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Proposal for a framework of procedures to outline scientific research in visual and collaborative format

Proposta de um quadro de procedimentos para delinear pesquisas científicas em formato visual e colaborativo

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Abstract

Introduction: Various methodological procedures underpin the development of scientific research through a range of methods and methodologies, typically expressed in text. However, the utilization of visual tools in scientific research methodologies presents an opportunity to expand the boundaries of knowledge, enhance communication, and simplify comprehension and collaboration among involved researchers. In this vein, this study aims to propose a framework for visual and collaborative delineation of scientific research. **Method:** The research approach is qualitative, with a case study focusing on the use of graphic facilitation in the collaborative management of innovation projects within Higher Education Institutions. The study is divided into three phases: presentation of the practical case, proposal of the framework, and results and discussion. **Results:** The incorporation of visual resources, involving graphic facilitation and the 5W2H method, into the framework for outlining scientific research serves as a link for visual and interactive sharing and collaboration. Research participants have the opportunity to view project information. The **conclusions** indicate that the collaborative use of visual resources in scientific research development facilitates understanding and connections with the research topic, problem, objectives, and methodological assumptions. It also fosters an environment that encourages creativity and collaboration among researchers.

Keywords: 5W2H; Graphic facilitation; Research methodology; Scientific research.

Resumo

Introdução: *Diferentes procedimentos metodológicos suportam o desenvolvimento de pesquisas científicas por meio de uma série de métodos e metodologias, os quais normalmente são expressos textualmente. Entretanto, o uso de artifícios visuais aplicados nas metodologias de pesquisas científicas surge como oportunidade para ampliar fronteiras do conhecimento, articular a comunicação e facilitar o entendimento e a colaboração entre os pesquisadores envolvidos. Neste sentido, este estudo busca propor um quadro de procedimentos para delinear pesquisas científicas em formato visual e colaborativo.* ***Método:*** *a abordagem da pesquisa é de natureza qualitativa, com estudo de caso sobre o uso da facilitação gráfica na gestão colaborativa de projetos de inovação em Instituições de Ensino Superior, sendo dividida em três fases: apresentação do caso prático; proposta do quadro; e resultados e discussão.* ***Resultados:*** *o uso de recursos visuais, por meio da facilitação gráfica e do método 5W2H, empregados ao quadro de procedimentos para delinear pesquisas científicas atua como um elo para o compartilhamento e colaboração, de forma visual e interativa, na qual os participantes da pesquisa têm a possibilidade de ver as informações dos projetos. As* ***conclusões*** *apontam que o uso de recursos visuais dedicados de forma colaborativa ao desenvolvimento de pesquisas científicas faculta a compreensão e conexões com o tema de pesquisa, problema, objetivos e pressupostos metodológicos, além de promover ambiente com estímulos a criatividade e colaboração entre pesquisadores.*

Palavras-chave: *5W2H; Facilitação gráfica; Metodologia de pesquisa; Pesquisa científica.*

INTRODUCTION

The enduring quest for knowledge spurs scientific inquiry in various spheres. However, different domains of knowledge require distinct research models, necessitating specialized approaches aligned with the research subject. According to Cooper and Schindler (2003), conducting research involves comprehending and evaluating information quality, discerning research reliability and robustness, understanding the research's methodological approach, and grasping the applicable scientific method. This approach is the path to knowledge accumulation, encompassing both intellectual and non-intellectual information, pertaining to theoretical or practical concepts within a given subject, whether scientific or not (Oliveira Netto, 2006). Furthermore, it is the researcher's responsibility to select the research format that aligns with their theoretical underpinnings, the research problem driving their investigation, and their epistemological assumptions (Vergara, 2012, p. 2).

When conducting scientific investigations, there is no single, universal research model. Instead, there exist various "strategies of scientific investigation with general and specific techniques, and specialized methods for different techniques and sciences" (Martins & Theóphilo, 2016, p. 35). Different methodological procedures support scientific research development through a range of methods and methodologies, typically expressed

in text. As the authors state, "the purpose of methodology is to refine the procedures and criteria used in research. In contrast, method is the path to reach a specific goal or objective" (Martins & Theóphilo, 2016, p. 35). Richardson, Peres, Wanderley, Corria, and Peres (2012, p. 22) complements this by explaining that "the scientific method is the route of science to achieve an objective. Methodology represents the rules established for the scientific method."

Therefore, considering method and methodology, the application of visual resources in scientific research presents an opportunity to expand the frontiers of knowledge, facilitate communication, and promote understanding and collaboration among involved researchers (Ribeiro, 2020). The visual language used in scientific research acts as a technique to facilitate the comprehension of specific topics or issues with a view to proposing solutions. "Visualizing a problem helps to better understand and focus more precisely on its solution" (Ball, 1998, p. 01). Additionally, collaboration (Branco, Vinha Junior, & Leite, 2016) fosters an environment conducive to project development, creativity support, and cooperative stimulation. Under the perspective of collaboration in scientific research, it encourages "researchers to engage in new dialogues with their research subjects, inviting them to become co-constructors of the investigation, creating spaces of inclusion and diversity within scientific studies" (Souza, 2021, p. 01).

Given these arguments, this article aims to propose a framework for visual and collaborative delineation of scientific research. This framework combines scientific research, graphic facilitation, and the 5W2H method. Graphic facilitation employs visual language to express ideas and contexts through metaphors and drawings (Ribeiro, 2020). Meanwhile, the 5W2H method is a tool that encompasses an action plan and activity mapping for the project, emphasizing the need for the utmost clarity (Klock, Gasparini, & Pimenta, 2016).

