04

PROPOSAL

FOR THE DEVELOPMENT OF INVESTIGATIVE SKILLS THROUGH THE USE OF DIGITAL TOOLS: MENDELEY AND OBSIDIAN

PROPUESTA PARA EL DESARROLLO DE HABILIDADES INVESTIGATIVAS MEDIANTE EL USO DE HERRAMIENTAS DIGITALES: MENDELEY Y OBSIDIAN

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ABSTRACT

In today's digital age, access to information and the ability to conduct research effectively are essential skills for lifelong success. Although these are usually addressed formally in the context of higher education, they are not always promoted in a systematic and didactic manner with an approach aimed at solving social problems, either due to ignorance or rejection of the transformation of traditional practices. Given this concern, this work aims to present an innovative educational proposal, aimed at developing research skills in higher education students through the integration of two digital tools in the teaching-learning process: Mendeley and Obsidian. This proposal seeks to strengthen the research training that students receive throughout their educational career, promoting a practical and applied approach to these skills. Furthermore, it is based on the premise that the use of digital tools not only facilitates and enriches the research process, but also prepares students holistically for a constantly evolving world increasingly oriented towards digitalization, contributing to the development of more competent and committed individuals in addressing global social problems.

Keywords:

Research, ICT, training.

RESUMEN

En la era digital actual, el acceso a la información y la capacidad para realizar investigaciones de manera efectiva son habilidades esenciales para el éxito a lo largo de toda la vida. Aunque estas suelen ser abordadas de manera formal en el contexto de la educación superior, no siempre se promueven de manera sistemática y didáctica con un enfoque dirigido hacia la resolución de problemáticas sociales, ya sea por desconocimiento o rechazo a la transformación de las prácticas tradicionales. Ante esta inquietud, este trabajo tiene como objetivo presentar una propuesta educativa innovadora, destinada al desarrollo de habilidades investigativas en estudiantes de educación superior a través de la integración de dos herramientas digitales en el proceso de enseñanza-aprendizaje: Mendeley y Obsidian. Dicha propuesta busca fortalecer la formación para la investigación que los estudiantes reciben a lo largo de su trayectoria educativa, fomentando un enfoque práctico y aplicado de dichas habilidades. Además, se basa en la premisa de que el uso de herramientas digitales no solo facilita y enriquece el proceso de investigación, sino que también prepara a los estudiantes de manera holística para un mundo en constante evolución cada vez más orientado hacia la digitalización, contribuyendo al desarrollo de individuos más competentes y comprometidos en el abordaje de problemáticas sociales globales.

Palabras clave:

Investigación, TIC, formación.

INTRODUCTION

Today, society is immersed in a transformation driven by the constant advance of Information and Communication Technologies (ICT). These have become essential elements of everyday life, generating unprecedented changes in the way people communicate, work, study, access information and understand the environment around them (United Nations Educational, Scientific and Cultural Organization, 2022). This trend has been accentuated by the COVID-19 pandemic, acting as a catalyst in the pace of change and digitization globally (United Nations Educational, Scientific and Cultural Organization, 2020; *Monterrey Institute of Technology and Higher Education*, 2023).

As society has evolved and professional and labor demands have changed, research, once considered an activity exclusive to experienced academics, has become a part of student practice. Research has become more important in the last decades, becoming one of the essential tasks of Higher Education Institutions (HEI). This has resulted in paying attention and strengthening the training processes regarding scientific research of students, both undergraduate and graduate, enriching their learning, allowing the acquisition and enhancement of research skills.

In this situation, HEIs acquire an elemental role in achieving the Sustainable Development Goals (SDGs) established in the 2030 Agenda of the United Nations. Their responsibility transcends the simple imparting of knowledge, and they must be trained to guide students in their formation as active and committed citizens capable of addressing the challenges of the 21st century and contributing significantly to sustainable development (Organization of Ibero-American States for Education, Science and Culture, 2022). This implies, to a certain extent, the incorporation and use of ICTs in educational processes, making them more dynamic, participatory and personalized, marking a turning point in the way research-related tasks are carried out.

It does not only entail the use of tools in the classroom or the preparation of students for their future in the working world, but also facilitates didactic transformation, by promoting deeper and more meaningful learning, providing them with the necessary tools to explore knowledge critically and face the challenges of a constantly evolving world, as well as an increasingly digital and globalized society.

DEVELOPMENT

According to Moreno Bayardo (2005), research training is a process that *"involves learning in the field of knowledge, skills, habits, attitudes and values, but the fundamental and integrating core of such learning is the development of research skills."*(p. 527)

At the international level, the development of research skills at the undergraduate level is a topic addressed in various educational researches and, in turn, different meanings. Among the authors who address the term development of research skills are Pérez and López (1999); Moreno (2005); and Machado et al. (2008).

