

Advancing biomedical research education through effective REDCap implementation

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Introduction. Effective research data management is essential in academic environments, particularly within the biomedical sciences. This study examines the implementation of the Research Electronic Data Capture (REDCap) system at Universidad Europea de Madrid to improve data management practices among faculty and students.

Aim. The project aimed to integrate the university into the global REDCap network, enable the platform's use for research data collection, and train faculty and students in its basic and intermediate functionalities.

Subjects and methods. A mixed-methods approach was applied, combining quantitative and qualitative analyses. Implementation involved three key phases: (1) joining the REDCap consortium, (2) establishing the technological infrastructure, and (3) delivering structured training sessions. Postgraduate students participated in the training program, and user experience was evaluated using an adapted version of the System Usability Scale (SUS).

Results. Out of 48 postgraduate students, 50% completed the follow-up survey. Results demonstrated high perceived usefulness of REDCap (mean score: 4.1/5) and strong agreement on integration of its features into workflows (mean score: 4.4). However, users noted a steep learning curve (mean score: 2.9) and moderate demand for ongoing support (mean score: 3.2).

Conclusions. REDCap was well received for its utility and integration. Nonetheless, initial learning challenges and the need for continuous support were noted. To fully leverage REDCap's potential, institutions should ensure thorough onboarding and accessible technical assistance.

Key words. Academic environments. Biomedical education. Biomedical research. Data management. REDCap. Research training.

Avances en la educación en investigación biomédica mediante la implementación eficaz de REDCap

Introducción. En los entornos académicos resulta fundamental una gestión eficaz de los datos de investigación, sobre todo en el campo de las ciencias biomédicas. Este estudio examina la implementación del sistema Research Electronic Data Capture (REDCap) en la Universidad Europea de Madrid con el fin de mejorar las prácticas de gestión de datos entre el profesorado y el alumnado.

Objetivo. Integrar a la universidad en la red global REDCap, permitir el uso de la plataforma para la recopilación de datos de investigación y formar al profesorado y al alumnado en sus funcionalidades básicas e intermedias.

Sujetos y métodos. Se aplicó un enfoque de métodos mixtos, con análisis cuantitativos y cualitativos. La implementación implicó tres fases clave: (1) unirse al consorcio REDCap, (2) establecer la infraestructura tecnológica y (3) impartir sesiones de formación estructuradas. Los estudiantes de posgrado participaron en el programa de formación y se evaluó la experiencia del usuario utilizando una versión adaptada de la Escala de Usabilidad del Sistema (SUS, *System Usability Scale*).

Resultados. De los 48 estudiantes de posgrado, el 50 % completó la encuesta de seguimiento. Los resultados demostraron una gran utilidad percibida de REDCap (puntuación media: 4,1/5) y un fuerte acuerdo sobre la integración de sus funciones en los flujos de trabajo (puntuación media: 4,4). Sin embargo, los usuarios señalaron una curva de aprendizaje pronunciada (puntuación media: 2,9) y una demanda moderada de asistencia continua (puntuación media: 3,2).

Conclusiones. REDCap fue bien recibido por su utilidad e integración. No obstante, se señalaron dificultades iniciales de aprendizaje y la necesidad de asistencia continua. Para sacar el máximo partido al potencial de REDCap, las instituciones deben garantizar un proceso de incorporación exhaustivo y una asistencia técnica accesible.

Palabras clave. Educación biomédica. Entornos académicos. Formación en investigación. Gestión de datos. Investigación biomédica. REDCap.

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Introduction

To strengthen biomedical research education, the implementation of tools such as REDCap can be highly beneficial. REDCap (Research Electronic Data Capture) facilitates collaborative research, enhances healthcare service delivery in rural areas, and improves data collection processes [1,2]. The multifunctional features of the platform support various stages of healthcare planning, assisting both research and operational activities [1]. Additionally, integrating CDISC standards into REDCap can streamline the adoption of best practices for clinical and translational researchers, promoting efficiency and quality in clinical trial data management [3]. The electronic data capture capabilities, collaborative tools, and security measures of REDCap make it a valuable resource for both research data capture and operational databases in academic environments [2].

