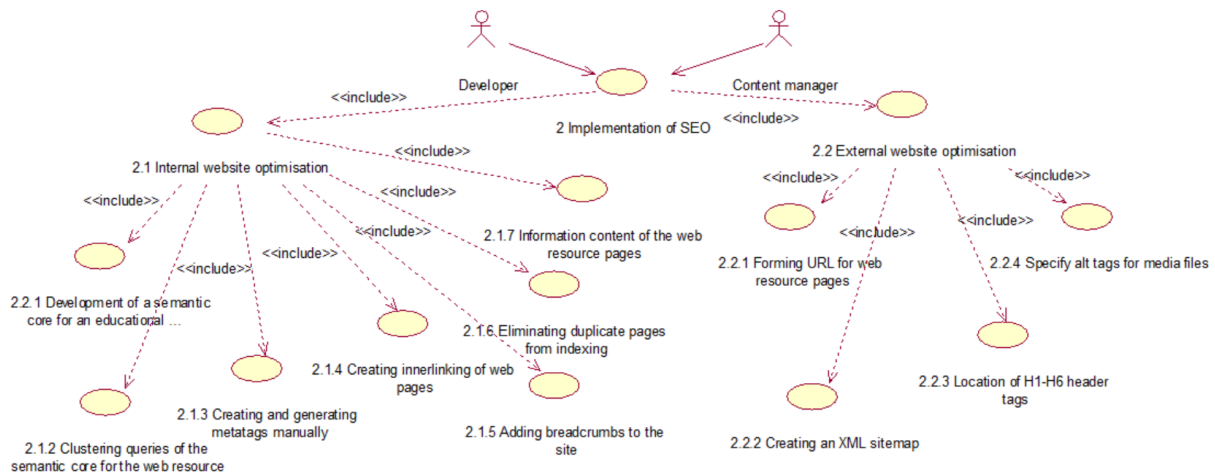


Fig. 2. Decomposition of a group of SEO methods

2.1 We used the following methods for internal optimisation:

2.2.1 Development of a semantic core for an educational web resource.

The necessary information was selected for displaying on the pages of the web resource to increase the positions in the world rating of assessment. The structure of the hierarchy of pages that must be followed during the development of a web resource has been established.

Having analysed all the data carefully, we used Serpstat service to form the semantic core of USUCT web resource.

2.1.2 Clustering queries of the semantic core for the web resource. After creating the semantic core, the keyword table file was uploaded to Key Collector that allowed determining the most relevant search engine pages. The obtained data were uploaded in MainLink, SAPE, and Rookee formats. After clustering the queries of the web resource core, the most relevant queries for using on the web resource pages were selected from the database of generated.

2.1.3 Creating and generating metatags manually. We implemented a compilation of templates for generating and forming metatags for the web resource. If the formation is performed automatically, the template snippet record in search engines will look like the following:

- the field "title" in the header of the page is filled in automatically: "Page name – Web resource name – Full name of the university";

- the field "description" is automatically filled with the first 140 symbols from the page;

- the field "keywords" must be filled in by the moderator or the content manager.

Due to automatic generation, it was possible to automate the process of filling page metatags and increase SEO promotion of the web resource.

2.1.4 Creating innerlinking of web pages. The innerlinking of the web resource pages was created using Xmind software which allowed to implement innerlinking for each page graphically. This made it possible to increase the level of low-frequency page queries on the web resource.

2.1.5 Adding breadcrumbs to the site. An auxiliary mechanism of breadcrumbs was implemented to facilitate navigation on the site. A programming code in PHP language that allowed displaying breadcrumbs on any web resource is given below:

```
$path=array_filter(explode($_SERVER['REQUEST_URI'],PHP_URL_PATH));
$base_url=(($_SERVER['HTTPS']?'https':'http').'://'.$_SERVER['HTTP_HOST'].'/');
$breadcrumbs=array("<a href='".$base_url.">$home</a>");
$last= end(array_keys($path));
$title=ucwords(str_replace(array('.php','_'),Array(',',' '),$crumb));
$breadcrumbs[]='<a href="'.$base_url.$crumb.">'. $title.</a>';
```

