Usage and Acceptance of the Nextcloud Platform in the University Context: An Exploratory Study

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Article

Usage and Acceptance of the Nextcloud Platform in the University Context: An Exploratory Study

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Abstract: Cloud platforms are widely employed in today's educational context to enhance collaborative learning and the overall quality of the teaching-learning process. In 2016, Nextcloud was implemented in the Faculty of Chemical Engineering at the Technological University of Havana "José Antonio Echeverría" (CUJAE), Cuba. Subsequently, an evaluative phase was conducted to ensure the continuous development of the platform. The objective was to assess the use and acceptance of the Nextcloud platform from the perspective of students and professors in the faculty. An exploratory, non-experimental, and cross-sectional study was conducted. Data was collected through observation and a survey. Matomo Analytics tool was employed for observation, revealing low visitation numbers. The survey was based on the Unified Theory of Acceptance and Use of Technology model. Better results were obtained in positive acceptances compared to negative ones, both for professors and students. It is concluded that the evaluation of the Nextcloud platform is infrequently used by users; however, there were higher positive acceptances than negatives from the perspectives of both students and professors.

Keywords: cloud computing; Unified Theory of Acceptance and Use of Technology model; Matomo Analytics; Nextcloud; University

1. Introduction

Cloud computing has garnered significant interest from researchers and professionals due to its applicability across various industries, including education as a service [1]. This technology has transformed educational spaces, bringing about a shift in how students learn and how educators teach [2].

In particular, cloud platforms are of great interest to the educational community for their accessibility features, enabling shared learning anytime, anywhere, across different devices and multiple platforms [3]. They offer services that enhance the functionality of learning management systems by facilitating the creation, editing, and sharing of educational resources [4].

Currently, cloud platforms enable collaborative projects and the development of teamwork and communication skills, essential attributes for success in the job market. This is a necessary requirement for the training of highly qualified engineering specialists geared towards the labor market [5]. Faced with this need, educational systems are confronted with the challenge of implementing new learning environments using technologies. In this regard, cloud platforms can be a valuable tool for promoting practical activities where students acquire the competencies required in their specialization area within a virtual environment [6].

The ability to access multiple services available on a cloud platform facilitates innovative teaching strategies in the classroom or enhances online education to meet the demands of modern

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education. Tobarra and colleagues [7] rely on game-based learning with a cloud platform to enhance the learning process of engineering students in the field of cybersecurity. Another research, also on an online cybersecurity course, employs a cloud platform to develop practical skills in computer engineering students [8]. Authors Pramod Abichandani and colleagues [9] utilize a virtual reality system based on a cloud platform for teaching about solar energy, employing team-based and project-based learning to generate motivation in first-year engineering students and develop up-to-date general competencies in solar energy from strategic and business perspectives. In another study, a cloud technology platform is used to adapt the flipped learning model and assess critical thinking skills in mathematics among fourth-year university students [10]. Another related research utilizes the deployment of resources from a cloud platform to support ubiquitous English language learning [11].

To achieve these aforementioned teaching strategies, there are various cloud platforms available. Research by Nur Diyana Rossiman and colleagues employs Google Drive due to its popularity among higher education institution students [12]. Dropbox is also widely accepted and highly useful for collaborative learning and content management [4,13,14]. Glazunova and colleagues evaluate through a set of criteria and indicators how platforms like Microsoft 365 and Google Workspace are the most suitable for providing group work to students in distance learning [15]. However, other studies propose implementing similar solutions using open-source software like Nextcloud [16–19]. The choice between them depends on issues related to software acquisition, having hardware resources for space allocation, and hiring personnel if one wishes to implement with their own infrastructure [20].

1.1. Usage of Nextcloud in the university context. Nextcloud at "José Antonio Echeverría" Technological University of Havana

In today's education, the learning environment extends beyond the physical classroom space, with cloud platforms like Nextcloud enabling universal access to education. This platform allows for hosting, synchronizing, and sharing files online with other users, accessible through a website or a desktop program for various operating systems (https://nextcloud.com/education/).

For many universities, Nextcloud proves to be a functional platform as it requires minimal financial investment and offers a solution for deploying storage as a service using free and open-source software [5,18].