In the era of artificial intelligence and data-driven research, enhancing competencies in research and simulation practices is crucial for academic institutions where tools like REDCap play a pivotal role in developing these competencies. REDCap facilitates the structured collection and management of research data, making it an invaluable resource for both academic and operational purposes [2]. The integration of artificial intelligence and data analytics in research practices demands advanced skills in handling complex datasets and simulation environments. REDCap's multifaceted features support the implementation of simulation practices, allowing researchers to model and analyze various scenarios without risk [1]. This capability is particularly important as AI-driven data analysis becomes increasingly prevalent, requiring researchers to be adept at managing large volumes of information with precision [4].

By adopting these strategies, academic institutions can enhance their research capabilities and contribute to the advancement of biomedical research. Several institutions around the world as University of Pennsylvania has effectively utilized REDCap to support a wide range of research activities, including clinical trials and epidemiological studies. Their use of REDCap has streamlined data management processes and improved research efficiency, as documented in institutional reports [5].

At the University of Nebraska Medical Center (UNMC), REDCap has been utilized for various academic and clinical research projects. The comprehensive guide provided by UNMC highlights REDCap's secure, web-based interface, customizable

user rights, and seamless data export capabilities, making it an ideal tool for managing complex research data efficiently [6].

Imperial College London has implemented REDCap to support non-commercial research projects. Although the software is not validated for Good Clinical Practice (GCP) standards, it provides a secure environment for data collection and management, allowing research groups to design and build electronic case report forms (eCRFs) for their specific needs [7].

Following these examples, but with a focus in education, the Universidad Europea de Madrid designed a project for REDCap implementation to support institutional clinical and translational research but also to be integrated with student education. The project aims to integrate REDCap into the university's educational framework, ensuring that students and researchers develop essential skills in data management and simulation. This approach aligns with the broader institutional goal of preparing researchers to navigate the complexities of modern data environments and leverage AI-driven insights effectively.

The objectives of the REDCap implementation project include joining the network of universities originally established by Vanderbilt University, facilitating the use of REDCap for research data capture by students and researchers at Universidad Europea de Madrid, and training faculty and students in the effective use of REDCap. The project scope encompasses the implementation of REDCap as the standard tool for research protocols and the training of faculty and students in both basic and intermediate use of the platform.

Subjects and methods

Study design

The study was designed to evaluate the integration and impact of REDCap (Research Electronic Data Capture) within an academic institution. This study adopts a mixed-methods approach, integrating quantitative and qualitative analysis to evaluate the integration and impact of REDCap (Research Electronic Data Capture) within the Faculty of Biomedical Sciences and Health at the Universidad Europea de Madrid.

The research was organized into three distinct phases: network membership acquisition, implementation and infrastructure setup, and training and capacity building.

Implementation

The initial phase involved securing membership in the REDCap network, which is essential for accessing the tool. This network, comprising over 7,000 institutions worldwide, provides collaborative support and regular updates. The application process required submitting a formal request to the managing institution, with the acceptance response typically taking several months. Detailed information about the network and its benefits is accessible through its official website [1].

In the subsequent phase, the focus shifted to the technical and infrastructural setup necessary for REDCap deployment. Key activities included:

- *Stakeholder identification.* Determining the roles and responsibilities of academic staff, researchers, technical personnel, and students involved in using REDCap.
- *Technological infrastructure.* Setting up a web server capable of running PHP, as REDCap relies on this programming language. A MySQL or PostgreSQL database was also established to store research data. Security measures included implementing an SSL certificate to ensure secure data transmission. To support ongoing operations, a technical support team was appointed, and a service contract was established with a provider for software maintenance and technical support.

