

Review Article

Criteria of Formality and Structural Elements of Research Proposals

Mariel Monrroy ^{1,2}, **Heriberto Franco** ², and **José Renán García** ^{1,2}

¹Research Center in Biochemistry and Applied Chemistry, Faculty of Natural and Exact Sciences, Autonomous University of Chiriqui, David, Panama

²Department of Chemistry, Faculty of Natural and Exact Sciences, Autonomous University of Chiriqui, David, Panama

Correspondence should be addressed to Mariel Monrroy; mmonrroy@gmail.com and José Renán García; joregam@gmail.com

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The preparation of research proposals is a challenge faced by anyone who wants to contribute to scientific research, since the specific requirements of different fields of study often cause technical or management aspects of research, such as obtaining funds to carry out research efforts, to be intermingled. The basis of a research proposal is the presentation and substantiation of the necessity of studying a particular problem, as well as the practical manner in which the study will be conducted. The objective of this article is to document the main attributes of each part of a research proposal. Therefore, we present a condensed and practical approach so that a research proposal can be consolidated in a document that enables the evaluation of the validity and usefulness of the planned study. Subsequently, the detailed and appropriately organized proposal will help the researcher in the development and execution of the study. This article has important implications for the development of well-structured and well-organized research proposals, which can, in turn, initiate high-quality scientific research efforts across all disciplines of science education.

1. Introduction

The main purpose of a proposal for scientific research should be the generation of new knowledge. Therefore, research proposals must be original and influence the development of a scientific study area. In general, scientific investigations are conducted on topics of personal (scientific curiosity), economic (improvement of a production process), or public (social problems) interest, among others, to answer a local or global question or enhance some specific knowledge or both. Therefore, questions are the starting point of any research proposal [1].

While writing a research proposal, care must be taken to prepare it such that it attracts the interest of the reader; it should be informative, meaningful, clear, easy to read, and concise and should not have any confusion or difficulty to understand words and grammatical or orthographic errors [2]. Further, it should follow the format requested by the institution or agency where the researcher wishes to register

or request financing. In addition, the proposal must show correspondence between the knowledge already disseminated on the subject and the contribution of the knowledge that will be acquired and convinced the evaluation committee of the credibility, viability, practicality, and reproducibility of the research [3]. Finally, emphasis should be placed on the importance of the proposal in ensuring scientific and social development.

In general, a teacher, researcher, or student who is performing research for the first time does not have a clear idea of where to start the development of the proposal or how to visualize the logical relationship between the elements that should conform. Therefore, such researchers often do not complete the research process successfully, and they sometimes lose their ideas on the generation of new projects that enhance scientific knowledge. For some researchers, there are two modalities for research ideas: one modality comprises ideas that completely belong to the proponent, and the second includes ideas that are a part of or

a contribution to the development of a project led by a research group that the proponent has joined. The second modality is denoted as a *spin-off idea* [4].

The preparation of a research proposal requires adequate time and effort to perform a review of the literature that is relevant to the topic under investigation, enabling one to reflect on the findings and new ideas [5]. Often, elaborating on a research proposal is a complex process. The reasons are that different elements should be considered and each element plays a key role in the successful development of the research proposal [6]. Accordingly, this article describes the main components of a research proposal, such as the title, the summary, approach to the research problem, the background, objectives, hypotheses, the methodological framework, the schedule, and the budget, which are described in the following sections.

2. Main Components Of A Research Proposal

2.1. Title. An appropriate title should immediately attract the attention of reviewers and make them want to know more about the subject under discussion. The title is the first part of the document that should be read, and it will determine the reviewer's first impression regarding a manuscript; hence, it must clearly define the purpose and scope of the research study in a concise, accurate, and interesting manner [7]. In addition, it should be brief, clear, informative, and classifiable and should not include any abbreviations or jargon. The title must facilitate the identification of the work, as well [8]. Phrases such as "Study about . . .," "Investigations about . . .," and "Observations about . . ." should be avoided in titles [9]. The words comprising the title should indicate what the study does and how it is carried out; what the study is going to do; and, sometimes, when and where the study was conducted. It is important for the title to be consistent with the problem being examined and the objective of the investigation. It is suggested to use brief titles; they can be between 10 and 15 words. According to some authors, the following three elements constitute a good title: the sample object of the investigation, intervention, and result [7].

