

Resistance Assessment as a Strategy to Increase the Adoption of Electronic Laboratory Notebooks

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Electronic Lab Notebooks (ELNs) have seen a significant rise in research laboratories. However, realizing the benefits of ELNs requires the active participation of employees within an organization. This study aims to identify the factors contributing to resistance towards adopting an ELN, specifically eLabFTW. A semi-structured questionnaire, validated by experts, was administered to record book requesters at the René Rachou Institute (FIOCRUZ MG). The findings revealed that individual decision-making factors include peer influence within the research group and familiarity with traditional physical logbooks. Assessing resistance can serve as a strategic tool to enhance system adoption.

Keywords: Electronic Lab Notebook. Resistance to Change. Strategy.

The credibility of research results relies on robust scientific principles and high-quality practices. For research to be considered scientifically valid, it must produce relevant, reliable, and reproducible results while adhering to ethical standards. Furthermore, research documentation should be auditable and accessible to the public, demonstrating that all procedures were conducted accurately within the specified timeframe. Failure to maintain comprehensive records may doubt the study's validity [1].

Traditionally, research documentation has been carried out using paper notebooks, but electronic lab notebooks (ELNs) offer several advantages. ELNs offer significant benefits over paper notebooks, including enhanced information retrieval and more accessible data sharing. They can handle and store large volumes of data, incorporating features such as data backup and security protocols. ELNs also contribute to research reproducibility and management by providing improved documentation of research processes, primarily through features like versioning and

revision tracking. Moreover, implementing security measures such as passwords and access levels ensures unauthorized individuals cannot access research data. Finally, using ELNs reduces paper waste, contributing to environmental sustainability [2].

The adoption of new ELN software and its implementation by research institutions has increased since 2000, driven by the recognized benefits of digitization. However, despite the advantages offered by ELNs, several barriers have been identified. Not all ELNs have proven successful or suitable, and many commercially available and open-source software packages have become defunct over time. An analysis of 172 ELN products (96 active and 76 defunct) revealed that the average lifetime of an ELN was approximately 7 ± 4 years. Consequently, selecting the right tool can be complex for a research institution if end-users are not actively involved in implementing these digital research management processes [3].

Numerous studies [4-6] on electronic systems implementation have highlighted varying levels of user acceptance and successful change processes. Each study addresses different strategies to overcome barriers within their unique organizational contexts. Ineffective change management strategies can lead to increased resistance to change. Change agents can address this situation by providing staff with clear

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information about the change and demonstrating a genuine interest in addressing the concerns of those involved. Another crucial factor that can help reduce resistance is the active participation of staff in planning and implementing change as active participants rather than passive recipients. Participation fosters a sense of control over the new process among individuals [7].

The current study targets change agents implementing ELN usage within research organizations. We aimed to identify the factors contributing to individual resistance and explore how institutions can address these challenges effectively.

Materials and Methods

This research employed a case study method [8] and followed these steps: a literature review to identify resistance factors to ELN usage, a case description, an expert evaluation of the questionnaire, and a pilot study. The semi-structured questionnaire used to assess why researchers opted for a physical book instead of eLabFTW® ELN was developed based on individual and organizational resistance factors (Table 1), derived from references [4,7].

For semantic consistency, goal achievement, inducing responses, and response time evaluation, we invited 5 experts to assess the questionnaire.

These experts included one change agent of ELN implementation, one expert in human behavior to evaluate psychological values, one expert in human/software interaction, one user, and one technical support specialist. The experts' opinions were analyzed for concordance frequency, with a minimum acceptable inter-rater agreement of 90% recommended.

This case was conducted at the Oswaldo Cruz Foundation, which operates several regional units, including the René Rachou Institute (IRR/Fiocruz) in Minas Gerais, Brazil. The IRR/Fiocruz is a renowned institution in public health research, boasting 18 laboratories dedicated to studying tropical diseases such as Chagas disease, leishmaniasis, schistosomiasis, and intestinal parasites. It also houses 13 biological collections and 4 reference laboratories.

Established in 2003, the institution offers a postgraduate course in health sciences focusing on training master's and doctoral students for scientific research, teaching, and professional activities in the health field. Additionally, the IRR provides scientific and technical support to the Brazilian Public Health System (SUS).

In 2021, the eLabFTW® ELN platform was carefully implemented at IRR/FIOCRUZ after a thorough viability study. IRR researchers chose this open-source ELN to advance the use of electronic lab notebooks (Figure 1). Since its

Table 1. Resistance factors.

