

Cloud services in the distance learning system for future sailors

Lyudmyla Kravtsova¹ [0000-0002-0152-635X], Nataliia Kaminska¹ [0000-0002-9975-7403],
Hennadiy Kravtsov² [0000-0003-3680-2286]

¹ Kherson State Maritime Academy, 20, Ushakova avenue, Kherson, 73000, Ukraine

² Kherson State University, 27, Universitetska St., Kherson, 73000, Ukraine

limonova@ukr.net, natalikamkam@gmail.com, kgm@ksu.ks.ua

Abstract. The widespread use of distance learning platforms and office services, in particular spreadsheets, sets the task of their integration, for example, for using Excel documents in distance learning systems (DLS). Using cloud services can be a technological solution to this problem. The advantage of using cloud services is access to information resources using only an Internet connection and a web browser.

The aim of the study is the development and implementation of the ExcelReader software module for using Excel spreadsheets on the web pages of the distance learning system.

The following tasks were solved in the work:

- 1) analyzed well-known software solutions for displaying Excel documents in web applications and training platforms;
- 2) an effective technology for programmatically processing Excel documents was selected;
- 3) a model of a system for accessing and using web services for processing Excel documents in DLS was developed;
- 4) the ExcelReader software module was developed for displaying and editing Excel documents on web pages in the distance learning system;
- 5) The program module "ExcelReader" is implemented in DLS "Moodle KMA" and "Kherson Virtual University" (KVU). In particular, the ExcelReader software module was introduced into the educational process for using Excel spreadsheets on the web pages in DLS KVU using the Microsoft Excel Web App cloud service.

Keywords: E-learning, iCloud services, Excel, embedding, distance learning, Kherson Virtual University, Moodle KMA, infrastructure.

1 Introduction

One of the tasks of the education system in modern society is to provide each person with free and open access to education throughout his life, taking into account his interests, abilities and needs. Therefore, learning management systems (LMS) are becoming relevant [1]. Now, education does not depend on the geographical location of a person and becomes more accessible with the advent of distance education.

Among the main functional requirements for electronic educational resources in distance learning systems, the requirements of visibility and interactivity can be distinguished, both in lectures and textbooks, and in tests and virtual laboratory work. Among e-learning resources, Microsoft Office documents are widespread. Therefore,

there is a need to display Excel spreadsheets with data, graphs, charts on web pages of resources.

Using spreadsheets, the calculation and processing of a large amount of data is quickly carried out. Their visual and dynamic presentation allows you to almost instantly display the calculation results on a computer monitor. The main advantage of spreadsheets is that it is possible to instantly automatically recalculate all the data associated with functional dependencies when changing the value of any elements of the spreadsheet.

Due to its simplicity and ease of use, the possibilities of teamwork, interaction with Internet resources, and the provision of powerful data analysis tools, Microsoft Excel is one of the most common, popular tools for working with documents with a tabular structure.

Especially significant is the task of building a model of using Microsoft Office resources in distance learning systems. So, combined network models that are able to take into account the indistinct content of some information can be adopted as mathematical models of the information resource of a distance learning system [2].

In order for the electronic learning resource in the distance learning system, for example, Moodle KSMA [3], to be the most effective and visual, it is necessary to solve the problem of displaying Excel spreadsheets on the Web page with data, graphs, charts, as well as creating and editing an Excel spreadsheet, for example, in lectures, practical works, tests. As a result of this, there is a problem associated with the display of spreadsheets data on Web pages.

The main technologies for displaying spreadsheet data on Web pages are:

- saving MS Excel spreadsheets in an XML file with subsequent processing to display it on a Web page [4];
- development of a Web-based software module for supporting the use of spreadsheets in the LMS with the connection of software libraries for processing spreadsheets: Microsoft Office Online [5,6], Excel Reader.NET [7], Excel Viewer 2.0, and others for processing and displaying MS Excel spreadsheets on Web pages;
- the use of online cloud services for working with spreadsheets, such as OneDrive [8], Google Drive [9], Microsoft Azure [10] and others.

A simple and convenient solution to the described problem is the use of cloud services.

Researchers at the UNESCO Institute for Information Technologies in Education note that the acquisition and maintenance of various computer equipment and software in modern educational institutions constantly requires significant financial investments and the involvement of qualified specialists (Neil Sclater, Cloud computing in education [11]). As a cost-saving technology, cloud computing and virtualization of the computing platform are currently playing.

Using cloud services, you can access information resources of any level and any capacity with the separation of the rights of various user groups in relation to resources using only an Internet connection and a web browser.

The advantage of cloud technology is the management of large infrastructures, security, the absence of dependence on computer and software modifications.

Disadvantages include dependence on the availability and quality of the communication channel, risks of technical failures and legal issues.