Vásquez Bermúdez et al. affirm that it can be a valuable tool for collaborative learning, allowing for control over files and applications within the universities where it is implemented [16,18]. This is because it boasts a high level of security and privacy, with data stored on the universities' own servers rather than third-party servers, ensuring full control over data and access [16,18].

This file management tool offers a wide range of features and functionalities for online learning [21], a necessity for the current training of professionals.

In Cuba, "José Antonio Echeverría" Technological University of Havana (CUJAE) adopted Nextcloud as the most suitable platform to support the teaching-learning process. By being installed on CUJAE's own servers, this platform offers greater technological independence, storage space at no additional cost, and data security and privacy. The Faculty of Chemical Engineering was the first to implement Nextcloud in 2016 and was named CloudIQ (Chemical Engineering Cloud). The term "cloud" was used for the computer services that would be provided via the Internet [18].

In its early stages, CloudIQ presented a structure of shared storage folders for users, among which stood out the management of teaching documents and academic theses. These experiences were enhanced with the cessation of face-to-face training, with the arrival of the COVID-19 pandemic; new tools were added to the platform, such as the activity calendar, forms, online office suite, conferences, and the inclusion of email and chat in a virtual collaborative environment.

However, once the various functionalities of the platform were implemented, the authors of this study posed the following questions:

Question 1: How frequently is the platform used by professors and students of the Faculty of Chemical Engineering?

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Question 2: Is the platform accepted by professors and students of the Faculty of Chemical Engineering?

To investigate this, the research was conducted with the aim of evaluating the usage and acceptance of the Nextcloud platform, from the perspective of students and professors of the Faculty of Chemical Engineering at CUJAE.

1.2. Information Technology Acceptance Models in Cloud Computing

Once the platform is selected, there are various user acceptance models in the literature to assess the impact of implemented technology [22]. In the educational context, these models are useful for academic researchers to study, understand, and improve variables such as usability, attitude, behavior, control, intention, perception, ease of use, among others, and their relationships. Research has been conducted that combines models to study the influence among various acceptance factors during the teaching and learning process using cloud-based platforms [23]. It has also been used to determine which platforms are most suitable based on their functionalities and what didactic strategies they enable teachers to develop [16,17,19], as well as to enhance understanding of the motivational factors behind student satisfaction or dissatisfaction [24].

This study will employ the Unified Theory of Acceptance and Use of Technology (UTAUT) model. According to the literature, despite the existence of various models, UTAUT has been considered one of the most popular in the field of technology acceptance and technological factors for the successful implementation of information systems [25–27].

2. Materials and Methods

The research was of an exploratory, non-experimental, and cross-sectional nature [28]. It was conducted from March to September 2022.

In line with the research objective, the instruments used for data collection were observation and a survey. Both instruments were validated by experts, yielding the following Cronbach's alpha values: α=0.88 and α=0.91, respectively.

A guide for observation was employed, taking into account variables such as the number of visits, web browsers, operating systems, types of devices, and services utilized (Figure 1). For this purpose, the online, free, and open-source tool Matomo Analytics [29] was used. This web analytics tool monitored user traffic, access, and interaction with the CloudIQ platform.

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GUIDE TO OBSERVATION TECHNIQUE

Software: Chemical Engineering Cloud Platform.
Period of time: March – September, 2022
Purpose: Traffic network monitoring in access and interaction of platform users.
Type of observation: systematic direct observation.
Users: students and professors.
Tool: Matomo Analytics.

Variables	Observation
Visits	
Operating systems	
Web browsers	
Devices	

Services cloud platform	Observation *How and how much do users use services cloud platform?*	
	Students	Professors
Files		
Mail		
Contacts		
Calendar		
Deck		
Tasks		
Quick notes		
Forms		
Conferences		
Activity		
Announcements		

Figure 1. Aspects used in the observation.