2.2. Summary. The summary is one of the most important sections of a research proposal. Through the summary itself, one should be able to sell the proposal. Accordingly, the summary should be brief, concise, clear, interesting, autonomous, and convincing. Further, it should describe the topic, problem, hypothesis, objective, strategy for solving the problem, and impact of the proposal, as well as mentioning how the proposal conforms to the mission of the funding institution, if possible. This section should clarify what will be conducted by the study and why and how it will be carried out [2]. The summary must comprise a single paragraph of no more than 250–300 words [10, 11]. One should take adequate time to write the summary, since the summary often influences the acceptance of the research proposal. It is better to write the summary after the proposal is drafted and all the planned research is completed. This is the section

where the intellectual goals and commitment of the research study are initially established.

2.3. Background. The literature that is reviewed to prepare the background section must be relevant to the problem statement and research questions. It comprises a review of existing studies or latest developments related to the research problem. The description of previously conducted studies clarifies the bases of these studies and explains how they differ from the current research proposal, besides identifying gaps or weaknesses that may justify a new investigation [12]. The antecedents are based on recent studies (preferably, not more than 5 years old, although exceptions can be made for older references that may be very important for the current research study and, hence, cannot be ignored) and from reputable sources. The central concepts should be discussed by contrasting against, comparing, and combining the literature to make a valid argument [3]. The review of the literature should be selective, critical, and quotable.

2.4. Research Problem. The research problem is the object, fact, or situation that the researcher wants to understand or explain, and it forms the basis of any research proposal. The approach to the research problem entails the statement and formulation of the latter. The statement involves providing a description of the object of the study, and the formulation comprises the question that should be answered by the current study [9]. The review of previous studies should serve as a basis to state and formulate a clear and delimited research problem. Therefore, when describing the problem, one must indicate all its characteristics, including data or number from previous studies, the current context, what has been achieved nationally and internationally, and why it requires investigation [6, 9, 13]. Further, the relationship between the variables of interest must be established. The same must be formulated by means of a contestable, viable, and concrete question [1] and indicate the study variables. The research question should clearly define the purpose of the investigation, since reviewers appreciate the clarity and specificity of the research question [2]. According to Quintana [14], the research problem section further elaborates a reasonable argument (in the context of relevant data and accepted conceptualizations) that explains the limitation of or inconsistency in existing knowledge with respect to the chosen topic, where the question or the problem to be investigated is the conclusion of the argument.

A research project starts with the identification of the problem, explanation of the main factors and components of the problem, and exposition of possible study dimensions. Its beginning is indicated by the actions of problem identification and ending is denoted by the determination of the study dimensions. The appropriate definition of the problem is important to establish the strategy involved in the development of the scientific project, for which purpose it is necessary to know all the causes of the problem and possible ways of solving it [15]. The approach to the research problem involves refining ideas; it further consists of formally structuring the initial idea of the research and providing an

in-depth description of what is considered a research problem [16].

2.5. Justification for Research. This section presents the reasons for conducting the research and provides convincing arguments supporting the necessity of conducting the study. It depicts why and for what purpose the research will be carried out and clarifies whether the study's contribution is intended to increase knowledge, has practical or methodological utility, has social importance, and improves convenience [9, 17]. It is important to consider the beneficiaries and possible benefits of the study. It should be mentioned whether the study's impact is academic, social, economic, or environmental [2]. In other words, the justification clearly and concisely specifies the deliverables of the research [4].

