RESEARCH 101 Booklet

Prepared by

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International Pharmaceutical Students' Federation

Table of contents

① Understanding Research in IPSF

The International Pharmaceutical Students' Federation (IPSF) is the leading international advocacy organisation that represents pharmacy, pharmaceutical sciences students, and recent graduates up to four (04) years after graduation from their first degree in pharmacy. For IPSF, research is a vital tool because it creates and generates evidence for all policy interventions in pharmaceutical education; all geared towards improving the health of the public.

The Federation aims to raise a generation of future pharmacists and pharmaceutical scientists who are versatile and knowledgeable in the basic elements of research. To achieve this, IPSF has developed the Young Researcher's Forum (YRF); an online platform for pharmacy, pharmaceutical science students and recent graduates to network, discuss and develop their research skills and initiatives.

This Research 101 Booklet aims to provide basic information and guidance on how pharmacy and pharmaceutical sciences students can improve their research skills and undertake initiatives. It is with great interest and hope that everyone who reads this booklet will be motivated to engage in life transforming research.

② Appreciating Research in General

Research is likened to a human device invented to push the limits of human knowledge and to improve the quality of life of individuals and a group of people. As an integral part of current trends in the fast paced world, it is commonly used by many, especially in relation to discovering new information or confirming previously discovered facts.

It is used as a basis of knowledge usually directed to solve problems, generate principles or develop theories. As a basis of knowledge, research aims to answer questions, without which the research will have no focus, drive or purpose.

In order to solve problems and generate principles and theories, research applies systematic approaches that entail collection of data, documentation of critical information, analysis and interpretation of that data/information, in accordance with suitable methodologies set by specific professional fields and academic disciplines.

2.1 Characteristics of the Research Process

- Applies a systematic approach which must be followed for accurate data collection. Rules and procedures are an integral part of the process that set the objective.
- Requires the practice of ethics and a code of conduct while making observations or drawing conclusions.
- Based on logical reasoning and involvement of both inductive and deductive methods.
- Requires an in-depth analysis of all data collected so that all results can be reasonably explained in the context of the process.
- Creates a path for generating new questions. Existing data helps create more opportunities for research.
- Analytical in nature and it makes use of all the available data so that there is no ambiguity in inference.
- Requires precision, accuracy and reproducibility as important parameters.

2.2 Importance of Research

The importance of scientific research can not be described with a few words or even many elegant quotes. Glorious scientists and researchers inspired us with beautiful words about scientific research and how it made and is still making the world a better place.

For example, the world's thoughts and theories of the solar system and the sun centralisation was totally wrong before the appearance of Galileo Galilei. With scientific research and a good observational system, Galilei corrected the false thoughts about many astronomical and astrophysical theories, and now he is considered as the father of astronomy. Jonas Salk, through a long process of scientific research, discovered the first polio vaccine, this saving many lives today.

The simple steps of research and observation allowed Alexander Fleming to initiate the era of antibiotics thereby saving millions of lives today.

Ernst Chain, Howard Florey and many other scientists have made achievements in the world of medicine and therapy. Endless tales in history can tell us why scientific research is important for humanity, as a long line of many unforgettable stories about scientists has shown the capability of research to shape the world.

To highlight a few importance of research, it:

- Improves living and wellbeing through discoveries and innovations.
- Corrects perceptions as well as expands them.
- Gathers information on subjects or phenomena we lack or have little knowledge about.
- Develops and evaluates concepts, practices and theories.
- Obtains knowledge for practical purposes like solving problems i.e. drug related adverse reactions.
- Provides hard facts which serve as the basis for planning, decision-making and evaluation.

As a student, early career pharmacist or pharmaceutical scientist, if you decide to start a research project, you will gain a lot of skills such as searching for information, acquiring knowledge, presentation skills, teamwork, writing skills and much more.

Involvement in scientific research will provide the opportunity to learn new topics and deduce solutions. This will help you inform action, policies and provide evidence-based interventions for making changes in practices and sciences. It will help improve your decision-making skills as it helps you to always gather evidence and alternatives to eliminate bias.

Despite there being a slow translation of research to implementation practices, it is worthy of note that research should be a key skill owned by all pharmacy and pharmaceutical sciences students. It is pertinent that even now and in the future, researchers should take a proactive step towards also disseminating research projects to policy makers, practitioners and the public.

Pharmacy research should link from the bench to bedside and always have the patient centered care approach while carrying out research beyond answering academic questions. Science and research-guided practice innovation is the way to ensure sustainable innovation for generations to come.