The survey was voluntarily administered to a sample of 32 students and 32 randomly selected professors (simple random sampling) of Chemistry Faculty at CUJAE. It was based on a design similar to the research [17], which used UTAUT as the model [30]. This instrument consisted of 4 constructs and 12 items (Figure 2), distributed as follows:

- Items 1 to 3 corresponded to Construct 1 (C1): Performance Expectancy, which is the user's perception of the platform's performance in carrying out their work.
- Items 4 to 6 corresponded to Construct 2 (C2): Effort Expectancy, which is the user's perception of the ease associated with using the platform.
- Item 7 corresponded to Construct 3 (C3): Social Influence, which is the user's perception of the platform's adoption by their reference institution.
- Items 8 to 12 corresponded to Construct 4 (C4): Facilitating Conditions, which is the user's perception of the technical and organizational infrastructure of the platform.

All items were assessed on a 4-value Likert scale, where positive responses corresponded to values 1 as "Completely Agree" and 2 as "Agree." Negative responses were values 4 as "Disagree" and 5 as "Completely Disagree."

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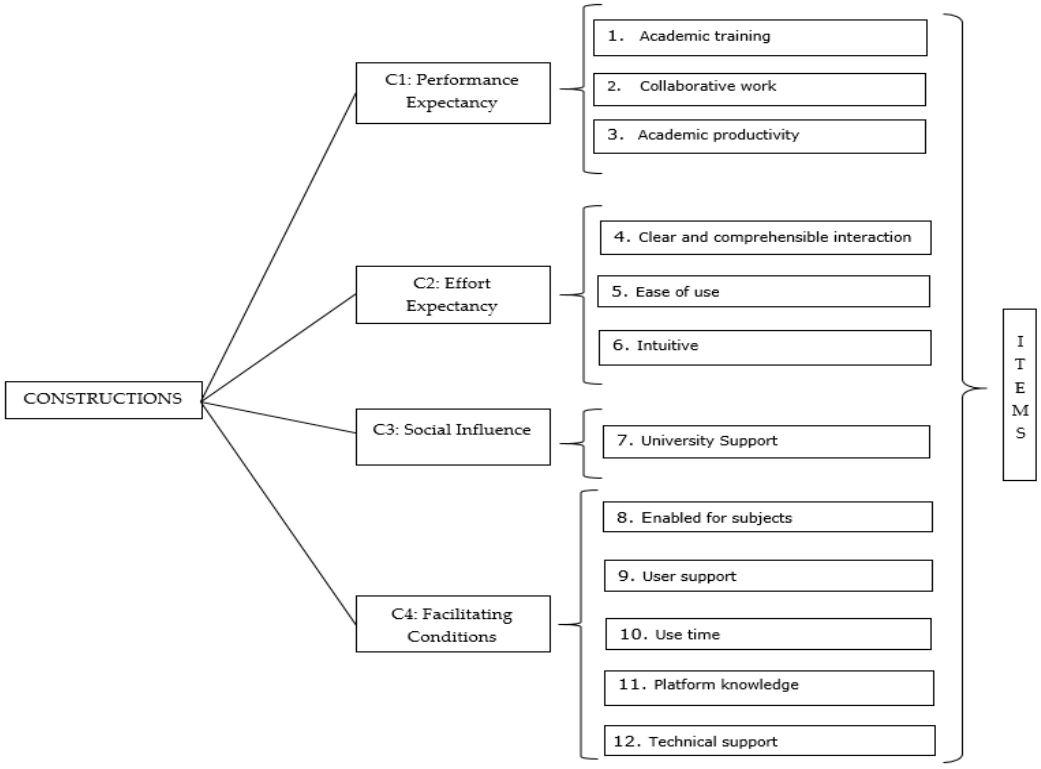

Figure 2. Representation of the Constructs and Items that Comprise the Survey.

Figure 3 shows the survey published from the form service of the CloudIQ platform (https://cloud.quimica.cujae.edu.cu/). This service allowed for the export of results in Microsoft Excel spreadsheet format for data processing.

Evaluation of the "Chemical Engineering Cloud"

Dear user:
We would like to know your evaluation of the "Chemical Engineering Cloud" platform (CloudIQ) implemented at the Faculty of Chemical Engineering at "José Antonio Echeverría" Technological University of Havana.

The results obtained from this evaluation will be used for the continuous improvement of the platform and its usage strategy. Please evaluate each item on a scale of 1 to 4 according to its acceptance and use as a learning tool.