2.6. Objectives. Objectives are the goals or purposes that the proposed research study intends to achieve. They must be clear, precise, feasible, and aimed at knowledge acquisition [1]. Further, they must be congruent with the proposal title and research problem and should not be written in a manner that describes procedures or activities. Verbs must be in the infinitive form and indicate realizable aims [9]. The research objectives should be established after determining the approach of the scientific problem, and they are closely linked to the problem, study variables, and the research question.

Ortega [18] emphasizes the necessity of establishing the difference between the objectives of the research, the researcher's objectives, and the research objectives. The objectives of the research refer to the expected impact of the results of the study beyond the study's framework. However, the objectives of the researcher are related to the desired consequences on the subject that is being investigated; they indicate the researcher's purposes and can be considered good wishes. The research objectives are related to the research problem, study variables, and the research hypothesis specified in the proposal. They help establish, in a measurable, clear, and unambiguous manner, partial results that must be obtained to answer the problem and guide the researcher in terms of the steps that must be followed to verify the hypothesis [18].

Care should be taken while using verbs to denote final actions, such as train, improve, change, motivate, understand, learn, and teach [1]. In all research studies, researchers must set two levels of objectives: general and specific. The general objective implies the knowledge that will be gained at the end of the investigation, whereas specific objectives include the partial knowledge that is necessary to achieve the general objective. For a research study, it is generally recommended to formulate a single general objective and several specific objectives [1].

2.7. Hypothesis. A hypothesis is the supposed answer or a tentative explanation to the question raised by the research problem. Its construction is based on prior knowledge, and it

indicates the relationship between two or more variables that reveal the answer to the research question [19]. A hypothesis must be measurable, verifiable, and falsifiable [20]. Hypotheses are almost always necessary in quantitative studies but not in qualitative ones [17]. A hypothesis should not include words such as "can" and "could," they prevent the hypothesis from being falsified, and the "and" and "or" connectors in its structure because these words make it difficult to distinguish the part of the hypothesis that should be tested [2]. Although a hypothesis can be proposed in different ways, it should include the following regardless of its format: variables (the attributes or properties to be measured), a unit of analysis (the object or study population), and the expected result. All these aspects should be expressed in clear, simple, and concise terms [19].

Hypotheses can be classified in different ways, such as work or research, null, and alternative hypotheses [9, 17, 19, 21]. However, there is no rule pertaining to the type of hypothesis to be used.

A work or research hypothesis (H_i) comprises an assertion or a conjecture about the probable relationships between two or more variables; work hypotheses can be divided into correlational, causal, descriptive, and comparative types [9, 17]. In correlational hypotheses, variables are related associatively, that is, variables change in relation to other variables. They are the most common hypotheses [19]. The causality hypothesis establishes cause-effect relationships by not only affirming the relationships between variables and their occurrence but also proposing a sense of understanding between them. The descriptive hypothesis considers the value of the variables that will be observed in a particular context or in the manifestation of another variable. Finally, the comparison hypothesis specifies the differences between groups [17].

Null hypothesis (H_0): This type of hypothesis expresses the absence of any relationship, difference, or causality among variables [17].

Alternative hypothesis (H_a): It offers a different explanation to that provided by the research and null hypotheses. Alternative hypotheses are formulated when there are other possibilities in addition to the research and null hypotheses. In this manner, an investigation can contain multiple hypotheses [21].

It is noted that not every assumption is a hypothesis; for an assumption to be considered a hypothesis, it must meet a double requirement: universality and contrast ability. The hypothesis must extend beyond empirical observations by placing itself at a higher level that encloses the entirety of the observed objects. The hypothesis must express something about the real world and be compared with the world of one who affirms or denies something. The essence of the hypothesis is an affirmation that extends beyond concrete experience and can be remitted and contrasted with it; its formulation and solution depend on the relevant field of scientific study and the viability of one or more scientific approaches [22].

