



Zhytomyr Ivan Franko State University Journal.
Pedagogical Sciences. Vol. 4 (103)

Вісник Житомирського державного
університету імені Івана Франка.
Педагогічні науки. Вип. 4 (103)

ISSN (Print): 2663-6387
ISSN (Online): 2664-0155

MODERN TEACHING TECHNOLOGIES СУЧАСНІ ПЕДАГОГІЧНІ ТЕХНОЛОГІЇ

UDC 378.147.227:004.4'273

DOI 10.35433/pedagogy.4(103).2020.77-87

USE OF PIXLR CLOUD GRAPHICS EDITOR IN THE COURSE OF COMPUTER SCIENCE TEACHER PROFESSIONAL TRAINING

O. M. Kryvonos*, S. S. Zhukovskyi, M. P. Kryvonos*****

The introduction of cloud technologies in the educational process is a priority for domestic education. The selection of appropriate services that can be used to improve the educational process remains a key issue in solving these problems. The authors note the possibility of using cloud services in all areas of education and emphasize the availability of online set of tools for processing graphics files, which provides users with corresponding software for creating and designing graphics files, provision of server storage space, as well as access to all saved assets at any time from any device with Internet access. The article describes the experience of using cloud services in the educational process of training computer science teachers of Zhytomyr Ivan Franko State University, in particular the online graphic editor Pixlr. Peculiarities of settings and functionality of this software product are described. A detailed description of the cloud service is given and a comparison is made with the most typical software products used to create computer graphics, illustrated with examples and screenshots. The use of the Pixlr Editor cloud service to solve one of the most common image processing issues, namely tone adjustment, is considered. Also, the authors mentioned the negative aspects of using cloud services. Further perspectives of researches are outlined.

* Candidate of Pedagogical Sciences (PhD in Pedagogy), Docent
(Zhytomyr Ivan Franko State University)

krypton@zu.edu.ua

ORSID: 0000-0002-4211-6541

** Candidate of Pedagogical Sciences (PhD in Pedagogy), Docent
(Zhytomyr Ivan Franko State University)

zss@zu.edu.ua

ORSID: 0000-0001-5826-0751

*** Assistant

(Zhytomyr Ivan Franko State University)

myroslava_kr@meta.ua

ORSID: 0000-0001-7563-2692

Key words: software, cloud services, picture tone adjustment, Pixlr, tone range.

ВИКОРИСТАННЯ ХМАРНОГО ГРАФІЧНОГО РЕДАКТОРА PIXLR В КУРСІ ПРОФЕСІЙНОЇ ПІДГОТОВКИ ВЧИТЕЛЯ ІНФОРМАТИКИ

О. М. Кривонос, С. С. Жуковський, М. П. Кривонос

Впровадження хмарних технологій в освітній процес є пріоритетним завданням для вітчизняної освіти. Добір відповідних сервісів, на основі використання яких можна поліпшити освітній процес, залишається ключовим питанням в розв'язанні даних проблем. Автори статті зазначають про можливість використання хмарних сервісів в усіх сферах діяльності навчального закладу, та акцент роблять на використання онлайн-додатку для опрацювання графічних файлів, який надають користувачам програмне забезпечення для створення та оформлення графічних файлів, місце на сервері системи для їх зберігання, а також доступ до них у будь-який момент часу з будь-якого пристрою при наявності виходу в інтернет. В статті описано досвід використання в навчальному процесі підготовки вчителів інформатики Житомирського державного університету імені Івана Франка хмарних сервісів, зокрема онлайн графічного редактора Pixlr. Описано особливості налаштування та функціонал даного програмного продукту. Зроблено детальний опис хмарного сервісу та проведено порівняння з найбільш типовими програмними продуктами, що використовуються для створення комп'ютерної графіки, проілюстровано прикладами та скріншотами. Розглянуто застосування хмарного сервісу Pixlr Editor для розв'язування однієї із найтипівіших задач стосовно опрацювання зображень – тонового коригування. Також, автори статті зазначили негативні сторони використання хмарних сервісів. Окреслено подальші напрями досліджень.

