A secondary school's experience of a cloud-based learning environment deployment

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Abstract

The article presents an analysis of the implementation and effectiveness of a cloud-based learning environment in secondary schools, with a focus on the integration of Google Workspace and the Microsoft 365 platform. Consistent with the research findings, the integration of these tools provides a more comprehensive and efficient learning experience. The feasibility of this approach has been supported by a survey of over 100 teachers and 500 high school students. The results of the survey have been statistically evaluated using descriptive statistics and the Spearman rank correlation coefficient. The data has indicated the importance of employing both cloud platforms in combination. To address this need, the paper presents a proposed model of an integrated cloud-based learning environment, which includes communication tools, data storage options, web development aids and event planning features. The model also encompasses learning opportunities for deploying applications to both Google and Microsoft services? addresses the management of credentials for authentication across various services, proposing a SAML-based solution. The pilot study results have confirmed that the developed model fulfils the initial requirements. The study may benefit teachers at secondary and higher education institutions.

Keywords

cloud technologies, cloud-based learning environment, Google Workspace, Microsoft 365, secondary school

1. Introduction

Every year, society is progressively digitized. As a result, the influence of information technologies on various areas of social life becomes more significant. These technologies are especially

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important in education [1]. The digitalization process becomes more relevant during social events such as the COVID-19 epidemic and the Russian-Ukrainian war [2]. Now these factors are changing the usual face-to-face learning format and stimulating the transition to distance and blended learning. However, it is worth understanding that students do not always have the opportunity to study at home using a computer or laptop, and many educational institutions do not have sufficient resources and opportunities to quickly adapt their IT infrastructure to the requirements of the modern digital world. Therefore, there is a problem related to the development and implementation of a convenient and accessible learning environment without the use of additional material resources. Cloud technologies are a promising tool for solving this problem. They provide educational institutions with the opportunity to use various services and resources. This approach allows for effective learning and collaboration between students and teachers [3].

Cloud computing is transforming the learning environment. It becomes more flexible, scalable, and affordable. As defined in [4], the creation of an educational environment based on cloud technologies opens up prospects for improving the results and level of the educational process. This contributes to a more effective organization of training, and joint exchange of knowledge and experience, and provides support for innovative approaches in training and scientific research. The combination of science and practice in such an environment contributes to the development of new approaches to the education and training of competent specialists for modern society. The author of the article [5] considers cloud-oriented digital technologies as a set of methods, means, and methods of activity used for its organization and support. Therefore, the use of cloud technologies is a key direction of development that meets the needs of the modern digital world.

The purpose of this study is to generalize the authors' experience in the integration of Google Workspace and Microsoft 365 cloud platforms at secondary education institutions. It is advisable to perform the next tasks to achieve this purpose:

- to study the experience of using cloud computing in the process of cloud deployment;
- to justify the need to integrate several platforms in a cloud-based learning environment;
- to develop a model of the environment and a presentation of the practical things that have been done to deploy it.

At the moment, a large number of students and teachers use cloud computing both in their everyday life and during their studies. But that does not mean they collaborate in a cloud environment. After all, the definition of a cloud educational environment includes not only technologies but also pedagogical principles and strategies aimed at the effective use of clouds to improve the educational process and achieve educational goals. The authors of the study [6] define the concept of a "cloud-based learning environment (CBLE) of an educational institution" as an environment where didactic goals and cooperation between teachers and students are achieved through the use of cloud computing technologies and services. Svitlana Lytvynova [7] says that in such an environment, attention is focused on the comprehensive development of students and the provision of conditions for educational activities. One of its main characteristics is educational mobility.

Therefore, administrators are responsible for establishing a consistent learning environment that is easily accessible for both students and teachers, regardless of their location or the

device they use. It should be noted that not all schools are able to purchase physical servers or completely transition to digital systems, which is where cloud technologies can provide support. In a previous study, we examined the integration of Google Workspace and Microsoft cloud platforms [8]. It entails establishing a nearby server for syncing accounts. Presently, we provide a serverless method. This enables cloud-only administration and synchronization of user accounts. Currently, several cloud platform providers focus not only on business but also on education. Cloud computing giants like Microsoft and Google also provide such curricula. By using these platforms, schools can avail a broad spectrum of tools and services that encourage efficient learning and collaboration. Currently, there are various connectivity options available in Microsoft, namely A1, A3, and A5. A1 comprises standard services such as Word, Excel, PowerPoint, Microsoft Teams, etc., accompanied by a facility to manage cloud accounts through a unified dashboard. The A3 package encompasses all the features present in the Microsoft 365 A1 plan, along with supplementary functionalities such as backups and live streaming. Furthermore, the A3 package furnishes advanced security, management, and analytics capabilities. Plan A5 is an optimised licence for potential cost savings, including an advanced set of training, compliance, security and management tools.

Google Workspace for Education provides a wide range of options for educational institutions.

