

## Requirements for a Postgraduate Engineering Student Before and During Starting Research

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**Abstract:** The need for knowledge, skills and techniques are essential to every graduate before starting research. This is an important element of real and often identical with the necessary skills available to a researcher. These three elements are vital in ensuring all objectives are achieved to give maximum impact to students and institutions. Knowledge will guide students to complete their research and achieve every objective. Skills the basic requirements are needed throughout the study in order to make it smooth. Technique is every achievement will result a maximum output. This study is discussing these elements as a requirement for every postgraduate before and during starting a research.

**Key words:** Postgraduate engineering students, research, skills, techniques, objectives, Malaysia

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### INTRODUCTION

Postgraduate programme refers to programme after bachelor degree in master or doctorate programmes. It can be done either by course work or by research or both. Duration for master programme is usually from 1-3 years and for doctorate programme, 3-5 years. Malaysia is one of the most popular destination countries for graduate students who aim to pursue studies and earn master and doctoral degrees. International students who choose to study in Malaysia said that pursuing postgraduate degrees at in universities in this country is a wise decision because there are many perks and advantages. It is estimated that there are about 50,000 foreign students in Malaysia. Most of these students are taking post-graduate studies. There is a great percentage of postgraduate students coming from Middle Eastern countries. Experts believe that such students decide to study in Malaysia because of the similarity of cultures. As an Islamic country many laws and policies in the country are almost the same as those implemented in other Muslim countries, particularly those from the Middle East (Sanders, 2011). At the same time, public universities offer more postgraduate courses that are highly attractive to

students. Public universities are government-funded research universities. The inventions, study findings and researches made at such universities are supported and utilized by the government. Thus, it is expected that there are enough resources that these universities can use to improve and maintain their operations. Being responsible adults, it is assumed that postgraduate students are mature individuals and are not troublemakers. That is why the country is very fond of inviting and convincing international students to get by and enjoy studying at its local universities. Postgraduate students are also highly productive and contributing to the overall improvement of the country's education system. Malaysia believes that as the number of postgraduate students in the country increases, the credibility and reputation of Malaysian universities are boosted. There are many reasons why postgraduate students are advised to study in country. Malaysia is a good tourist destination and now, it is also a good venue for pursuing post graduate studies.

**Engineering study:** Most of the international students studied in Malaysia will probably do their studies in either Arts or Science. Although, the daily life might be quite similar for Arts and Science students but there are still

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some significant differences between these two. For example, the kind of academic writing assignment as well as the teaching method might be different.

Therefore, the students who planned to do their studies in Science, Technology and Engineering need to aware and realize the expectation of these courses. In this study, you will be able to identify some of the particular skills required by the students studying in Science, Technology and Engineering based subjects as well as what kind of writing tasks that need to do by these students (Anonymous, 2011a). There are thousands of challenging activities in various areas like research and development (R&D), design, manufacture and operations of products and services in this engineering field. Demand for good engineers is high especially in Information Technology (IT) and electronic sectors as the unemployment amongst professional engineers is lower than for almost any other profession.

Engineering degrees offer a huge number of career opportunities with graduates in almost every sector of the economy.

For examples, in electrical, civil, mechanical, chemical, software information and manufacturing engineering. Within each of these fields, there are opportunities in research, design, development and tests as well as management, production, marketing and sales. Furthermore, it also can provide a passport into the world of education either as teacher, trainer or lecturer. The environment in this field is very interesting and dynamic because new material, technologies and processes are being developed everyday. It may offer an international career opportunity with increasing globalization new markets and changing employment patterns (Anonymous, 2011b).

**Elements requirement to strengthen the research**

**Knowledge requirement:** To achieve a good result in research, a postgraduate student has to know certain aspects such as types of methodology and the tool, types of seminar that he/she can participates, types of exhibition that he/she can involves, types of fund or scholarship and the most important thing is types of journal that he or she may submit his/her manuscript.

This knowledge may contribute in generating a research output into high impact journal publication. Figure 1 shows types of knowledge that has needed into every postgraduate students that will help them successful in their research. All those information’s can be seek from the talk with supervisor, attending seminars and an online searching like shown in Table 1.