Ключові слова: програмне забезпечення, хмарні сервіси, тонове коригування зображення, Pixlr, тоновий діапазон.

Introduction of the issue. The rapid development of information and communication technologies (ICTs), as well as the emergence of new electronic devices, including the improvement of application software, contribute to the improvement of educational technologies. However, taking into consideration current conditions, it is necessary to constantly devote time to software and hardware maintenance, purchase and installation of up-to-date applications, upgrade of the existing equipment. Unfortunately, higher education institutions can't always offer suitably qualified service staff and adequate funding, moreover, it is not also always possible to ensure the appropriate mobility of the software in the learning process (the ability to install and use a particular software product on any desktop computer). Use of cloud technologies in the educational

process is a way to solve the above-mentioned issues, for with the combination of modern ICTs and high-speed broadband Internet connection most services can be transferred to the cloud, where the most data-related operations are processed. According to the National Institute of Standards and Technology (NIST), cloud computing [10] is a model for providing ubiquitous, convenient on-demand network access to computing resources (such as networks, servers, storage systems, applications, and services) that can be provided quickly and flexibly with minimal effort and interaction with the service provider. Therefore, almost all software developers try to provide their users with an online version of their software products.

Current state of the issue. Possibilities of using cloud services in the initial process and in scientific work

were investigated by V.Yu. Bykov [1], T.A. Vakaliuk [2], M.I. Zhaldak [3], O.O. Hrybiuk, S.H. Lytvynova [4], N.V. Morze [5], Yu.H. Nosenko [6], S.O. Semerikov [7], O.M. Spirin [8], Yu.V. Tryus [9], M.P. Shyshkina [10] and other [11, 12].

In "The NIST Definition of Cloud Computing" the authors define cloud technologies as a model for providing network access to a shared array of computing resources of variable configuration (servers, storage systems, services, or/and applications) in any convenient location that can be provided instantly with minimal management efforts and interaction with the service provider [13]. A distinctive feature of cloud technologies is granting fast service delivery and access to resources at any time in any user-friendly and convenient environment.

Thus, currently there are three main types of cloud services: SaaS (software as a service), PaaS (platform as a service), IaaS (infrastructure as a service). SaaS, as one of the most popular entities, is a software deployment model that involves providing software directly to the user as an on-demand service through the use of an Internet browser. The main end-user advantage of such distribution is the absence of necessity of installation/uninstallation, troubleshooting, update of the software and/or maintenance of local hardware. Most services support simultaneous multiuser interaction with the file.

One of the main trends in education today is informatization and computerization, which imply the introduction of new information technologies in the educational process, equipping educational institutions with computers, as well as broadband stable access to the Internet. These processes formed a new scientific and technical base for the formation and development of new forms of educational activities, which led to the emergence of virtual

educational institutions operating on the Internet. Creating a virtual educational environment is a solution to one of the tasks of pedagogy, namely the development of effective forms of organization of the educational process. The basis of information systems that provide the virtual environment of the educational institution are different approaches, methods and tools, but the most effective is the use of cloud technologies, which are a promising area that opens up huge benefits and perspectives in the sphere of data management.

Cloud computing is a model of providing ubiquitous and convenient on-demand network access to a common pool of configurable computing resources (e.g. data networks, servers, storage devices, applications, services (together and separately)) that can be effectively used with minimal operating costs or necessity to contact the provider.

Compared to traditional technologies, cloud computing has a number of significant advantages, such as: affordability, mobility, flexibility, reliability, high level of sophistication, rental and cost-effectiveness, thanks to which they are widely used in many fields of science and technology.

Today, cloud technologies are used in various fields of human activity: banking, medicine, business, including education. Thus, educational cloud services are used not only in distance learning, but also in traditional educator-student face-to-face interaction forms, for they provide a number of opportunities, such as the creation of virtual laboratories on the Internet, Internet conferences and webinars, management of various processes of the virtual environment of the university, which is identified as a digital entity that aims not only to support distance learning, but also to manage and optimize the business processes of the university.