This is an exploratory study and does not seek to serve as a standard for other research endeavors. Nevertheless, the framework was employed as a means to delineate the research case: the contribution of graphic facilitation to the collaborative management of innovation projects in Higher Education Institutions.

THEORETICAL FRAMEWORK

Scientific knowledge, as opposed to other types of knowledge, stands out for its "foundations and methodologies to be followed, based on classified information subjected to verification, providing plausible explanations for the object or event in question" (Prodanov & Freitas, 2013, p. 22). It relies on logical and rational aspects, is expandable and replicable. Moreover, it can be verified, with its conclusions derived from research and critical analysis, enabling predictions regarding other similar research (Martins & Theóphilo, 2016). Bufrem (2011) adds that research is an intentional action that illuminates "roads and paths." According to the author, "the recognition of these paths is necessary, a goal that justifies the reliance on the testimony of those we journey with and from whom we draw knowledge, seeking to theoretically ground our experiences" (Bufrem, 2011, p. 05).

In a broader sense, scientific knowledge results from scientific research, which is understood as the means to obtain answers to questions posed for investigation. According to Prodanov and Freitas (2013, p. 43), scientific research is focused on conducting a "planned study, with the method of approaching the problem being what characterizes the scientific aspect of the investigation. Its purpose is to discover answers to questions through the application of the scientific method." Marconi and Lakatos (2021) emphasize that scientific research serves not only the critical development of reports and empirical facts derived from data collection but also the "correlation of research with the theoretical framework, choosing a theoretical model to serve as the basis for interpreting the meaning of data and facts collected" (Marconi & Lakatos, 2021, p. 145). Bufrem (2012) highlights the importance of a careful selection of relevant components to address the research questions, considering that assigning value is a complex task that "requires criteria related to the research problem, object, objectives, and methods" (Bufrem, 2012, p. 08).

However, regarding scientific research, Richardson et al. (2012, p. 16) points out that there is no perfect research because "research is a human product, and its producers are fallible." The author advises paying attention to an understanding of reality, central methodological concepts, and research techniques. According to Bufrem (2012), the intentional nature of research can be guided by the following criteria: the research problem must involve a difficulty, concern, or need that is reflected in scientific research; it should be relevant, and its resolution should be meaningful and feasible; and, regarding originality, "either in relation to its object or in relation to the way this object will be researched, as a problem can be relevant, but not necessarily original, and vice versa" (Bufrem, 2011, p. 06).

However, in the context of scientific research, Marconi and Lakatos (2021) emphasize that nothing occurs by chance; everything should be planned in the research project, from choosing the topic, defining the research question, objectives, method, data collection, data analysis and interpretation, to the final report. Therefore, the researcher, in the face of their research, "must answer the classic questions: What to research? Why research? For what? For whom? Where? How? With what? When? How much will it cost?" (Marconi & Lakatos, 2021, p. 112).

To support knowledge development through scientific research, this study addresses two other concepts: graphic facilitation and the 5W2H method. Together, these concepts form the proposal of a framework for the visual and collaborative delineation of scientific research.

Through collaboration, it is possible to obtain information and collect data for research development, as well as find cooperative support in interactions and the continuous exchange of knowledge (Ribeiro, 2020, p. 164). According to Vanz and Stumpf (2010), collaboration among researchers occurs when two or more scientists work together on a research project, with interaction facilitating research activities and sharing the meaning of these activities, "related to a larger shared goal between two or more scientists" (Vanz & Stumpf, 2010, p. 44). Thus, the authors emphasize that the purpose of collaboration among researchers is to work together to achieve collective goals, in order to produce new scientific knowledge (Vanz & Stumpf, 2010).

Collaboration involves people interested in research working together for the benefit of all. According to Souza (2021, p. 17), collaboration among researchers is a space for co-creation, inclusion, and diversity within the research environment, representing a "process that involves trust, dialogue, exchange, respect, democracy, ethics, and, above all, caring for the human being."

According to Odelius and Ono (2019), collaboration largely occurs in research groups. The authors emphasize that collaboration occurs jointly with the aim of "sharing financial, human, material, or knowledge resources to obtain results related to increasing scientific production, advancing knowledge, developing skills, and stimulating learning" (Odelius & Ono, 2019, p. 104). Koné et al. (2000) highlight the importance of collaboration among researchers in the development of research methodologies and expectations in academic communities.

Vanz and Stumpf (2010) point out that one of the primary reasons for collaboration is the interaction among researchers from diverse fields of knowledge. Furthermore, the ease of data flow, information exchange, idea sharing, and knowledge transfer plays a significant role. According to Oliveira (2018), conducting research within networks of researchers is an advantageous option as it helps in achieving goals related to scientific growth among the groups of involved scientists. "Working within research networks provides shared learning, new research opportunities, the establishment of new projects, joint fund applications, and technology transfer" (Oliveira, 2018, p. 09).

Graphic facilitation, as described by Ribeiro (2020), encompasses, at its core, practices and principles related to the application of creative visual language resources in the form of visual messages to help individuals literally see information. Visual language begins with the generation of images or visual modes with the purpose of expressing ideas or messages because it assumes that, just as it's acceptable to verbalize thoughts, knowledge, or ideas, it's also conceivable to visualize these elements through images (Ribeiro, 2020, p. 49). It serves as a means of guiding groups and activities, using visual and interactive metaphors to create meanings related to a specific subject or issue.