Pérez & López (1999), define research skills as *the "domain of psychic and practical actions that allow the rational regulation of the activity, with the help of the knowledge and habits that the subject possesses to go in search of the problem and its solution by means of scientific research."* (p. 22)

Moreno Bayardo (2005), refers to these as *"a set of skills of diverse nature that begin to develop before the individual has access to systematic training processes for research. Most of them are not developed just to make possible the performance of research tasks, but they have been detected by trainers as skills whose development, in the researcher in training or in functions, is a fundamental contribution to enhance the ability to perform good quality research"*. (p. 527)

While Machado et al. (2008), conceive them as *"the domain of action that is deployed to solve research tasks in the teaching, work and research environment with the resources of the methodology of science"* (p. 164). (p. 164)

The different definitions converge in the fundamental idea that these skills are essential to carry out quality research, but they differ in the perspective from which they approach them. From this, it is identified that research skills are a set of skills that allow addressing research tasks effectively and that are considered essential in the training and development of individuals in different contexts. These skills involve both cognitive and practical aspects and have a versatile application in the professional and personal life of the human being, promoting the ability to solve problems and conduct high quality research.

Likewise, each definition has its own classification of these skills; however, for the purposes of this paper, the Research Skills Profile, developed by Moreno Bayardo et al. (2005), is adopted. It is made up of seven cores that group skills of the same nature, as follows (Table 1):

Table 1. Research Skills Profile proposed by Moreno Bayardo et al. (2005).

Research Skills Profile	
Core A: Perceptual skills	• Sensitivity to phenomena. • Intuition. • Breadth of perception. • Selective perception.
Core B: Instrumental skills	• Formally master language: reading, writing, listening, speaking. • Master basic cognitive operations: inference (induction, deduction, abduction), analysis, synthesis, interpretation. • Know how to observe. • Knowing how to ask questions.
Core C: Thinking skills	• To think logically. • To think reflectively. • To think autonomously. • To think flexibly.
Core D: Conceptual construction skills	• To appropriate and reconstruct the ideas of others. • To generate ideas. • To organize, expose and defend ideas logically. • To problematize. • To unravel and elaborate (construct) systematically an object of study. • To perform creative conceptual synthesis.
Core E: Methodological construction skills	• To construct the research method. • To make the method of knowledge construction relevant. • To construct observables. • To design procedures and instruments to search, recover and/or generate information. • To manage and/or design techniques for the organization, systematization and analysis of information.
Core F: Skills for social construction of knowledge	• To work in groups. • To socialize the process of knowledge construction. • To socialize knowledge. • To communicate.
Core G: Metacognitive skills	• To objectivize personal involvement with the object of knowledge. • To self-regulate cognitive processes in action during knowledge generation. • To self-question the pertinence of intentional actions to knowledge generation. • To re-evaluate the approaches to an object of study. • To self-evaluate the consistency and validity of the products generated in the research.

Source: Moreno Bayardo et al. (2005).

In this proposal for the development of research skills, the choice of digital tools is a critical component. Therefore, it is based on the integration of two: Mendeley and Obsidian. The selection of these tools is based on their ability to enhance and enrich the research process, as well as their versatility to adapt to different levels of competence.

By incorporating them, we not only seek to improve the effectiveness of investigations, but also to foster interactive, applied and problem-oriented learning. Both tools that contribute significantly to research training are described below.

Mendeley

A reference management and collaboration tool designed specifically for academics, researchers and students. Developed by Jan Reichelt, Victor Henning and Paul Foeckler, launched its first beta version in August 2008 and being acquired by Elsevier in 2013. Mendeley combines management with academic social networking features, making it a comprehensive tool for academic research. Its main goal is to simplify and improve the way users manage, organize, and collaborate on research, while facilitating access to scholarly resources and the generation of citations and references (Elsevier, 2023). To download this application, you can access this link: https://www.mendeley.com/.

This tool has the following functions that help students to be more efficient and effective in their academic research:

1. *Reference management*: it allows students to organize and manage their references efficiently. They can import them from academic databases, books and articles, and then organize them in a personal library. This facilitates the search and retrieval of relevant information for their research.
2. *Automatic citation and reference generation*: facilitates the creation of citations and references in various publication styles, such as APA, MLA, Chicago, among others. This saves students time and ensures that their work is correctly cited.
3. *Collaboration and group work*: they can work on research projects by sharing their libraries, collaborate on writing papers, and conduct joint reviews. This encourages teamwork and collaboration in academic research.
4. *Annotations and highlighting*: allows students to annotate and underline PDF documents, making it easier to review and study research materials. They can add notes, comments, and tags to better organize information.
5. *Cloud sync*: offers the ability to sync library and annotations to the cloud, allowing students to access their work from any device with Internet access. This is especially useful for those who wish to access their research resources on the go.
6. *Information search*: it also acts as a search platform, as they can explore and discover new articles and topics related to their areas of interest through the Mendeley network, allowing them to stay up to date in their field.
7. *Analysis and statistical tools*: Mendeley provides tools for performing citation analysis and tracking the influence of research papers. This can be valuable for students who want to better understand the impact of research in their field.
8. *Training and educational resources:* Mendeley offers a variety of educational resources, tutorials and webinars to help students learn how to use the tool effectively. It also provides an online community where students can ask questions and share tips and experiences.

