

THE USE OF CLOUD COMPUTING IN STUDIES

Gražina Tautvydienė, Ingrida Morkevičienė

Šiauliai State College
Lithuania

Annotation

The article reviews the use of functions of services based on cloud computing principles in studies, analyzes the solutions of possibilities for their use in the study process. The conducted comparative analysis of college students' surveys in 2013 and 2018 on cloud computing and the use of its services is presented.

Key words: *cloud computing, SaaS, SOA, Google Apps for Education, GAFE, software, information technology.*

Introduction

The article "Cloud Computing Solutions in Studies and Business", presented five years ago, dealt with the conception of cloud computing, discussed the use of cloud computing in studies and reviewed functions of the most popular services based on the principles of cloud computing. At that time, Lithuanian educational institutions were introduced to the latest technologies for education, which would reduce the costs of IT installation and updating, allow to discover new ways of communication, create new possibilities for collaboration and solution of activity processes, improve flexibility and mobility of the study process. Today, most educational institutions have already chosen such technologies. One of such solutions in the education sector is *Google Apps for Education (GAFE)*, which is free for these institutions. According to Victor Alhadeff, the founder of Egghead Software and CEO of Boost eLearning, *Google Apps for Education* is a cloud based on the suite of applications, enabling teachers and students to communicate, collaborate, and create (Victor Alhadeff, 2015). Cloud computing services became an integral part of the academic society and its solutions became relevant to the study process. It is a fast, effective and simple way to reach educational services, enabling students to acquire the latest knowledge and skills required for the 21st century (Kosta Andreev Garov, Lambri Yovkov Yovkov, Liliyana Ivanova Rusenova, 2018). Based on the conclusion of the study conducted by the scientists of the USA in 2015, *Google Apps for Education (GAFE)* is a useful tool for colleges to achieve learning outcomes (Maury Elizabeth Brown, Daniel L. Hocutt, 2015).

The aim of the article is to analyze the use of cloud computing services in studies.

The research object: cloud computing services.

Research objectives:

1. To review functions of services based on cloud computing principles, used at the college.
2. To find out knowledge of cloud computing and the use of its services among students of Šiauliai State College.
3. To compare the research results with the results of the study conducted five years ago.
4. To provide proposals for application of cloud computing solutions in the study process.

Research methods: the analysis of scientific literature and sources, comparative and graphical data analysis.

The use of functions of services based on cloud computing principles at the college

Cloud computing is the delivery of on-demand computing services ranging from applications to storage and processing over the Internet (Steve Ranger, 2018). Cloud computing technology has already penetrated not only to people's everyday life and business but also integrated into educational institutions, starting with technology infrastructure and finishing with information exchange and the use of numerous applications and resources. By 2022, 62 percent of all organizations will run 100 percent of their IT in the cloud. (David Politis, 2015). By 2020, *Google Apps for Education* services will be used by more than 110 million users (Victor Alhadeff, 2015). According to McKendrick (Forbes analyst), in 2030, "clouds" will be a tool that will not only facilitate communication with the surrounding world but will also be the means for collecting, processing, computing and performing functions that are difficult to understand or imagine today.

According to the data of The Lithuanian Department of Statistics, in 2018, the Internet for learning purposes was used by 58,7 percent of 16- to 24-year-olds and 26,4 percent of 25- to 34-year-olds in Lithuania. The use for educational purposes includes online learning (studies, courses), the use of teaching material directly on the Internet, communication with teachers or other online learners on webpages of educational institutions and the like for learning purposes.

Cloud technologies used in the college's study process include the virtual learning environment *Moodle* and *Google Apps* services. In the *Moodle* system, 50 distance study courses for subject studies, consultations, practices, activities of students' scientific society and other activities have been prepared. Looking for ways to ensure high quality of services and more opportunities for learning, the educational institution chose free *Google Apps* service. Such solution for the college is also beneficial and viable due to budget constraints and students' mobility. The technology chosen – cloud computing services *SaaS (Software as a Service)* and its delivery method *SOA (Service-Oriented Architecture)*⁴² – provide the organization with a possibility to use software existing in the cloud computing infrastructure, which can be accessed from various devices with a remote login and there is no need to bother about software installation, maintenance, updates and licenses. Based on the research conducted by the company *BetterCloud*, 91 percent of *Google Apps* users state that *SaaS* service is useful and they spend 80 percent of all of their working time, using this service (Scott Solomon, 2016).

