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Review Article



Biomedical Research: The Research Problem Matters

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Abstract

Research, a systematic inquiry, is the bridge that connects existing knowledge to the research question in an objective and testable manner, ultimately solving problems. Just as the foundation is crucial to a building's construction, the research problem is the initial and the most vital step in scientific research. Therefore, problem identification is a task of utmost importance and challenge for researchers prior to the design and execution of research. In this paper, we delve into the concept of the research problem, a term distinct from the research topic and question, its potential sources, and the common approaches for its identification. A difficulty or deficiency that needs to be overcome, a desirable condition that needs improvement, a gap in existing knowledge or a conflicting issue, a theory that requires meaningful understanding, a neglected area of knowledge, and an idea that requires validation or confirmation or application are all examples of the research problem. Known problems, existing literature, or serendipitous ideas may serve as potential sources of a research problem. Research problems are often constructed from the literature by structuring intertextual coherence or problematization strategies. Overall, the most common way of defining research problems is gap-spotting.

Keywords: Scientific research, Research problem, Structuring intertextual coherence, Problematization, Gap-spotting

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Introduction

Science is a continuous effort to understand¹ and a special kind of less fallible knowledge²⁻⁴ that acts as a method for separating workable from non-workable ideas.⁵ Research is a systematic inquiry linking existing knowledge to the research question in an objective and testable way (scientific method) that solves the problems.⁶⁻⁸ Scientific research should be problem-driven,9,10 not method-driven or even topic-oriented10; in fact, we seek knowledge and research to solve problems.^{6-8,11} Scientific research begins with the research problem,^{10,12} a hurdle with no acceptable solution available.9,11 The research problem is the heart of every research and acts as an axis around the whole research effort.9 This quotation from Albert Einstein indicates the importance of the research problem: "The formulation of a problem is often more essential than its solution".13

Identifying the research problem is the starting point,^{14,15} the most challenging, and the most important part ^{9,15} of the research process. Finding the right research problem can result in effective research.¹³ Personal interest,⁹ being

immersed in the literature,¹⁶ suggestions for further research by others,¹⁵ particularly in dissertations,¹⁷ and unexpected results reported in the literature¹³ play a role in identifying research problems. However, despite the importance of the research problem, it is not adequately introduced in the books intended to teach research practice. Therefore, this paper aims to define the research problem, discuss its characteristics, and summarize the sources for identifying it.

Definition and characteristics of the research problem

The word problem comes from the Greek *problema*, meaning a hurdle or an impediment to some action of a person.^{10,11} A problem is a hurdle that we must overcome to achieve a goal, i.e., problems are goal-directed.¹¹ Although anything that needs attention is a problem,⁹ a research problem can be a concern,⁹ an undeveloped research area,¹⁸ an extension in a given field,¹⁸ a knowledge gap,^{12,18} a controversial issue,⁹ a challenge about previous theories,¹⁶ or an unnoticed association between two phenomena.¹²



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Research problems differ from research questions since questions are problematic and unproblematic, and only some questions impede our knowledge.¹¹ After defining the research problem, it undergoes a crucial process of being narrowed down to yield a research question,¹⁵ which is an interrogative statement about the problem under study¹⁹ that researchers intend to resolve/answer by conducting the study.^{20,21}

A research problem has two main characteristics⁹: (1) the current state differs from the ideal state, and (2) there is no acceptable solution available. The research problem should also be researchable, interesting, and manageable¹⁵ and address a critical (not trivial) issue (i.e., its solving makes a difference and has a significant impact on the literature)^{14,17,22} from the real world.²² A trivial research problem wastes resources.¹³

Identifying a research problem

Problems arise from logical inconsistency that forces us to seek an explanation.¹⁰ Logical inconsistency occurs when we encounter a clash between theories and observation or when our theories run into difficulties.¹⁰ According to the Cha-Cha-Cha theory, scientific discoveries can be categorized as charge, challenge, and chance.²³ Charge discoveries solve known problems; for example, to explain the movement of stars, earth, and sun (a problem open to everyone and needed solving), Isaac Newton discovered the concept of gravity.^{11,23} Some known medical problems include the need for oral insulin therapy and a method for noninvasive glucose measurement with acceptable precision and accuracy in diabetic patients. Figure 1 illustrates the main steps from a research problem to providing a solution through research.

In the chance discoveries, scientists see what no one else



Figure 1. The main steps from identifying a research problem to providing a solution through research. Research problems can be identified by charge, challenge, and chance (i.e., Cha-Cha-Cha theory). Upon its identification, the research problem should be formulated as a research question, which can be answered through research. The answer to the research question is implied to provide a solution to the research problem.

has seen and can realize its importance.²³ For example, Fleming saw clear spots on the petri dish, a problem that needed solving.²³ Feleming's discovery of penicillin emphasizes the role of chance in capturing research ideas.¹³ However, discovery based on serendipitous observation comes after a long and challenging gestation,¹³ emphasizing that "Chance favors the prepared mind," as said by Pasteur.¹³

Challenge discoveries are a response to facts that are unexplained with scientific theories of the time;²³ this anomaly (the problem) may perceived by other people, but the discoverer proposes the idea to solve the problem.²³ For example, to explain DNA replication, Watson and Crick discovered the double helix structure of DNA.²³

The literature review is the foundation on which the research is built⁹ and is an integral part of identifying the research problem.^{14,15,24} A thorough knowledge of the topic is needed to find the correct problems,^{13,14} and a researcher should be thoroughly familiar with facts and ideas in the field and be aware of gaps in knowledge in the field.¹⁷ For more details on the importance and functions of the literature review, see.²⁵ Peer-reviewed published papers in scientific journals are the primary sources of the existing literature.²⁶ Literature review plays a more critical role in the challenge type of discoveries in which the research problem is constructed by referring to the literature.^{15,18,25} This issue is further discussed below.