Research can be divided into two main types, based on paradigms which are concepts and procedures that need to be accepted and recognised by scientists working in the same field. These include Fundamental/Basic Research and Applied Research.

Fundamental/Basic Research

This research type aims to create an understanding of basic reasons related to specific subjects while using a technical language designed for those subjects. It will usually provide deep insight into a specific subject and why it occurs. It provides the needed help to discern the facts and extract the science-related explanation and logical conclusion behind it. It does not lead to solving practical problems. The conclusions of fundamental/basic research usually form the basis for applied research.

Applied research

This research type aims to solve specific problems by using known and widely acknowledged theories and principles. It studies specific problems or individuals without generalization and tries to identify the independent variable that will lead to a different, interesting and useful outcome. This research type determines the needed strategy to engage in a different outcome. It leads to a practical and frequent application of the outcomes.

> *Notably, fundamental/basic research and applied research can both be considered as quantitative or qualitative research.*

Quantitative research

In this approach to research, one makes numerical, quantifiable, and non-descriptive observations. It is based on statistics, mathematics and uses numbers in an iterative way, allowing for precise measurement of facts and making conclusive decisions. It can be used to compare two situations as correlations. It is an approach that is helpful when trying to figure out the "what", "where" and "when" of decision making. The results are often summarised through graphics and charts.

Qualitative research

This approach does not include numerical facts (numbers, statistics etc). The main purpose is a description and the tool used is language. Its objectives are to better understand, fathom and describe a specific subject or phenomenon. It aims to collect non-numerical data, which can not be expressed through graphics. This approach explores and determines the "why" and "how" of decision making.

Other types of research which exist include:

Mixed Research: This involves quantitative and qualitative procedures or paradigms. The data are usually a mix of variables, illustrations and language.

Conceptual research: This does not use any practical experimentation. This methodology is based on the study of already existing information and the knowledge obtained from another ongoing research and concluded one.

Empirical Research: This is focused on empirical evidence, that is the use of valid and confirmable information and data (graphics, numbers, statistics). The information and data can be either quantitative or qualitative. It does not include any theory. This approach of study takes into consideration direct and indirect observations and experiences. The goal is to design research to answer empirical questions using the collected information and data.

Analytical Research: It involves critical thinking skills and fact-checking to find new ideas and to make more correct assumptions. It is based on the compiling and evaluating of research articles, data and other important facts which are then used to support a hypothesis or idea. It can be used either to form new ideas or to support current research.

Descriptive Research: It provides answers for "what is this" questioning. It uses language as the main tool for expressing data.

Explanatory Research: This aims to apprehend or to analyse relationships by answering the question: "how every part of a situation is linked and related to one another?". It uses correlations to study relationships between dimensions or attributes of beings, groups, events or phenomena.

Exploratory Research: This is used in the first steps of a scientific research program and does not revolve around finding answers but more on identifying key issues and key variables requiring literature checking or some focus group interviews. This approach is used when studying a new phenomenon to allow for better understanding. It is mainly used to investigate the possibility of a large-scale study, but also to find the most appropriate methods to conduct it.

Longitudinal Research: This uses data collection as many times as needed through a specific period of time. It usually consists of cohorts or panel respondents. Longitudinal studies may be:

Trend study: Focus mainly on the same population, by analysing their attitudes over a specific period of time. Example: consumption of antibiotics rates during the course of a year.

Cohort study: Traces a specific population over time. Example: consumption of antibiotics rates for the senior population.

Panel study: Utilises the same sample taken from the same population in a given period of time. Example: medicines exportations track over the period 2000 – 2010 for the same starting group.

Cross-sectional Research also called one-shot research is an approach to research studies where data are gathered once, amid a specific period of time (days, weeks, months, years). Often, cross-sectional research is designed as exploratory or descriptive. They are schemed to analyse how the facts are now, while not taking into consideration if there is or was a history or trend at work.

Classification research aims to regroup different entities based on their differences and similarities.

Comparative research stresses out the differences and similarities between two units, phenomenon or cases.

Policy-Oriented Research aims to find effective solutions to stop or prevent a given problem.

Theory based research aims to test the validity of a theory, unit or process.