Thank you for your cooperation!

Legend	
1	Completely Agree
2	Agree
3	Disagree
4	Completely Disagree

	1	2	3	4
Do you consider Nextcloud useful for your academic formation?				
Do you believe that using Nextcloud allows you to perform online tasks simultaneously?				
Do you think that using Nextcloud could increase academic productivity in students?				
Do you find the interaction with Nextcloud clear and understandable?				
Do you consider Nextcloud easy to use?				
Do you think Nextcloud is easy to learn to manipulate for any type of user?				
Do you believe the university should support the use of Nextcloud?				
Do you think the Nextcloud platform should be enabled for all undergraduate and postgraduate courses?				
Have you received support in the proper use of Nextcloud platform?				
During the time you have used Nextcloud, have you enjoyed working with the platform?				
Do you have the necessary knowledge to use Nextcloud?				
Do you believe there should be a specific person available to help with difficulties in Nextcloud experience?				

Figure 3. Design of the survey.

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3. Results

3.1. Results Obtained Through Scientific Observation

During the evaluated period from March to September 2022, user access and usage of the CloudIQ platform experienced several fluctuations. After reaching its highest value in April, there was a prolonged drop to zero due to issues in the data center. From late July and throughout the month of August, very low visit numbers were recorded due to the vacation season. Figure 4 displays the visit numbers obtained from the records in the Matomo Analytics tool.

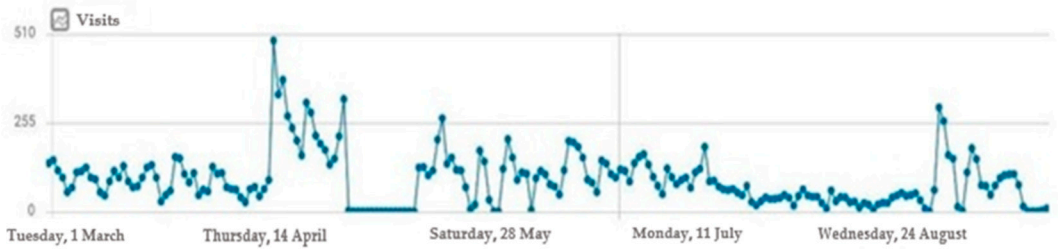

Figure 4. Monitoring of user visits to the platform from March to September 2022.

Access to the platform was done through various web browsers. The top three were Google Mobile, Firefox, and Chrome. Following them were Mobile Safari, Samsung Browser, Microsoft Edge, MIUI Browser, Chrome Mobile iOS, Firefox Mobile, and Opera to a lesser extent. Similarly, there were various accesses from a diverse range of operating systems, with Android taking the lead, followed by Windows. Subsequently, iOS, GNU/Linux, and Mac were also used. There was a greater tendency to use mobile devices (smartphones, phablets, tablets, and laptops) rather than desktop computers to access the platform.

There was limited use of the services offered by the platform. The most commonly used were email, chat, and files (shared folders) containing bibliographic materials and software programs. Therefore, in the early stages of implementing Nextcloud, a strategy to encourage its use was to unify various tools as services integrated into the platform, including the most commonly used ones like email and chat. This way, users could navigate from one service to another within the platform itself, without the need to access different avenues.

Furthermore, professors used the platform with their students in their final year of study to develop their undergraduate theses. Meanwhile, students shared study materials with each other to avoid overloading their phones with files.

3.2. Results Obtained from the Survey

The survey results provided the percentage of positive and negative responses for the twelve items. Table 1 displays the results based on the students' perceptions, while Table 2 presents the results from the perspective of the professors.

Table 1. Percentage of Items Based on Student Acceptance.

Acceptance	Item											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Completely Agree (%)	44	13	22	22	28	28	47	50	25	34	28	63
Agree (%)	44	56	56	31	50	31	38	38	38	34	41	19
Disagree (%)	13	25	22	47	19	34	13	9	25	28	22	9
Completely Disagree (%)	0	6	0	0	3	6	3	3	13	3	9	9

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Table 2. Percentage of Items Based on Teacher Acceptance.