According to Sibbet (2013), graphic facilitation employs words and text, symbols, icons, drawings, colors, and figures to record and express information, thoughts, and ideas. It supports individuals, through visual connections, in learning and understanding complex ideas. Sibbet (2006), Ribeiro (2011), Mullen and Thompson (2013), Espiner and Hartnett (2016), Mendonça (2016), North, Sieberhagen, Leonard, Bonaconsa, and Coetzee (2019). Naves and Reis (2017) add that, being a visual language, graphic facilitation makes it easier to understand complex subjects, themes, and content and encourages visual reflection. Eppler and Pfiste (2019) argue about the benefits of using drawings in visual metaphors as catalysts for dialogue and stimuli for collaboration, helping establish a common focus among people, promote interactivity and engagement, encourage the creation of shared meanings, and "aid in articulating notions or previously implicit beliefs" (Eppler & Pfiste, 2019, p. 7). Additionally, Bertoso, Moraes, and Padovani (2021) emphasize the importance of collaborative visual discussion dynamics as a fundamental element in establishing communication among group members.

The 5W2H method is a practical and visually comprehensible tool that allows for the decomposition and organization of a project for its application as an action plan. According to Klock et al. (2016), the 5W2H method was originally developed at Toyota Motor Corporation's factory as a way to address problems and non-conformities in the extraction of root causes for potential system failures or production issues. According to the authors, the goal of the 5W2H method is not only to identify problems but also to facilitate the implementation of corrective and preventive actions. If the organization removes the cause of the failure, it will avoid the recurrence of the same problems (Klock et al., 2016).

To address these situations, the 5W2H method seeks answers through questions that clarify the problem and the search for corrective and preventive solutions through actions, as described by Lisbôa and Godoy (2012). These questions are "focused on the production process and allow the identification of the most important routines, detecting their problems, and pointing out solutions" (Lisbôa & Godoy, 2012, p. 01). According to Dias, Arlindo, Santos, and Santos (2015), the tool encompasses an action plan and activity mapping of the project, which needs to be developed with utmost clarity. Therefore, the application of the 5W2H method involves responding to seven basic questions: what? who? where? why? when? how? how much? (See Table 1.)

5W2H Method			
5W	What?	O quê?	What action will be executed?
	Who?	Quem?	Who will execute or participate in the action?
	Where?	Onde?	Where will the action be executed?
	When?	Quando?	When will the action be executed?
	Why?	Por quê?	Why will the action be executed?
2H	How?	Como?	How will the action be executed?
	How Much?	Quanto custa?	How much does it cost to carry out the action?

Table 1. 5W2H Method.
Source: Lisbôa and Godoy (2012); Dias et al. (2015); Reis, Silva, Corbellini, and Rabuske (2016)

According to Reis et al. (2016), this management tool allows for describing an action plan with the mapping of not only the activities but also the reasons for their execution, who will perform them, when they will be carried out, and the costs associated with the action. The answers to these questions generate a visual, detailed, and easily understandable action plan for the project.

METHOD

The research approach is qualitative because "truth is not numerically or statistically proven but is established through empirical experimentation, detailed analysis, comprehensiveness, consistency, and logical argumentation of ideas" (Michel, 2009, p. 37). Martins and Theóphilo (2009) further emphasize that one of its main characteristics is the predominance of description. This description encompasses people, reactions, events, situations, and accounts that can, in one way or another, affect the interpretation of the research data. "A small detail can be an essential element for understanding reality" (Martins & Theóphilo, 2009, p. 141).

The research technique employed is the case study because it aims to understand complex phenomena (Yin, 2005) and requires a qualitative perspective. Its goal is to study an analytical unit in-depth and intensively (Martins & Theóphilo, 2009). This research is based on the application of the framework for delineating scientific research in a visual and collaborative format in the practical case: the contribution of graphic facilitation to collaborative project management in Higher Education Institutions. It is divided into three phases: 1. Presentation of the practical case; 2. Proposal of the framework; 3. Results and discussion. See Table 2.

Phases	Description	Activities	Description	Author
Phase 1 Case Presentation	Sources of evidence in the case study	Presentation of the practical case	Present the practical case where the framework was applied, considering the title, research question, general and specific objectives, methodological aspects, the organization studied, level of analysis, unit of analysis, sources of evidence, and data collection instruments.	Ribeiro (2020).
Phase 2 Framework Proposal	Propose a framework for outlining scientific research in a visual and collaborative format	Step 1: Divide the framework	Divide the framework according to the seven questions of the 5W2H method, namely: 1) Who? 2) What? 3) Why? 4) Where? 5) How? 6) When? and 7) How much?	Lisbôa and Godoy (2012), Dias et al. (2015), Reis et al. (2016).
		Step 2: Add graphic facilitation icons	At this stage, graphic icons were added through graphic facilitation to provide visual support and convey the meaning of the 5W2H method questions.	Sibbet (2013), Ribeiro (2020).
		Step 3: Align elements of the methodology with the framework's sections	Direct the elements that constitute scientific research to the related sections of the framework. The 5W2H method questions are integrated with the methodological research procedures.	Oliveira Netto (2006), Vergara (2012), Martins and Theóphilo (2016), Marconi and Lakatos (2021), Richardson et al. (2012).
		Step 4: Experimental model	Demonstrate the framework for outlining scientific research in a visual and collaborative format, which encompasses the sections of the 5W2H method, graphic facilitation figures, and research elements.	Ribeiro (2020).
		Step 5: Framework completion	Provide guidance and reflections on filling out the framework, considering the 5W2H method questions versus the elements that make up scientific research to complete the framework modules.	Ribeiro (2020), Souza (2021).
Phase 3 Results and Discussion	Results Analysis		Ways of Understanding: Scientific Research Graphic Facilitation Collaboration 5W 2H	Koné et al. (2000), Dondis (2007), Vanz and Stumpf (2010), Lisbôa and Godoy (2012), Vergara (2012), Sibbet (2013), Dias et al. (2015), Branco et al. (2016), Reis et al. (2016), Kerzner (2017), Naves and Reis (2017), Drigo and Candiotto (2018), Oliveira (2018), Eppler and Pfiste (2019), Ribeiro (2020), Souza (2021).