From 2014, the free GAFE service is delivered to the college, providing unlimited capacity email *Gmail*, data storage *Google Drive*, administration interface for managing user environment and the possibility to use *Google* office apps suite, website and calendar designing tools, chat system and other apps⁴³ not just on a standard computer but also on a tablet or smartphone. The advantages of private and hybrid cloud computing are used to create a controlled and secure system of using cloud computing at the college.

The company *Google* offers intuitive applications and platforms for mobile devices. Every year, learning and communication based on the advantages of affordable and entrenching mobile technologies is increasing. According to the data of The Lithuanian Department of Statistics, in 2018, smartphones were used by 97,5 percent of the population aged 16-24 and 95,4 percent of 25- to 34-year-olds.

The usefulness of GAFE services must be assessed considering how they allow creation and not how students jointly manage technologies (Maury Elizabeth Brown, Daniel L. Hocutt, 2015). In the study process, the resources of *Google Apps* service help to perform such functions as organisation of joint academic activities, hosting of various information, communication, the use of online surveys, teamwork, assurance of a flexible learning environment, the use of web applications, planning of accounting and other activities (see Figure 1).

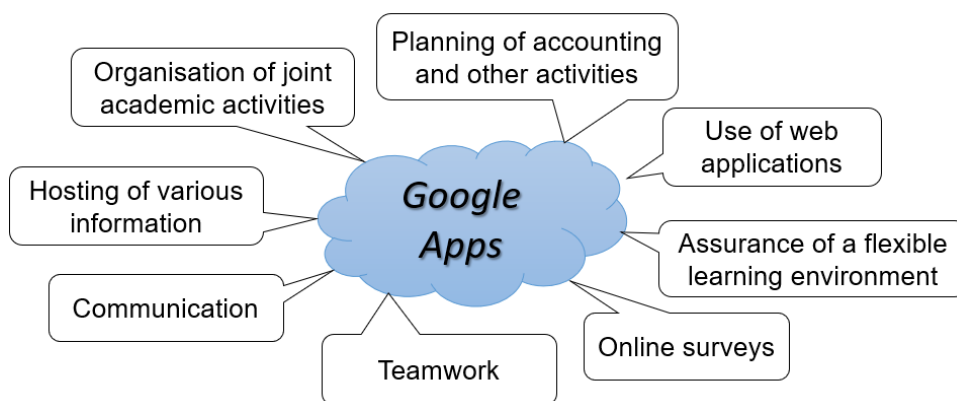


Fig.1. Features of *Google Apps* services in the study process

Reviewing the functions of *Google Apps* services in the study process, it was sought to find out what services tools can be used in every function (see Table 1).

⁴² Retrieved from: <<https://slideplayer.com/slide/5765502/>>

⁴³ Retrieved from: <https://edu.google.com/products/gsuite-for-education/?modal_active=none>

Tools of *Google Apps* services in the functions of the study process

Organisation of joint academic activities	Assurance of the flexible learning environment	Team work	Use of web applications
<ul style="list-style-type: none"> • Email <i>Gmail</i> • <i>Google Drive</i> • Groups • <i>Google Calendar</i>; • <i>Google office apps</i> • Chat system <i>Hangout</i> • <i>Hangout Meet</i> • <i>Google Sites</i> • <i>Google+</i> • and other 	<ul style="list-style-type: none"> • Email <i>Gmail</i> • <i>Google Drive</i> • <i>Classroom</i> • <i>Hangout Meet</i> • Chat system <i>Hangout</i> • <i>Google+</i> • and other 	<ul style="list-style-type: none"> • <i>Google Docs</i> • <i>Google Sheets</i> • <i>Google Slides</i> • <i>Teamwork Projects</i> • Chat system <i>Hangout</i> • <i>Hangout Meet</i> 	<ul style="list-style-type: none"> • <i>Google Docs</i> • <i>Google Sheets</i> • <i>Google Slides</i> • <i>Google Forms</i> • <i>Google Drawings</i> • <i>Google My Maps</i> • <i>Google Sites</i> • <i>Lucidchart</i> • <i>Sketchboard</i> • <i>Asana</i> • <i>Translator</i> • <i>Photos</i> • <i>Keep</i> • <i>Google Trends</i> • <i>Google Analytics</i> • <i>Think with Google</i> • <i>Google Scholar</i> • and other
Hosting of various information	Communication	Use of online surveys	Planning of accounting and other activities
<ul style="list-style-type: none"> • <i>Google Drive</i> • <i>Google Classroom</i> • <i>Google+</i> • <i>Dropbox</i> 	<ul style="list-style-type: none"> • Email <i>Gmail</i> • Chat system <i>Hangout</i> • <i>Hangout Meet</i> • Groups • <i>Asana</i> • <i>Google+</i> • and other 	<ul style="list-style-type: none"> • <i>Google Forms</i> 	<ul style="list-style-type: none"> • <i>Google Calendar</i> • <i>Google Forms</i> • <i>Google Classroom</i> • <i>Google+</i>