Cloud services can be divided into three main categories [12]:

- Infrastructure as a service (IaaS);
- Platform as a service (PaaS);
- Software as a Service (SaaS).

An example of the use of cloud technologies in education is personal accounts for students and teachers, electronic journals, thematic forums where students can exchange information and much more. This is a search for information, where students can solve certain educational problems even in the absence of a teacher or under his guidance.

The object of this article is cloud services.

The subject of the study is Microsoft and Google cloud services in the distance learning system.

The purpose of the study is the design, development and implementation of the ExcelReader software module for using Excel spreadsheets on the web pages of distance learning systems, in particular, Moodle KSMA [3] and Kherson Virtual University (KVU) [13].

The following tasks are considered in the article:

- 1) to analyze well-known software solutions for displaying Excel spreadsheets in Web-based applications;
- 2) choose an effective technology for software processing of Excel spreadsheets;
- 3) to design a system for access and use of web services for processing Excel spreadsheets in a distance learning system;
- 4) to develop the ExcelReader software module for the correct display and editing of Excel spreadsheets on Web pages in distance learning systems;
- 5) introduce the software module "ExcelReader" in the distance learning system "Kherson Virtual University".

2 Statement of the problem

The use of cloud services in the educational process is an important resource not only for the teacher, but also for future sailors, as an example of their possible use on the ship.

In the field of training of marine specialists, the main focus is on teaching professionally oriented disciplines, such as "Theory of the ship's structure", "Navigation and the field", "Management of the ship", etc. However, the quality of specialist training is determined in all areas, including the ability to use modern innovative technologies in professional activities. The knowledge gained during the training should be sufficient to correctly operate computer equipment on the ship, to be able to use the information provided by the computer.

Especially important is the ability to quickly and accurately carry out calculations for skippers who, by virtue of their duties, must carry out navigation pads, determine the stability indicators of the vessel when empty and in load, evaluate the error in the

readings of ship's instruments, etc. The most widely used tool for this purpose is MS Excel spreadsheets, access to which can be obtained both from a stationary computer and from a mobile device on which the corresponding mobile application is installed.

The range of tasks that a professional skipper has to solve is quite wide. The program for the preparation of the skipper in disciplines focused on the use of information technology takes into account all aspects of his professional activity, including the tasks associated with the calculations as a necessary component of the navigator's terms of reference. Of course, special navigation programs are installed on ship computers, with which you can solve various navigational tasks. However, the vast majority of these programs are also executed in MS Excel. Spreadsheets are primarily intended for conducting various computational work, where it is necessary to process large arrays of numbers, which the navigator often has to deal with in his work. It should be noted that the crew of any ship changes periodically, and the navigator, arriving at the place of the one who was discharged from the ship, must quickly understand the structure of the calculations, understand their logic and be included in the daily work process.

However, the navigator does not always have access to MS Excel. With this in mind, an analysis of the possibilities of working with spreadsheet data in SaaS cloud services was carried out.

Thus, we set the task of developing methods and technologies for using cloud services in the educational process of future mariners in the LMS in the study of the above disciplines.

3 Modeling a learning system using cloud services

Some of the most popular cloud services include: shared hosting Amazon, TheRackspace, Google, Microsoft, iCloud, SugarSync, Dropbox, Joyent, GoGrid, Terremark, Savvis, Verizon, NewServers, etc.

There are some disadvantages of cloud technologies, which are mainly technical and technological nature. These disadvantages are limiting of functional properties of software compared with local analogues, the lack of native providers of cloud services (Amazon, Google, Salesforce etc. are concentrated in the USA), the lack of national and international standards, and the lack of legal framework applying cloud technologies in education.

Currently there are four models of cloud deployments:

- Private cloud - it is used to provide services within the organization that is both customer and service provider. It is the variant of cloud concept embodiment when the organization creates it's for itself in limited use;
- Public cloud - it is used to deploy of the infrastructure and software to provide access outside of boundaries of institution's infrastructure;
- Hybrid cloud - it is two or more different types of clouds;
- Community cloud - type of infrastructure, designed for use by the specific consumer society of organizations with common objectives. Examples, platform Windows Azure, Web services Amazon, Google App Engine and Force.com.

We study public and community cloud systems [14].

Cloud technologies make possible to integrate various active learning methods in the information environment. Let's consider the most popular and affordable for users Internet services:

- Google Docs is an online office to create various documents for share access;
- OneDrive – service of Microsoft, it is similar service of Google Drive;
- Scribd – Internet service of cloud document storage, which allows publishing documents prepared in the most popular formats: Microsoft Office, Open Office, Adobe Acrobat, etc.;
- Slideshare – online storage of presentations;
- Google Scholar – search engine of educational and scientific publications;
- YouTube – a service that allows you to download and watch videos in a browser;
- Skype – a service that provides audio and video communication;
- Wikipedia – online encyclopedia, based on wiki technology;
- ResearchGate, Academia.edu – social networking sites for scientists and researchers to share papers, discussions, and find collaborators;
- Blogger – Internet-service in the form of online journal (or blog);
- Facebook, LinkedIn – a social network that provides the ability to create study groups, business and employment-oriented communities, etc.