Modern information and educational environment of the university is analyzed in the context of digital manifestation of various aspects and fragments of the university on the Internet. There are different design patterns of e-learning environment that take into account the interests, likes and dislikes of different groups of network users. From the socio-psychological standpoint, the role of the digitalized educational environment of the university in the improvement of educational technologies includes the emergence of new aspects of teaching, as well as the conditions of self-realization of students.

However, cloud technologies can become not only the basis of distance learning, but also provide continuous support for improving real-life interaction-based education. The educational institutions have a set of tools and mechanisms with well-established algorithms of interaction: the educational process is closely intertwined with the processes of accounting, personnel accounting, contractual relations. Therefore, we should consider cloud computing as a means of consolidating various internal subsystems and creating a virtual environment that will ensure the interaction not only of teachers and students, but will make the following features available:

- publication of announcements, news, including announcements of important events;
- exchange of electronic messages between users, centrally or in separate categories;
- organization of scientific conferences, seminars, including Internet events and webinars;
- remote interaction with students, including the provision of electronic teaching materials, online consultations, testing, digital schedule;
- electronic interaction with applicants, including information

provision, consultations, remote registration of applicants.

Today, the online applications for creating presentations and related materials are becoming more widespread, which provide users with corresponding software, server store space, as well as access to them at any time from any device with internet access. It is also possible to publish already created works, view and use presentations of other users (if published for free access).

Summarizing the above-mentioned, it should be noted that the use of cloud technologies in the educational process will allow educational institutions to significantly reduce costs, as well as increase the efficiency of computing resources. In this case, access to information stored on the cloud server can be obtained by any user who has a computer or mobile device connected to the Internet. In addition, the use of cloud technology will reduce the staff of maintenance personnel, as well as eliminate the need to involve third-party programmers and IT professionals.

Let's review a free cloud service for working with bitmap graphics – online graphic editor Pixlr.

Aim of research is to analyze online graphic editor Pixlr and peculiarities of its use in the process of computer science teachers' professional training.

The research was conducted within the framework of R&D (research and development works) "Use of modern information technologies (ITs) in education and science" of the Department of Applied Mathematics of Zhytomyr Ivan Franko state university.

Research Methods. During the research the following methods were used: analysis of psychological-pedagogical, scientific-technical literature on the issues of introduction of ITs in the education; modeling the functioning of web services of information-educational space; method of parallel experiment.

Thanks to the wide availability of affordable scanners and high-quality digital cameras in smartphones, computer graphics have taken one of the leading positions in the life of a modern individual. Thus, even amateur picture processing requires certain knowledge and skills related to the creation of graphic objects using a personal computer (PC), as well as application of post-effects.

Currently, there are several online raster graphic editors: 2IP, Aviary, Befunky, Pixlr, Canva, Figma, Fotor, Sumo Paint, Splashup, PicMonkey and others. All of them feature convenient and user-friendly interface, a standard set of tools for processing photos and digitalized drawings, as well as functionality for creating collages, etc.

Pixlr is a cloud service by Autodesk software developer, which provides

almost complete functionality of the original Adobe Photoshop CC. Pixlr has a variety of features and a user-friendly localized (fully translated into 28 languages, including Ukrainian) interface with clear description of every available graphic instrument. The service can be used for processing HD (high definition and resolution) images, including altering curves and layers of the picture with a documented history of user actions, as well as the possibility to use a number of filters. Thus, this cloud service requires reliable Internet connection and the latest version of the compactible browser.

When you first start the cloud service, a dialog box appears (fig. 1), in which you are asked to choose from two editor options: Pixlr E (for advanced users) and Pixlr X (for beginners).