Table 2 shows how the different functions of Mendeley are aligned with various research skills cores proposed by Moreno Bayardo et al. (2005), to be developed within research training. This allows a better understanding of how Mendeley can enhance not only the efficiency in the organization of academic information, but also the comprehensive development of skills.

In particular, the advantages that the Mendeley program offers for the development of research skills are the following: it promotes sensitivity to phenomena by helping users to identify relevant information and explore new sources. It facilitates language proficiency by automatically generating citations and references in a variety of styles. In addition, it fosters critical and logical thinking by enabling the evaluation of information and the organization of arguments.

The ability to annotate and highlight PDF documents supports reflective thinking and autonomy in study. It also contributes to conceptual construction by facilitating the appropriation of ideas from others and the generation of new perspectives. Collaboration and group work are boosted by the ability to share resources, thus fostering the social construction of knowledge.

Table 2. Functions of the Mendeley program in the development of research skills.

Functions	Investigative skills				
	Perceptual	Instrumental	Thinking	Conceptual construction	Of social construction
Reference management			Logical thinking.	To generate ideas.	
Automatic generation of citations and references		Formal command of language: writing.		Appropriating and reconstructing the ideas of others.	

Collaboration and group work		Formal command of language: listening and speaking.	To think critically.	To organize logically, present and defend ideas.	To work in groups.
					To socialize the process of knowledge construction.
					Communicate
Annotations and highlights		To formally master the language: reading and writing.	To think critically.	Appropriate and reconstruct the ideas of others.	
			Think reflectively.	Generate ideas.	
		Analysis, synthesis and interpretation.	Thinking autonomously.	Creative conceptual synthesis.	
Synchronization in the cloud.					Working in groups.
					Communicating.
Searching for information.	Breadth of perception.	Formal language proficiency: reading.	To think logically.	Generate ideas.	
	Sensitivity to phenomena.	Analysis and interpretation.	Thinking autonomously.	To problematize.	
		Knowing how to ask questions.			
Tools of analysis and statistics	Breadth of perception.	Analysis and interpretation.			
Training and educational resources		Formal command of the language.	To make thinking more flexible.		To socialize knowledge.
					To communicate.

However, like any program, it presents a series of limitations that must be considered by users for their research and document management needs. These do not disqualify it, but they are essential to understand its scope and possible conditions for its use. Mendeley presents online dependency, since it requires an Internet connection to access the libraries and documents stored in the account created. In addition, the free version has restrictions on the storage and synchronization of documents in PDF format.

It does not address key aspects of research methodology, such as design of experiments, data collection, sample selection or validation of results. In some cases, it does not adequately extract information from the documents such as title, author(s) name(s), year of publication, among others, which requires manual corrections, making it a tedious and time-consuming activity. Likewise, it is not an open source tool, which means that it cannot be modified, customized or adapted according to specific research needs. Although it allows collaboration, its ability to do so in real time is limited compared to specific groupware tools.

Obsidian

Obsidian is a knowledge management and note-taking tool focused on networking ideas and creating a solid personal knowledge base. At the same time, it allows creating and organizing notes, having the ability to establish bidirectional links, which facilitates the links between ideas, concepts and topics. Likewise, it contributes to the creation of a knowledge network that helps users to explore and deepen their areas of interest, being of great help to students in various ways:

1. *Information organization*: allows you to organize your research notes efficiently. They can create a structured personal knowledge base, linking related notes and creating a network of information that facilitates navigation and searching.
2. *Connections and relationships*: ability to create bidirectional links between notes. This encourages the creation of connections between ideas, concepts and theories, which can help students develop a deeper understanding of their areas of study and identify meaningful relationships in their research.
3. *Source and reference tracking*: can be used to record and link research sources. This allows for tracking relevant citations and references, which is essential for academic integrity and accurate referencing.