Consider two popular cloud services from Google and Microsoft for their use in distance learning systems. We list the main services that Google provides:

- Gmail - mail service;
- Google Sites – free hosting using wiki technology;
- Google Calendar – an online service for scheduling appointments, events and affairs with a calendar. It is possible to share the calendar with a group of users. The service is integrated with Gmail;
- Google Drive – cloud storage with the ability online (in the browser) to view the contents of many file types. There is support for popular office formats such as *.docx, *.doc, *.rtf, *.xlsx, *.xls, *.pptx, *.ppt, *.pdf, *.txt, *.html, *.jpeg, *.png, *.gif, *.zip, *.rar and others. Files downloaded to the disk with such formats can be opened, viewed, and some can also be edited online and offline directly in a web browser. The user is provided with storage up to 15 GB.

To use all of the above services, the user must have a Google account.

Now consider what is included in the cloud service from Microsoft:

- OneDrive – cloud storage up to 105 GB.
- Office Online (known before 2014 as Office Web Apps) – a tool for creating and processing MS Office documents created in Word, Excel, OneNote and PowerPoint.
- Outlook is email service.
- Calendar – a classic organizer.
- People – a means of communicating with your contacts on Facebook, Google, LinkedIn, Sina and Twitter.

To work in OneDrive and to use other services from Microsoft, you must have a Microsoft account.

Both of these services allow you to embed a document stored in cloud storage into the site. Microsoft, unlike Google, allows you to dynamically work with embedded documents on a web page.

It was this opportunity that played a decisive role in our choice of cloud service, since dynamic work with documents in distance learning systems is important for us.

An important feature is that this interactivity will allow the teacher, during the learning process, to demonstrate the relationship of the stated theoretical material with the practical use of interactive documents in the same system, and the student himself to apply theoretical knowledge in practice during the lesson, which will consolidate the learning results.

And all this will be possible within the framework of one LMS. For example, in a lesson, a simplex method is studied for solving problems using Excel spreadsheets. The teacher will be able to visually demonstrate to students the dependence of the solution of the problem on the values of its variables, as well as the student will be able to "probe" this method.

Features when working in Excel Web App: working with spreadsheets and books in a browser or in MS Excel for desktop computers (Fig. 1).

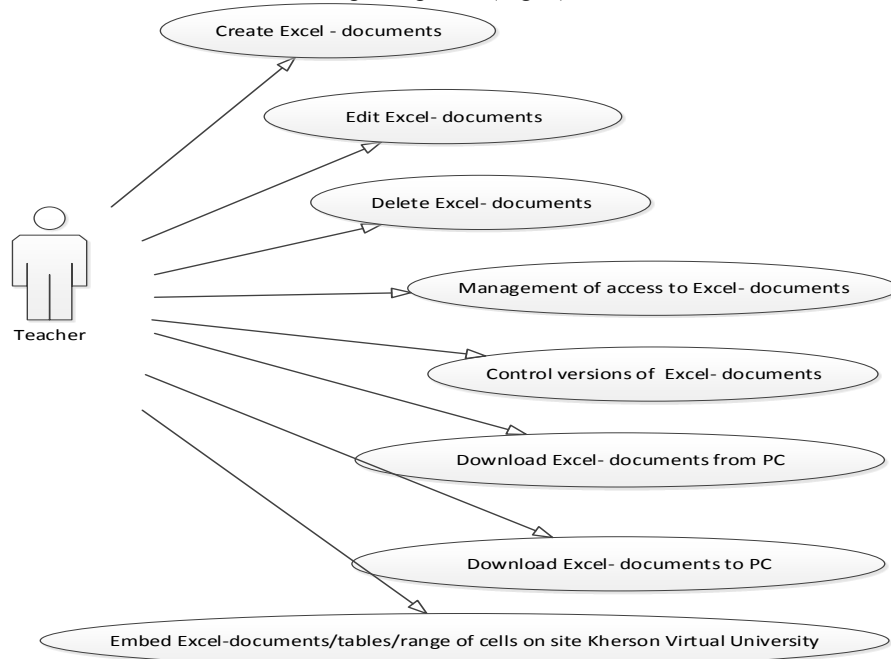


Fig. 1. Use Case-diagram "Teacher Features in Excel Web App".

Consider the algorithm for inserting an embedded object into the html page of the LMS electronic resource using the example of a document in OneDrive [15].