- Google Workspace for Education Fundamentals offers teaching and learning tools such as Classroom, Google Meet, Google Docs, Google Forms, and Google Chat.
- Google Workspace for Education Standard provides the same tools as Education Fundamentals but with enhanced security features and advanced administration tools.
- The Teaching and Learning Upgrade provides enhanced video capabilities, Classroom add-ons, and other useful tools for users who have Education Fundamentals or Education. Standard versions.
- Google Workspace for Education Plus includes all the features of Education Standard and Teaching and Learning Upgrade as well as additional functionalities for selected services, for instance, attendance tracking in Google Meet.

In this study, we utilise the no-cost options of two platforms – A1 and Google Workspace for Education Standard. Both platforms have comparable functionalities, yet Microsoft's product presents greater analytics and storage options compared to Google's which provides more efficient administrative methods. Reliable and scalable cloud services are accessible through Microsoft Azure and Google Cloud Platform, enabling the secure storage, processing, and distribution of data. They offer integration with different curricula, collaborative resources and tools for creating and finishing learning assignments. According to the review by the authors [9], the usage of e-learning tools through Microsoft Teams and Google Classroom platforms offers efficiency, accessibility, performance, confidentiality, responsiveness, contact and has an overall positive impact on user satisfaction. These platforms have been extensively researched individually [10], [11], [12]. The aim of our investigation was to justify the necessity of incorporating various platforms into a cloud-based educational setting.

According to the scientific principles of system development and the specific needs of users, each cloud learning environment must be constantly improved [13]. This process corresponds to modern approaches and principles, ensuring high-quality education of subjects of study. A

cloud-oriented educational environment is an innovative pedagogical concept based on the use of cloud technologies to support the educational process. It involves the use of virtual resources, applications, and other tools located at cloud providers [14]. These resources provide access to educational materials, joint work of students and teachers regardless of their physical location. In this environment, it is imperative to endorse all the three protagonist components involved: the technology itself, evaluated according to the educational or entertainment goals; the child to whom it is addressed; and the omnipresent adults (teachers, parents, or caregivers) who guide learning and demand their share in control and safety issues [15].

As defined in [16], the purpose of creating CBLE is to achieve didactic goals, perform educational tasks, and ensure the joint work of participants in the educational process. Valery Bykov and M Shyskina [17] highlight the main advantages of this environment, such as flexibility and openness. Modern technologies ensure the deployment and integration of various services into the CBLE structure. Another advantage of the cloud-based learning environment is the facilitation of collaboration and exchange of knowledge and data between students and teachers. With online tools available in cloud services, students can easily communicate, share ideas, work together on projects, and complete assignments. This contributes to the development of students' communicative competence. The use of cloud technologies reduces the load on the school local IT infrastructure, as it is no longer related to the type of computer and operating system, the amount of data storage increases, and costs for server and network maintenance are reduced. Other advantages of cloud computing in education are increasing user productivity, simplifying the process of administering the IT infrastructure of an educational institution, constant updating of services, improved compatibility, the possibility of joint work of a group of users, economical consumption of natural resources, as well as reliable data storage [18].

However, the use of a cloud-based learning environment is accompanied by problems [19]. One of them is the dependence on an Internet connection, since without access to the World Wide Web, the functionality of cloud services is limited. To reduce this risk, let us consider various strategies to ensure a stable Internet connection. For example, users can consider a backup Internet connection, the use of mobile Internet, or the use of private clouds in educational institutions. Such measures can reduce the risk of limiting access to educational resources in cases where the Internet is not available. Another disadvantage is related to the changing role of the teacher and the need to prepare for working with cloud tools. Teachers must be ready to work with cloud computing, understand its capabilities and limitations, and have the necessary skills to effectively use these tools in the educational process [20]. The lack of sufficient training can become an obstacle to the successful integration of cloud technologies into educational practice. It is important to ensure that teachers are properly trained and supported. The right strategies and measures allow educators to effectively overcome the disadvantages of using cloud technologies in education and provide a positive experience for all participants in the educational process. This will make it possible to implement the main idea of CBLE, which involves the transition from local computer resources and software to the use of services and platforms. In turn, this allows to reduce the cost and complexity of technical support, as well as ensure flexibility and mobility of the educational process.

2. Methods

In this work, a systematic review of the literature and an analysis of previous studies aimed at studying cloud-based learning environments have been carried out. This review included a critical analysis of scientific articles, theoretical concepts, and models related to CBLE in order to obtain objective and systematic information. For additional data collection and feedback, the questionnaire method of students and teachers was used. This method provided quantitative and qualitative information about their perceptions, experiences, and the impact of CBLE on learning and teaching. The results of the survey were verbally described and analyzed, as well as statistically evaluated using the non-parametric correlation method, specifically Spearman's rank correlation coefficient. The study was conducted in a joint research laboratory on the use of cloud technologies in education of Ternopil Volodymyr Hnatiuk National Pedagogical University and the Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine. A visual model of CBLE was then developed based on a synthesis of theoretical approaches and concepts to illustrate the key components and relationships within this learning environment. This approach enabled the complex aspects of a cloud-based learning environment to be structured and conceptualized, providing a deeper understanding and definition of a holistic model. In addition, the stages of formation of CBLE are defined and described, including requirements analysis, design and development, implementation, and testing of this model. This approach ensured a systematic and phased implementation of a cloud-based learning environment, taking into account best practices and scientific recommendations.