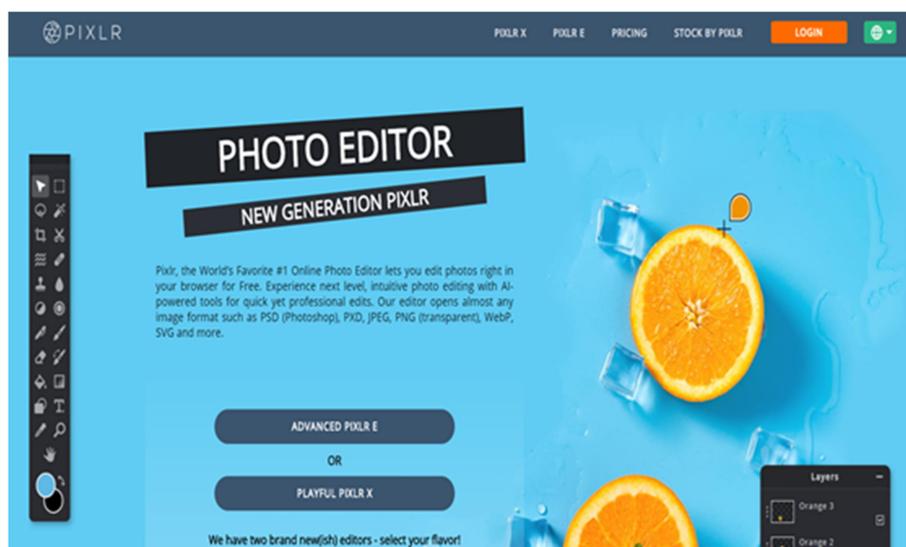


Fig. 1. Pixlr startup dialog box.

Let's review the functionality of Pixlr E. In the left part of the screen there is a start menu of the editor which contains the following options: history; create new; stock search; open existing photo; download from URL. Thus, we press the 4th button and upload an existing photo. The image from the file itself opens in a small window in the central part of the screen; it can be resized by using mouse scrolling. On

the left side of the screen is the **Tools panel**, which allows to perform a series of image-related actions, such as *merge, trim, resize, retouch, reduce or increase contrast*, and more. Moreover, the following functions can be used to alter the file: *cut, separate, move, lasso, magic wand, pencil, brush, eraser, fill, gradient, stamp-clone, color change, draw, blur, contrast, finger, sponge, magic tool, "scratch", remove "red eyes"*

effect, heat, convexity, concavity, choose color, hand, text, scale, user palette. There are three windows on the right side of the screen. "**Navigator**" is a window in which you can use the cursor to zoom in/out (percentage-based); the "**Layers**" window is used to work with image layers: *styles, masks, and setting switches*; the "**History**" UI displays the latest changes applied to the image - the last 15 steps are saved by default and can be cancelled by the user. At the top of the screen is located the **main menu** of the program, which contains the following list of options: *file, edit, image, layer, select, correction, filter, view, help*. Let's analyze these nine items:

1. The menu item "**File**" contains the following sub-items: new image, open image, open image URL, open library, view items, save, print, close.

2. The menu item "**Edit**" includes such commands as: cancel, repeat, cut, copy, clear, paste, arbitrary transformation, change, contour, fill, preferences.

3. The "**Image**" menu item combines such editing tools as: image size, canvas size, rotate the canvas 180°, rotate the canvas 90° clockwise, rotate the canvas 90° counterclockwise, display the canvas vertically, display canvas horizontally; it also includes basic options: bend, trim and restore.

4. The "**Layer**" menu item includes tools for editing layers, including: new layer, duplicate layer, delete layer, open image as layer, open image URL as layer, open libraries as layer, merge, merge visible objects, merge image,

move layer up, move layer down, layer style, rasterize layer, add layer mask, remove layer mask, apply layer mask, rotate layer 180°, rotate layer 90° clockwise, rotate layer 90° counterclockwise arrows, display layer vertically, display layer horizontally.

5. The following commands are included in the "**Select**" menu item: select all; select the peak of the village, cancel the selection; inversion of the selected; conversion to mask; save selected; restore selected.

6. The menu item "**Correction**" includes the following: autocorrection, brightness and contrast, temperature and hue, tone and saturation, juiciness, color balance, color search, glare and shadows, exposure, curves, levels, threshold, pasteurization, discoloration, color inversion.

7. The menu item "**Filter**" includes such sub-items: library of effects, details (sharpness, transparency, blurring, Gaussian blur, blur zoom, smoothing, graininess, sharpen, add noise, remove noise), vignette, bloom, glamor, remove fog, internal radiance, external radiance, contour, remove shadow, side light, titleSobel, variance, titleScanlines, pixelation, mosaic, halftone.