To embed a Microsoft document in the text of an electronic learning resource, the user needs to perform a series of actions: authorize in OneDrive, create the necessary Microsoft document in OneDrive or use an existing document in OneDrive, configure access to this document, and configure its display on the resource's html page, into

which the document will be embedded, receiving the html code and, finally, inserting this html code in the html page editor.

We will consider the implementation of an object from the Microsoft OneDrive service in an html page using the example of inserting an Excel spreadsheet into the electronic resource of the LMS KVVU. When the command to insert an object from the Microsoft OneDrive service is called, a request is sent to its address to add a table to the KVVU server, and the KVVU server, in turn, sends a request to the Microsoft server. After which the user authorization is checked, after the authorization is completed, all the files of this user are displayed, that is, the OneDrive document storage cloud service page opens. The user has the opportunity to create a Microsoft document (Excel, Word, PowerPoint, OneNote) or open a document stored on OneDrive for further work with him.

As an example, consider the processes of creating and editing Excel documents (Fig.2-3).

A prerequisite for adding an Excel spreadsheet to the text of the html page of an electronic learning resource is an account in the OneDrive service, therefore, when you request to add a Microsoft document, authorization will be checked in OneDrive.

To add an Excel spreadsheet to the text of an html page in the LMS, you need to configure the display of the document and access rights to it on the OneDrive website, as well as get the html-code of the document, for example, an iframe tag of the form:

```
<iframe width="402" height="346" frameborder="0"
scrolling="no"
src="https://onedrive.live.com/embed?cid=2B0C4195906D5E81
&resid=2B0C4195906D5E81%21197&authkey=ALxgdY4CVNRy7bk&em=
2&AllowTyping=True&wdDownloadButton=True"></iframe>
```

The attributes of the iframe tag contain information about the display size of the document we want to embed: width = "402" height = "346", display the frame frameborder = "0", the ability to scroll through the document scrolling = "no", as well as a link to this document and additionally displaying the ability to download a document to a computer:

```
src="https://onedrive.live.com/embed?cid=2B0C4195906D5E81
&resid=2B0C4195906D5E81%21197&authkey=ALxgdY4CVNRy7bk&em=
2&.
```

After that, it is necessary to insert the received code in the editor of the html page of the electronic learning resource and save the changes.

Similarly, PowerPoint Online, OneNote Online, and Word Online documents can be used.

