Topic ▶ The Research Problem
4

▶ INTRODUCTION

> **Problem:** How can we design a more user-friendly vending machine?

Problems for research are everywhere. Take a good look around you. We might see various kinds of vending machines placed everywhere. But have you thought of having a more user-friendly vending machine that is much more easier to use? Or, you might be frustrated waiting for a public transportation that never shows up on time and you wish somebody can come out with a better system that prioritises punctuality. These are examples of problems which need to be relooked and researched.

That is why we say that the heart of every research is the problem. Research problem is paramount to the success of a research effort. In ICT, the problems are broad and technology-centric. According to Powers, Meenaghan & Twoomey (1985), potential research questions may occur to us on a regular basis but the process of formulating them in a meaningful way is not at all an easy task. As a beginner, it might be easy to formulate a problem but it requires considerable knowledge of both the subject of interest and research methodology. Once you examine a question more closely, you will realise the complexity of formulating a research problem into something that is researchable. It is essential for the problem you formulate to be able to withstand scrutiny in terms of the procedures required. Hence, a student should spend considerable time in thinking to formulate a researchable research problem.

4.1 THE IMPORTANCE OF FORMULATING A RESEARCH PROBLEM

The formulation of a research problem is the first and most important step of the research process. This is more like identifying a destination prior to beginning a journey. A research problem is like the foundation of a building. The type and architecture of the building depends on the foundations. If the foundation is well designed and strong, you can expect the building to be strong as well. You must have a clear idea with regard to what it is that you want to find out but not what you think you must find.

A research problem can begin with something simple to something very complex, depending on the nature of the research theme. In ICT, with new emerging technologies, many research problems may be churned from issues in performance, reliability and daily user applications.
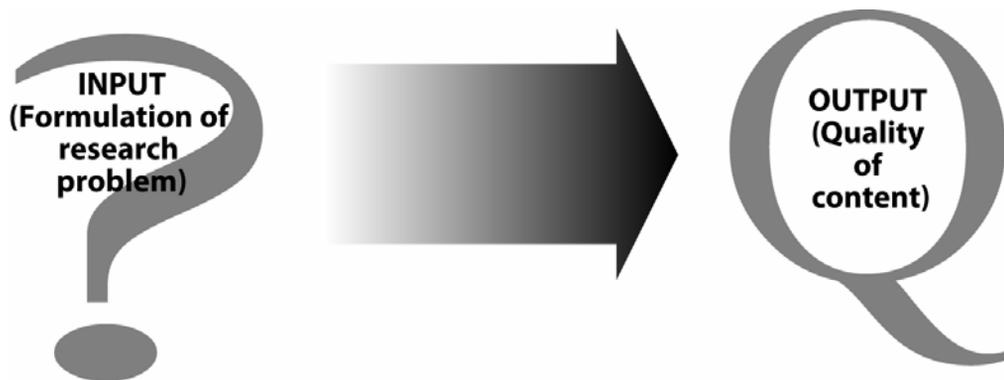
Figure 4.1: Relationship between research problem (input) and quality of content(output)

The formulation of a research problem is like the "input" for a research work and the "output" refers to quality of contents of the research report and the validity associated is entirely dependent upon it, as illustrated in Figure 4.1 above. As a student, you must remember that formulating research problem is the most crucial step. So take time in formulating your research problem because a clearer research problem means clearer research output and progress.

ACTIVITY 4.1

1. Describe why a research problem is the heart of the research process.

2. Research on the Internet. Find at least two problems graduate students face when they are doing their thesis.

Discuss both questions in the myLMS forum.

4.2 CONSIDERATIONS IN SELECTING A RESEARCH PROBLEM

When selecting a research problem for your study, there are a few factors which you need to consider. These factors will ensure that your research process is more manageable and you will remain motivated. Table 4.1 below shows the factors to consider in selecting a research problem.

Table 4.1 : Considerations in Selecting Research Problem

	Consideration Factor	Description
1.	Interest	• The most important criterion in selecting a research problem.
		• The whole research process is normally time consuming and a lot of hard work is needed. If you choose a topic which does not greatly interest you, it would become difficult to keep up the motivation to write.
2.	Expertise	• Before selecting a research problem, you need to ensure that you met certain level of expertise in the area you are proposing.
		• Make use of the facts you learned during the study and of course your research supervisors will lend a hand as well.
		*** *Remember, you need to do most of the work yourself.*
3.	Data availability	• If your research title needs collection of information (journal, reports,proceedings) before finalising the title, you need to make sure you have these materials available and in the relevant format.
4.	Relevance	• Always choose a topic that suits your interest and profession. Ensure that your study adds to the existing body of knowledge. Of course, this will help you to sustain interest throughout the research period.
5.	Ethics	• In formulating the research problem, you should consider some ethical issues as well.
		• Sometimes, during the research period, the study population might be adversly affected by some questions.
		• In ICT, some scenarios might occur especially research related information security, which might concern certain authorities. Therefore, it is always good for you to identify ethics related issues during the research problem formulation itself.