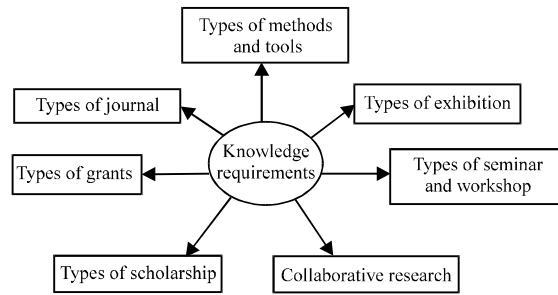


Fig. 1: Knowledge requirement for a postgraduate student in assisting to achieve research objective and contribute into high impact journal publication

Table 1: Element requirement and delivery method to obtain the element

Elements	Delivery methods
<b>Knowledge</b>	
Types of research method and skill	Workshop and seminar
Types of exhibition	Briefing by supervisor
Types of seminar and workshop	Briefing by supervisor and online searching
Types of journal	Briefing by supervisor and online searching
Types of scholarship	Briefing by supervisor and online searching
Types of education grant	Briefing by supervisor and online searching
<b>Skill</b>	
Technical report writing	Workshop and seminar
Effective presentation	Workshop and seminar
Time management	
Effective communication	Workshop and seminar
Record	Workshop and seminar
Criticize	Solid reading and research
Graphic	Workshop and seminar
Software analysisation	Workshop and seminar
Mathematic	Comprehension and practice
<b>Technique</b>	
Multi dimensional assessment	Workshop and seminar
Stress relieved	Workshop and seminar
Quick reading	Workshop and seminar
Writing proposal	Workshop and seminar
Creativity	Comprehension and practice
Quick writing	Workshop and seminar
Planning and strategy	Seminar and workshop

**MATERIALS AND METHODS**

Generally, there are two types of methodology which are quantitative and qualitative. The quantitative involves calculation and data observation from experiments. Meanwhile, the qualitative method concentrates on surveys and perception towards research subject. From the history of knowledge development, these two methods are related and not separated to each other because the objective of knowledge is to find the truth. The separation of knowledge development occurred in 19th century when the West separated the knowledge into different premises. Therefore, modern researchers have to make an attempt to integrate all these methods

because the excellence of research output can be seen through two dimensions which are numerical and perception. For example, a product is considered the best product because of the quality that has been sustained continuously research and development. It was dissimilar for a product from a new company compared to an established company (Fig. 1).

Three general approaches to achieve the objective of research are simulation, analytical modeling and designated prototype or an experiment. These approaches may have the limitations or benefits. It may result into the operation cost so the selection has to be according to grant size or the allocation provided. In simulation tool, using right parameter may result an ideal output and it can be used as benchmark to experiment another methods. Result from characterization of other method will be compared with simulation result to get deviation from ideal condition. Thus, the cost from this kind of experiment is usually low and applicable for medium size grant. Analytical approach will be taken when characterization process cannot be done from simulation. For example, an attempt made to cascade of subsystem into thousands and more. This method is not practical using tool or simulator but it can be done with analytical method. The realistic research approach is the availability of an idea to be developed by using tool's experiment. It has been considered on factor such as contamination and atmosphere effect towards developing system connection. The strength of a research project is research methodology or developing prototype that has been used. However, this approach needs an intensive research and high cost for development.

**Types of journal:** One of maximum publication catalysts is database development. Database refers to accumulation of journal information like URL, ISSN, Scope, guides for researcher, impact factor, manuscript template etc., in one folder. Every folder refers to one journal. The database should be improvised from time to time and give it to every student. It is very useful for students to use the database in helping them submitting their manuscript for publication in order to understand very shortly. Every information that is needed is inclusive in the folder. In beginning, the database can be set up in 2 or 3 days workshops to gather all the information and need to be upgraded regularly. Activities related to journal publication can use the information from the database in catalyzing their writing. Every folder has all these information's as:

- Journal information (URL, ISSN, impact factor) and scopes

- Guide to researcher
- Method of submission
- Template (Microsoft word, Latex )
- Sample of letter submission
- Copyright form
- Necessity items needed in submission process

For a student who has submitted an article to the respective journal but was not accepted, try harder and do not give up until the article is accepted and ready to be published. The article may be restored in database and can be used by other students to guide them in submitting an article to the respective journal publisher.

**Collaborative research:** Prototype development usually demands high cost for development and characterization. Besides that a researcher should plan from pre-processes until the execution. Several methods that may be used to reduce fabrication cost and characterization process are listed as:

- Develop collaboration with institute or company who has adequate equipment
- Deliver sample to institute or company who has adequate equipment
- Rent the necessary equipment

**Types of scholarships and research grants:** Full commitment but lack of financial support will affect the research activity. There are two types of financial support like allowance for student and grant to buy raw material to complete the research. Apart from technical knowledge, every student has to know how to get financial sources. Student must be active in finding all the information on scholarship or grant like duration of offering, requirement and so forth. Student must be eager to find financial support and do not rely on university grant or supervisor. It will give advantage to them in future. Without financial support, success is not your dream (do not even dream of success).