2.1.6 Eliminating duplicate pages from indexing. After discovering copies of the web resource pages in Google, Yandex, and Yahoo webmasters, we configured the 301st redirect for server redirection of users to another URL when changing the web resource address or URL page. This made it possible to redirect duplicate traffic to the main page. The program code that is located in ".htaccess" configuration file is given below:

```
Options +FollowSymLinks
RewriteEngine On
RewriteCond% { HTTP_HOST } ^site,.com$ [NC]
RewriteRule ^(.*)$ http://www.site.com/$1 [R=301,L]
```

2.1.7 Information content of the web resource pages. Considering the call of the world rating systems for assessing web resources of universities to present all files of official, scientific, and research areas which have extensions: *.pdf, *.doc, *.docx (so-called "rich files") for public access, we implemented a common file storage on the web server. The "robots.txt" file contains a parameter for indexing "rich files" by file name and its

description for Google, Bing, and Yandex search engines.

2.2 External SEO optimisation includes the following developed methods:

2.2.1 Forming URL for web resource pages. We optimized URL for each page hosted on the web resource. Besides, URL were converted into a human-like form. Convenient URL structure, a clear domain name, relevant headers, descriptive headers, and structured source code with a fast loading interface are absolutely necessary for SEO on the page.

2.2.2 Creating an XML sitemap. We created XML sitemap for the web resource and uploaded it to Google, Yandex, and Bing webmasters for further indexing by search engines.

2.2.3 Location of H1-H6 header tags. The headings on each page were optimised for the web resource: only page names were added to H1 tags (H1 tag contains the metatag of the page keyword), H2 tags were used to highlight information headlines, H3 tags were used to highlight all the text, H4, H5, and H6 tags were not used for SEO page optimisation.

2.2.4 Specify alt tags for media files. Image pages for the web resource were optimised by adding alt tags to all media files. As a consequence, this made it possible to index media files by search engines. The program code for indexing media files by search engines is as follows:

```
<head>
<title>TerIMG, attribute alt</title>
</head>
<p><a href="/index.php">
```

3 Web resource optimisation

Web resource optimisation includes front-end, back-end, and server-side optimisation (Fig. 3).

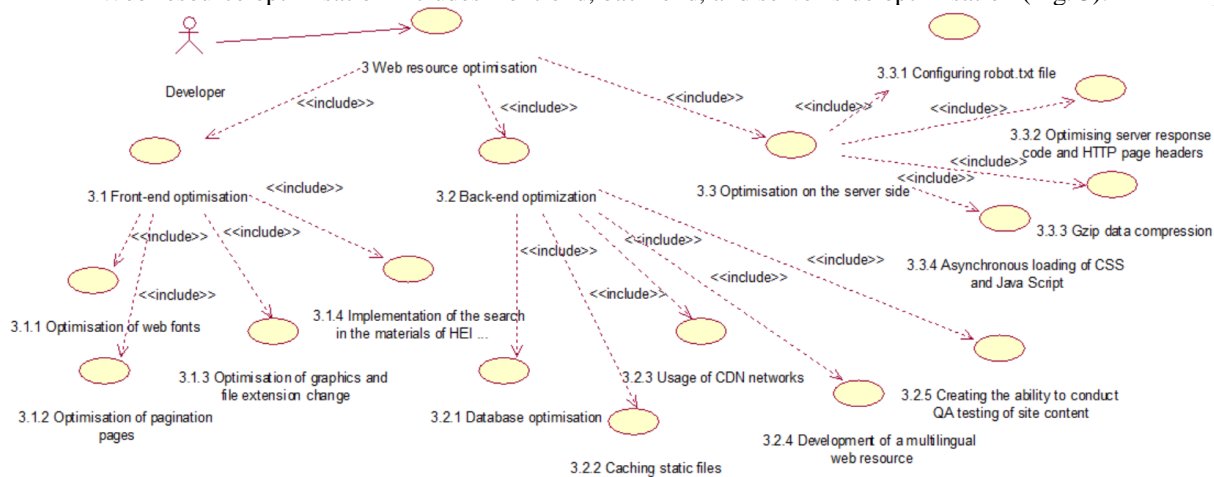


Fig. 3. Decomposition of a group of website optimization methods

3.1 We have applied the following measures for the front-end optimisation:

3.1.1 Optimisation of web fonts. Fonts were optimised to correctly display the web resource in web browsers and speed up the download speed of the web resource. Selected and installed fonts: ArialRegular, Helvetica, Arial, Lucida, sans-serif, and OpenSans.