Table 2. Research Phases in Detail

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In the next section, the three research phases will be presented, taking into account the presentation of the practical case where the framework was applied, the framework proposal, which introduces the framework for outlining scientific research in a visual and collaborative format, and the results and discussions, with observations related to scientific research, graphic facilitation, collaboration, and the 5W2H method.

RESULTS

The proposal for a framework for outlining scientific research in a visual and collaborative format is divided into three phases: Phase 1 – Presentation of the practical case; Phase 2 - Framework proposal; Phase 3 – Results and discussion.

Phase 1 - Presentation of the Practical Case

Practical Case: The Contribution of Graphic Facilitation in Collaborative Project Management in Higher Education Institutions, presented (Table 3) to the Master's and Doctorate Program in Administration at the Universidade Positivo.

Phase 2 - Proposal for a Visual and Collaborative Framework for Scientific Research Procedures

The framework proposal consists of five stages that describe its sequence of composition, developed based on the concepts of scientific research, the application of graphic facilitation, and the 5W2H method, as follows. In the first stage, the framework was divided in accordance with the seven questions of the 5W2H method or visualization modules, which correspond to: 1) Who? 2) What? 3) Why? 4) Where? 5) How? 6) When? and 7) How much? The framework also indicates the name of the research project (Figure 1).

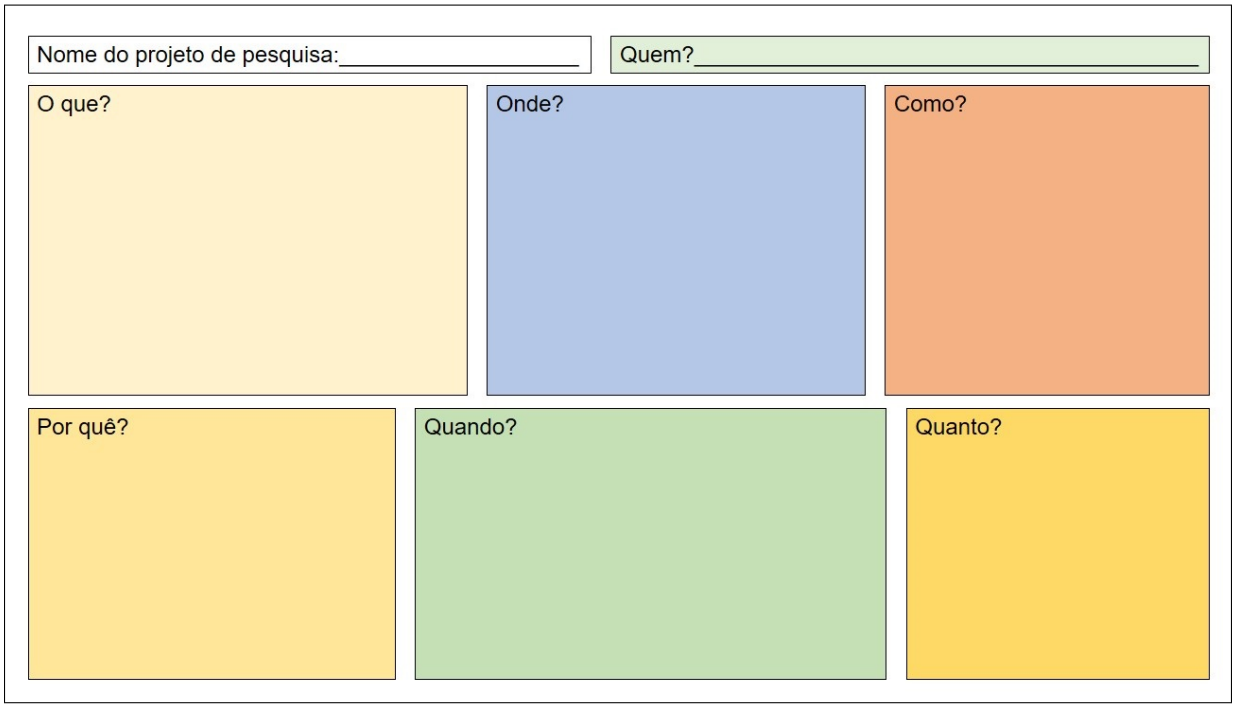

Figure 1. Framework for Delineating Scientific Research - 5W2H

In the second stage (Figure 2), graphic icons were added through graphic facilitation to provide visual support and meaning to the questions. The composition of the icons is based on the 5W2H method questions.

In the third stage (Figure 4), it was necessary to identify and direct the elements that make up scientific research with the related areas of the framework. Thus, the 5W2H method questions were related to the elements of research methodology. Note: it should be emphasized that the 5W2H method questions were rewritten/adapted by the authors to include elements of scientific research.