The questionnaire was implemented in the form of a survey distributed to users through the REDCap application itself. Additionally, it was promoted through digital channels among registered users on the platform, ensuring adequate and representative reach. The statements included in the questionnaire were as follows:

- *Overall, I consider REDCap useful for my routine work.*
- *I believe I would need support from a technical person to use REDCap.*
- *I think the various functions of REDCap are well integrated and explained.*
- *I believe REDCap is easy to use with the training received.*
- *I think I would need to learn a lot before being able to use REDCap practically.*
- *Overall, the use of REDCap after the training received has been carried out without complications.*
- *I believe most people working in a biomedical or clinical research environment should quickly learn to use REDCap.*
- *I feel confident using REDCap, even if I have no prior experience, after the training received.*
- *Open text field (for additional comments).*
- *Responses were evaluated on a Likert scale from 1 to 5, with 1 representing 'Strongly disagree' and 5 'Strongly agree.'*

Training and capacity building

The final phase involved developing and delivering a training program to ensure effective use of REDCap. A user manual was created, and an asynchronous online course was designed by an expert to provide comprehensive instruction on utilizing the tool. This training was aimed at equipping all users—academic staff, researchers, and students—with the skills necessary for proficient use of REDCap in managing research data and simulations.

Questionnaire elaboration

To measure the current satisfaction of users with the REDCap application, an adapted version of the System Usability Scale (SUS) was utilized. This questionnaire has been previously validated and used to assess the perceived usability of technologies applied to education, as detailed previously by Sevilla-Gonzalez et al and Vlachogianni and Tselios [8,9]. The adaptation of the SUS for REDCap allows for an accurate assessment of user satisfaction and usability with this specific platform.

Results

Description of the intervention

As of July 2024, the European University comprises a total of 127 individuals, including 79 faculty members and 48 postgraduate students. In response to the need for enhanced research data management, an introductory course on utilizing REDCap has been developed, offering 1.5 ECTS credits. This course is designed to equip participants with a thorough understanding of the REDCap interface, data collection methodologies, and essential functions of the platform. Additionally, it addresses how to customize REDCap for specific research applications, including the creation of surveys tailored to research objectives.

The pilot study for this course was conducted exclusively with the 48 postgraduate students invited to participate in the training, of whom 28 successfully completed the program. Following their training, participants were invited to complete a questionnaire aimed at evaluating their experiences and outcomes. However, the survey yielded responses

Table. User feedback on REDCap usability and training effectiveness.

Variable (question)	Category	Average score	Standard deviation	Interpretation
[redcap1]: Overall, I consider REDCap useful for my routine work.	Overall usefulness of REDCap	4.1	0.81	Generally high perceived usefulness
[redcap2]: I believe I would need support from a technical person to use REDCap.	Need for technical support	3.2	1.14	Moderate concerns about needing assistance
[redcap3]: I think the various functions of REDCap are well integrated and explained.	Integration and explanation of functions	4.4	0.73	Strong agreement on function integration
[redcap4]: I believe REDCap is easy to use with the training received.	Ease of Use Post-Training	4.1	0.82	Generally perceived as easy to use
[redcap5]: I think I would need to learn a lot before being able to use REDCap practically.	Learning curve before practical use	2.9	1.03	Concerns regarding the learning curve
[redcap6]: Overall, the use of REDCap after the training received has been carried out without complications.	General experience using REDCap post-training	4.0	0.76	Positive overall experience reported
[redcap7]: I believe most people working in a biomedical or clinical research environment should quickly learn to use REDCap.	Importance for biomedical/clinical researchers	4.4	0.73	Strong belief in its importance for researchers
[redcap8]: I feel confident using REDCap, even if I have no prior experience, after the training received.	Confidence using REDCap without prior experience	4.1	0.81	High confidence level among users

from only 14 students, resulting in an approximate response rate of 50%. This response rate provides a preliminary insight into the participants' perceptions of the course and the REDCap platform.