3. Main findings of the study

3.1. Survey of users of a cloud-based learning environment

The topic of cloud computing and its application in education has been studied for many years, but the creation of a high-quality cloud-oriented learning environment still remains an urgent problem. Given the different needs and requirements of educational institutions, it is impossible to create a model that would suit everyone. Therefore, in order to implement an effective cloud-based learning environment, a detailed analysis of needs and requirements was conducted by surveying students and computer science teachers of Ternopil region (Ukraine). We developed two anonymous questionnaires, one for teachers and one for students. In addition to data on respondents (gender, age), both questionnaires contained questions about the use of cloud services, such as

- frequency and ease of use of individual Google Workspace and Microsoft 365 services;
- determination of the types of problems that arise when working with these services;
- interest in the future use of cloud platforms.

105 teachers (67.3% women and 32.7% men) and 512 high school students (54.2% women and 45.8% men) who live within Ternopil region took part in this survey. The age of teachers is from 20 to 59 years (the average age is 37 years). 20% of the respondents have more than 20 years of work experience, 42.9% of respondents have experience from 10 to 20 years, the percentage of respondents with experience from 5 to 10 is 21%, from 3 to 5 years is 10.5%, and 5.8% of

respondents have experience less than 3 years. These size samples allow us to use various methods of statistical data analysis. Both groups of interviewees most often use Google services in the educational process. In particular, the Meet service is never used by only 3.8% (figure 1) of teachers and 9% of students (figure 2). Gmail is also a popular service among students, which only 5.9% have never used. 39% of teachers often use the Disk service, and 35.2% always use it.

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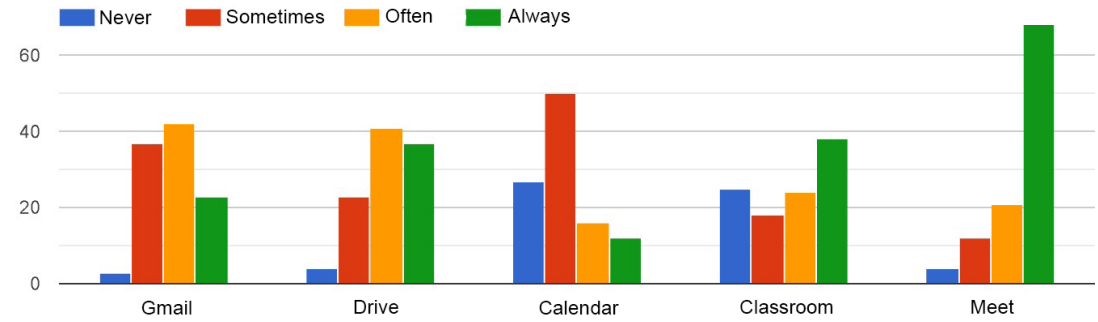

Figure 1: Use of Google Workspace services by computer science teachers.

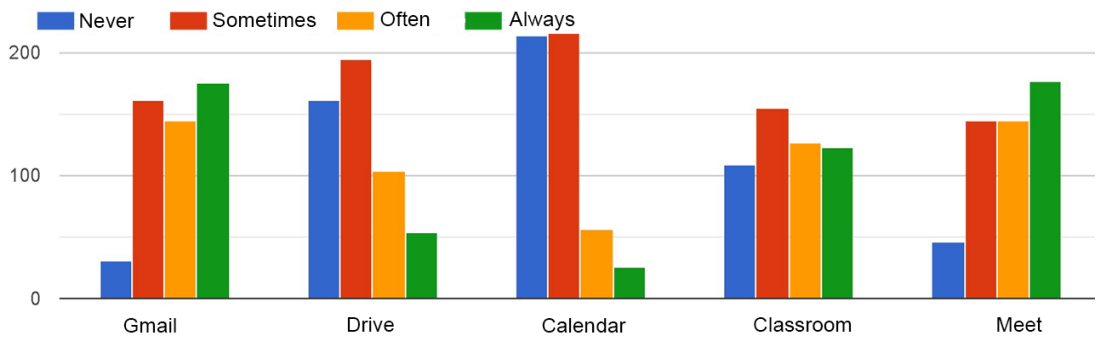

Figure 2: Use of Google Workspace services by students.

Microsoft is a new platform for these groups because most of them never use its services, or very rarely (see figure 3 and figure 4). 66% of teachers already use educational plans from Google, of which 79% consider this platform very appropriate. Educational plans from Microsoft are used by 4.9% of respondents, of which 43.2% consider them relevant, and 25% think they are very relevant. Google Workspace was chosen as a fairly convenient and very convenient platform by 54.7% and 16.1% of students, respectively, and Microsoft 365 was chosen by 42.6% and 6.8%, respectively.