Title	The Role of Graphic Facilitation in Collaborative Innovation Project Management within Higher Education Institutions
Research Question	How does graphic facilitation enhance collaborative project management for innovation in Higher Education Institutions?
General Objective	To delineate the contribution of graphic facilitation to collaborative project management for innovation within Higher Education Institutions.
Specific Objectives	To trace the progression of scholarly research concerning collaborative project management for innovation through the utilization of graphic facilitation. To identify the challenges and opportunities of collaborative project management for innovation in Higher Education Institutions through the application of graphic facilitation. To elucidate the contributions of graphic facilitation in collaborative project management for innovation within Higher Education Institutions. To propose an adapted model for collaborative project management for innovation in Higher Education Institutions using graphic facilitation.
Methodological Aspects	This research assumes an exploratory and descriptive nature with a cross-sectional temporal perspective. The data collection technique employed is action research. Data collection instruments include bibliographic research, document analysis, participant observation, and structured interviews. The analytical approach is qualitative, with methods of analysis encompassing content analysis, document examination, and graphic facilitation.
Studied Organization	Federal University of Paraná. Information Management Center, Graduate Program in Information Management.
Level of Analysis	Higher Education Institutions engaged in innovation projects, characterized by the following criteria: a) The institution undertakes innovation projects. b) Identification of the innovation project as either incremental or radical (Reis et al., 2011). c) Type of innovation: product, service, process, marketing, or organizational (FINEP, 2005). d) Collaborative project management through the application of knowledge, skills, tools, and techniques (Kerzner, 2017). e) Utilization of graphic facilitation (Sibbet, 2006). f) Access of the researcher to the innovation project conducted by the institution.
Unit of Analysis	Case 01: Open Education Model for Engineers and Architects – Dissemination of Sustainability Research. The project's overarching goal is to construct a structured open education model that facilitates collaboration among researchers and/or groups of engineers/architects possessing knowledge relevant to the dissemination of environmental sustainability within the construction industry (Fundação Araucária (FAPPR), 2017, p. 02). Case 02: Knowledge Dissemination through Cross-Transversal and Hybrid Courses in the Massive Open Online Course (MOOC) Format. The principal objective of this project is to develop and experiment with methods and processes aimed at modeling competency-based management for Massive Open Online Courses (MOOCs) from the vantage point of cross-transversal and hybrid courses.
Sources of Evidence	Internal documents pertaining to Case 01: Open Education Model for Engineers and Architects – Dissemination of Sustainability Research. Internal documents associated with Case 02: Knowledge Dissemination through Cross-Transversal and Hybrid Courses in the Massive Open Online Course (MOOC) Format. Meetings conducted with project teams, executed in two formats: 1) in-person at UFPR's Information Management Center (prior to the COVID-19 pandemic) and 2) virtually via online meeting tools (during the COVID-19 pandemic). Interviews with project participants.
Data Collection Instruments	Bibliographic research, document analysis (both primary and secondary), participant observation, and structured interviews. (This section appears to be truncated, and further details about data collection instruments may be available in the complete text.)
Researcher	Removed for Peer Review