After finding out what services tools can be used for each function of the study process, GAFE services tools used in the college were reviewed.

Organization of joint academic activities. Web-based technology facilitates access to digital information resources and software at the educational institution, makes it easier to establish relations, helps to perform such functions as collaboration, file hosting, and access to the computer environment. Organising joint academic activities, various *Google Apps* services, such as information search, email, chat system, social networks, internet hard drive service, web applications and other can be employed.

The educational institution, using *Google Apps*, has registered its domain with which the organization' email box is created. *Google* organisation's members are given personal email boxes, while departments, faculties, divisions, centres and student groups are provided with shared e-mail boxes. Email service *Google Gmail* that has a convenient mail organization system, virus scanning tool, integrated *spam* protection, link to other parts of the *Google* system and operates not only on regular computers but also on *Android*, *iPhone*, *BlackBerry* devices is used in all study process activities.

Other *Google Apps* services, such as cloud storage *Google Drive*, *Google office applications*, are also used to organize the college's academic activities. For example, the electronic data sheets system for presentation of college students' marks and information is installed in the *Google Sheets* environment.

Various information search is performed using the long-known *Google* search tool, which helps to find reliable information related to study activities.

Hosting of various information. In cloud computing, all user data and the applications the user needs are stored in data storages, otherwise called internet drives. According to the data of the Lithuanian Department of Statistics, in 2018, online data storages were used by 58 percent of 16- to 24-year-old and by 48,6 percent of 25- to 34-year-old residents.

Cloud data storage service *Google Drive* provided by *Google Apps* enables the college community to store any types of files, share them with other users or access from other computers and mobile devices. To use this internet drive, a user account *gmail.com* is required, which is provided to the members of the college community as soon as they become its member.

Using *Google Drive* service, teachers upload teaching material of the delivered subject in a variety of formats (*MS Office*, *Google doc*, video, audio, links, etc.) and share it for a fixed or indefinite period, while students can view it without downloading it. Students use *Google Drive* not only for hosting their works but also for submitting individual, project or other accounting works to the teacher. It is convenient to use this service, having turned on the web and desktop interface, synchronising files between the user's computer desktop and the cloud.

Most of the teachers host their teaching materials and tasks in the learning environment *Google Classroom*. This software tool allowing to create, solve, analyze, present, communicate – exchange information, opinions, discuss and the like – is partly an alternative to *Moodle* system tools. *Google Classroom* is defined as GAFE tool helping teachers to quickly create and organize tasks, provide feedback effectively and communicate easily within a group.⁴⁴

Communication. Members of the college community use *Google Apps* service providing the possibility to communicate with each other by messages, emails, create documents and share them, share videos, collaborate to write blogs, comment and more. The main communication tool used by college members is email *Gmail*. This tool enables students to consult, exchange information and solve various other problems. Other communication services tools are integrated into the applications and they are used in creative processes, when teachers give their comments, and students give their feedback.