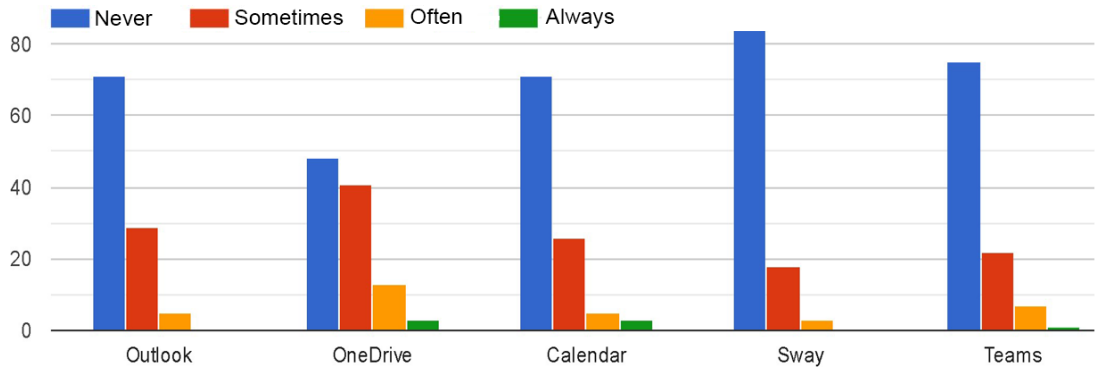

Figure 3: Use of Microsoft 365 services by computer science teachers.

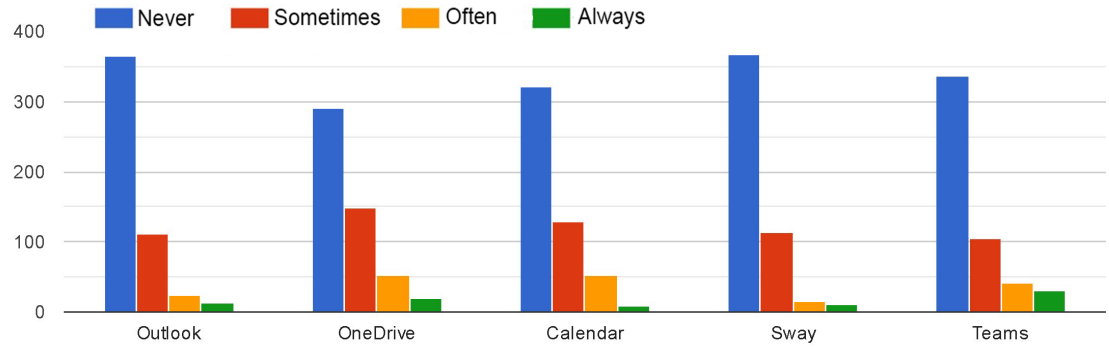

Figure 4: Use of Microsoft 365 services by students.

This shows that both platforms can be used in the educational process depending on the needs and preferences of teachers. Also, students were asked questions about the appropriateness of using the same login and password for both environments. 48.2% of respondents consider this approach convenient, and another 13.9% evaluate it as very convenient. In addition, 38.2% and 28.1% consider it appropriate and very appropriate to set up separate logins for school computers (figure 5). This confirms the importance of creating separate spaces for each student. A large number of teachers (93.2%) expressed a desire to continue using these services in computer science lessons (93.2%) and in all other subjects (63.2% for Google Workspace, and 37.5% for Microsoft 365). This shows that they see the usefulness and significance of these services in their work. Among students, the interest in using these services at informatics lessons is slightly less (37.8%), another 32.3% of respondents were indifferent and 20.7% were undecided. Regarding conducting all subjects using Microsoft services, 28.3% of respondents voted, and the majority were still undecided (50.1%). A similar situation is observed with the Google Workspace platform since 47.5% of respondents chose “yes”, and 38.3% are still undecided. Such results may be due to children’s ignorance of the possibilities of these services due to their absence in the educational space or unsuccessful implementation. It is appropriate to use the correlation analysis to study

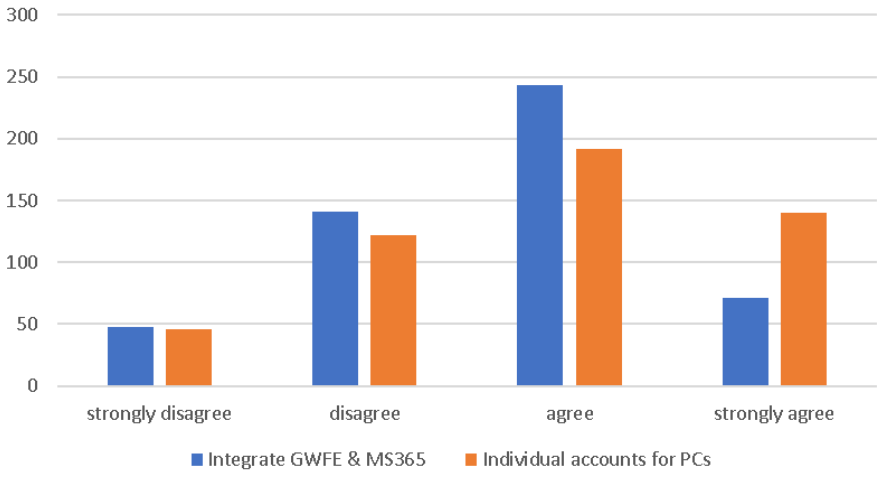

Figure 5: Attitude of students towards setting up individual accounts.

the relationship between the use of individual services. For its implementation, we transform the nominal scale to an ordinal with values such as 1 is never, 2 is sometimes, 3 is often, and 4 is always.