4. *Writing process and drafts*: this is a tool for the writing process. Students can create drafts of research papers, theses or essays on the platform and link them to their reference notes. This facilitates revision and organization of ideas before final writing.
5. *Collaboration and group work*: although Obsidian is primarily a personal tool, students can collaborate on research projects by sharing their notes and knowledge bases. This is useful for teamwork on academic projects.
6. *Flexibility and customization*: it is highly customizable and students can tailor their workspace to fit their specific needs, which may include creating templates for different types of notes or customizing views and panels.
7. *Security and privacy*: Obsidian allows students to maintain full control over their data, which can be a concern in academic research. Users can choose to store their notes on their own devices or on cloud storage services of their choice.
8. *Long-term learning*: promotes long-term learning by facilitating continuous review and expansion of knowledge as students progress in their research and studies.

To download this application, you can access this link: https://obsidian.md/. As with the previous application, Table 3 gives an overview of the Obsidian tool in the development of different research skills, with the purpose of improving their ability to organize and access their knowledge more effectively.

This program fosters the development of research skills to the extent that it promotes the ability to observe and organize information efficiently, which is fundamental for the research process. In addition, it allows students to establish connections and relationships between concepts, developing their ability to think critically and logically. It also supports the tracking of sources and references, which contributes to the formal mastery of language and critical thinking when evaluating the quality of sources.

It is also a tool for the writing and revision process, which helps students organize and develop their ideas effectively. It facilitates collaboration in research projects and promotes flexibility by adapting to the specific needs of each user. In addition, it ensures data security and privacy, which is essential in academic research.

Table 3. The functions of the Obsidian program in the development of research skills.

Functions	Research skills				
	Instrumental	Thinking	Conceptual Construction	Social Construction	Metacognitive
Organization of information		Formal command of language.	Logical thinking.	Self-questioning the relevance of intentional actions to knowledge generation.	Self-regulate cognitive processes in action during knowledge generation..
		Inference and analysis.	Reflective thinking.		
			To make thinking more flexible.		
Connections and relationships	Inference and analysis.	Think logically.	Generate ideas.	Re-evaluate approaches to an object of study.	Objectify personal involvement with the object of knowledge.
			Problematize.		
			Unravel and semantically elaborate an object of study.		
			Perform creative conceptual synthesis.		
Tracking sources and references			Appropriating and reconstructing the ideas of others.		

Writing process and drafts	Formally mastering the language: reading and writing.	Think critically.	Appropriating and reconstructing the ideas of others.			Re-evaluate approaches to an object of study.
	Analysis, synthesis and interpretation.	Reflective thinking.	Generate ideas.			
		Think autonomously.	Perform creative conceptual synthesis.			
Collaboration and group work.	Formal command of language: listening and speaking.	Think critically.	Organize logically, expose and defend ideas.	Work in groups.		
				Socialize the process of knowledge construction.		
				Communicate		
Flexibility and personalization		Make thinking flexible.			Self-regulate cognitive processes in action during knowledge generation.	
Long-term learning					Objective personal involvement with the object of knowledge.	
					Self-regulate cognitive processes in action during knowledge generation.	
					Self-evaluate the consistency and validity of the products generated in the research.	

It promotes long-term learning by facilitating the continuous review of knowledge and the development of a deeper understanding of research topics, making Obsidian a comprehensive tool that strengthens research skills. However, it is not without limitations that must be taken into account.

For new users, editing Markdown files and creating bidirectional connections between notes can be complex, so understanding the system and working efficiently takes time. In terms of mobile device compatibility, it is often less fluid than the desktop version, affecting portability and in turn productivity.

Although it allows group work, it does not have real-time collaboration functionality, which is a drawback for those who need to share and edit notes simultaneously with other people. It allows exporting notes, but the range of formats is limited compared to other tools. Finally, it does not include the ability to import and manage references, nor to generate citations.

CONCLUSIONS

The use of digital tools plays an important role in the development of research skills in higher education students. These tools provide access to a wealth of resources, encourage self-directed learning, improve information organization and management, and facilitate collaboration and communication. In an increasingly digitized world, they are not only essential for academic and professional success, but also for lifelong learning. Therefore, it is crucial that Higher Education Institutions train, encourage their use, teach and above all guide students to take full advantage of these valuable tools in the research process.

Together, the use of Mendeley and Obsidian offer an enriching opportunity in the research training of both undergraduate and graduate students. While Mendeley focuses on reference management and organization of scholarly sources, Obsidian encourages synthesis, critical thinking and knowledge construction through knowledge management and interconnected notes.

Although both have limitations, they are different due to their particular approaches and it is essential to be aware of them when incorporating them into the teaching and learning process. By using them in a complementary manner, students can improve their ability to conduct quality research. They can also be aided by other applications that address those facets of the research process that have been omitted.

Ultimately, omitting the use of these tools implies a more complex and time-consuming handling of information, which restricts students' ability to conduct in-depth and comprehensive research that contributes to the achievement of the

SDGs and to addressing the challenges of 21st century societies posed in the 2030 Agenda.

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