Online surveys. The use of *Google Forms* allows not only to create digital tasks, tests, surveys, registration forms to various events (workshops, conferences, etc.) but also to assess group works. This tool allows both quick development of various forms and handy presentation and later, generalisation of the results of the forms. The obtained data is exported in various formats and more exhaustive data analyses are performed. Accounting often includes tests that not only show the student his overall result upon completion but also the result of every separate question. Online surveys integrated into the teaching/learning process allow the teacher to get feedback more quickly and enable the student to evaluate the delivered subject. *Google Forms* in the college are used to conduct online teacher and student surveys, for example, to analyse the assessment of the implementation of the study programme and monitoring of students' self-study time.

Assurance of the flexible learning environment. *Google* services provided at the college ensure the flexible learning environment: information, teaching materials and other resources are available online from anywhere, anytime. This allows optimizing time, reducing costs, and ensures the possibility to learn independently. Students and teachers use *Google Apps* services both in college laboratories, faculty libraries, the Self-Study Centre and using computers and mobile devices at home.

The use of online applications. *Google Apps* office applications suite hosted on the online drive is employed creating documents, spreadsheets, presentations, drawings, and surveys. Work with applications is done using a web browser, there is no need to install them on your computer. For example, monitoring students' intermediate accountings, distributing hours of various planned courses, *Google* spreadsheets are used, allowing collecting data and seeing results quickly and conveniently. *Google Docs* tool collects and combines information related to studies, e.g., the demand for software or hardware, ebooks, etc.

Additional applications of *Google Drive* suite are used to perform various tasks: creation of schemes, models, UML, mind maps (*Lucidchart*), websites (*Google Sites*), maps (*Google My Maps*), drawing (*Sketchboard*), video editing, organisation of teamwork and projects (*Asana*), translation (*Translator*), photo hosting (*Photos*), information search in articles, journals for professionals (*Google Scholar*), etc. Students also use a number of additional apps (*Google Apps*)⁴⁵ for mobile devices and tablets.

Teamwork. This activity is applied when teamwork (group work) is performed. Students' creative tasks are carried out not only individually but also collectively. The use of *Google Docs*, *Google Sheets* and other applications of the office suite allows the group of persons to work with one document at the same time. This is widely applied preparing new study programmes or updating existing study programmes, preparing self-evaluation reports of study programmes, in students' group assignments, when in shared documents every member of the group can see which places of the document are edited by others and discuss each change using the correspondence application.

Planning of accounting and other activities. The main tool for this activity *Google Calendar* is intended for time planning and monitoring of involvement. The calendar shows the entire agenda providing the possibility to know what is planned. Sharing your calendar with other persons makes it easy to plan a common agenda, monitor and organize meetings, inviting guests to events, and send messages by email or to the mobile phone.

In summary, it can be stated that free functions of cloud computing services GAFE are used in the college's study process as additional functions of the study process, which help to organize joint academic activities, communicate and collaborate, ensure the flexible learning environment, plan accounting and other activities, host various information, and improve creation skills.

⁴⁴ Access over the Internet 2019-02-10: <https://edu.google.com/products/classroom/?modal_active=none>

⁴⁵ Access over the Internet 2019-02-10: <<https://get.google.com/apptips/apps/#/all>>

Analysis of college students' knowledge of cloud computing and the use of its services

In order to find out knowledge of students studying at Šiauliai State College about cloud computing and the use of its services and to compare with the analogous study conducted in 2013, the study was carried out, choosing students of Šiauliai State College as respondents. The study sample consists of 144 full-time (85%) and part-time (15%) college students studying in all years of study: 60 students of informatics sciences and 84 students of other sciences (engineering, social, health sciences, business and public management). During the study conducted in September-December 2018, the questionnaire analogous to the one given in 2013 was presented, seeking to find out whether students know and use cloud computing services and to identify the demand for cloud computing in the study process. The selected survey tool was GAFE tool *Google Forms*. The survey created in it was given to college students and upon exporting of the results, data analysis was performed.

The study revealed that in 2018, unlike in 2013, cloud computing services were known and used (66 percent). Only 13 percent of respondents do not know and do not use cloud computing services and 28 percent know about these services but do not use them (see Figure 2). The conducted survey demonstrated that the word combination “cloud computing” was becoming increasingly known and understandable over the years (increased by 46 percent).