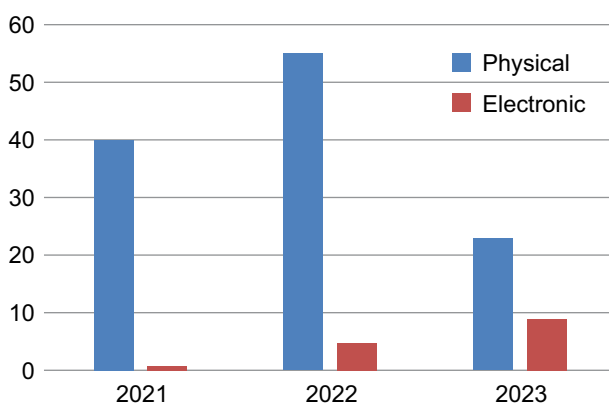
Individual	Organizational
Inertia factor: has always worked this way than will not change	Quality Management System and institutional policies: organization values and wills for changing
Example factor: others in same group did not join ELN so they do not change	Organization's formal structure, systems and processes.
Trauma factor: fear of losing data/insecurity	Computerized System quality
Lack of information: didn't know the ELN existence	Technical support quality
	Institutional communication

Source: Althunibat A and colleagues; Nedelcu and Busu [4,7].

implementation in 2021, there have been 118 lab notebook requests, of which only 15 researchers opted to use the eLabFTW® ELN to record their research data. This represents approximately 14% of all lab notebook requisitions.

Figure 1 displays the number of lab notebooks delivered over time.

Figure 1. Number of Lab notebook delivered.



To collect data for this study, we emailed a questionnaire to 102 logbook requesters, who were invited to respond using the Google Form platform. Participants' identities were kept anonymous, as the responses did not include personal details or email addresses. This research was not submitted for approval by the Research Ethics Committee as it complies with Article 1, item VII of CNS Resolution No. 510, dated April 7, 2016.

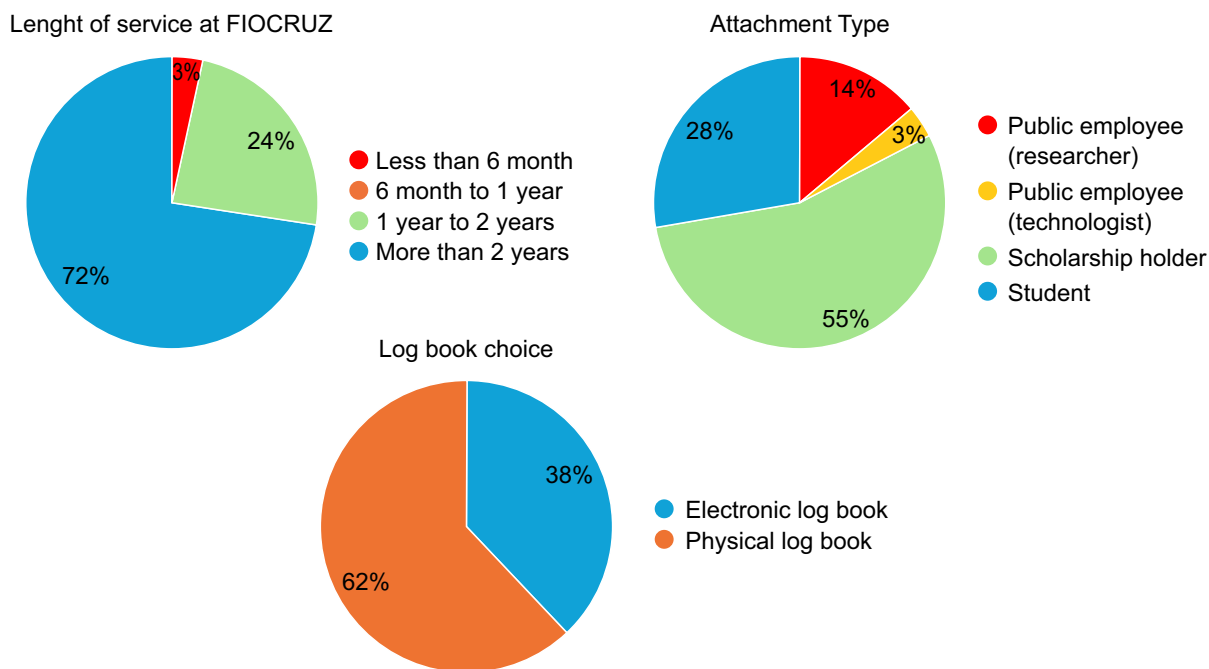
Results and Discussion

Figure 2 presents the respondents' profiles predominantly consisted of scholarship holders and students working at FIOCRUZ for over 2 years, with an average age of 35. Among the 29 respondents, nearly 40% opted for electronic logbooks to register their research data, with usage frequencies ranging from once a week to once a month. All 11 respondents who used electronic logbooks reported using the eLabFTW platform on their computers.