2.8. Methodology. This section indicates how the researcher intends to address the research problem. It includes the work

plan and a description of the activities necessary to realize the planned objectives. It must detail how the research will be carried out to guarantee its replicability. In addition, this section specifies the type of research focus, such as quantitative, qualitative, or mixed.

This article emphasizes quantitative research, which includes aspects such as the level of research, definition of variables, a complete description of the design to be used, measurement instruments, and data processing and analysis. The section should indicate whether the research is exploratory, explanatory, or descriptive.

It is necessary to define the variables used in the hypotheses both conceptually and operationally so that researchers or users of the results interpret the same meaning and can compare the study with other published works and evaluate the results. The conceptual definition indicates the meaning of a term, and the operational definition specifies the procedures that should be performed to measure a variable and indicates a way of translating concepts into units of measurement. The conceptual definition of a variable is very similar to a dictionary definition and that it provides a general idea of the meaning of the variable [23]. The operational definition of a variable enables us to explain in advance how the variables that have been conceptualized will be measured or evaluated. In the process of operationalizing variables, it is necessary to determine the measurement parameters based on which the relationship among the variables is enunciated by the hypothesis or research question [24]. The logical process of operationalizing a variable begins with the statement of the most general phenomenon that is examined by the research study; definition of the concepts included in the phenomenon; subdivision of the most complex concepts into dimensions or categories; definition of the variables; and, finally, a search for the indicators of each variable. Then, indexes are developed, which enable data synthesis to produce new information that explains reality [25].

The design comprises the plan that is proposed to answer the research questions. The type of design is described as either experimental (where there is control over the variables) or non-experimental (where the research is observational). Further, the following aspects are clarified: what will be the population under study (people, animals, events, or objects) and whether it is finite or infinite; the type of sampling used to select samples, whether it is random, stratified, for convenience, or systematic [12]; who should be included in the sample, and what characteristics should the sample have or what is the object of the study [6]; the representative number of samples; research activities; and the place and time of conducting the research.

The measurement instruments include the different ways of collecting relevant information [26]. Some of the instruments used are as follows: surveys, interviews, observation, laboratory equipment, or instruments specific to each discipline [12, 17]. The researcher must consider the validity and reliability of each instrument. According to Bernal [9], an instrument is reliable if

similar results are obtained at each attempt when the instrument is applied repeatedly to measure the same event, and it is valid if it really measures what is to be measured. When selecting an instrument, a researcher should consider its advantages, disadvantages, and different applications.

Data processing includes all the operations to which the data will be submitted: classification, registration, tabulation, and coding [26]. Further, data analysis includes the techniques that will be used to interpret the information contained in the data; the examples of some logical techniques are induction, deduction, and synthesis [26]. By maintaining a clear idea about the tests that may be applied, one can ensure well-organized data collection and analysis and avoid the wastage of valuable time [7].

2.9. Schedule. A schedule or Gantt chart presents the activities to be performed, which are previously described in the methodology section of the proposal and the time required to complete them. It comprises a table with many columns. In the first column, the activities are placed in the order in which they should be executed and the other columns denote where the activities are located in time (months, weeks, or days) [27]. It is a chronological outline of the activities that have been established to realize the study's goals until the conclusion of the investigation. It enables one to quickly evaluate the simultaneity or sequential order of research activities, which facilitates and improves organization and logistics.

2.10. Budget. The budget indicates the costs of the investigation over a certain period and plays a key role in a request for financing [4, 7, 28–30]. The format of the budget and the items included in it vary according to the agencies that sponsor research studies. However, the main parts of the budget plan are similar across the applications of funding agencies.

