



QUALITY PhD RESEARCH - SOME PRACTICAL CONSIDERATIONS

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Abstract: Research or PhD research is a systematic study and experimentation that can generate new knowledge or findings which can directly or indirectly be useful for the developing of society. Research may also involve developing new theories, or application of theories that are beneficial to many. Quality research involves performing the steps in research including problem definition, review of related research, design, experimentation, testing and verification of results and making conclusions following scientific methods and systematic procedures. Quality in research is essential as the findings may be used by many researchers to extend the research work resulting in new findings. In this paper some practical considerations in all the phases of research such as providing the basis for understanding the proposed work, highlighting the need of proposed research in view of existing related work, design of appropriate methodology for solving the proposed problem, experimentation with relevant data, systematic testing, verification and interpretation of results and making correct conclusions are presented. It is concluded that research performed with correct and required focus on each phase and following systematic procedures can lead to quality research.

Keywords - PhD, Quality research, Originality, Practical considerations

I. INTRODUCTION

Research is the systematic study and investigation in a particular field in order to establish facts and reach new conclusions. Thus, research results in contribution for the potential transformation of existing knowledge or creation of new knowledge in a particular discipline. Research leading to development work produces products. Useful and quality products are produced with quality research. Research is produced mainly as a part of doctoral research or PhD (Doctor of Philosophy). It is awarded to a candidate who has submitted a thesis or dissertation based on original research in their chosen field and successfully defended the thesis in viva-voce examination. Thesis or dissertation is a systematic documentation of PhD research work. PhD dissertation reflects the quality of research. Quality in research is achieved when scientific procedures based on principles and standards are followed.

According to the University Grants Commission (UGC) report (2019), there is a great concern in academic and professional bodies all over the world on the quality of research. Due to large number of PhDs, and subsequent issues of the quality of research, there is an urgent need to take corrective measures to improve the state of research in India. High quality of research covers all aspects of the study that enables to arrive at reliable answers for the pertinent research questions. Quality research significantly enhances the prevailing knowledge base and creates new knowledge. Quality research is characterized by (i) question(s) to be investigated, (ii) independent, objective and transparent approach to the research problem, (iii) use of appropriate methodology to address the research problem, (iv) proper conceptualization and operationalization of research, and (v) involvement in disseminating ideas through publishing papers in reputed national and international journals and attending conferences [1].

There is a need to develop strategies and take necessary measures for enhancing research and promoting research quality at higher educational institutions in India. A number of measures such as innovation in methodology, design, and goals of research; maintaining integrity, and following ethics in research are important for research quality [2].

There are mainly three types of research namely basic, applied and empirical. Basic or theoretical research is the foundation for new ideas generated due to a candidate's curiosity or interest in a scientific question. Theoretical research leads to a greater understanding of the science behind experimental results. Basic research lays down foundation for applied research. Applied research employs established theories, knowledge, methods and techniques to solve practical problems of the real world. Empirical research is done to clarify and test the theory. Empirical research tests the feasibility of a solution using empirical evidence, i.e., evidence based on observation or experience rather than theory. Irrespective of the type of research, systematic study and scientific methods play an important role in quality of research. A researcher with an analytical mind, curiosity, commitment, patience and excellent written and verbal communication skills can produce quality research.

II. REVIEW OF RELATED RESEARCH

According to authors in [3], a PhD should make an original contribution to knowledge. Originality can be achieved through solid foundation of theoretical concepts, knowledge synthesis and involvement in research. Originality in science, technology, engineering and mathematics subjects is often inferred if the work is published in reputed journals. The authors mention that for a good PhD, the research question and objectives must be well defined. PhD students must be able to clearly justify the decisions regarding the methods chosen and employed for the proposed research question.

Clinton Golding et al. [4] reviewed 30 articles and identified common practices of examiners and their expectations on theses. They collected data from different disciplines, multiple institutions and different countries. A thesis examiner is an academic who reads the finished thesis and gives a report. They mentioned that examiners read with academic expectations and distracted by presentation errors. Examiners favour a thesis with published work. An original contribution is generally publishable. Original and creative work with high level contribution to knowledge provides quality to research. An original contribution might lead to a new area of research, or introduce a new method or new theoretical concept. A thesis can make original contribution by collecting new data which lead to new findings and conclusions or by providing novel interpretation of established data, theories, or conclusions.

They further mentioned that examiners expect good introduction, literature review with analysis and interpretation, and a logical structure that integrates and connects various parts of thesis. Examiners expect the thesis candidates to address a gap in the literature and argue that their results and conclusions are worthwhile and make an important contribution to the literature. Examiners are particular to check whether the thesis does what it stated would be done. Examiners want thesis candidates to critically discuss their findings and also compare with other researchers' findings.