Table 3. Presentation of the Practical Case

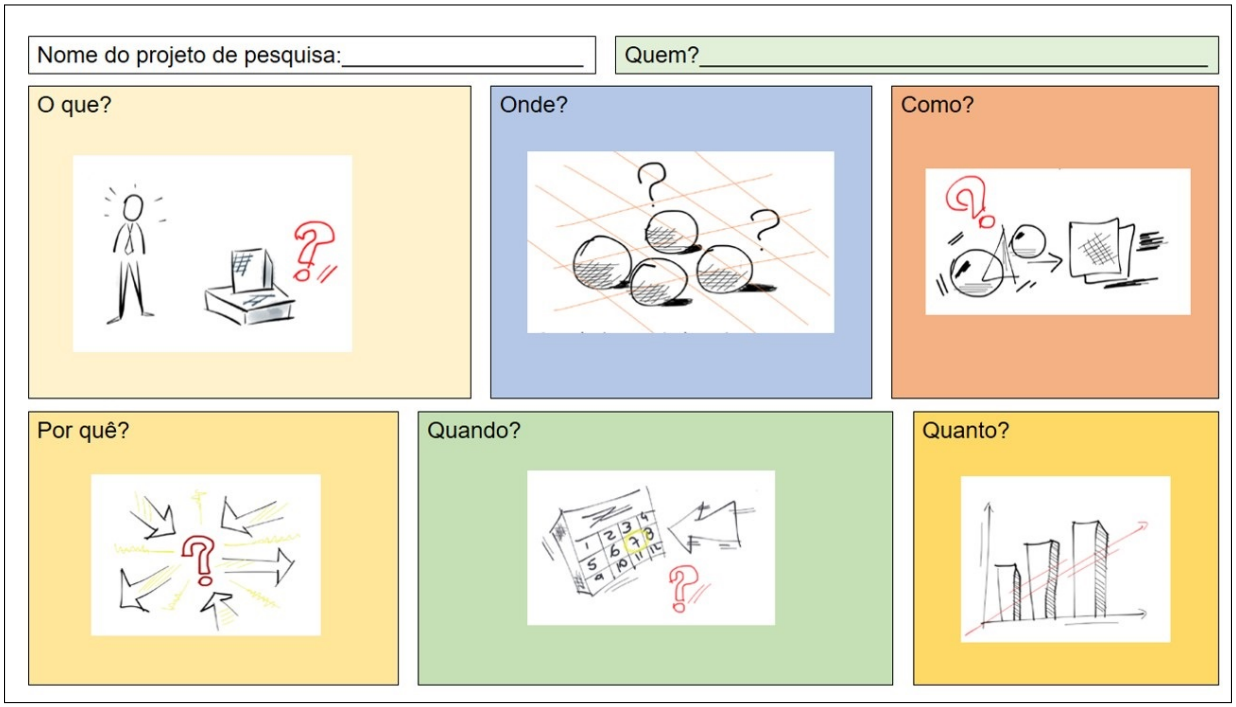

Figure 2. Framework - 5W2H and Graphic Facilitation

When? When will the research be conducted?	1 - Research schedule.	In this phase, the researcher should develop the research schedule and present the main phases of the research with the start and end of activities (Creswell, 2007; Marconi and Lakatos, 2021).
How Much? How much does it cost to conduct the research?	1 - Costs related to the use of resources for research.	For the composition of this phase, the researcher should describe the main costs related to the research's development. In this case, they can specify the resources, unit quantity, unit value, and total value (Creswell, 2007; Marconi and Lakatos, 2021).

Table 4. Framework of Procedures for Delineating Scientific Research

The fourth stage (Figure 3) presents the framework of procedures for outlining scientific research in a visual and collaborative format, which encompasses the areas of the 5W2H method, the figures of graphic facilitation, and the components of scientific research.

The fifth stage involves filling in the framework (Figure 4). At this point, the researcher should reflect on the 5W2H method questions in relation to the elements that make up their scientific research and complete the framework modules (Ribeiro, 2020). In this case, post-it notes and markers can be used. This reflection is carried out collaboratively, involving not only the researcher and the advisor but also other stakeholders in the research project (Souza, 2021).

The framework is visual, enabling collaboration, interaction, and a comprehensive view of the entire project. It's important to remember that a research project is not static, so changes may be necessary at some point. Therefore, any necessary changes can be made directly on the framework, where the impact of the alteration on other research project activities and within each framework module is visualized. As a result, the model is adaptable to the research needs.

For the purposes of this study, it was necessary to abbreviate part of the content due to formatting constraints. Information related to the topic, research question, general objectives, specific objectives, and justifications were presented in Phase 1.

The framework for outlining scientific research in a visual and collaborative format in this research study unfolds as follows:

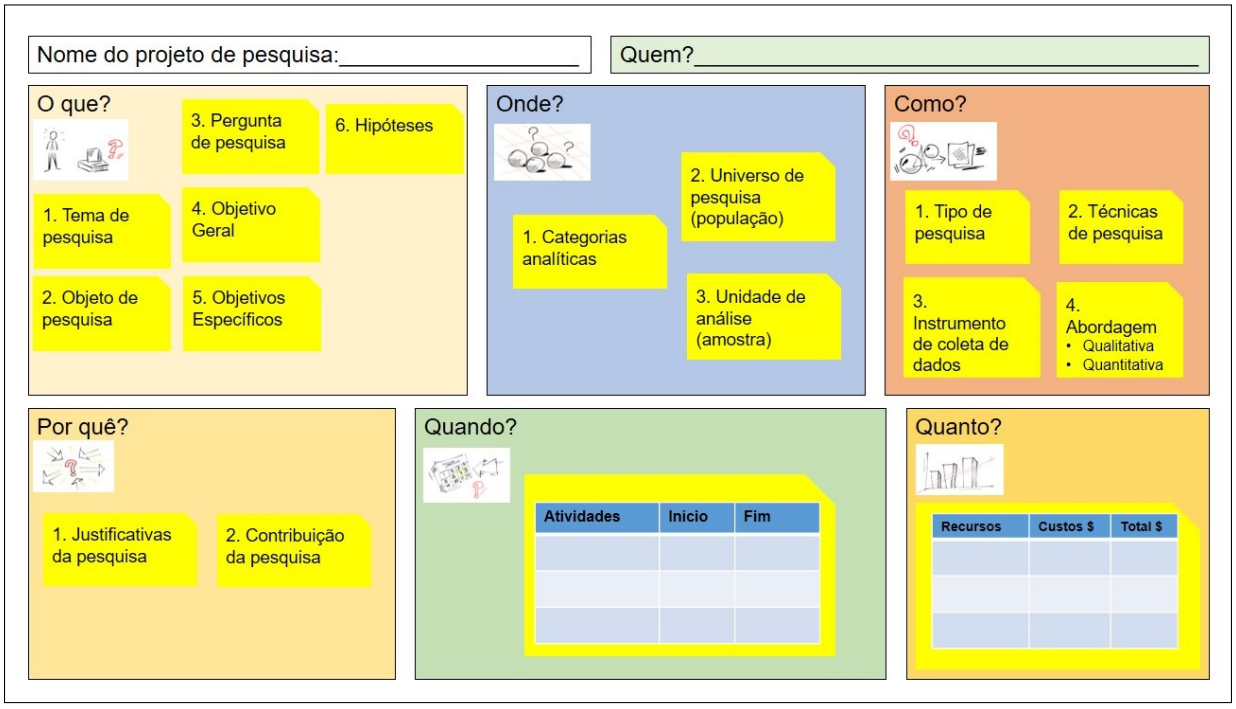

Figure 3. 5W2H Framework, Graphic Facilitation Icons, and Scientific Research

Project Title.

a) Who? Project Author.

b) What? This module covers the topic, research subject, research question, general and specific objectives, and hypotheses (if applicable).

c) Where? This module includes analytical categories, level of analysis, and units of analysis.

d) How? This module outlines how the research will be conducted and includes the research type, research techniques, data collection instruments, and the research approach.

e) Why? This module corresponds to theoretical and practical justifications and the contributions of the research.

f) When? This module presents the research schedule or its phases.

g) How Much? This module represents the costs related to the research project.