8. The "**View**" menu item combines the commands: enlarge, reduce, screen size, full screen, zoom (100 %, 200 %, 300 %), full screen mode, dark or light modes.

9. The "**Help**" section contains information about hotkeys and links to community pages on social networks.

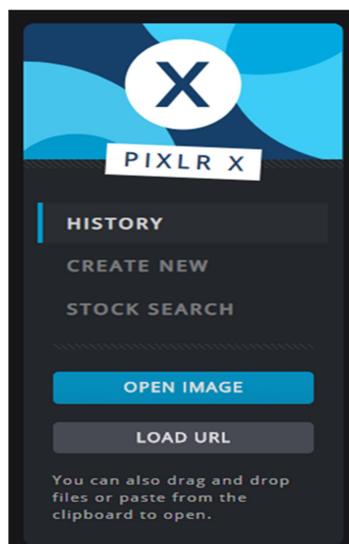


Fig. 2. Pixlr X startup dialog box.

The editor offers a light version of the product – Pixlr X, which includes only basic image processing tools and functionality (fig. 2), the startup dialog

box displays the following options: history, create new, stock search, open image or download from the Internet (URL picture).

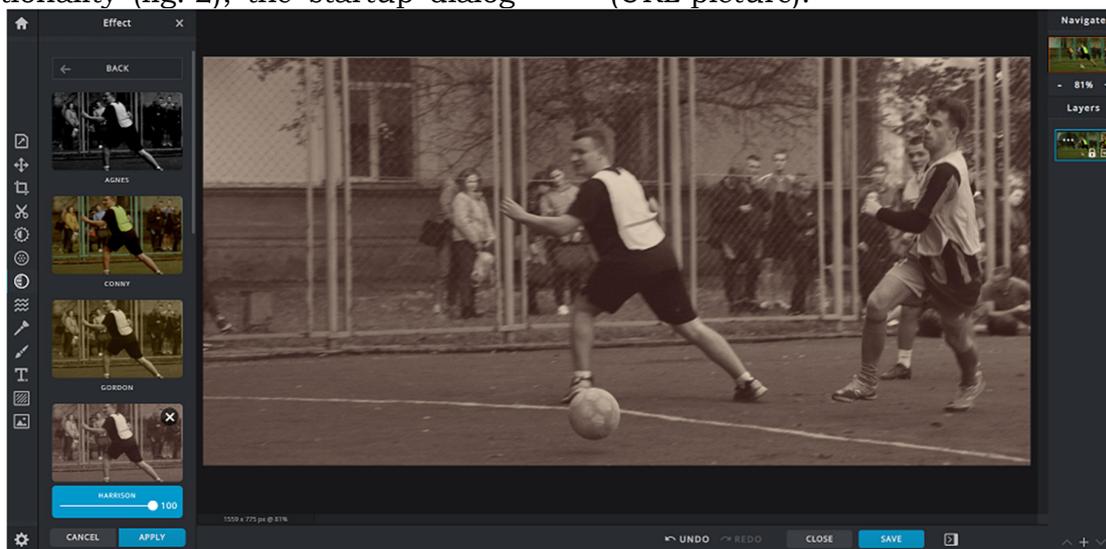


Fig. 3. An example of using one of the effects in Pixlr X.

Pixlr X provides modern tools for deep photo editing; it supports most image types and formats, such as: PSD (Photoshop), PXD, JPEG, PNG; this software complex is ideal for quick photo editing and adding sophisticated effects with one mouse click, namely: resizing the canvas or the image itself, cropping, removing extra elements, changing the brightness, saturation in the growth layers, applying filters and effects (12

main groups of effects), retouching, adding elements, and so on.