#### **Skills requirement**

**Mathematics skill:** Today, a wide variety of disciplines require their students to have knowledge of certain mathematical tools. Students from biological sciences, finance, business and management now find that they routinely need to perform calculations which require them to have a firm understanding of basic ideas in algebra and calculus.

Some employers use standard mathematics tests as a screen for recruiting graduates regardless of their degree discipline. There is a wealth of mathematical material in

many books, handouts and other resources but getting the most from these requires a particular approach. The following points may help you to develop your own mathematical skills:

- New ideas are built upon existing ones
- Learning mathematics needs active participation
- A lot of practice is required
- Technology can help you to learn

**Criticize:** Criticize is another skill that student needs to develop during the research. This skill depends on the depth of understanding and knowledge in the certain topic. It also applied during thesis and journal writing. Every result has to undergo MDA technique and then criticized with helpful critic. As a result, the output will be viewed in a different way (Zain *et al.*, 2011).

**Graphic:** Seminar presentation, exhibition and technical report presentation need interesting and presentable slide shows or layout to attract audience or judges.

**Technical report writing:** As a student or an academician, every significant result should be published either in proceeding or journal. These two publications have their own credibility. Journal publication is more competitive and has higher impact. It needs innovation, well-motivated and novelty inside the study (Lee, 2011). Thus, an established research group or university is evaluated by number of publication per year. In Malaysia, reward system is built to motivate and encourage lecturer to publish journal and it depends on the quality of journal that has been published. Proceeding is more linear compared to journal and every manuscript submitted need to present. Every activity in organized proceedings typically participated by researchers around the globe. The most promising benefit in joining proceeding is widening collaboration with researchers that may contribute high impact research in future.

**Presentation and communication:** Presentation and effective communication is a channel to convey information about research progress to co-researchers or other parties. A variety of comment and input can be recorded through a good presentation and interactive. An enhancement can be done to upgrade the research quality and manuscript and publish in high impact journal (Fig. 2).

**Technique requirement**

**Multi Dimensional Assessment (MDA):** Multi dimension Assessing (MDA) is an approach to maximize research output from the research activities. MDA can be achieved

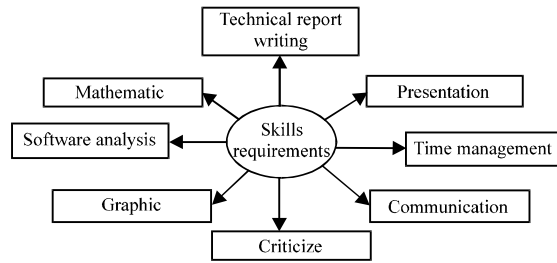


Fig. 2: Skills requirement for a postgraduate student to guide them in their research and channel, the results into impacted channel

through research and result like graph from different point of view or dimensions (Ab-Rahman, 2011). It also may applied achieving one objective and simultaneously solve other projects in one time (Ab-Rahman *et al.*, 2011a). Thus, small output result can be modified to obtain big impact output. It is desired from researcher’s creativity as well as widen knowledge in certain field or may be through joint venture with researcher from different field. A variation point of view may be transcribed into innovative product like technical study writing such as journal, post-proceeding or patent.

**Creativity:** K<sup>+</sup> component or creativity in ensures the result from research can be published maximum. K<sup>+</sup> component is very important because it will ensure every article has different quality and focus. Result like graph or table can be published again but with different focus and elaboration from the previous research.

In conclusion, K<sup>+</sup> component is important to execute MDA. Ab-Rahman *et al.* (2011a) mentioned creativity is a must in research area and contributes to achieve the objective of research. MDA also has been applied to undergraduate students in my classroom. Reseracher have introduced one algorithm to represent a system and students are required to study the connection every parameter and to determine the mathematic formulae or the limitation from the system. According to student report’s, there was a quality report that has been submitted.

From the report, an enhancement of the report has been upgraded by research assistants and later was successfully sent to four index journal publications in SCOPUS. Apart from contributing 0.01% towards publication University’s KPI, an innovative in lecturing can be applied to intensify on teaching and learning.