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SELF-CHECK 4.1

1. Define the importance of a research problem.

2. Explain **three** considerations when selecting a research problem.

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4.3 STEPS IN RESEARCH PROBLEM FORMULATION

In any research task, the formulation of a research problem is the most important part of the research process. The process of formulating a research problem consists of a number of steps. These steps are illustrated in Figure 4.2.
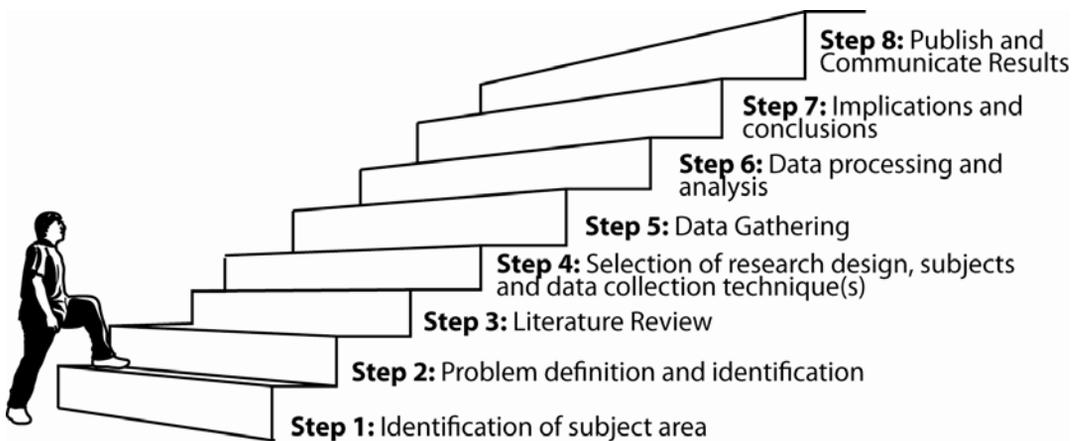

Step 8: Publish and Communicate Results

Step 7: Implications and conclusions

Step 6: Data processing and analysis

Step 5: Data Gathering

Step 4: Selection of research design, subjects and data collection technique(s)

Step 3: Literature Review

Step 2: Problem definition and identification

Step 1: Identification of subject area

Figure 4.2: Steps involved in formulating research problem

Step 1: Identification of Subject Area

Ask yourself what you like to do after your graduation or what field you would like to specialise in. This will help you to find an interesting topic. For example, if you are a computer networking student, inclined to work in the area of fiber optics network troubleshooting, information security, system administration or quality of services, you can carry out research in these areas.

Figure 4.3: Identifying the area of interest

Step2: Problem Definition and Identification

A problem should be identified in the ICT field that is close to your interest or related to your specialisation. A student should develop vast knowledge in his/her area of interest that is designed for a long-term accumulative process. For example, design and development on knowledge management framework for best practice of your organisation, qualitative analysis of customer and company's role in e-commerce, implementation of service-oriented architecture in supply chain management and so forth.
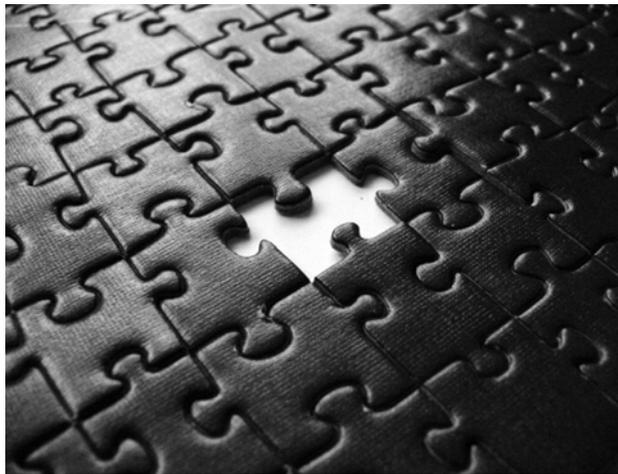

Figure 4.4: Identify problem in the area of interest

Step 3: Literature Review

The scope in ICT is huge and it is expanding. Therefore, it is important to have proper literature review in the area of study. Literature review can reveal similar investigations and suggest approaches in dealing with similar problems. For example, if you are interested in exploring web-based database management for specific application, you could start with textbooks in that area or books that are related to databases and web-based services. Textbooks could provide fundamental knowledge to start with a particular area. However, journals and theses could provide critical information as they review related literature. Journals and theses can reveal sources of data never known to you. It could also introduce you to significant research personalities whose research and writings are not known to you.

Figure 4.5: Review literature: books, journals, articles etc. to investigate existing work in your research area

For example if you are interested in software engineering research then you should read ACM Transactions on Software Engineering and Methodology and the Elsevier Journal of Systems and Software.

Generally, students tend to refer to other popular sources such as magazines and newspapers compared to journals and theses. Journals are presumed to be original investigation into unexplored areas of ICT since technologies in ICT become obsolete very fast. Thus, the challenge is to extract new ideas and methods that never occurred to you prior to starting your research. Leading edge research in ICT are broad and could be tracked accordingly in prominent journals such as IEEE Transactions and ACM.