As an example, we'll consider the use of the Pixlr E cloud service to perform one of the most common image processing tasks – tone adjustment. Let's explain the essence of the process in more detail: the key difference between quality photos is the correct distribution of light and shadows. In this case, the objects in the image look embossed and well perceived by the

human eye. However, the vast majority of pictures taken by non-professional photographers are characterized by defects in lighting, shadow distribution and image contrast. In general, they can be combined with the phrase "tone image defects", and the process of correcting them – tone adjustment.

The tone of a digital image is the brightness of the pixels that make it up, while part of the range used in the image is called the "tone range" [14].

Among the whole list of tools designed for editing digital photos in the Pixlr cloud environment, two important **"Correction"** menu commands should be singled out: **"Levels"** and **"Curves"**. These tools are similar to those included in desktop and laptop software applications such as Adobe Photoshop CC, GIMP and are designed to perform similar operations: redistribution of shadows and light in the image.

Let's review them in more detail. The **"Levels"** toolkit is used to alter the tonal range by adjusting the intensity levels of shadows, halftones, and light tones of the image. Picture 3 shows the view of its UI window in the cloud service Pixlr, however, the window itself is divided into the following parts:

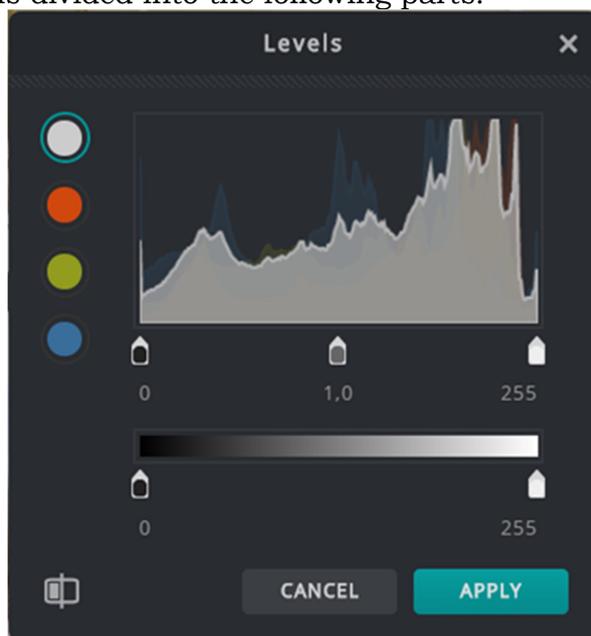


Fig. 4. "Levels" toolkit UI window.

- Window's title;
- Color channel selection field;
- Image tone-based pixels' quantity distribution histogram field (distribution occurs in the range from 0 to 255, where 0 corresponds to value of black, and 255 – white);
- Image tone correction results;
- Apply and cancel changes buttons.

A key feature of the tool is the ability to specify which tone of the original image will correspond to a completely dark or light (white) point on it, as well as to pinpoint a correct place for penumbra. The result of applying the corresponding enhancements will be an increase in the contrast of the picture, thus improving the clarity of small details, as well as the removal of grayish tone. It is possible to edit each color channel separately, which adds more opportunities for image decoration. The **"Curves"** tool is more flexible than **"Levels"** command, its settings are shown in figure 5.

The toolbox UI window contain:

1. Window title.
2. Color channel selection field.
3. Color curve edit field.
4. Apply and cancel changes buttons.

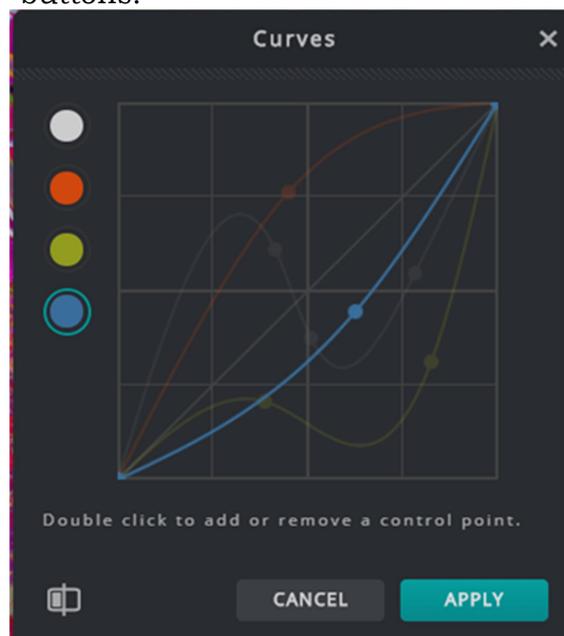


Fig. 5. "Curves" toolkit UI window.