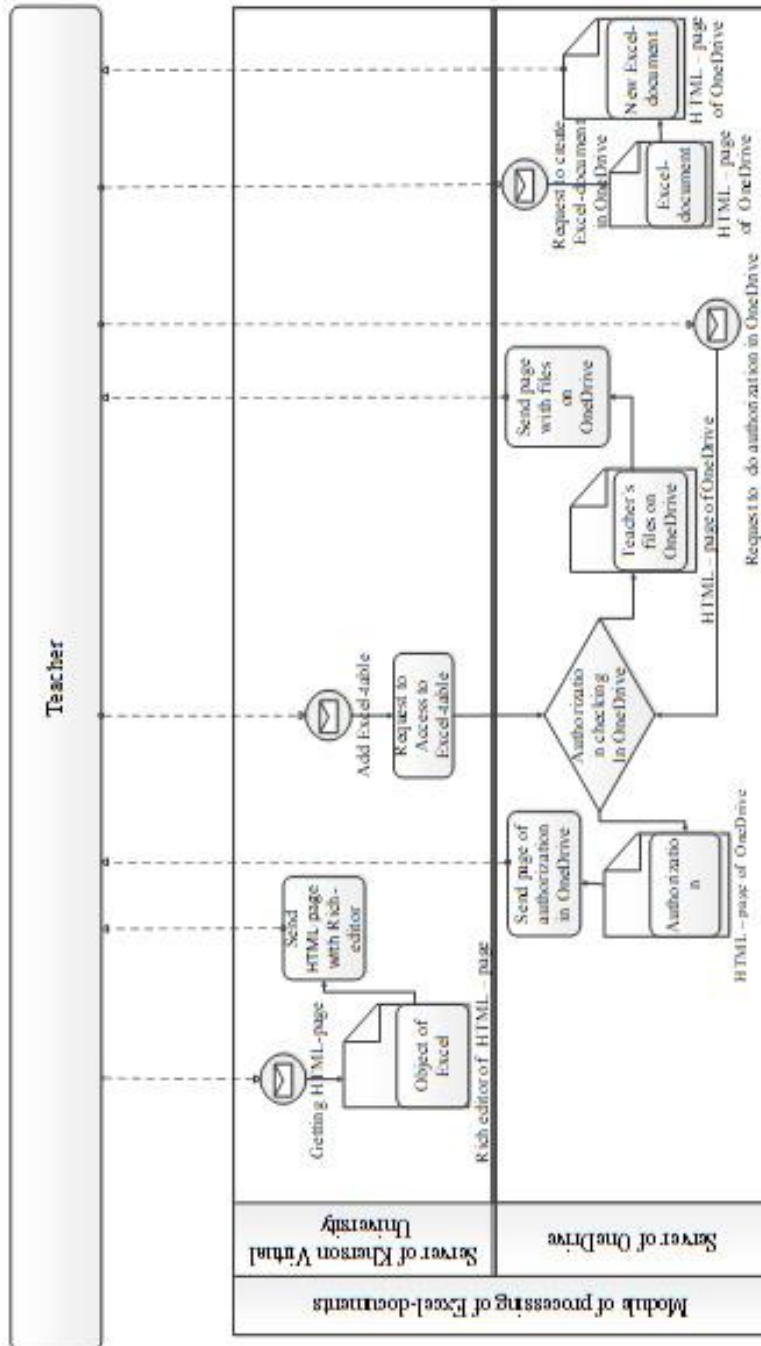


Fig. 2. Scheme of the model for creating an Excel document.

The following technologies were used to develop the ExcelReader module: JavaScript, HTML, .Net.

Consider the JavaScript code:

```
<script type="text/javascript">
<!--
var theElement = document.getElementById("div1");
//-->
</script>
```

`document.getElementById` - method of the document object. It returns a link to the document node, which can be used to change properties and access node methods. We use this method to find a place in the code where the document will be embedded in the future.

Now consider the html code used to insert a document into text:

```
<form name="my_form" id="my_form" action="#"
method="get">
```

Insert HTML - code:

```
<input type="text" name="content" id="content" size="60"
/>
<input type="button" value="Send"
onclick="theElement.innerHTML =
document.my_form.content.value;" />
<input type="button" value="Update"
onclick="theElement.innerHTML =
document.my_form.content.value;" />
</form>
```

The `innerHTML` method we use to insert text.

When you click the “Send” button, a document will be added to the text of the html page of the electronic learning resource in the LMS.

When you click the “Update” button, the document in the text of the html page in the LMS will be updated to the latest version of this document on the OneDrive server.

4 Testing the model in the educational process

As an example, we consider a typical curriculum task.

One of the tasks included in the section “Navigational calculations” of the course of information technologies for navigators is the task of calculating the parameters of a large circle arc. Without going into details of navigational concepts, we note only for clarity that the orthodromy (the arc of the large circle) as the shortest distance between two points on the earth's sphere is a curve facing (on the map in the Mercator projection) the convexity to the nearest pole.

We give the calculation formulas of the problem.

Navigation along the arc of a large circle (orthodrome length):

$$S_{opt} = \arccos(\sin \varphi_H \cdot \sin \varphi_K + \cos \varphi_H \cdot \cos \varphi_K \cdot \cos(\lambda_K - \lambda_H)),$$

where $\varphi_H, \varphi_K, \lambda_K, \lambda_H$ – coordinates (latitude and longitude) of the starting and ending points. The latitudes of the intermediate points of the arc of a large circle for drawing on the Mercator map can be found by the formula:

$$\varphi_i = \arctg \frac{\sin(\lambda_i - \lambda_0)}{\operatorname{tg} K_0}$$

where λ_i is the longitude of the intermediate point, λ_0 is the longitude of the point of intersection of the equator with the orthodrome, K_0 is the angle between the meridian and the orthodromy at the point of intersection of the equator.

$$\lambda_0 = \frac{\lambda_H + \lambda_K}{2} - \arctg \left[\frac{\sin(\varphi_H + \varphi_K) \cdot \operatorname{tg} \frac{\lambda_K - \lambda_H}{2}}{\sin(\varphi_K - \varphi_H)} \right], \quad K_0 = \arctg \frac{\sin(\lambda_H - \lambda_0)}{\operatorname{tg} \varphi_H}.$$

The initial data of the task are the coordinates (longitude and latitude) of the departure point and the point of arrival of the vessel. As an example, consider: $\varphi_A = 47056 / N, \lambda_A = 5023 / W$ (latitude and longitude of the departure point); $\varphi_B = 11040 / N; \lambda_B = 58036 / W$ (latitude and longitude of the point of arrival). The calculation procedure, obviously, is as follows: first, the distance traveled along the orthodromy is calculated, then λ_0, K_0 , and finally, the latitude of the intermediate points of the arc of the large circle φ_i .