Phase 3 – Results and Discussion

The application of visual elements in scientific research makes knowledge, learning, and information exchange more explicit because it operates in the realm of explicit visuals, using visual metaphors, messages, drawings, icons, and other elements that collectively represent the research (Ribeiro, 2020).

The framework, structured according to the proposed 5W2H method, offers a comprehensive view of the research project as a whole (Dias et al., 2015). It highlights not only the research itself but also the paths that researchers will take during the execution and development of their research (Lisbôa and Godoy, 2012, Reis et al., 2016).

Visual resources are employed in various forms, whether through research outlining frameworks or the use of metaphors representing research project information, particularly through the application of icons, drawings, and arrows to illustrate the flow of research (Sibbet, 2013). The application of visual resources is accomplished through various means of consolidating research information, emphasizing its representation, understanding, and collaboration (Ribeiro, 2020).

The visual format, combining graphics (drawings) and text, facilitates the comprehension of messages and information. Details within the drawings contribute to the understanding of the concepts proposed by the research (Ribeiro, 2020). One significant contribution of employing visual resources lies in enhancing collaboration. Information visualization is didactic in conveying messages to viewers, making the research's general concepts clear, objective, and easy to understand, thus promoting cooperation among project participants (Eppler and Pfiste, 2019, Ribeiro, 2020).

Collaboration in the context of the framework for outlining scientific research in a visual and collaborative format primarily involves the sharing of information and collaborative actions to achieve research goals. Researchers

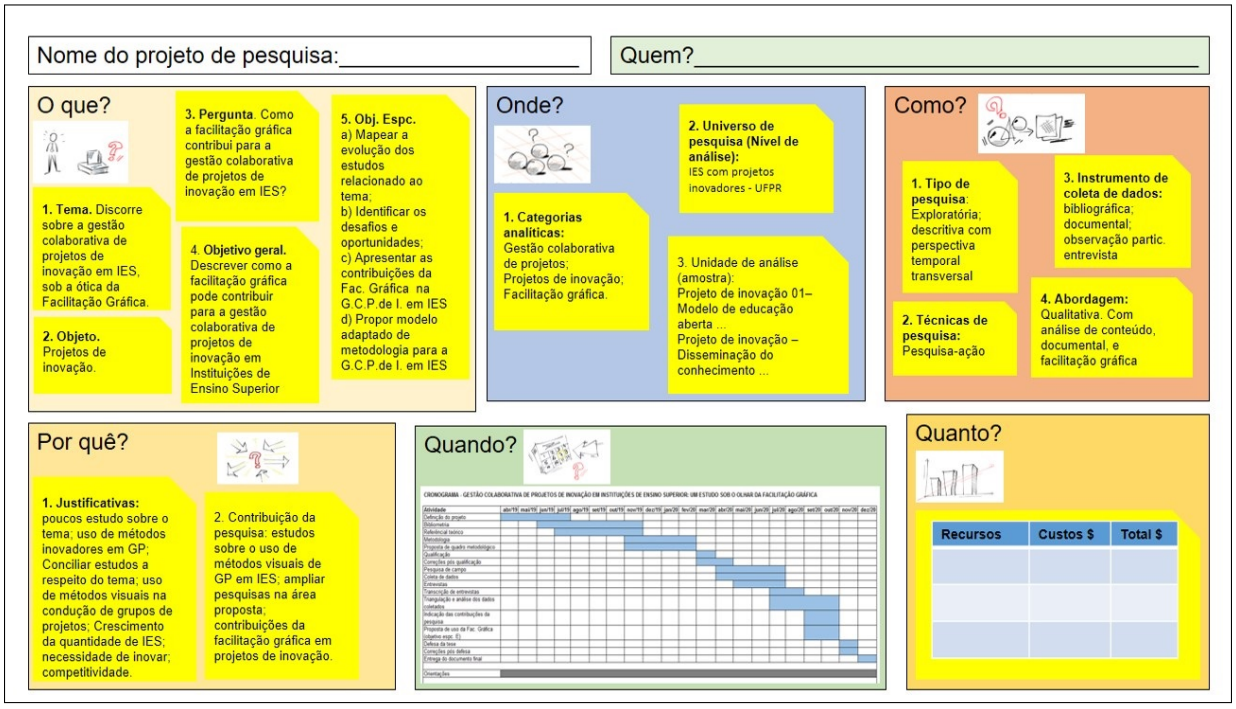

Figure 4. Methodological Procedure Outline Framework

must be willing to work together and share responsibilities (Branco et al., 2016, Kerzner, 2017, Souza, 2021). Consequently, in the context of the framework for outlining scientific research in a visual and collaborative format, the following aspects stand out regarding collaboration among researchers:

- Knowledge sharing and learning: Information exchange between researchers in a visual format (Sibbet, 2013, Oliveira, 2018).
- Interaction among researchers in conducting research activities: The visual format facilitates the identification of research activities, allowing the identification of roles and tasks to be performed (Vanz & Stumpf, 2010).
- Development of visual methodological procedures: Presentation of research methods and methodologies in a visual format (Koné et al., 2000, Eppler and Pfiste, 2019, Ribeiro, 2020).