3.1.2 Optimisation of pagination pages. When developing the web resource, we used ajax pagination which allowed to make dynamic requests to the server without a visible reload of the web page. This saves user traffic, reduces the load on the web server and speeds up the response of the web interface to user commands. The program code that can be used to enable ajax pagination on any web resource is as follows:

```
<?phpif ($dataProvider->totalCount> $dataProvider->pagination->pageSize): ?>
<p id="loading" style="display:none"></p>
<p id="showMore"> Show the following </p>
<scripttype="text/javascript">
/*<![CDATA[*/(function($))
```

3.1.3 Optimisation of graphics and file extension change. We performed optimisation of the graphic content using the WPSmush plugin to increase the speed of loading web pages. According to the recommendations for web pages, it was decided to use JPEG file extension.

3.1.4 Implementation of the search in the materials of HEI web resource. Since USUCT web resource was developed on the WordPress content management system, the file search is implemented using Relevanssi a bettersearch plugin.

3.2 The following measures were applied for the back-end optimization:

3.2.1 Database optimisation. Web resource databases are characterized by the problem of constant accumulation of old versions and revisions of news or pages, spam, deleted posts, files from older versions of plugins etc. Obviously, this increases the size of the database, and, as a result, increases the time for creating and restoring backups of the web resource as well as affects the speed of loading the web pages. We used WP-

Optimize plugin on USUCT web resource that allowed to optimise the database to solve this problem.

3.2.2 Caching static files. The web resource caches static files using WPSuperCache plugin that provides generating static pages into cache files and maintaining cache files on mobile devices.

3.2.3 Usage of CDN networks. CDN network is a geographically distributed network infrastructure that makes it possible to optimise the delivery and distribution of content to end users on the Internet. The use of CDN helps to increase the download speed of "rich files": audio, video, software, and text content in the presence of CDN. CDN technology can prevent data transmission delays, interruptions, and data loss on congested channels and junctions between them.

We used CDN networks from Google to fill sections with "rich files" on some pages of the web resource that allowed to increase the speed of page loading.

3.2.4 Development of a multilingual web resource. A multilingual version of the site should be available to present free economic zones at the international level. The use of autotranslators of the textual content of web pages is not effective, because the world ranking requires separate pages for each language version of the web resource. The functioning of the bilingual version of USUCT website affected a significant increase in positions in the world ranking for evaluating university web resources and SEO promotion of the web resource in the future.

3.2.5 Creating the ability to conduct QA testing of site content. The diviQAtesting module from ElegantThemes was used for functional, non-functional testing, and testing of changes on the web resource. During the functional testing all functions and modules of the developed web resource are checked for operability; during non-functional testing – testing of the visual part of the web resource; when testing changes – the code for errors. QA testing determined that the USUCT web resource works correctly, all developed modules perform their tasks, and the visual part is performed properly and efficiently.

3.3 The following optimisation measures are applied on the server side of the web resource:

3.3.1 Configuring robot.txt file. Search engines primarily look for the file "robot.txt" web resource. If it does not exist or it is present but does not contain any information, search engines perceive this situation as a permission to scan throughout the site without any restrictions. If you do not hide individual directories with configuration files, it can lead to vulnerability of the web resource to malicious attacks. Robot.txt file is configured for USUCT web resource as follows: configuration files and user account files are blocked for search robots to scan. This allows the files to be hidden from attackers.

3.3.2 Optimising server response code and HTTP page headers. Every time visitors and search engines visit the web resource, the web server gives certain server responses which allow indexing the web resource quickly with the right setting. However, in case of incorrect usage of the answer codes, the entire web resource can be removed from the search engine index.

We optimised the server's response on the web resource to the following access codes:

200 OK – successful request. If some client has requested any data, it is in the title and / or the text of the letter.

202 Accepted – the request was accepted for processing but it has not been completed. The client does not have to wait for the final transmission of the message, as a very long process may start.

301 Moved Permanently – the requested document has been permanently transferred to the new URI specified in Location field of the header.