The calculation results using MS Excel are presented in Fig. 4

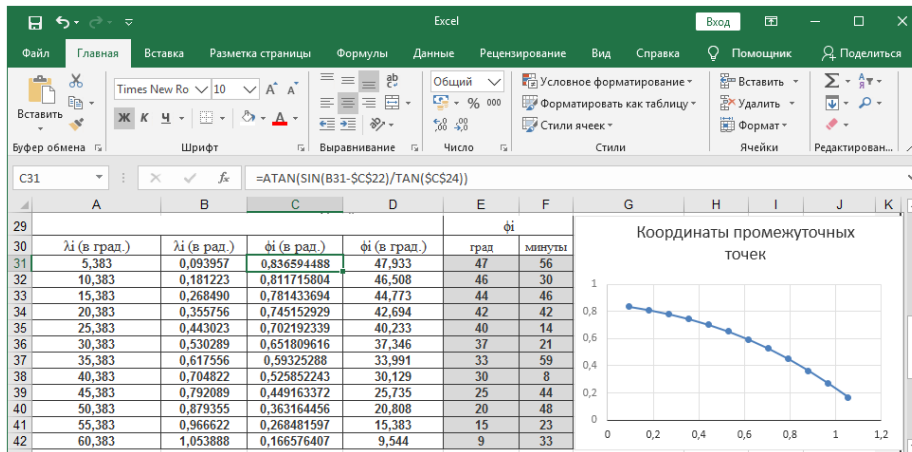


Fig. 4. Calculation of the parameters of the arc of a large circle with MS Excel.

Obviously, the result obtained is correct, since the values of intermediate latitudes are in the interval $[\varphi_H, \varphi_K]$. We construct the trajectory of the ship along the coordinates (longitude and latitude), the type of diagram is “point”.

Perform a similar calculation using the OneDrive cloud service. The calculation results with are presented in Fig. 5.

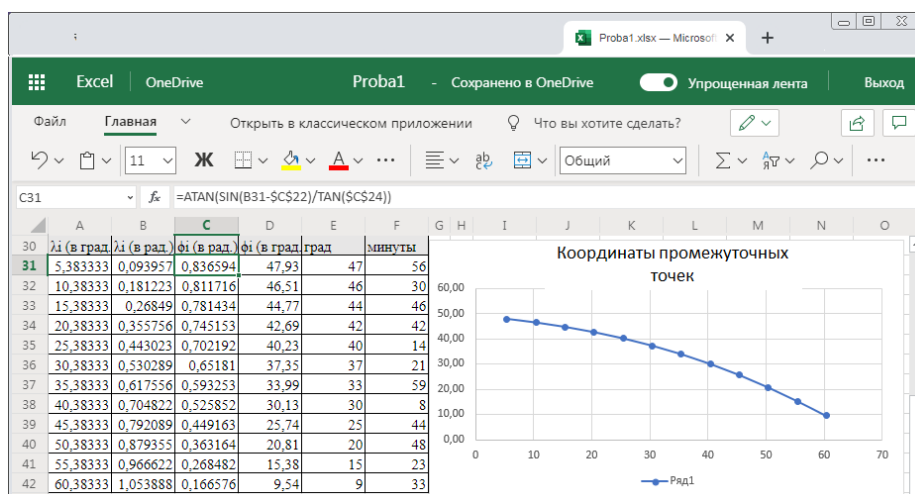


Fig. 5. Calculation of the parameters of the arc of a large circle with OneDrive.

The considered problem is a clear example of how important it is for the future navigator to be able to understand analytical formulas, conduct calculations, and analyze the result. Incorrect calculations can lead to negative consequences. Suffice it to say that the error in calculating the position of the vessel by only one degree leads to a discrepancy of 60 miles.

Pay attention to the fact that the calculation results are presented by two similar screenshots. In Fig. 4 - a screenshot of the calculation performed in standard MS Excel, in Fig. 5 – the same calculation, however, performed using the OneDrive cloud service.

Excel on the Internet is a web application that you can use to view and edit Excel workbooks in a browser. When editing in a browser, you can change data, enter and edit formulas, create tables and diagrams and apply basic formatting options in a spreadsheet. Workbooks and spreadsheets look almost the same in Excel on the Internet and familiar MS Excel. Many MS Excel functions are available in the Excel cloud service, but not all functions are supported or work in exactly the same way. But at the same time, the OneDrive Excel functions are quite enough so that the navigator can perform all the necessary calculations and arrange ship documentation.

Excel cloud service allows you to:

- use Excel functionality and features in a Web environment;
- perform work anywhere in the world, regardless of whether the office programs are installed on a computer or gadget. To access spreadsheets, you only need a browser and Internet access;
- perform work in projects with colleagues regardless of their version of Excel.

For simultaneous collaboration with other users in the same workbook, you can provide access to the book if there are spreadsheets on which you want to enter data, for example, a group project, or a registration spreadsheet. All that needs to be done is to create a separate folder for workbooks to which you need to share.