Curve editing field is the key element of the interface. It is divided into 16 squares (4x4). The underside of the square corresponds to the original image, namely its tonal distribution. At the same time, the left side is the result of processing using certain algorithms in accordance with the specified settings. It is important to point out such features of the field itself. Editing the curve in the upper right square allows to change the redistribution of pixels in the light part of the range of tones. Instead, the lower left square is used to represent shadows. The four central squares are a conditional representation of the semitones. The essence of the **"Curves"** toolkit is that when it is used, it can not only narrow the tonal range, but also edit it in certain areas. Based on the mentioned overview of both the general possibilities of using Pixlr and its tone adjustment tools, we will reveal the techniques of tone editing of images in this cloud service. Download the image and at the first stage use the "Levels" toolkit from the "Adjustment" menu. Let's analyze the obtained histogram: here's the case when the photo has no pixels in the shadows and light part of the tone range. In order to overcome these defects, it is necessary to move the appropriate markers, so that the shadow marker should be placed at the base of the darkest real point of the photo, the white marker – at the corresponding base of the brightest point. The halftone marker must be shifted to illuminate the picture. The performed manipulations indicate that the darkest point of the image will correspond to the actual tone of the image from the position of shadows, and the lightest point – the brightest tones. In fact, the tonal range is stretched. In the second stage, we will use the **"Curves"** toolkit, which is a much more effective tool. In most cases, an **"S-shaped"** curve is used to preserve bright colors. In particular, it should be

noted that there are modifications in the field of shadows and light. Dark pixels were more shaded and light ones were lightened.

Conclusions and research perspectives.

In general, tone correction is not limited to the use of only above-mentioned tools, but for most cases, joining them allows to edit photos on the basic level. Moreover, the toolkits of the Pixlr cloud service are quite similar to the ones of the most popular software solutions, such as Adobe Photoshop. UI similarity can be used for educational purposes in the training of pupils and students, including the specialty "Computer Science". In fact, the combination of accessibility, the use of services in an average browser window, and functionality that is not inferior to the leading software for creating and editing images, makes it an important subject for studying the features of modern computer graphics. Thus, cloud technology is one of the areas that is developing extremely fast, as evidenced by the activity of such companies as Intel, Adobe and Autodesk. Therefore, the prospects for the study of relevant graphics services in school and in higher education institutions justify the prospects for our further research, which implies development of appropriate methods of teaching CS-based disciplines.

However, it is important to mention a number of problems of cloud technologies, namely data protection and security. Most connections to/from cloud service are encrypted in order to preserve confidentiality of customer data. However, some services don't guarantee the total safety of uploaded files, for a possibility of the user data to be viewed by unauthorized entities remains a serious issue. Moreover, some companies enforce obligatory moderation of the data uploaded, which compromises confidentiality even more. Another disadvantage of cloud

technology is that to work with cloud services you need a stable Internet connection.

Despite the above-mentioned shortcomings of cloud technologies, their application in various fields, including education, still remains a topical issue. Cloud computing services offer great opportunities for learners and teachers, as well as for developers of resources and subsystems that are directly related to education or accompany the educational process.

Currently, an important challenge is to maximize use of cloud technologies and improve the quality of modern education without compromising existing effective teaching methods and tools.