Constructing research problems from existing literature

Identifying research problems by referring to the literature is done to enhance our understanding of nature.¹⁴ As indicated in Table 1, there are two main ways to identify research problems from existing literature¹⁸: (1) structuring intertextual coherence and (2) problematization. In structuring intertextual coherence, where intertext is described as a "mosaic of quotations," an interplay between existing literature and the current study is shaped in which previous studies are reconstituted into a new context beyond the embedded references.^{16,18} There are three textual strategies for connecting existing studies into a context^{16,18}: synthesized coherence, progressive coherence, and non-coherence.¹⁸

In synthesized coherence, other studies in various domains are cited and connected in a way that suggests the existence of undeveloped research areas.¹⁸ An example of synthesized coherence is highlighting the importance of body image in obesity management.²⁷ In progressive coherence, other studies in the same domain are cited to indicate an advance in the field over time and point to a consensus; then, in a complementary study, we can suggest a hypothesis that further develops/extends the field.^{15,18} An example of progressive coherence is the isolation of an enzyme that synthesizes nitric oxide after the discovery that nitric oxide is produced enzymatically

Table 1	1. Models	of identifying	research	problems	from the	existing literature	9
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Model	Definition	Strategies	Example	
	Reconstituting previous	Synthesized coherence (i.e., connecting unrelated pieces of existing knowledge)	The importance of body image in obesity management	
Structuring intertextual coherence	studies into a new context that goes beyond the embedded references	Progressive coherence (i.e., building up of an area of knowledge with considerable consensus)	Isolation of nitric oxide synthase upon discovery of enzymatic production of nitric oxide in the human body	
		Non-coherence (i.e., highlighting disagreement or controversial issues in an area of knowledge)	Benefits of intensive insulin therapy in type 2 diabetes	
		Incompleteness problematization (i.e., specifying gaps)	Determining the side effects of a newly introduced drug in real practice	
Problematization	Challenging the established context for some deficiencies	Inadequate problematization (i.e., criticizing existing literature for the inadequacy of some relevant perspectives)	Criticizing scarce literature on nitrate transporters despite a considerable bulk of data on nitrate's positive and negative impacts on human health	
		Incommensurate problematization (i.e., criticizing existing literature for misleading)	Falsifying Galen's theory of blood flow by William Harvey	

in the human body.²⁸ To more examples of progressive coherence in a given field, refer to the work of Ghasemi and Kashfi.²⁹ In non-coherence intertextual, works are cited to highlight disagreement in an important domain (controversial issues) and then propose a solution.¹⁸ An example of non-coherence intertextual is the benefits of intensive insulin therapy in type 2 diabetes.³⁰

In problematization, the researcher problematizes the established context as being deficient in some way; three strategies of problematization are incompleteness, inadequate, and incommensurate.18 In incompleteness, which is more common, investigators claim that literature is incomplete somehow, and their study could advance it.¹⁸ The hallmark of incompleteness problematization is the textual act of gap-spotting,18 the most common way of defining research problems.15,16 An example of gap-spotting is determining the side effects of a newly introduced drug in actual practice. In inadequate problematization, investigators criticize existing literature for being inadequate in some relevant perspectives, and its hallmark is the textual act of illuminating oversights.¹⁸ An example of illuminating oversights is scarce literature on nitrate transporters despite a considerable bulk of data on nitrate's positive and negative impacts on human health.³¹ In the incommensurate, investigators claim that the existing literature is wrong in some ways, and their study will correct them.¹⁸ In this sense, incommensurate is a disruptive mode of constructing research problems and differs from gap-spotting in the existing literature, a track-bound mode of constructing research problems that cannot actively challenge existing literature.16 An example is the seminal works of William Harvey that falsified Galen's theory of blood flow (blood flows from its origin in the liver to the heart and other organs) and proposed and demonstrated circulation theory.32

Conclusion

Research begins when a problem arises that existing literature has yet to solve. A problem is an obstacle that must be overcome to achieve a goal. Identifying the research problem is the most crucial and challenging part of the research process. The most common way of identifying research problems is by spotting gaps; a gap is something that has not been addressed, and a researcher believes that it should be addressed. This issue indicates that, in most cases, researchers create the research problem rather than find it.

Authors' Contribution

Conceptualization: Asghar Ghasemi. Supervision: Asghar Ghasemi. Validation: Asghar Ghasemi. Visualization: Zahra Bahadoran. Writing-original draft: Asghar Ghasemi. Writing-review & editing: Asghar Ghasemi, Zahra Bahadoran, Parvin Mirmiran.

Competing Interests

The authors have no conflicts of interest to declare.

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