As the Shapiro-Wilk test has shown, the distributions of the usage values of both cloud platforms are not normal. Therefore, it is advisable to use Spearman's rank correlation coefficient to establish correspondence between them. For this, we have used some R language libraries such as ggpubr, corrplot, and ggplot2. All correlations are significant at 0.05 level. As can be seen from the correlation diagrams in both questionnaires (see figure 6), there is a positive relationship between the level of use of the services of the same platform. This can be explained by the fact that teachers usually define and use the services of a certain platform. However, the correlation coefficients for Microsoft 365 services (greater than 0.6 for all cases) are greater than those for Google Workspace (greater than 0.2). This is so, despite the fact that teachers and students use them much less than Google Workspace (see figure 3 and figure 4). The correlation analysis has not revealed any dependence between the use of services of different platforms. All correlation coefficients are close to zero or slightly less than zero. Since the sample sizes for groups of teachers and students are not the same, it is not possible to calculate correlation coefficients between these groups. However, it is possible to consider the rating scales of the services of each platform as intervals. Such an assumption has the right to be justified since all indicators measure the attitude of respondents to services as a whole. Therefore, we can group them and analyze them as a single Likert scale. In particular, it is possible to calculate the average values of the level of service use for all respondents of each group (Table 1).

The Spearman's rank correlation coefficient has been calculated for these mean values. Its value (rs=0.92) has testified to a strong, positive relationship between the levels of service use in groups of teachers and students. A graphical representation of the mean values also shows this correlation (see 7).

As schools and teachers decide which platform to use, such a conclusion is quite predictable. Nevertheless, it can be reasonably argued that both groups do not use both platforms at the

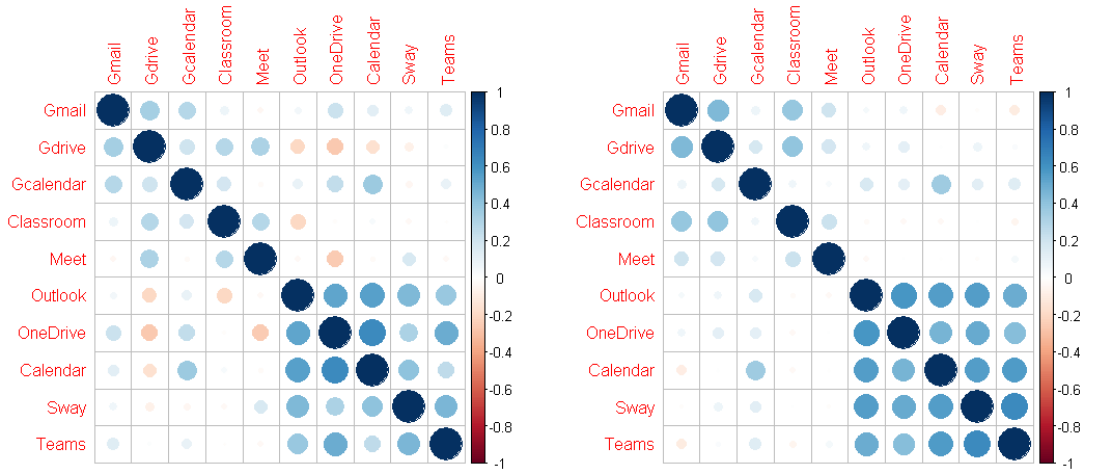

Figure 6: Matrix of correlations between the levels of use of cloud services (the left image for teachers, and the right image for students).

Table 1
Average levels of use of services

Services	Teachers	Students
Gmail	2.81	2.91
Google Drive	3.06	2.10
Google Calendar	2.12	1.79
Google Classroom	2.71	2.52
Google Meet	3.46	2.88
Outlook	1.37	1.38
OneDrive	1.72	1.61
Calendar	1.43	1.51
Sway	1.23	1.35
Teams	1.37	1.54

same time. So, we conclude that both platforms, although convenient, do not meet all the needs of their users. Therefore, it has been decided to create a cloud-oriented environment by integrating these platforms. A combination of Google Workspace and Microsoft 365 platforms can be a profitable solution. This allows us to take advantage of the best aspects of both environments, providing ample opportunities for learning and collaboration. Students and teachers can access a wide range of tools such as Google Classroom, Google Drive, Microsoft Teams, and Microsoft Office Suite. All of them allow working with different types of documents, presentations, spreadsheets, and other digital resources. It also allows taking into account the individual needs and preferences of students and teachers. Some users may prefer Google, others work with Microsoft. Access to both environments allows for diversity and flexibility in the learning process.