Action research combines taking actions and then analysing the effects of those actions.
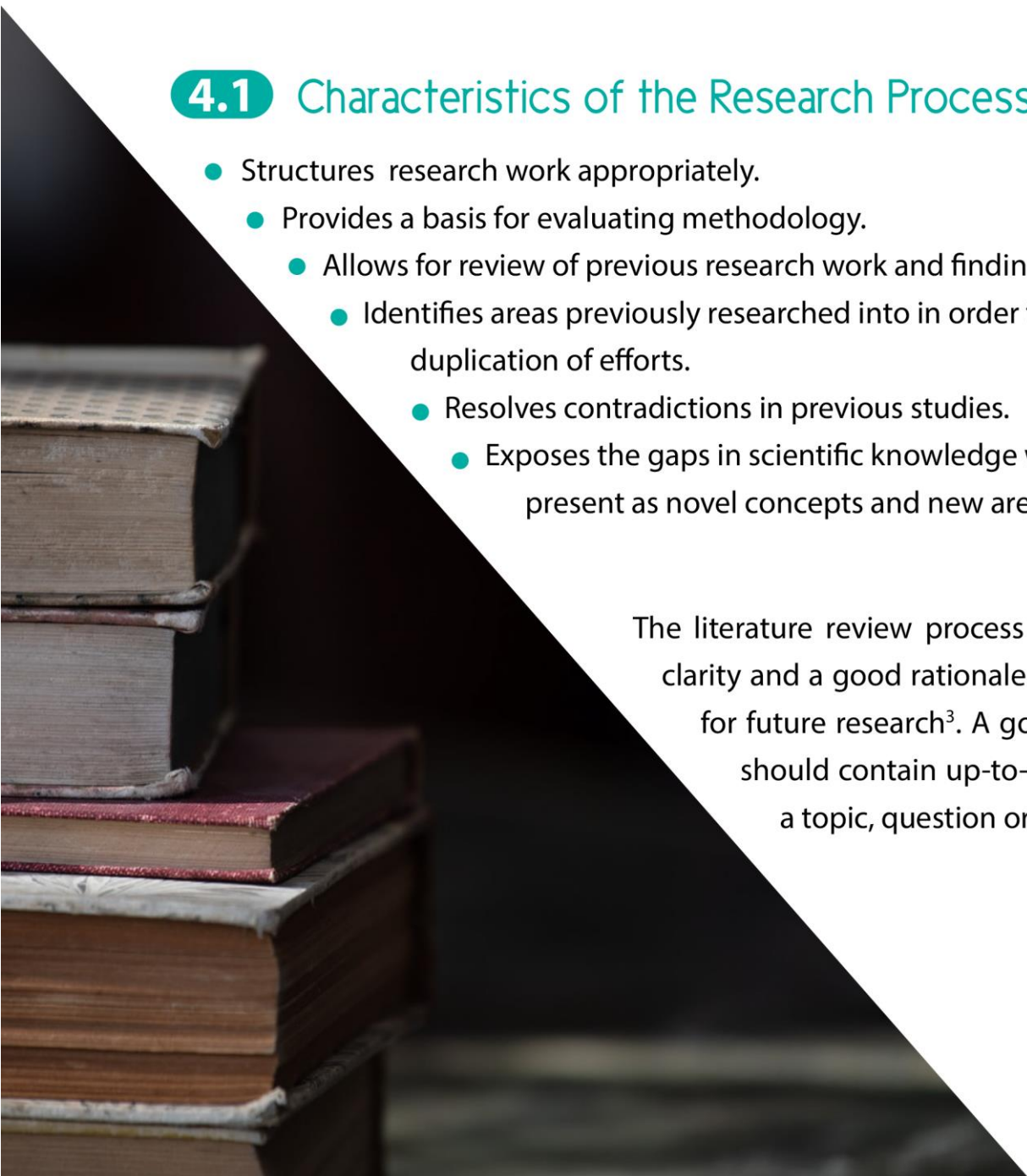
4 The Literature Review

The literature review process is one of the focal points of a research project. It is essential for the success of research work as it reveals the knowledge, information and observations available on a topic, idea or concept. A literature review is a compilation, evaluation and overview of what other researchers have observed, discovered and written on a particular topic, idea or concept. A well written literature review demonstrates the in-depth understanding a researcher has on a topic[1]. A literature review can be of two kinds:

An independent dissertation, or a stand-alone article, research work or publication;

An introduction that provides a theoretical foundation, background and justification for a study[2].

4.1 Characteristics of the Research Process

- Structures research work appropriately.
- Provides a basis for evaluating methodology.
- Allows for review of previous research work and findings.
- Identifies areas previously researched into in order to prevent duplication of efforts.
- Resolves contradictions in previous studies.
- Exposes the gaps in scientific knowledge which can present as novel concepts and new areas to work on.

The literature review process ultimately provides clarity and a good rationale on the way forward for future research[3]. A good literature review should contain up-to-date information on a topic, question or concept of choice.