User feedback on REDCap usability

User feedback regarding the REDCap application through the eight-item questionnaire is presented in the table. Responders indicate that users generally perceive REDCap as highly useful for their routine work, with an average score of 4.1 –standard deviation (SD) = 0.81– for the statement 'Overall, I consider REDCap useful for my routine work.' Notably, there is strong agreement on the integration and explanation of functions, yielding an average score of 4.4 (SD = 0.73). Users reported a generally positive experience post-training, as indicated by an average score of 4.0 (SD = 0.76) for 'Overall, the use of REDCap after the training received has been carried out without complications.' However, concerns about the learning curve are reflected in the

lower average score of 2.9 (SD = 1.03) for the statement 'I think I would need to learn a lot before being able to use REDCap practically.' Additionally, moderate concerns regarding the need for technical support are highlighted by an average score of 3.2 (SD = 1.14).

Qualitative

Respondents expressed appreciation for the comprehensive and didactic nature of the training, highlighting its practical relevance to their work in academic and research environments. Some participants noted that while they found the platform intuitive, they felt additional support or resources would enhance their ability to navigate more complex features effectively. Others mentioned a desire for ongoing assistance, suggesting that continued mentorship or access to technical support could facilitate a smoother transition to independent use of the software.

Discussion

Organizational support, infrastructure development, and training programs were crucial to overcoming resistance and promoting widespread use of REDCap. Tiffin et al., which provided a comprehensive case study of REDCap's adoption at the University of the Witwatersrand Faculty of Health Sciences (Wits FHS) in South Africa [10]. This pilot study at the Universidad Europea de Madrid aimed at assessing user feedback on the REDCap platform following a specialized training course yields important insights into both the perceived usability and the effectiveness of the intervention. Participants reported a generally high level of satisfaction with the platform, as reflected in an average score of 4.1 for its overall usefulness. This finding aligns with existing literature that emphasizes the utility of technology in enhancing research productivity and efficiency [9]. Users recognize REDCap as a valuable tool for their routine academic and research tasks, indicating that effective training can significantly improve user perceptions and adoption of new technologies.

Notably, the strong average score of 4.4 regarding the integration and explanation of REDCap's functions suggests that users find the software intuitive and well-structured. This outcome resonates with previous studies highlighting the importance of user-friendly interfaces in promoting technology adoption and satisfaction [11]. The high score in

this domain indicates that the training program successfully equipped users with the knowledge to navigate the platform's capabilities effectively, which is crucial for successful implementation in research settings.

However, the feedback also highlights significant concerns about the learning curve, as evidenced by an average score of 2.9 for the statement regarding the necessity of extensive learning before practical use. This finding points to a potential barrier that could hinder user engagement and satisfaction. Research has shown that perceived ease of use is a critical factor influencing user acceptance of technology [11]. Similarly, a score of 3.2 related to the need for technical support reveals that while users may feel competent, they still recognize the necessity for additional assistance as they delve deeper into the platform's functionalities. This need for ongoing support is consistent with the literature, which emphasizes the importance of providing users with adequate resources and assistance as they transition from training to independent use.

The qualitative feedback enriches these findings by providing context to the quantitative data. Participants expressed appreciation for the course's comprehensive approach but also indicated a desire for ongoing support and resources. This is particularly relevant in educational settings, where users often encounter various challenges as they attempt to apply their newly acquired skills in real-world scenarios [12]. The emphasis on the need for continued mentorship and access to technical support highlights a critical area for program enhancement. Ongoing mentorship can facilitate a smoother transition to independent software use, improving overall user satisfaction and reducing frustration during the learning process [13].

These insights suggest that while the initial training effectively introduces users to REDCap, there is a clear need for a more robust support system. Future iterations of the training program should consider incorporating a blended learning approach, combining initial face-to-face instruction with online resources, tutorials, and a support community. This approach is supported by research indicating that blended learning can enhance user confidence and facilitate a smoother transition to independent usage of the software [14,15].

Conclusions

While our pilot study demonstrates the positive reception of REDCap and the training program be-

tween our students, it also underscores the necessity of ongoing support structures. By addressing these needs, the European University can optimize the use of REDCap among its faculty and students, ultimately enhancing research efficiency and outcomes in academic settings. The findings contribute to a growing body of literature advocating for comprehensive training and support systems in educational technologies, emphasizing that user satisfaction is contingent upon both initial training and continued resources.

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