Acceptance	Item											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Completely Agree (%)	69	41	50	44	50	41	84	81	63	66	28	56
Agree (%)	16	38	38	34	28	38	3	3	22	22	44	31
Disagree (%)	6	9	9	16	9	19	0	3	9	0	22	3
Completely Disagree (%)	9	13	3	6	13	3	13	13	6	13	6	9

When comparing Tables 1 and 2, it is observed that for students, the majority of responses were in the categories "Agree" and "Disagree." As for the professors, the majority of responses fell into the categories "Completely Agree" and "Completely Disagree."

In Figure 5, the percentage of the four constructs in positive and negative acceptances is shown, except for the third construct which maintains the same data as it corresponds to only one item (item 7). It is evident that the highest results were in positive acceptances of "Completely Agree" and "Agree," both for students and professors, when compared to negative acceptances of "Disagree" and "Completely Disagree."

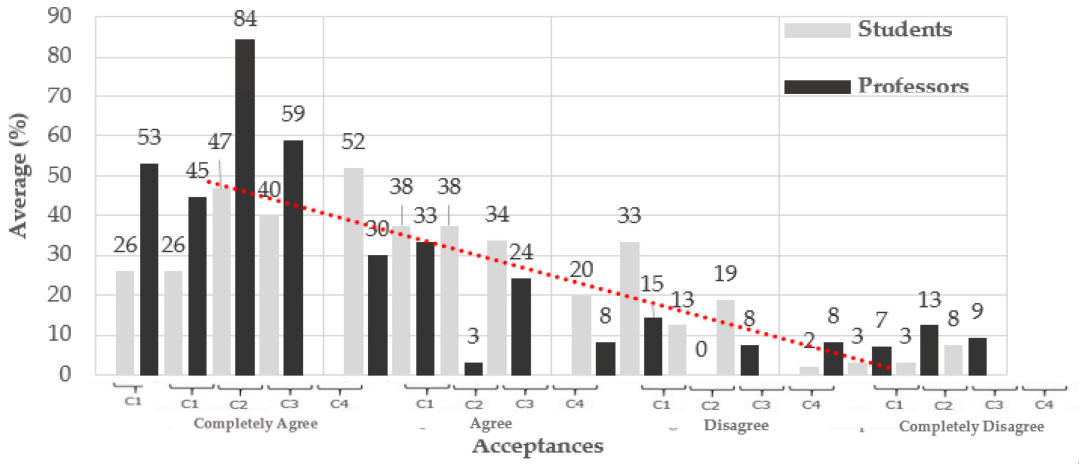

Figure 5. Percentage of Constructs According to Acceptance in Students and Professors.

4. Discussion and Interpretation

The objective of this research aligns with what authors Garzón and colleagues have analyzed. They argue that positive acceptance by users is a key factor for the success of any technology implemented in an organization, and it is more likely that they will actively engage in its use. [31].

4.1. Question 1: How often is the platform used by the users?

To address question 1, the evaluation method employed was observation. This method utilized a guide based on the reports obtained through the Matomo Analytics tool. The results revealed that while users frequently utilize the CloudIQ platform, the registered visit count was relatively low in comparison to the number of students and professors in the faculty.

Although Nextcloud proves very useful in supporting the teaching-learning process due to the tools it provides, it's important to note that the platform alone is not sufficient to guide learning. In the Faculty of Chemical Engineering, an underutilization issue has been identified in terms of the advantages offered by the platform regarding the implementation of didactic and methodological strategies that promote its use and acceptance by students.

It's worth noting that cloud platforms, including Nextcloud, ensure an enriching educational experience that fosters the development of strategies such as project-based learning [9], game-based learning [7], and flipped learning [10,32], among others.

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The above requires motivating teachers to acquire digital competencies through training provided by the platform administrator or administrators [33,34], in order to achieve a greater integration of technology in the teaching-learning process. In this regard, they should explore the various available tools, learn to use them, and apply them effectively to make the most of classes and connect with students through technology [24]. It would be valuable for the platform administrator to have pedagogical training that allows them to understand the needs of the teacher and support them in their educational work.