REFERENCES (TRANSLATED & TRANSLITERATED)

1. Bykov, V.Y. (2011). Khmarni tekhnolohii, IKT-outsorcing i novi funktsii IKT pidrozdiliv osvitykh i naukovykh ustanov [Cloud technology, ICT outsourcing and new features of ICT departments of educational and scientific institutions]. *Information Technologies in Education*, № 10, 8–23 [in Ukrainian].
2. Vakaliuk, T.A. (2016). Pidkhody do vykorystannia khmarnykh tekhnolohii u navchalnomu protsesi vyshchoi shkoly u vitchyzniani naukovii literaturi [Approaches to the use of cloud technologies in the educational process of higher education in the national scientific literature], *Modern information technologies and innovative methods of training in the training of specialists: methodology, theory, experience, problems*, № 47, 123-126 [in Ukrainian].
3. Zhaldak, M.I. (2012). Problemy informatizatsii uchebnogo protsesa v shkolakh i pedagogicheskikh universitetakh [Informatization challenges in the learning process at secondary schools and pedagogical institutes]. *Informatization in education: history, situation, perspective: International research and training conference information package*. Omsk, [in Russian].
4. Litvinova, S.G. (2014). Ponyattya y osnovni kharakterystyky khmaro oriyentovanoho navchalnoho seredovyscha serednoyi shkoly [Concepts and characteristics of cloud-oriented learning environment of school]. *Information Technologies and Learning Tools*, № 40, 26-41 [in Ukrainian].
5. Morze, N.V., & Kuzminska, O.G. (2011). Pedagogichni aspekty vykorystannia khmarnykh obchyslen [Pedagogical aspects of using cloud computing]. *Information Technologies in Education*, № 9, 20-29 [in Ukrainian].
6. Nosenko, Y.H., Popel, M.V., & Shyshkina, M.P. (2016). Khmarni servisy i tekhnolohii u naukovii i pedagogichnii diialnosti [Cloud services and technologies in scientific and pedagogical activity]. Kyiv: IITZN NAPN Ukrainy [in Ukrainian].
7. Kiv, A., Soloviev, V., & Semerikov, S. (2018). CTE 2018 – How cloud technologies continue to transform education. *Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE2018), CEUR Workshop Proceedings*. Kryvyi Rih, 1-19 [in English].
8. Spirin, O., Oleksiuk, V., Balyk, N., Lytvynova, S., & Sydorenko, S. (2019). The blended methodology of learning computer networks: cloud-based approach. *ICT in Education, Research and Industrial Applications, CEUR-WS, Kherson*, 68-80 [in English].
9. Tryus, Y.V. (2012). Khmarni Tekhnolohii U Profesiinii Pidhotovtsi Studentiv Kompiuternykh Spetsialnostei [Cloud technologies in the training of computer science students]. *Cloud technologies in education: materials of the All-Ukrainian scientific-methodical Internet-seminar*. Kryvyi Rih–Kyiv–Cherkasy–Kharkiv, 147-149 [in Ukrainian].
10. Shishkina, M.P. (2016). Teoretyko-metodychni zasady

formuvannya i rozvytku khmaro oriientovanoho osvitno-naukovoho seredovyshcha vyshchoho navchalnoho zakladu [Teoretiko-methodical ambush of formulating and developing of an orthodox sci-entific and technical medium for a viscous naval mortgage]. *Extended abstract of candidate's thesis*. Kyiv: Institute of Information Technologies and Learning Tool, 441 [in Ukrainian].

11. Seydametova, Z.S., & Seytvelieva, S.N. (2011). Oblachny`e servisy` v obrazovanii [Cloud services in education]. *Information Technologies in Education, № 9*, 105-110 [in Russian].

12. Gritsuk, Y.V. (2012). Cloud technologies in the technical university: review and prospects. *Cloud*

technologies in education: materials of the All-Ukrainian scientific-methodical Internet-seminar. Kryvyy Rih–Kyiv–Cherkasy–Kharkiv, 68-70 [in English].

13. Mell, P., & Grance, T. (2011). *The NIST Definition of Cloud Computing*. Recommendations of the National Institute of Standards and Technology, NIST Special Publication 800-145, Gaithersburg [in English].

14. AdobePS.ru (2012). *Tonovaya korrekciya izobrazheniya [Tone image correction (photoshop tutorials)]*. Retrieved from <https://adobePS.ru/photoshop-lessons/47-tonovaja-korrekcija-izobrazhenija.html> [in Russian].

Received: October 30, 2020
Accepted: November 27, 2020