Step 4: Selection of Research Design, Subjects and Data Collection Technique(s)

Upon deciding the research problem and having a clear idea of the related literature, the next step is to select and plan the research design, subjects as well as identify data collection techniques. Research design is crucial as it provides overall structure for the research procedure, the data that a researcher collects and the data analysis that the researcher conducts. It is planning that would ensure the success of your research by identifying resources, procedures and data always with the goal from the very beginning.

Step 5: Data Gathering

We understood that research design provides the design of the particular research and method of data collection to answer the research question we formulated earlier. For example, say one of your research questions is to measure the relationship between bandwidth and quality of service in university network. To answer this question, you have to collect data on the bandwidth capacity of all network infrastructures within the university area. This can be done using existing instrument or developing a software-based network analyser and administering it to a sample of network clusters. Here, in this type of data gathering, you will be using the quantitative data collection method. [We will discuss the quantitative approach in detail in coming topics]

On the other hand, if you are interested in the security and reliability of the university network, you may gather data on the types of firewall configuration and security attacks faced on the network. You can propose a new novel firewall framework with intrusion prevention system by using a structured observation checklist and recording all the occurrence of security attack on the university network. Here, you are using qualitative data collection methods. [We will discuss qualitative data collection methods in detail in coming topics]

Step 6: Data Processing and Analysis

Typically, in any field's research methodology, the data collected need to be analysed and computed to provide us inferential and interpretation on the problem. If the research question involves quantitative approach, statistical methods are used to analyse. The analysed data will be presented in tables and graphs. A researcher interprets the data in relation to the research questions based on the analysis performed. For the qualitative approach, information is coded, justified and presented with valid reasoning.

Step 7: Implications, Conclusions and Recommendations

Implications and conclusion are important justifications that every researcher should take note as part of the research process. The novelty of the work and contribution of new knowledge are seen in the implications and conclusion part of the entire research. Recommendations normally highlight a few potential research questions derived at the end of the research process and to foster new research continuation based on the findings. Now, we can see clearly that research is said to be helical or cyclical because research begets more research and one comes across additional problems that need resolving after a conclusion is reached.

Step 8: Publish and Communicate Results

Once the findings of the research are obtained, it is important for you to communicate with other fellow researchers and practitioners. The results should be published in journals and conference proceedings as these are platforms for interested parties to communicate and discuss on the findings. In the field of ICT, there are a few reputable journals like ACM, Elsevier and IEEE Transactions which could function as a wide-reaching medium to experts in a similar area. If you are a graduate student, you will most probably be communicating your findings in the form of a thesis or dissertation.This is an established format for presenting the findings of your research to the academic world.

Tips: Remember the first responsibility is to formulate a problem that is carefully phrased and represents the single goal of the total research effort.

4.4 SUB-PROBLEMS IN RESEARCH

While constructing your research problem, you might come across several sub-problems. Sub-problems are sub-parts of the main research problem you designed. As a student, you must be able to distinguish sub-problems that are an integral part of the main problem from things that look like problems but are nothing more than procedural issues. The latter is actually pseudo-subproblems which involve decisions the researcher must make before he/she can resolve the research problem and its subproblems.

> Students must remember clearly that pseudo-subproblems are not researchable problems.

There are **four key** characteristics of sub-problems:

(a)   **Each sub problem should be a Completely Researchable Unit**

- A sub-problem should constitute a logical sub-area of the larger research undertaking.

- Each sub-problem might be researched as a separate subproject within the larger research goal.

- The solutions to the sub-problems, taken together, combine to resolve the main problem.

- It is essential that each sub-problem be stated clearly and succinctly (expressed briefly and clearly).

- Often, a sub-problem is stated in the form of a question because it tends to focus the researcher's attention more directly on the research target of the sub-problem than does a declarative statement.

- After all, an interrogative attitude is what marks a true researcher.

(b)   **Each Subproblem must be Clearly Tied to the Interpretation of the Data**

- At some point in the statement of the sub-problem – as within the main problem – the fact that data will be interpreted must be clearly evident

- This fact may be expressed as a part of each sub-problem statement, or it may occupy an entirely separate sub-problem.

(c)   **The Subproblems Must Add Up to the Totality of the Problem**

- After the sub-problems have been stated, check them against the statement of the main problem to see that nothing in excess of the coverage of the main problem is included.

(d)   **Sub problems Should be Small in Number**

- If the main problem is carefully stated and properly limited to a feasible research effort, the researcher will find that it usually contains two to six sub-problems.

- Sometimes, the inexperienced researcher will come up with as many as 10, 15 or 20 sub-problems.

SELF-CHECK 4.2

1. What are the steps of research problem formulation?
2. Differentiate between research problem and sub-problems.

KEY TERMS . . . .

Problem definition   Sub problem

Research Problem

DISCUSSION

1. Do yo agree that formulating research problem should be the first thing to do in undertaking a research project? Discuss.

2. Discuss some ICT-related research problems that you are interested in pursuing. Construct a statement of research problem at the end of your discussion.

3. List any manageable sub problems of research based on your designed research problem.

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