The comparison of survey results of students studying informatics sciences and other sciences (engineering, social, health sciences, business and public management) of 2013 and 2018 showed that the assumption that students whose specialty is directly related to IT are aware of cloud computing and use its services is not valid. The results show that responses about knowledge and use of cloud computing are distributed equally (see Figure 2). To confirm the assumption, a correlation analysis, calculating the Chi-square criterion, was performed. The established statistical relationship ($p=0,34$) between variables confirmed the assumption.

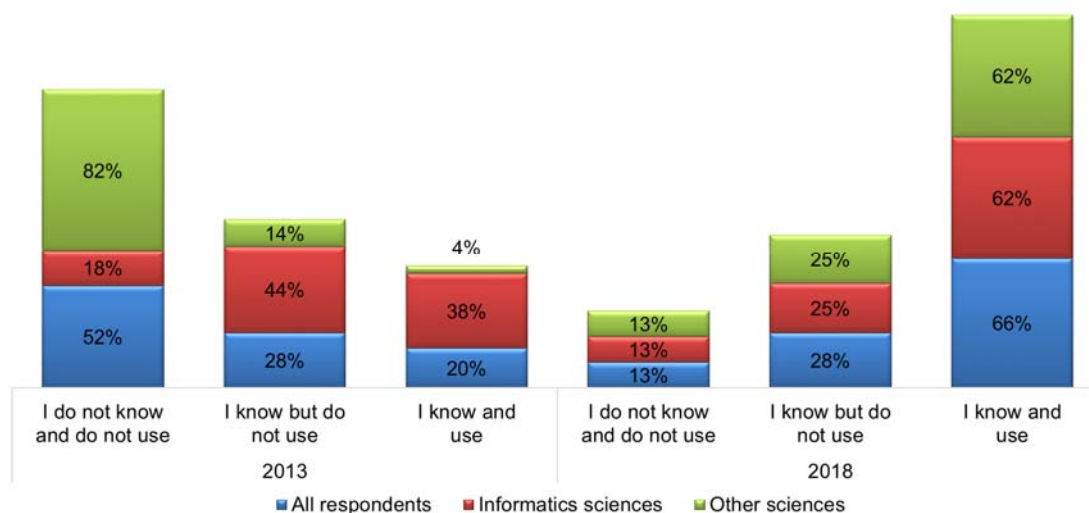


Fig. 2. The level of students' knowledge and use of cloud computing in 2013 and 2018

However, analyzing the responses of the respondents representing separate fields of science (informatics and engineering and other sciences), to validate the assumption that knowledge and use of cloud computing is not dependent on the specialty, the statistical relationship was identified ($p=0,037$). If the assumption is not confirmed, it is concluded that knowledge of cloud computing and its use still depend on the chosen field of science. Based on the obtained results, it can be stated that knowledge and use of cloud computing is greater among students studying informatics and engineering sciences. Here you can envisage links with the areas of exact sciences where cloud computing services are used in technological processes. Compared with the data of the survey conducted in 2013, there is a considerable change between informatics, engineering and other fields of science (see Figure 3). The percentage of responses of respondents representing other sciences about knowledge and use of cloud computing particularly distinguishes itself (from 3 percent to 66 percent). “Salesforce” experts state that after 10 or 15 years, “clouds” will be perceived even by that person who totally avoids communication with technologies.

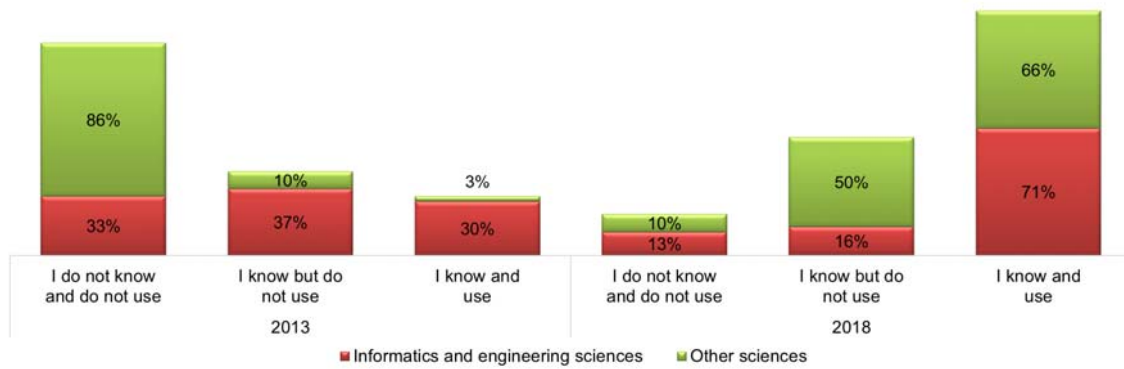


Fig. 3. The level of students' knowledge and use of cloud computing in 2013 and 2018 with regard to the fields of science

Based on statistical calculations, it was found that knowledge of cloud computing and its use did not depend either on the mode of study (full-time, part-time) or on the year of study or gender.