The budget section includes two categories: direct and indirect costs [29]. Direct costs comprise fees or salaries (for assistants, researchers, and technicians), recurrent expenses (consumables, reagents, glassware, laboratory analysis, kits, stationery, printing, and publications), nonrecurrent expenses (laboratory equipment, infrastructure, and computers), and travel expenses (attendance in meetings, conferences, training, and sampling). However, direct costs are not limited to the aforementioned elements alone [29, 31]. The amounts allocated for each item within the direct costs vary across financing agencies and, in some agencies, these amounts are not considered at all. To prepare this section, you must understand the rules established by funding agencies or institutions.

In general, indirect costs are associated with institutions and their counterparts and include building facilities or infrastructure and water and electricity payments [29]. These costs can be equivalent up to 20% of the amount of the requested budget.

Usually, the budget is presented in the tabular format. The columns on the left specify the different research-related items, and the columns on the right depict the amounts requested for each item. At the end of the table, the supporting paragraphs pertaining to the requested items are placed.

2.11. References. In addition to attributing a research work and identifying the legitimate author, the references section enables one to assess the quality of the documents that were reviewed during the writing of the project and is an indication of the exhaustive level of revision that was carried out [7]. All the sources cited in the research proposal should appear in this section, which is located at the end of the proposal document. References should follow the formatting style specified by the funding agency and completely agree with the citations provided in the text.

2.12. Annexes. In most cases, research projects require the attachment of complementary documents that support the proposal, which must be placed at the end of the proposal in a section called annexes [32]. Some of the documents that should be included are letters of commitment, letters of recommendations, and resumes of researchers and co-investigators.

3. Conclusion

Preparing a good research proposal requires time, dedication, and the establishment of follow-up guidelines based on the agency that provides the funds. The coherence and agreement between the problem to be investigated and the appropriate organization and planning of how the new knowledge will be obtained enable not only the execution of the project but also the formal writing of articles to disclose the contributions of the project. This article has important implications for the development of well-structured and well-organized research proposals, which can, in turn, initiate high-quality scientific research efforts across all disciplines of science education.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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References

- [1] J. M. Alústiza Echeverría, E. Salvador Pardo, and A. Castiella Eguzkiza, "How to establish the hypothesis and the objectives of a research project in Radiology?" *Radiología*, vol. 54, no. 1, pp. 3–8, 2012.
- [2] G. M. Crawley and E. O. Sullivan, *The Grant Writer's Handbook. How to Write a Research Proposal and Succeed*, Imperial College Press, London, UK, 1st edition, 2016.
- [3] D. Duggappa, K. Sudheesh, and S. S. Nethra, "How to write a research proposal," *Indian Journal of Anaesthesia*, vol. 60, no. 9, pp. 631–634, 2016.
- [4] L. Barker, R. R. Rattihalli, and D. Field, "How to write a good research grant proposal," *Paediatrics and Child Health*, vol. 26, no. 3, pp. 105–109, 2016.
- [5] E. D. González, *Research Methodology: Proposal, Preliminary Project and Project*, Ecoe Ediciones, Bogotá, Colombia, 4th edition, 2009.
- [6] G. Bordage and B. Dawson, "Experimental study design and grant writing in eight steps and 28 questions," *Medical Education*, vol. 37, no. 4, pp. 376–385, 2003.
- [7] N. Attard, "WASP (write a scientific paper): writing an academic research proposal," *Early Human Development*, vol. 123, pp. 39–41, 2018.
- [8] M. F. Barrera-Morales, "How to write the title of a research," *Impacto Científico. Revista arbitrada Venezolana del Núcleo LUZ-Costa Oriental del Lago*, vol. 6, no. 2, pp. 276–284, 2011.
- [9] C. Bernal, *Research Methodology*, Pearson, Bogotá, Colombia, 3rd edition, 2010.
- [10] J. O. Hinojosa Pérez, "Summary structure of a research paper," *Pediatría de México*, vol. 12, no. 1, p. 39, 2010.
- [11] P. Wong, "How to write research proposal. International network on personal meaning," International Network of Personal Meaning (INPM), 2017, <https://www.meaning.ca/article/write-research-proposal/>.
- [12] M. J. Verhoef and R. J. Hilsden, *Writing an Effective Research Proposal*, Departments of Medicine and Community Health Sciences, University of Calgary, Calgary, Canada, 2004.
- [13] A. I. Vargas, "Guide to prepare a research proposal," *Educacion*, vol. 29, no. 2, pp. 67–97, 2005.
- [14] A. Quintana, "Approach of the research problem: errors of the superficial reading of textbooks of methodology," *Revista IIPSI*, vol. 11, no. 1, pp. 239–253, 2008.
- [15] J. L. Abreu, "The formulation of the background of the problem of scientific research," *Daena: International Journal of Good Conscience*, vol. 7, no. 1, pp. 163–168, 2012.
- [16] G. J. Bauce, "Why the research problem?" *INHRRR*, vol. 4, no. 1-2, pp. 1–6, 2016.
- [17] R. Hernandez-Sampieri, C. Fernández-Collado, and L. Baptista, *Research Methodology*, McGraw-Hill, New York, NY, USA, 1st edition, 2010.
- [18] J. Ortega, "Enunciation of objectives in research projects," *Revista Medica del Instituto Mexicano del Seguro Social*, vol. 41, no. 5, pp. 437–440, 2003.
- [19] J. Haber, *Research Questions, Hypotheses, and Clinical Questions, Part I. Overview of Research and Evidence-Based Practice*, Nursing Research J. H. Geri LoBiondo-Wood, Ed., p. 606, Mosby, an Imprint of Elsevier Inc, St. Louis, MO, USA, 2013.
- [20] P. K. Strode, "Hypothesis generation in biology: a science teaching challenge & potential solution," *The American Biology Teacher*, vol. 77, no. 7, pp. 500–506, 2015.
- [21] P. Grogan, "The use of hypotheses in ecology," *British Ecological Society Bulletin*, vol. 36, no. 1, pp. 43–47, 2005.