302 Moved Temporarily, 302 Found – the requested document is temporarily available at another URL which is specified in the Location field of the title.

303 See Other – The document on the URI request must be requested at the address in the Location field of the header using the GET method, despite the fact that the first was requested with another method.

304 Not Modified – The server returns this code if the client requested the document using GET method, used If-Modified-Since or If-None-Match header, and the document has not changed since that time. The server message must not contain a body.

3.3.3 Gzip data compression. A universal program code that can be used on any web resource for data compression was created to enable the Gzip function via the system file ".htaccess":

```
<IfModulemod_deflate.c>
AddOutputFilterByType DEFLATE text/html text/plain text/xml application/xml application
/xhtml+xml text/javascript text/css application/x-javascript
BrowserMatch ^Mozilla/4.0[678] no-gzip
BrowserMatchbMSIE !no-gzip !gzip-only-text/html
<ifmodulemod_gzip.c>
mod_gzip_onYes
mod_gzip_item_includefile \.js$
mod_gzip_item_includefile \.css$ </ifmodule>
</IfModule>
```

3.3.4 Asynchronous loading of CSS and Java Script. The performance, size, and weight of each item on the page is an important factor. Large JavaScript and CSS files significantly slow down page loading. There are a number of methods for loading JavaScript asynchronously and many different methods in order to download images asynchronously. The problem is that browsers block web page rendering in some cases.

Asynchronous CSS download for the web resource is enabled using the following code:

```
$(“head”).append(“<link rel=‘stylesheet’ type=‘text/css’ href=‘/stylesheet.css’ />”)
$(document).ready(function() {
$(“head”).append(“<link rel=‘stylesheet’ type=‘text/css’ href=‘/stylesheet.css’ />”);
});
```

Asynchronous Java Script download is enabled with the code:

```
<script>functioninit() {
$(‘a’).addClass(‘ajax’);
}</script>
<script src=‘/jquery.js’ asynconload=“init()”></script>
```

After enabling asynchronous loading of CSS and Java Script, the download speed of the web resource was increased.

Conclusions

It is necessary to emphasize the high importance of the site for any modern free economic zone in terms of competitive advantages and taking the right position in the information field.

There are many tools to increase the rating of sites in search engines and the world rating of universities but the analysis of current approaches and trends in official websites of higher education institutions and publications on this topic revealed a lack of systematic practical information on SEO methods and ranking of educational sites.

Regarding a number of recommendations developed earlier in the form of a set of basic methodological and organizational measures as well as software to raise the position of free economic resources on the Internet, we improved the position of the web resource in the world ratings of universities and the site rotation in search engines. Aspects of implementation are realised in three areas – bibliometric, SEO optimization, and web resource optimization. The proposed complex is implemented on the official educational web resource USUCT with the possibility of using it on a similar educational web resource.

This made it possible to increase the internal and external optimisation of the web resource, increase the traffic of visitors to the web resource, optimise the web server which the web resource is hosted on, and increase the download speed of the web resource.

Considering the aspects of promoting the educational web resource, its position in the world rankings is of particular importance. The study given above allowed achieving the following indicators:

- increasing the position in Webometrics world ranking: World ranking – from 9825 to 6719;
- increase of the position in Webometrics rating: rating of the Free Economic Zone of Ukraine from 114 to 65;
- increasing the position in UNIRANK world ranking from 170 to 139;
- increase of the position in the Consolidated Rating of Ukraine from 88 to 66;
- inclusion in the evaluation base of the world rating SCOPUS and occupying 15 positions among Ukrainian universities.

Besides, the developed and implemented methods had a positive effect on the indexing of pages by search engines. According to relevant queries, the educational site USUCT is on the first page in the lists of search engines Google, Bing, and Yahoo.

Search engine optimization is a long-term strategy that should work under professional administration. Communicative feedback is effective for further development of an educational site, namely creation of micro-blogs for teachers and an opportunity for students to leave feedback on the pages of teachers.

The results obtained during the study will help to solve specific practical problems of raising the ranking of educational sites on the list of search engines and the world ratings of universities. The suggested proper combination of basic methodological and organizational measures as well as software will be useful to those who plan to carry out activities to promote an educational site on the Internet.

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