Among the obvious advantages of "cloud" Excel, you should definitely pay attention to some points. The main, in our point of view, is the following. During the period of study at the university, the cadet is provided with all the opportunities for acquiring skills for performing calculations of any complexity. He masters the methodology of structuring spreadsheets, using built-in functions and modules, building mathematical models of technological processes that can take place during the performance of professional duties on board a ship. A comparative analysis of spreadsheets showed that the ability to work in MS Excel, knowledge of the properties of built-in functions, the principles of filling their ranges will greatly facilitate and speed up the transition to OneDrive Excel.

5 Prospects for the use of cloud services in the educational process and on ship

We applied an expert method to assess the prospects of using cloud services in the educational process and on ship. Ten experienced teachers and sailors of Kherson State Maritime Academy were interviewed. Experts assessed the prospects for using cloud services in educational proses and on ship. For evaluation, a five-point Likert's system was chosen. Table 1 shows the results of the evaluation of indicators.

Table 1. Expert assessment of using cloud services in the educational process and on ship.

#	Evaluation Options	Grade
1	Compliance with the training program	3,9
2	Compliance with the requirements of the register of international maritime organizations of Ukraine and STCW	4,2
3	Expediency and prospects of using cloud services tables in the educational process	4,1
4	Expediency and prospects of using cloud services tables in the professional work of a sailor	4,6
5	The scientific feasibility of using a cloud electronic resource	3,8
6	Convenience of use during classes	3,3
7	Characteristics of ease of use in calculations and documentation on ship	4,5
8	Exchange of information between users of the program executed in the cloud service tables on ships	4,2
9	Compliance with a unified methodology	3,5
10	I plan to use cloud services spreadsheets in my professional work	3,9

The results of expert's assessment showed on Fig. 6.

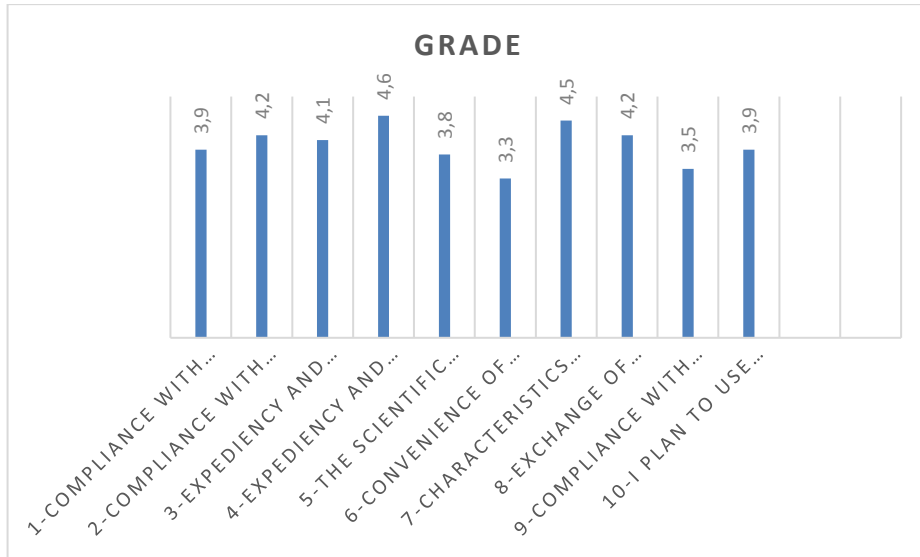


Fig. 6. Expert assessment of using cloud services in the educational process and on ship.

An expert assessment of the quality and prospects of using training resources can be considered sufficiently reliable only if the expert evaluations are in good agreement. Therefore, statistical processing of the results of expert evaluations should include an analysis of the consensus of experts. The Concordance method is used to assess the degree of consensus of experts on options for assessment [16].

The results of the expert survey are presented in Table 2.

Table 2. Expert data on assessment of using cloud services in the educational process and on ship.

Exp ert	Evaluation Options									
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
1	9	8	3	4	5	2	6	7	10	1
2	8	9	2	5	4	3	6	5	10	1
3	10	9	3	4	6	2	5	7	8	1
4	10	7	2	4	5	3	8	6	9	1
5	10	9	2	3	4	5	7	8	6	1
6	9	10	3	2	5	4	6	8	7	1
7	7	10	2	5	4	3	6	8	9	1
8	8	10	3	2	6	9	5	4	7	1
9	9	10	4	5	8	2	3	7	6	1
10	9	8	5	4	10	2	3	6	7	1

Δ_i	34	35	-26	-17	2	-20	0	11	24	-45
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Concordance coefficient W is calculated according to the formula proposed by Kendall [16]

$$W = \frac{12S}{m^2(n^3 - n)} \quad (1)$$

Here $S = \sum_{i=1}^n \Delta_i^2 = \sum_{i=1}^n \left\{ \sum_{j=1}^m x_{ij} - \frac{1}{2} m(n+1) \right\}^2$, m – number of experts, n – the number of objects of examination, x_{ij} – assessment of the i -object by j -expert. Coefficient of concordance may vary between 0 and 1. If $W = 1$, all experts gave the same evaluations for all objects, if $W = 0$, the evaluations of experts are not coordinated.