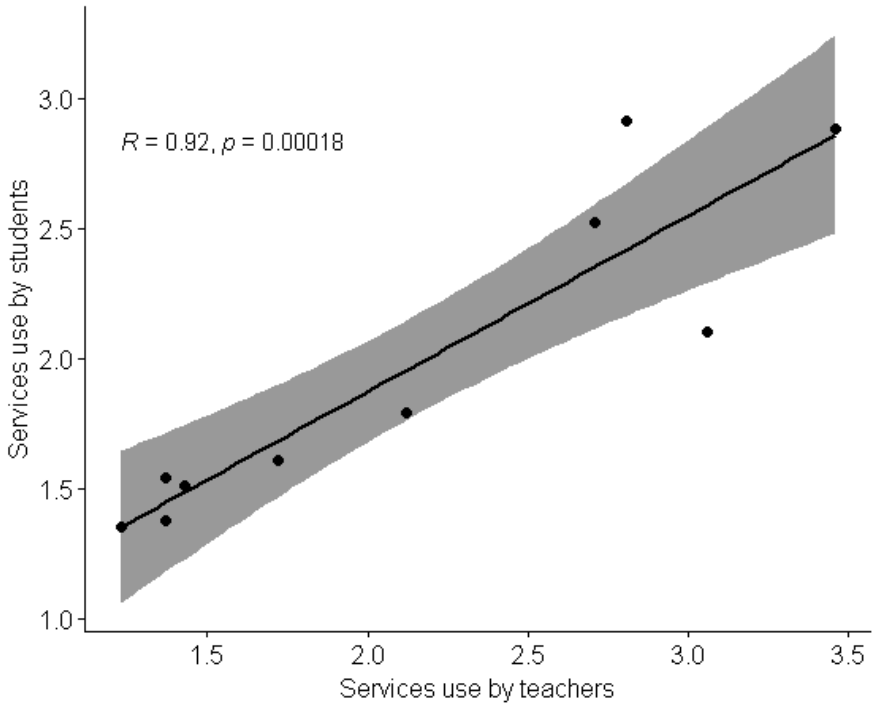

Figure 7: Correlation graph of the use of services by teachers and students.

3.2. Deployment of cloud-based learning environment

Based on observations, survey data, and the capabilities of these cloud platforms, a model of a cloud-based learning environment for the school was created (see Figure 8). It was implemented in one of the schools in the Ternopil region of Ukraine. In implementing this research, we considered the primary organizational and pedagogical aspects. We utilized the school's existing material and technical resources without the need for additional server equipment. Project staffing involved the participation of teachers and the school administration. There are four main types of facilities in this model: communications, data storage, event planning, and web page creation. Blue colour indicates opportunities for students, teachers, and administration, green colour is for teachers and administration only, and yellow clour is for administration only. Communication tools allow users to conduct online training, exchange instant messages, and provide individual and group consultations. All of this is implemented by the Microsoft Teams service. The administration has the option of using corporate Gmail for communications with external users.

To save different types of files during perform practical, laboratory, or other types of work, teachers and students can choose a more convenient service for themselves between Google Docs and Office. This is due to the fact that, for example, in computer science [21], part of the practical tasks must be performed on the Google Workspace platform. Among the tools for planning events, Google Calendar has been chosen. We have performed synchronization of its objects with the calendar from Microsoft Teams. For creating web pages teachers can

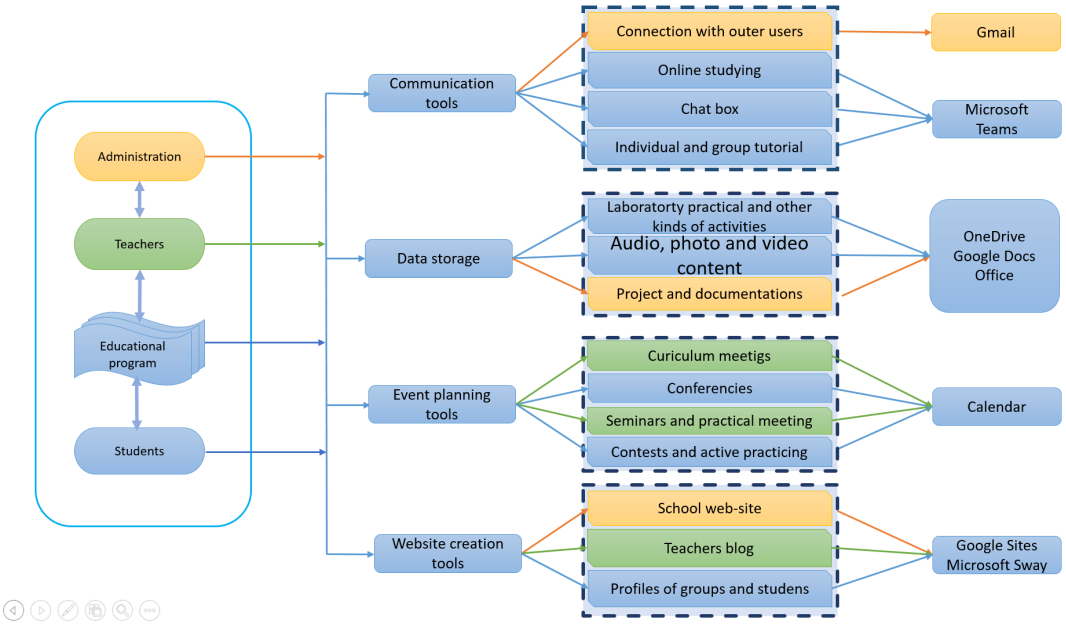

Figure 8: The model of the cloud-based learning environment.