The use of visual resources, through graphic facilitation and the 5W2H method, integrated into the framework for outlining scientific research in a visual and collaborative format, acts as a link for sharing and collaboration, in a visual and interactive manner. Participants in the research have the opportunity to visualize project information, fostering an understanding of complex issues and supporting reflection and analysis through visual formats among researchers (Dondis, 2007, Naves and Reis, 2017). Furthermore, according to Drigo and Candiotto (2018), the visual arrangement of topics and the alignment between drawings, colors, and texts promote the interpretation of various specific elements that constitute the development of methodological procedures.

When using the proposed framework for outlining scientific research in a visual and collaborative format, researchers must select the research method in line with the theories that underpin their study and the research problem that motivated their investigation. This alignment should also correspond to epistemological assumptions. "Epistemology refers to knowledge, the belief in how it can be transmitted: whether tangibly, objectively, or more subjectively, based on personal experience" (Vergara, 2012, p. 02). Researchers must use their sensitivity and flexibility to choose the best path for their research and make a meaningful contribution to the field.

In this regard, Vergara (2012, p. 03) highlights the following aspects to which researchers must pay attention: the quality and relevance of the bibliographic reference, which should support the study; the crucial importance of the connection between theory and method; research conclusions must address the research problem and align with the theory and methods used; the more the study advances existing knowledge, the more relevant it becomes; exposing research to specialists offers opportunities for enriching it based on the criticisms it receives.

CONCLUSIONS

The application of visual resources in scientific research offers an alternative perspective to researchers, as visualization is an integral part of the thought process. This provides a unique vantage point to understand the research project, distinct from a purely textual approach. It allows for a comprehensive view of the project,

enhancing comprehension of its complexities. When harnessed effectively, visual resources (as represented by the proposed framework) support reflection on the research process and guide researchers toward achieving their defined objectives. These visual aids also help in navigating the project's challenges in its entirety and uncovering potential research opportunities that may not have been previously visualized. Therefore, the collaborative use of visual resources in the development of scientific research facilitates comprehension and enhances connections with the research topic, problem, objectives, and methodological underpinnings, fostering an environment conducive to creativity and collaboration.

However, when adopting the use of visual resources, researchers must thoughtfully consider which elements of scientific research can be effectively represented in a visual format. The most suitable methodological approach involves combining methodology, flexibility, and collaboration. Researchers are tasked with seamlessly integrating the framework for outlining scientific research in a visual and collaborative format with the research process itself. This integration should harmonize with the problematization, the current state of the field, and alignment with epistemological assumptions.

In terms of collaboration among researchers through visual means, it enables a reevaluation of how scientific research is conducted, transitioning from a primarily textual approach to a collaborative visualization of project information among researchers. Nevertheless, it is vital to understand that the use of visual resources, such as the one proposed in this study, should be applied in formats that convey clear, straightforward ideas while preserving the depth of the research. This approach should also align with the researcher's intentions and the methodological procedures essential for achieving meaningful results.

The format for conducting scientific research within the model proposed in this article warrants attention, as it deviates from the traditional framework for planning academic research. It necessitates collaboration and ongoing interaction among researchers, encouraging the use of visual elements, graphic facilitation, and the 5W2H method. This study paves the way for future research opportunities, including the promotion of collaborative scientific research through visual means among researchers and further investigations into didactic development within research methodology disciplines.

5W2H	Methodological Procedures	Description
Who? Who will execute - participate in the research?	Name of the researcher, supervisor, and other research participants.	Identification of the project's name and the individuals involved in the research (Oliveira Netto, 2006; Creswell, 2007; Marconi and Lakatos, 2021).
What? What research will be conducted?	1 - Research topic. 2 - Object of research. 3 - Research question. 4 - General objectives. 5 - Specific objectives. 6 - Hypotheses.	In this phase, the researcher will present the research topic, define the object, research question, as well as the general and specific objectives. If applicable, the researcher should also indicate the research hypotheses (Creswell, 2007; Martins and Theóphilo, 2016; Marconi and Lakatos, 2021).
Why? Why will this research be conducted?	1 - Justifications for the research - theoretical and practical. 2 - Research contributions.	In this phase, the author presents the theoretical and practical justifications for the research, as well as potential contributions to scientific knowledge (Creswell, 2007; Vergara, 2012; Marconi and Lakatos, 2021; Richardson et al., 2012).
Where? Where will the research be conducted?	1 - Analytical categories. 2 - Research universe. 3 - Unit of analysis.	In this phase, the researcher will indicate where the research will take place. Thus, analytical categories, the research universe (population), and units of analysis (sample) will be presented (Creswell, 2007; Martins and Theóphilo, 2016; Marconi and Lakatos, 2021).
How? How will the research be conducted?	1 - Type of research. 2 - Research technique. 3 - Data collection instrument. 4 - Approach.	This phase indicates how the research will be conducted or put into practice. Thus, the researcher must specify the type of research to be carried out (exploratory, descriptive, or explanatory); research technique (case study, survey, documentary research, bibliographical research, etc.); data collection instruments (primary or secondary, interview, questionnaire, etc.); approach: qualitative or quantitative, and the method of analysis (Creswell, 2007; Vergara, 2012; Martins and Theóphilo, 2016; Marconi and Lakatos, 2021; Richardson et al., 2012).

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NOTAS DA OBRA E CONFORMIDADE COM A CIÊNCIA ABERTA

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EQUIPE EDITORIAL