During the research, students were asked what cloud computing services they were using. Answering the questions in the questionnaire, students name the following services: email (100 percent), information search (71 percent), social networking (46 percent), interactions in chat systems (36 percent), online drive service (56 percent), web applications (e.g., *Google Docs*, spreadsheets, presentations, etc.) (55 percent). However, 13 percent of respondents do not know and do not use cloud computing services, maybe they still do not know that the said services are based on the cloud computing technology.

The comparison with the data of the survey conducted in 2013 shows that communication in social networks decreased by 33%; in chat systems, by 32%. Such results suggest that the services that require interactive communication have reduced because students use other means of communication, e.g., *Facebook*, *Instagram*, *Snapchat* and others. There is an increase in the use of services of the internet drive (by 24 percent) and web applications (by 27 percent) (see Figure 4). It is likely that this was influenced by simple use, intelligent constraints and easy-to-use interface of GAFE functions.

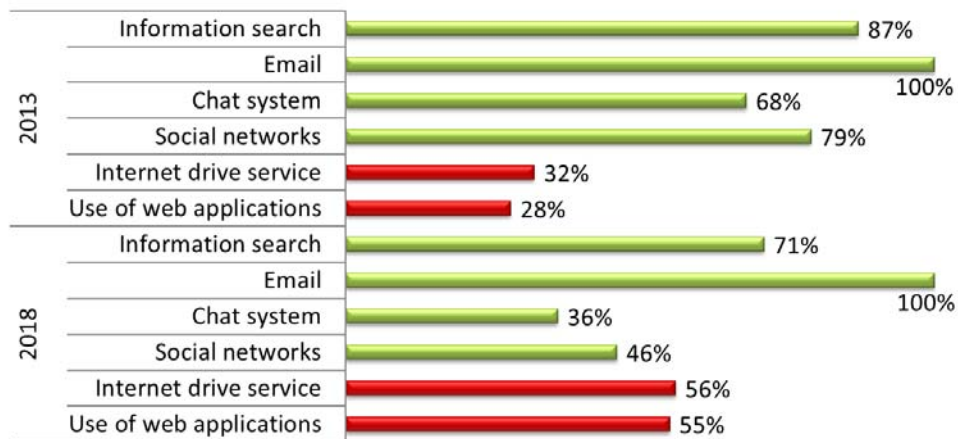


Fig. 4. The use of cloud computing services in 2013 and 2018

It was sought to find out in the research what study activity based on cloud computing technology was most significant for students. The questionnaire included the same functions of *Google Apps* services in the study process as five years ago.

Based on the data of the study conducted at the college, all study process activities presented in the questionnaire are relevant and significant for students (see Table 2). In the first place, students distinguish uploading of various information (18 percent). Here links with the advantages of cloud computing provided by Miller M. (2008) can be envisaged: unlimited memory, increased data security and universal access to data. Students find teamwork in the study process activities, planning of accounting and other activities and communication with students equally important (15 percent). Students indicate the provision of the flexible learning environment as the least acceptable activity.

Table 2

Study activities based on cloud computing technology

Activity	2013, percent	2018, percent
Organization of joint academic activities	8	9
Teamwork	14	15
Planning of accounting and other activities	10	15
Communication	17	15
Online surveys	10	8
Assurance of the flexible learning environment	10	7
Uploading of various information	16	18
Use of web applications	15	13

Comparing with the results of the survey conducted in 2013, it can be seen that students' opinion about the significance of study activities based on cloud computing technology is similar: there is an increase or decrease by 1-5 percent.