Using the formula (1) calculated coefficient $W = 0,78$ is significantly different from zero, so we can assume that among experts there is objective concordance. Given that the value of $m(n-1)W$ is distributed according to χ^2 with $(n-1)$ is the degree of freedom, then $\chi_w^2 = \frac{12S}{m \cdot n \cdot (n+1)} = 70,6$. Comparing this value with the tabulated

value χ_T^2 for $n-1 = 9$ degree of freedom and significance level $\alpha = 0,05$, we find $\chi_w^2 = 70,6 > \chi_T^2 = 16,9$. Therefore, the hypothesis of consistency of expert evaluations confirmed according to Pearson.

Thus, the results of a pedagogical experiment can be taken as a basis for the design and creation of learning resources using cloud services.

6 Conclusion and future work

The article analyzes the cloud services Excel Reader.NET, Excel Viewer 2.0, shared hosting Amazon, TheRackSpace, Google, Microsoft, iCloud, SugarSync, Dropbox, Joyent, GoGrid, Terremark, Savvis, Verizon, NewServers for processing Excel documents. The analysis showed that cloud services can be used to display the contents of MS Office documents in the form of html text pages of electronic training resources.

The comparative characteristic of cloud services from Google and Microsoft is carried out. The choice of the OneDrive Office Online cloud service for implementation in the distance learning system "Moodle KMA" and "Kherson Virtual University" was justified.

A model of the process of creating, editing and implementing Excel documents in the distance learning system "Kherson Virtual University" using the Microsoft Excel Web App cloud service was built.

The functional properties, as well as features of the development of the software module "ExcelReader" are described.

An expert method for assessing the quality of the use of cloud services in the educational process and on the ship showed its good perspective.

7 References

1. Aleksander Spivakovsky, Lyubov Petukhova, Evgeniya Spivakovska, Vera Kotkova, Hennadiy Kravtsov. (2013) Three-Subjective Didactic Model. Springer Verlag, Berlin-Heidelberg, CCIS Vol. 412, pp. 252-273
2. Shebanin V., Atamanyuk I., Kondratenko Y., Volosyuk Y. (2019) Development of the Mathematical Model of the Informational Resource of a Distance Learning System. In: Chertov O., Mylovanov T., Kondratenko Y., Kacprzyk J., Kreinovich V., Stefanuk V. (eds) Recent Developments in Data Science and Intelligent Analysis of Information. ICDSIAI 2018. Advances in Intelligent Systems and Computing, vol 836. Springer, Cham
3. Moodle KSMA, online <https://mdl.ksma.ks.ua>
4. How to insert a Microsoft Excel file into a Web page with HTML code, online <https://www.techwalla.com/articles/how-to-insert-a-microsoft-excel-file-into-a-web-page-with-html-code>
5. Web App – Easy Excel Tutorial, online <http://www.excel-easy.com/examples/web-app.html>
6. Office Online, online https://en.wikipedia.org/wiki/Office_Online
7. Excel Reader .NET, online <http://www.devtriogroup.com/Excelreader/Default.aspx>
8. OneDrive, online <https://onedrive.live.com>
9. Google Drive, online <https://drive.google.com>
10. Azure documentation, online <https://docs.microsoft.com/en-us/azure/?product=featured>
11. Sclater, N. (2010) eLearning in the Cloud, International Journal of Virtual and Personal Learning Environments, Vol 1, No 1, pp. 10-19, IGI Global
12. Cloud Computing, online <https://www.investopedia.com/terms/c/cloud-computing.asp>
13. Spivakovsky V. (eds). DLS “Kherson Virtual University”. Certificate of copyright registration No 32719, Ministry of Education and Science of Ukraine, State Department of Intellectual Property. Kyiv, 06.04.2010, online <http://dls.kherson.ua/dls>
14. Kravtsov, H.M., Gnedkova, O.O. (2016) The Use of Cloud Services for Learning Foreign Language (English). In: Ermolayev, V. et al. (eds.) Proc. 12-th Int. Conf. ICTERI 2016, Kyiv, Ukraine, June 21-24, 2016, CEUR-WS.org/Vol-1614, ISSN 1613-0073, p.620-631, online http://ceur-ws.org/Vol-1614/paper_87.pdf
15. Kravtsov H.M., Chemisova I.O. (2014) Microsoft Cloud Services in Distance Learning System “Kherson Virtual University”. Information Technology in Education: Scientific Journal, vol. 20, pp. 53 – 65. Kherson: KSU
16. Kendall M. (1948) Rank Correlation Methods, Charles Griffen & Company, London