**Record:** Record is an activity performed over the years, i.e., during prehistoric times longer. Many studies and

photographs that were carved on rocks, caves so that they can be delivered from time to time. The world's holy book the Koran can be handed down until today is because of initiatives from the practitioners of/scholars in the past which recorded a revelation.

**Express writing:** Express writing have always received a lot of comments from my students that she/he is not capable or experienced to write an article. In this situation, a supervisor must be wisely to solve this problem.

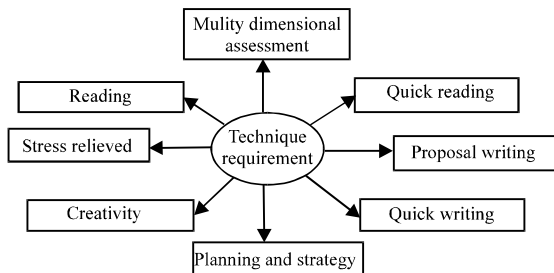


Fig. 3: Technique requirement of a postgraduate student will help to ease research on going progress as well as channeling the result to the impactful channel

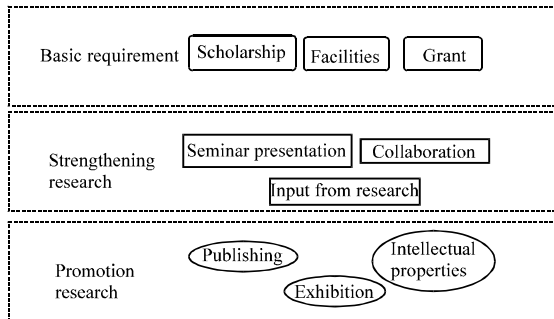


Fig. 4: Requirement of the elements based on research basis

Benchmark refers to other research as a target. It is also applied to journal writing when using other outstanding study a reference. It is called express writing when it can be done fast. How can it be done? Through continuous reading and analyzing technical studys, proceedings, journals and recently published books may expose reader's mind to develop a new idea inspired by earlier research. To achieve express writing, use an article similar to your idea from a reputable journal. Let the journal as the benchmark to your writing. Follow the style of writing and journal appearance because it has been through referee process and successfully published. But bear in mind, plagiarism is banned and using any words inside the journal need citation. Data like graph or table have to refer to the journal. If the data is not enough, researcher needs to do more experimental work abiding to the style of the journal.

**Planning and strategy:** Lanning and strategy is important when arranging task that need to be achieved in a smart and efficient way. Planning refers to plan that arranged according to interest hierarchy or priority to achieve the objective. Strategy is a planning to achieve the objective using the best method through the best way and safe. These two elements are important for a student to succeed in research and using the result in a maximum way.

Ab-Rahman *et al.* (2011b) stated that strategic planning with guidance of supervisor may help the student throughout their research activity. A supervisor will guide the student stays orderly in the right pathways of his/her research. Time table can be used to mark achievement every semester, month or week. Arrangement of every objective must be clear and organized according to size and level that has to be completed (Fig. 3 and 4, Table 2).

Table 2: Requirements of the research and elements that contribute to the requirements

Requirement	Element needed	Explanation
Scholarship application	Proposal writing	Financially support the students during the duration of the study/research. The proposal prepared must be convincing that the project will succeed and give high impact to the society
Grant application	Proposal writing Planning and strategy	Providing facilities for the researcher to achieve the research objective. The proposal prepared must be convincing that the project will succeed and give high impact to the nation and society
Presentation	Effective presentation	A good and effective presentation will give impact to the presentation objective thus increasing the research market capability and the result
Collaboration	Effective presentation Effective communication	Collaboration enhances the quality and quantity on output of the research. Large network will result to an expanding collaboration
Journal writing	Multi Dimensional Assessment Analyzing software Quick reading Mathematic	The acceptance of an article to be published in a quality journal is subjective. It needs to be refined with certain techniques in order to enhance the quality to be published
Exhibition	Effective presentation communication Graphic	From this exhibition, the result of this research can be presented to the public and get rewarded as well as attracting interest from others to bring it to the higher level to add its commercial value

## CONCLUSION

For those who are pursuing their doctorate and going to register next semester, remember that the actual life starts after we obtained a PhD because from there you will begin your own empire and practice all the acquired knowledge and further implement the ideas generated during the learning period.

Please bear in mind, the more time you spend for your PhD, the more powerful person in the future we will be. Therefore, during the study duration, mastering of the elements explained in this study is very important because it might be useful for us in the near future as an academician or engineer since, any arising matter need to be handled professionally through research (identification, testing, solution, presentation).

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