4.2 Types of Literature Review

It could either be narrative, integrative, theoretical or systematic [1,2]:

A narrative (traditional) review appraises and summarises what has been written on a topic. It gives a comprehensive background for understanding available knowledge on a topic and identifying gaps or inconsistencies in a body of knowledge. It mostly provides a historical framework highlighting the reason why a study is significant.

An integrative review criticises available data (information) and generates a secondary opinion, perspective and idea on a topic.

Theoretical review focuses on different ideologies, concepts, phenomena, and theories on a topic. It reviews what theories exist, the relationship between the different theories, investigations into these different theories and developing new hypotheses.

The systematic review collates findings and research data across many studies. It involves the comprehensive collection, review and analysis of data (information) available on a topic. The data collected may be analysed using statistical methods (meta-analysis) or qualitative methods. Meta-analysis involves combining data with similar properties (e.g. similar statistical formula) from multiple studies into a simple quantitative estimate and analysing it using statistical techniques. Meta-analysis often calculates an average of the results from multiple research findings. This helps create a more precise and reliable estimate than those derived from individual studies.

4.3 Structure of Literature Review

The literature review should be well-structured by starting with an introduction that examines the different dimensions of the topic and gradually narrows down, focusing on the research question. The themes or subtopics in the review should be arranged in a sequential and logical manner that will assist in narrowing the focus to the specific research question.
A well-structured literature review will help communicate the writer's intended argument and convey the writer's in-depth understanding of previous literature to the readers. A substantive, thorough, and sophisticated literature review is required to produce a great research work. Therefore, equipping yourself with the knowledge on how to write a high- quality literature review is imperative to both the learning and the writing process.

4.4   Sources of Literature

Finding and reading the appropriate literature is an integral process in developing a good literature review and it will influence the effectiveness, credibility and authenticity of a research work. Reading the right sources helps in developing the appropriate outline, themes, subtopics, and focal points for the literature review. It also helps in structuring the literature review and creates a 'fluid' write-up with a natural progression in the writing process.

You, however, need to know how to locate the right sources and identify which sources are the most appropriate for your literature review. Sources for literature reviews include scholarly articles, essays and dissertations, encyclopedias, dictionaries, trade journal articles, governmental publications, credible national and international newspapers, magazines and articles. Information can be sourced from online databases at any University or college library website. Electronic databases (such as Google scholar, Science direct, Public Library of Science, Web of science, Medline, PubMed, and Education Resources Information Centre) can serve as extremely useful resources in the search for credible scientific literature.

5   Data Collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. It is an essential element and component of the research process in all fields.

The goal for all data collection is to capture quality evidence that then translates to rich data analysis. This allows for the building of a convincing and credible answer to questions that have been proposed or which will be the basis of the upcoming steps of research.

Data collection is the most critical stage in conducting research and important to maintain the integrity of research.

5.1 Requirements of data collection

Data collection is a very demanding task which needs planning, hard work, patience, perseverance and more to be able to complete the task successfully. It starts with determining what kind of data is required, followed by the selection of a sample from a certain population. After that, you need to use an appropriate instrument to collect the data from the selected sample. The data to be collected can be classified into primary and secondary data:

Primary sources are original data sources, in which the data are collected firsthand by the researcher for a specific research purpose or project;

Secondary sources offer an analysis of primary sources; they often try to explain the primary sources

5.2 Types of data

A. Qualitative data: This is usually applied in qualitative research methods and is mostly non-numerical and descriptive or nominal in nature. It addresses quality, so that they are descriptive rather than numerical. It is generally not measurable.

Qualitative data tend to use unstructured methods of data collection to fully explore the topic. Qualitative data collection methods play an important role in evaluation by providing helpful information to understand the processes behind the observed results.

Methodology for qualitative data

- Observational methods- data are collected through participants observation and interviews
- Document review
- Case studies and focus groups

B. Quantitative data: Quantitative data is numerical in nature and can be mathematically computed. It can be measured using different scales including nominal scale, ordinal scale, interval scale and ratio scale. The use of statistics to generate and subsequently analyse this type of data adds credence or credibility to it, so that quantitative data is often seen as more reliable and objective. It produces results that are easy to summarise.

Methodology for quantitative data

- Experiments and clinical trials
- Surveys with closed-ended questions
- Observation and records of well-defined events (related to numbers)

Data are analysed through numerical comparisons and statistical references

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6 Research Ethics

Research ethics are the moral values that all researchers must follow and comply with irrespective of their area of research. Ethics are reminders that help humanity to keep the standards of morals and elegancy. There are ethics also for scientific research that you need to know before launching your noble journey in the research field.