- [22] F. J. Díaz-Llanos, L. Martínez, C. Cermeño, and G. Calleja, "Epistemology of the hypothesis test," *Anales de la Real Academia de Doctores de España*, vol. 12, pp. 45–58, 2008.
- [23] J. L. Abreu, "Construct, variables, dimensions, indicators & congruence," *Daena: International Journal of Good Conscience*, vol. 7, no. 3, pp. 123–130, 2011.
- [24] M. Carballo and E. Guelmes, "Some considerations about the variables in the research that are developed in education," *Universidad y Sociedad*, vol. 8, no. 1, pp. 140–150, 2016.
- [25] M. Reguant and F. Martínez, *Operationalization of Concepts/Variables*, Deposito digital de la Universidad de Barcelona, Barcelona, Spain, 2014.
- [26] F. G. Arias, *The Research Project, Introduction to Scientific Methodology*, Episteme, Caracas, Venezuela, 5th edition, 2006.
- [27] A. Al-Riyami, "How to prepare a research proposal," *Oman Medical Journal*, vol. 23, no. 2, pp. 66–69, 2008.
- [28] S. Arthur and S. Sheffrin, *Economics: Principles in Action*, Pearson Prentice Hall, Upper Saddle River, NJ, USA, 2003.
- [29] S. G. Patil, "How to plan and write a budget for research grant proposal?" *Journal of Ayurveda and Integrative Medicine*, vol. 10, no. 2, pp. 139–142, 2019.
- [30] R. R. Rattihalli and D. J. Field, "How to write a good research grant proposal," *Paediatrics and Child Health*, vol. 22, no. 2, pp. 57–60, 2012.
- [31] NIH, *NIH Grants Policy Statement: Direct Costs and Facilities and Administrative Costs (Internet)*, National Institute of Health US, Bethesda, MD, USA, 2017.
- [32] H. Klopper, "The qualitative research proposal," *Curationis*, vol. 31, no. 4, pp. 62–72, 2008.