Nextcloud offered teachers' Faculty of Chemical Engineering to develop of undergraduate theses in chemistry students during their final year of the program. It allowed them to share documentation with their mentors and synchronize it from various devices with different operating systems.

4.2. Question 2. Is the platform accepted by users?

On the other hand, to answer question 2, a survey was administered to a sample of students and teachers who commonly used the CloudIQ platform. This survey was based on the UTAUT model. In the results obtained from this instrument, higher levels of positive acceptance were observed in the categories "Completely Agree" and "Agree," both in the overall analysis of the constructs and in the different items that compose them.

Regarding negative acceptances, it was observed that the category "Disagree" had higher results among students compared to teachers. Conversely, a greater number of negative acceptances were observed among teachers in the category "Completely Disagree." These general results demonstrate the interest of the teaching staff in exploring new teaching methodologies that incorporate technologies; however, there still exists a predominant use of traditional teaching strategies in face-to-face education and a resistance to change. Consequently, low levels of interaction in the use of the platform's services by students are generated in relation to the exploitation of the services it offers. These results are reaffirmed in the research by Robles-Gómez and collaborators [23], who combined the UTAUT and TAM (Technology Acceptance Model) models.

To expand the response to the second question, an analysis was carried out on the relationship between the constructs that make up the survey. In our case, the results of the construct "Better Expectations" were related to the constructs "Performance Expectancy" and "Social Influence," while the construct "Ease of Use Conditions" only influenced "Performance Expectancy." However, this did not occur in another similar study where the results were different, and new evaluation variables were added [2].

Firstly, the results of the construct "Better Expectations" were related to the construct "Performance Expectancy," where acceptable values were obtained with better results in teachers than in students, which coincides with the findings of other research [35,36]. In the context of the Faculty of Chemical Engineering, students consider Nextcloud as complementary, as there are other platforms that meet their needs, such as Moodle. In a related study, both platforms were integrated to provide users with greater technological possibilities in an e-learning environment [21]. The authors believe that this synergy between both platforms enhances the quality of virtual teaching and enriches the learning experience of students by allowing teachers to use innovative and personalized pedagogical tools for each student.

Next was the construct "Social Influence," which was also related to the construct "Better Expectations," as affirmed by the authors [37]. However, in this research, these results were only present in the "Completely Agree" ratings among teachers, without a significant impact among students. In a similar study where only students participated, no significant effects of Social Influence were observed in the evaluation of an electronic learning system [38]. It is undeniable that students today have a wide mastery of electronic and technological devices, allowing them to navigate digital environments with ease [39]. In this sense, it is evident that they do not need an external entity to develop their learning in a technological environment, as their familiarity with these tools enables them to access a large amount of educational resources autonomously. However, it is important to

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highlight that the presence of teachers is essential to provide appropriate pedagogical guidance and personalized support to students, contributing to maximizing their learning potential.

Finally, the constructs "Ease of Use Conditions" and "Performance Expectancy" were related, as users increased their confidence in the platform when technical support was provided to remove barriers that hindered its effective use. Similar results coincide with other research studies where it is affirmed that when infrastructure conditions are facilitated and technological and organizational support is provided, users' perception is very positive in the acceptance of a technological system [35,40]. Therefore, the Faculty of Chemical Engineering must consider these factors in order to improve the acceptance of the platform for those students and teachers who find it difficult to understand.

4.3. Limitation

This research is fundamentally limited by the chosen sample for the survey, which hinders a deeper analysis of the results. Therefore, as part of the current doctoral research project, it is intended to conduct an analysis with a larger number of participants, which would allow for the verification and enrichment of these findings. It is important to note that the obtained results confirm that the use of Nextcloud enables better collaboration between students and teachers and more efficient management of educational resources, reaffirming findings presented in similar studies [16,17,19].

In the educational context, this research is important for improving the educational experience with Nextcloud, adapting to the needs and requirements of students and teachers, as they are the ones using it. This helps identify possible difficulties that may be affecting the platform's usage and take measures to address them. The authors believe that the results serve as a reference for the continuous improvement of other Nextcloud platforms implemented in the remaining faculties of CUJAE.

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Conflicts of Interest: The authors declare no conflict of interest.

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