Regarding individual resistance factors, such as EXAMPLE, it was found that for most respondents (17), the experience within their research group influenced their choice. Only 12 respondents rated this factor below 3, indicating that the EXAMPLE factor can positively and negatively influence the decision to use an electronic record book. Among the 18 users of physical logbooks, 11 indicated that their choice was influenced by their habitual use of this type of record, highlighting the importance of considering the INERTIA factor. In contrast, only 3 users of physical logbooks rated the TRAUMA factor higher than 4, indicating that negative experiences were not a significant deterrent in choosing an electronic record book.

Communication was assessed in two aspects: awareness of the eLabFTW platform and the evaluation of information flow within FIOCRUZ. Nearly half of the respondents were aware of the platform, and 41% of respondents rated the adequacy of communication channels with a score of 4 or 5. However, 15 respondents were either unaware or did not respond, suggesting that communication remains an area for improvement within the institution. Most respondents agree with these factors regarding the training provided, the quality of training, and the recognition of the institution's efforts in providing information resources. This suggests that the organizational aspect of information is not a critical concern. However, it remains a factor that should be continuously monitored in effective change management strategies. Future training sessions could benefit from including testimonials from current eLabFTW users, given the significant impact of the EXAMPLE factor, as mentioned in the work of Bravo and colleagues [5].

As highlighted by Kanza and colleagues, people's resistance to adopting a new tool can be a significant barrier, especially if they perceive it to be complex [9]. However, the quality of the eLabFTW platform and technical support was generally well-received, with almost all electronic users agreeing that the system is easy to use, secure,

Figure 2. Respondent profile and logbook choice.

and integrates well with other record sources. Only one respondent disagreed with these aspects. This positive feedback validates the feasibility study conducted prior to implementing the system.

When respondents were asked about the resources available for using the eLabFTW platform, including internet quality and computer availability, 16 agreed that the resources were sufficient. However, suggestions for improving adherence to the eLabFTW platform highlighted the need for additional notebooks. Several strategies were proposed to address this, including improving communication in academic spaces, advertising on the intranet and requisition system, and encouraging mentors to discuss the ELN with their mentees.

The questionnaire included a range of questions and statements that assessed individual and organizational factors influencing resistance to change and evaluated the quality of the implemented computerized system. Unlike previous studies that focused on specific factors, our study comprehensively assessed various

aspects. For example, Althunibat, Almaiah, and Altarawneh studied multiple factors affecting students' non-adherence to remote learning but did not delve into students' emotional responses to remote learning [4].

In contrast, Bravo and colleagues [5] designed a questionnaire to assess stakeholders' acceptance of an Educational Management System at a public university. The questionnaire had elements that allowed for evaluating both individual and organizational factors. However, the wording of the questions made them challenging to understand, and the questionnaire was lengthy, comprising 40 questions. Ben, Geyer, and Kahl [6] investigated the adherence of various stakeholders involved in IT projects within public institutions. While they did not explore individuals' emotional responses to the proposed changes, the semi-structured nature of their questionnaire might have captured such factors in respondents' answers. However, neither questionnaire specifically addressed aspects related to the quality of IT projects.

Conclusion

The study has yielded valuable insights that will be instrumental in enhancing the adoption of the eLabFTW Platform among IRR/FIOCRUZ MG employees. Individual resistance factors such as EXAMPLE and INERTIA emerged as significant influencers. Increased adherence to the new electronic data recording system will catalyze a broader migration to the new ELN platform.

The commendable efforts of FIOCRUZ's senior management in spearheading the implementation and enhancement of this innovative research data recording method have been duly acknowledged. Nevertheless, there is a recognized need to refine communication strategies and training programs further to promote the utilization of the ELN across the institution.

The questionnaire to assess individual and organizational resistance to using the eLabFTW electronic record book was distributed to all employees who requested a logbook at FIOCRUZ/MG. However, to evaluate the quality of the platform effectively, it was necessary to target electronic logbook users specifically. Separate questionnaires tailored to each profile may be beneficial to gauge resistance to comprehensively adopting the new eLabFTW platform. One questionnaire could focus on individual and organizational barriers to ELN use, applied to those who requested the physical logbook. At the same time, another could concentrate on assessing the quality of the eLabFTW system for ongoing improvement efforts.

A limitation of this study was the relatively low response rate, with less than 30% of the invitations resulting in completed questionnaires. A more significant number of respondents would provide deeper insights into the reasons for non-adherence to the electronic logbook. Despite this limitation, the questionnaire is advantageous due to its ease of application and minimal time investment required from respondents, allowing for efficient analysis. However, efforts should be made to increase the response rate in future studies for a

more comprehensive understanding of resistance factors and quality assessments.

The method had limitations, particularly regarding the questionnaire response rate. To address this, the study intends to explore alternative methods, such as semi-structured interviews or focus groups. These approaches aim to provide a deeper understanding of the factors contributing to the low adherence to using the ELN. The application of these tools will extend to other FIOCRUZ units that have also implemented the eLabFTW electronic logbook.

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