use Google Sites or Microsoft Sway. The CLBE model offers a range of tools, such as Teams, OneDrive, and Google Classroom to monitor student grades. However, it does not specify the process for assessing the standard of education. We suggest that an independent study be conducted to address this issue. The next stage is the deployment and administration of CBLE. To work with the Microsoft platform, it was necessary to perform some steps such as

- Register a tenant using the provided domain. During registration, an account with super administrator rights is immediately created.
- Confirm the domain in the administration center. If this is not done, then the domain name of users will end with onmicrosoft.com.
- Connect the selected plan. To do this, the cloud administrator needs to configure the required number of licenses for teachers and students.
- Disable two-factor authentication. Microsoft recommends that educational institutions do not use this type of authentication because of the need for students to install additional programs.

After registration, we created user accounts, divided them into Microsoft security groups by class, and granted licenses. At the same time with these tasks, the school was registered for the Google Workspace for Education program. After confirming the educational institution we chose a fundamental billing plan.

The next task in the CLBE deployment was a single sign-on system. Single sign-on (SSO) is a user authentication session or process that allows a user to provide credentials to access one or more applications. Azure offers several options for creating single sign-on using different protocols. LDAP can be considered to be the most popular of them. It is a protocol used to

work with various directory services, such as Active Directory, that store information about users, accounts, and other security-related data, such as passwords. This data can be used to share access with other devices on the network. But in our case, the use of this protocol was impractical due to the lack of a local Active Directory, so we decided to focus on a completely cloud-based solution – the SAML protocol. Security Assertion Markup Language (SAML) is a protocol for exchanging messages between various components of the SSO system. SAML allows users to use the same set of credentials to authenticate to different systems. Logins for users were created later and were synchronized with Azure in Google Workspace. To implement this, a user account with super administrator rights was created in Google. Next, in the single sign-on settings in Azure Active Directory, Provision Mode must be changed to automatic. Then it was necessary to sign in to the Google account that we recently created and give it access to Azure. It is desirable to review the rights of this user after the first login and leave only the necessary ones. As a result, when entering an email in the Google service, the user will be redirected to the Microsoft login page to enter their accounts.

In addition to using a completely cloud-based approach in the A3 and A5 plans, Microsoft provides the ability to use Intune services to manage endpoints. They allow users to install and configure programs on connected devices remotely, as well as create a personal space on the computer for each of its users. In our plan, only the introductory version is valid for 3 months and 250 users, so we consider its use not too appropriate, taking into account the serverless approach. After all, children will perform most of the tasks thanks to online services, access to which is already personal. However, the ability to connect devices to Azure Active Directory as unmanaged as needed remains. After configuring most of the administrative processes, we moved to the stage of testing and pilot application of the created environment. Since Microsoft Teams was chosen as the main service for conducting lessons, the settings began with it. Microsoft Teams is a collaboration and communication platform that allows students and teachers to communicate, collaborate, and share documents in real time. Its navigation is built with tabs and web pages that can be changed, removed, and added as needed. First, it is necessary to create teams that will work. We decided to use one class or subgroup for one subject as a team. To create a team, a teacher must choose what function it should perform. There are 4 main types of teams such as

- Class. This option is the most extensive and customizable, and it is in it that we conduct classes.
- Professional educational community. A working group of teachers working on certain joint tasks. In addition to the standard chat, there are notebook templates with tips for effectively solving tasks that a group can work on and sample reports to describe the results.
- Personnel. Only its manager can add users to this group. There are no ready-made templates here, so the organization of work depends entirely on the team owner.
- Other. This type is recommended for creating groups, extracurricular activities, excursions, and so on. By default, there are only two options (Posts and Files).

After choosing the type of a team, it is necessary to give it a name and description. In the next step, the administrator or teacher adds participants. But we consider it a better solution to

provide access to students already after setting the initial parameters of the team. Homepage. This web page is semi-automatic, as tasks, recently added materials, and calendar events are transferred from other tabs automatically. Therefore, here the teacher can customize the image and greetings for the class, and add resources to which access is necessary throughout the year (for example, the textbook, the schedule of topics, control or final papers), and information about themselves. The next tab offers to create notebooks for the class. These are digital notebooks where all students and classroom teachers can store texts, images, handwritten notes, attachments, links, audio recordings, videos, and more. Each notebook has three parts.

1. Student‘s notebook as a personal space for individual work. Teachers have access to each student’s notebook, and students can only view their own notebooks.
2. Content library. This is a read-only space where teachers can provide accompanying materials to students.
3. Space for collaboration. This is an area where everyone in the class can share content, organize data, and work together.