Summarizing the research conducted at the college, it can be stated that college students know and perceive the concept of cloud computing and its provided functions. GAFE services used at the college, integrated into the study process, are a useful and appropriate teaching technology. After five years, functions of GAFE services as an integral part of the study process are accessible and useful to students.

Cloud computing solutions for the study process

Various learning tools integrated into the study process, containing cloud computing functions, are useful and innovative (Gutiérrez-Carreón, G., Daradoumis, T., & Jorba, J., 2015).

GAFE offers a number of tools and functions ensuring successful functioning of the institution. Reviewing GAFE services in the study process, it was noticed that some services or their functions were not used at the college. The decision to use one or another service or their separate functions should be influenced by easy, simple and fast receipt of its result.

One of such tools is *Google Calendar*, which can be used to create and review the plan of college events, to organize meetings. Entering the event or meeting in the calendar, you can not only specify the time, place and description of the event but also send messages to the invitees by email or to the mobile phone. Event guests can inform about their attendance by email or the calendar itself.

Students and teachers find the time planning service useful. Planning lectures and accountings, you can enter lectures in the calendar by adding their descriptions. The teacher can set up a schedule for his subject, specifying the lectures and their time. The schedule of lecture topics would provide students with the opportunity to see what subject will be analysed on that day. Calendars of students' groups can also be created by providing the schedule for completion of accounting tasks. This would enable to control students' accounting, foreseeing their number per week.

Google Gmail service is long known and used at the college, but most college members do not use mail management tools, which would facilitate and speed up their work with letters. Using labels and colours to identify them, filtering and other settings, every user can create a comfortable environment in the mailbox. In 2018, the mail service was supplemented with a new additional email "snooze" function, which allows to postpone mail viewing for a specified time, two-step authentication tools for mail protection and tools for detecting *phishing* attacks execution letters. For better integration of email, calendar, tasks and contacts, a side toolbar is embedded in the mail service, allowing to see both the content of the email and involvement in the calendar simultaneously.

The tool *Google Sites* allows to take advantage of the institution's intranet. Using this tool, college members could create webpages for hosting college information.

The communication platform *Google Hangout* developed by the company includes messaging, video chat, SMS and VOIP functions. All members of the college community can correspond, use voice and video calls, talk to one person or involve all friends and participate in group conversations. The video conferencing support system integrated into the service, allowing connection of up to 15 users at the same time, can be used organizing department meetings, project participants' meetings, seminars, consultations for students or other similar activities.

Google tools offered for marketing management, such as *Google Trends* for tracking search changes locally and globally, *Consumer Barometer*, which provides survey data from around the world, *Google Alerts* watching for changes of selected words on the web and sending messages about the observed changes by email, *Google Digital Garage*, which allows to acquire digital marketing knowledge and skills, *Google Analytics* allowing to analyze

attractiveness and functionality of webpages by watching website visitors' flows and behaviour, can be included in the studies of respective subjects. Students studying subjects related to marketing could be introduced to the tool designed for that *Think with Google*, which would help to gain insights into the most relevant industrial processes. To improve skills of students studying informatics sciences, tools *TensorFlow* and *App Engine* could be used.

Google Apps also provide other useful applications that could be applied in the study process. The tool *Sketchboard*, designed for drawing sketches, schemes and generating ideas, provides a possibility to use web application commands in real time. It is proposed to use *Teamwork Projects* tool for team project work. *Ganttter* application can be used for project planning. *Pixlr* application is offered for editing photos. The use of note taking and reminder application *Keep* helps the user to keep a variety of documents, images for reminding in one place, and if there is no time, the user can use his voice to record the reminder.

GAFE provides quite a number of tools that are suitable for implementation of the study process, but it lacks the tools to assess learners' learning outcomes. *Google Apps* service is useful in some cases but is not always ideal (Scott Solomon, 2016).

Conclusions

Functions of free cloud computing services *The Google Apps for Education* are used in the process of college studies as additional functions of the study process, which help to organize joint academic activities, communicate and collaborate, ensure the flexible learning environment, plan accountings and other activities, host various information and improve creation skills.

The survey conducted at the college identified that cloud computing services are known and used by students. 66 percent of respondents know and use cloud computing services, 28 percent know about these services but do not use them and only 13 percent do not know and do not use them.