Before initiating any research, a researcher shall have good knowledge about the major ethical principles of research:

Honesty and values: Strive for honesty in all scientific communications. Honestly report data, results, methods and procedures, and publication status. Do not fabricate, falsify, or misrepresent data.

Beneficence: Researchers should have the welfare of the research participant in mind as a goal and strive for the benefits of the research to outweigh the risks.

Objectivity: Strive to avoid bias in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research where objectivity is expected or required.

Integrity and dignity: Keep your promises and agreements. Be sure to act with sincerity while striving for consistency of thought and action.

Carefulness: Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities, such as data collection and research design.

Privacy: Research participants have the right to control access to their personal information and to their bodies in the collection of biological specimens. Participants may control how others see, touch, or obtain their information.

Confidentiality: Researchers will protect the private information provided by participants from release. Confidentiality is an extension of the concept of privacy; it refers to the participant's understanding of, and agreement to, the ways identifiable information will be stored and shared.

Social Responsibility: Researchers and research must contribute to the well-being of society.

Non-Discrimination: Researchers should minimise attempts to reduce the benefits of research on specific groups and to deny benefits from other groups.

Competence: Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.

Legality and regulations: Know and obey relevant laws and institutional and governmental policies.

Animal Care: Show proper respect and care for animals when using them in research. Do not conduct unnecessary or poorly designed animal experiments.

Human Subjects Protection: When conducting research on human subjects, minimise harms and risks and maximise benefits; respect human dignity, privacy, and autonomy; take special precautions with vulnerable populations; and strive to distribute the benefits and burdens of research fairly.

Non-Exploitation: Researchers should not exploit or take unfair advantage of research participants.

Nonmaleficence: Nonmaleficence means non-harming or inflicting the least harm possible to reach a beneficial outcome.

Academic Integrity: This requires that researchers should ensure to avoid plagiarism and ensure to credit every source of information through appropriate referencing.

⑦ Dissemination of Research Article

It's one thing to conduct and write a research article, and it's another thing for the research to get the attention of the right audience. Dissemination of research involves:

- The right audience;
- Identifying platforms to reach the right audience;
- Deciding the best and most effective means to communicate with your target audience.

Your audience for scientific research is often professionals. This includes people that share similar characteristics in common with your participants, scholars who study similar topics and policy makers and stakeholders that work on areas similar to your research. Your target audience could also be the general public.

To identify the best platform to reach the right audience, you need to first determine your target audience. Your research will be relevant where your target audience is. If your audience includes professionals and scholars that study topics similar to your work, then academic conferences and symposia would be an excellent platform to share your research work. Academic and scholarly journals or newsletters will also help you reach the right audience. If you desire to reach the public, then a magazine, newsletter, website or blog would be great. This is an important step because the information given to scientific professionals is different from that given to the general public. Often, Scientific professionals require a more detailed and a more specific research work. Research results are useful in policy making at all levels and the stake-holders of policy making can be reached via advocacy groups.

You need to present your research project in the right way to get the attention of your audience. You can publish your research as articles in peer-reviewed journals and publications. You can also present them as oral or poster presentations in scientific conferences and symposia. Poster presentations require you to present your work in visual graphics using charts, tables, graphs, bulleted points and images. In presenting your research, you must adhere to the rules, guide-lines and format of the organisation, journal, or conference you will be presenting at.

As a member of IPSF, your research articles can be published in the Phuture scientific publication. The IPSF Regional Symposia and the IPSF World Congress are other platforms to share your research work with a large audience of pharmacy and pharmaceutical science students from all over the world through poster presentations.

8 Promoting Research Initiatives in IPSF

Promoting high quality research standards and skills among pharmacy and pharmaceutical sciences students is one of the goals of the Federation. To achieve this goal, IPSF has initiated various research activities and events that can promote research skills of its members as follows:

1. The Online Young Researchers Forum

2. The Offline Young Researchers Forum

3. The Educational and Scientific Poster competition

4. Research Webinar series

8 Links to Additional Resources for Research Writing

1. [Do you want to know more about the literature review process, its importance how to carry it out? Well this PowerPoint Presentation will help you out.](#)

2. [This link directs you to a power point presentation that examines the sources of literature review and also provides details on how to write a literature review.](#)

3. [This here is the link to a video that will help you understand what a Literature Review is, the purpose of a literature review and how it should be done.](#)

4. [This video guides you on how obtain relevant data for your literature review.](#)

5. [Are you having trouble paraphrasing. Well relax because we are here to help. This link directs you to a video that will help you on paraphrasing.](#)

6. [Practical steps to help you avoid plagiarism.](#)

7. [Free e-learning resources for researchers](#)

8. [IPSF EMRO Research Corner](#)