Next, we suggest creating necessary channels for lessons. Each teacher can create them depending on the tasks they set before the class and the subjects themselves. In our case, channels were created for each topic so that children could see the necessary materials for the current topic and return to previous ones more easily. Also, with the channels, we divided students within the same class into subgroups, for example, to work on projects. In each of the channels, there are two main tabs posts (for communication) and files (for providing key files for a certain topic). In addition, a teacher can create their own new tabs depending on the tasks of a specific topic. These can be both regular resources and task lists, third-party websites, or other services from Microsoft.

Then we set up meetings for lessons. In order for them to be displayed in the Google Calendar, before creating meetings, it is necessary to add the Microsoft Teams Meeting add-on for the entire organization. After adding this add-on for the entire organization, a teacher can return to the meeting settings. It is necessary to specify their name and date, teachers can also add mandatory participants and registration for the meeting. After each meeting, the teacher has the opportunity to view a CSV file with detailed information about who participated in the meeting, how long each participant was present, and how long the meeting itself lasted. Also, a board for joint work is created for each of the meetings. On it, participants can collaborate using both their own ideas and ready-made templates. The next tab is used to create tasks for students. In addition to the usual tasks with the ability to add instructions and files, there is an opportunity to create own tests, which are visually similar to the familiar Google Forms. For a better understanding of the assessment system by students, it is possible to add criteria for assessing tasks by level. Then there are three tabs that are only available to teachers. These are Assessments, Reflect, and Insights. They are designed to understand the general knowledge level of the class and obtain statistics. On the evaluation tab, teachers can get a report in the form of a table of all tasks assigned to the class. Here teachers can also adjust the parameters of assignments and grades. On the reflection tab, a teacher can ask children to check their well-being and the atmosphere in the classroom. In a playful way, they can choose a mood and expand their emotional vocabulary with the help of Feeling Monsters. And the last Insights tab

is designed to get statistics in all directions: digital engagement, number of tasks completed, the atmosphere in the classroom, tardiness, and more.

3.3. Discussion

The survey results affirm that the current school settings are suboptimal. This can stem from various factors since each school has unique needs for CBLE. Thus, seeking to impose one-size-fits-all solutions on all educational institutions is unwise. Instead, educators and administrators need to discuss avenues for integration, conduct workshops and seminars to enhance their digital aptitude and awareness in this sphere. Then, there will be greater accessibility and autonomy in regulating the elements of the educational environment. Participants in the educational process will have the freedom to choose the services and resources that they require. Our solution facilitates this by enabling cross-platform integration that grants access to a broader range of resources. This empowers participants to choose the type of work they prefer. For instance, an instructor can use the chat feature of Microsoft Teams to communicate, whilst creating lessons with Google Docs. This approach empowers students to gain mastery over a vast array of resources.

The pilot study was carried out during computer science lessons with fifth-year students, as they are usually fast and eager learners, and often employ unconventional methods to solve problems during the learning process. Following one month of using this system, the study has shown that the designed model serves as a useful resource for supporting contemporary educational processes. Its implementation allows teachers to improve communication with students, analyse individual performance in the class, and incorporate the formula of experience and technology to maximise engagement. Students observed that the learning environment was pleasant, and interactive features, including shared chats, online whiteboards, and reactions during virtual meetings, were of particular interest. Additionally, it was revealed during the initial rollout that prior training is essential for participants to utilize these platforms proficiently before implementing them completely. Another significant element is the onboarding procedure. Because of Microsoft's stringent security protocols, transitory passwords necessitate conversion to permanent ones, and supplementary information must be provided. Therefore, it is advisable for administrators to assist students during the initial login phase to prevent probable stress and disappointment. In general, the present environment satisfies the demands stated by the participants surveyed. However, these results require additional refinement and clarification. It is noteworthy that these conclusions are tentative and serve as a foundation for the future extensive deployment of the proposed model. A scientific and precise approach is preferred, emphasizing the continual nature of the research rather than excessive rhetoric.

4. Conclusions

Using cloud technology in education is promising. It offers limitless opportunities for learning and collaboration, as well as flexibility and scalability. Furthermore, it can help decrease hardware and software expenses. However, the selection of the appropriate platform is crucial to the successful integration of cloud technology in the educational process. We should take into account the offers of all potential platforms, as well as their combination.

The study has revealed that the developed model proves to be an efficient tool for ensuring a modern educational process. During the course of this work, a survey was conducted amongst both students and teachers to gauge their needs and requirements for a suitable learning environment. Additionally, solutions from various cloud providers were explored, leading to the creation of a CBLE model which amalgamates the features of both Microsoft and Google platforms. The utilization of SAML technology facilitated the implementation of a solitary sign-on mechanism for users, streamlining the authentication and authorization process. Additionally, configuring the team in Microsoft Teams as the primary communication application ensured an effective dissemination of information and cooperation in the learning setting. The pilot use of the CLBE model with 5th graders has validated its practicability and applicability. Timely registration for educational plans on cloud platforms, user creation, and system configuration have enabled the successful implementation of a new model and ensured the educational process in CBLE.

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