The use of *Google Apps for Education* services is increasing every year. Compared with the results of the same study conducted in 2013, the share of students who know what cloud computing is and who use it increased by 46 percent; while of those who do not know about it and do not use it, decreased by 39 percent.

Google provides quite a number of services suitable for implementation of the study process activities. Using these services, shortcomings were noticed, but most of these shortcomings are related to unawareness of tools of provided services and the inability to use them.

The article presents *Google Apps* solutions that are likely to increase the effectiveness of the study process and help to implement innovations in higher education.

Recommendations

The teachers of the subject Information Technologies should deliver broader presentations on functions and new solutions of cloud computing *Google Apps* services and practically familiarize the college's academic staff and students with them in workshops and trainings.

Additional research could help to find out how *Google Apps for Education* services are used by students with hearing or visual impairments.

References

1. Gulbinienė, E., Tautvydienė, G. (2013). Debesų kompiuterijos sprendimai studijose ir versle. *Profesinės studijos: teorija ir praktika*, 12, p. 148-158. Retrieved from: <https://svako.lt/uploads/pstp-12-2013.pdf>
2. Lietuvos statistikos departamentas. Retrieved from: <https://osp.stat.gov.lt/statistiniu-rodikliu-analize?hash=e472f428-0f4c-4040-8aba-828233d0620c#>
3. Alhadeff, V. (2015). Google Apps for Education Anticipated to Reach 110 Million Users by 2020. *PR Newswire*. Retrieved from: <https://www.prnewswire.com/news-releases/google-apps-for-education-anticipated-to-reach-110-million-users-by-2020-300107878.html>
4. Brown, M.E., Hocutt D.L. (2015) Learning to Use, Useful for Learning: A Usability Study of Google Apps for Education. Retrieved from: <http://uxpajournal.org/usability-study-google-apps-education/>
5. Cloud Computing. Retrieved from: <https://www.salesforce.com/ca/cloud-computing/>
6. Education Solutions. Retrieved from: <https://cloud.google.com/solutions/education/>
7. Furht, B., Escalante A. (2010). *Handbook of Cloud Computing*. Boston: Springer.
8. G Suite for Education: Spark learning with G Suite for Education. Retrieved from: https://edu.google.com/products/gsuite-for-education/?modal_active=none

9. Google Analytics. Retrieved from: <https://www.umassmed.edu/globalassets/it/web-services/google-analytics/google-analytics-user-guide.pdf>
10. Google įrankiai, kuriuos verta žinoti. Retrieved from: <https://marketingovaldymas.lt/google-naujienos/google-irankiai-kuriuos-verta-zinoti/>
11. Gutiérrez-Carreón, G., Daradoumis, T., & Jorba, J. (2015). Integrating Learning Services in the Cloud: An Approach that Benefits Both Systems and Learning. *Educational Technology & Society*, 18 (1), p. 145–157.
12. Knorr, E. (2018). What is cloud computing? Everything you need to know now. Retrieved from: <https://www.infoworld.com/article/2683784/cloud-computing/what-is-cloud-computing.html>
13. Garov, K.A., Yovkov, L.Y., Rusenova, L.I. (2018). Cloud-based e-learning. *TEM Journal*, Volume 7, Issue 2, p. 286-292.
14. Miller, M. (2008). *Cloud Computing: Web – Based Applications That Change the Way You Work and Collaborate Online*. Que. Retrieved from: http://books.google.lt/books/about/Cloud_Computing.html?id=8es62w1MOVcC&redir_esc=y
15. Politis, D. (2015). Trends in Cloud IT: Dissecting Adoption Across Thousands of Organizations. Retrieved from: <https://www.bettercloud.com/monitor/cloud-office-systems-adoption/>
16. Ranger, S. (2018). What is cloud computing? Everything you need to know about the cloud, explained. Retrieved from: <https://www.zdnet.com/article/what-is-cloud-computing-everything-you-need-to-know-from-public-and-private-cloud-to-software-as-a/>
17. Solomon, S. (2016). Google and Microsoft's Battle for the Enterprise: How Users Are Interacting With SaaS Applications. Retrieved from: <https://www.bettercloud.com/monitor/google-apps-and-office-365-differences/>

Received: 2 April 2019

Accepted: 10 December 2019