In [5], C. Golding mentioned a number of important issues a researcher has to focus, while writing a good thesis. These issues are addressed based on examiners' expectations of a thesis [4]. For example, introduction and review of literature are to be written and re-written to give a good impression in the beginning itself. The thesis must be clear, interesting and convincing without any mistakes. Each chapter in the thesis must contribute to overall research. Literature review must be such that it can show how the proposed work of the candidate is a contribution to the existing related work. If any new method is proposed, it is to be justified that proposed new method can address the research problem in a better way.

In [6], the authors presented a case study of the Pakistani universities for assessment of PhD research. They observed that though the quantity of number of PhDs is increasing over the years, there is hardly any improvement in quality. They also suggested a number of measures to improve the quality of PhDs. Some of the measures include the need of originality and creativity in research work, required to read several good quality theses and other relevant publications by the PhD candidates, essential to understand clearly the usefulness of research and the new component that will be added to existing knowledge due to their research.

Bani B, Ganguly [7] discusses the quality of PhD in biomedical sciences that will help to implant policies for continual improvement. He expressed concern that though quantity of PhD theses is increasing, the quality is not satisfactory. According to him, the quality of PhD depends on capabilities of the candidate, academic achievements of the PhD supervisor, and the examination system of PhD granting university. The author emphasized that a PhD candidate needs to have perseverance, determination and logical aptitude in work. He listed a number of points to assess the performance of the candidate such as problem-solving skills, ability to evaluate and synthesize research literature, and capability to effectively communicate research findings. He also listed a number of characteristics of a good thesis. A good thesis contains clearly stated research aims, well presented tables with illustrated figures and graphs, and findings that make a significant contribution to the field. Finally, he concluded that a researcher with a good PhD can occupy an important position.

In [8], Vijay Kumar and Elke Stracke mentioned that there are two components in examiners' reports on theses. One is summative assessment, where a judgement is made about whether the thesis has minimum standards required for the award of the degree. The second one is formative component where examiners provide feedback to assist the candidate to revise the thesis or to improve the quality.

III. GENERAL CONSIDERATIONS FOR THE QUALITY OF PhD THESIS

The steps in PhD research include fixing a title for the proposed and useful research work to be undertaken, introduction to the proposed problem to justify the need of undertaking the problem, understanding the existing work and making a critical review of it, following suitable methodologies to solve the problem with high level and low level designs, testing and verification with existing standard datasets or collected real time datasets and making correct conclusions and finally writing thesis or documenting all the work performed in these steps.

There needs to be connection among the steps and each preceding step is a pre-requisite to the following step. To have quality in research, special considerations are required in each step. For example, before fixing the research problem, one must acquire thorough knowledge about the problem area and the sub area to which the proposed problem belongs to. After fixing the problem, the researcher must perform systematic review of related work done by other researchers that is published in standard journals and other authentic documents. The thesis must be without grammatical errors and with correct spellings, and presented in an interesting manner. The objectives mentioned in the start of the thesis must be fulfilled at the end of the thesis.

The researcher must highlight the research component involved in the proposed work and needs to explain adequately regarding the approach adopted, datasets generated, results obtained, verification techniques used and conclusions made. The candidate is not supposed to assume that the examiners can understand without explanation. Wherever required it is necessary to include both the positive and weaker aspects. It is important to provide the scope of the research. In the Scope of research, the candidate has to mention clearly what is included in the research work and what is not included.

Due to lack of required standards and focus on each step, quality may be lacking in research. As the thesis is a reflection of work done, the thesis must include what is done rather than what can be done or what will be done. Though the selection and use of appropriate tools is important, one must give due importance to proposed methods and techniques rather than tools used in the explanation. Due to deviation from the above mentioned requirements, the thesis may not reflect the actual work, or there can be very less research component or the work may include only the application of some software tools. As a result, the research thesis may lack the required quality and may not qualify for a PhD degree.

IV. SPECIFIC CONSIDERATIONS WHILE WRITING PhD THESIS

4.1 Practical Considerations while writing Introduction

Introduction establishes the basis for research. It provides the meaning and interpretation of terminology used in the proposed title and the overall gist of the title. Applications, uses, and objectives of the proposed research are also to be mentioned. Objectives provide the detailed steps of how to proceed to reach the goal or solution of the proposed problem. Thus, introduction needs to establish the high level purpose of the research and also required to justify why the proposed research is important to perform. To provide correct and relevant information in introduction, the researcher must acquire knowledge of the area and sub area of the proposed work from relevant books, good quality theses, journal publications, and other standard published documents. After acquiring sufficient background, only required material that is related to the proposed problem is to be provided in introduction. Care must be taken not to repeat the sentences from the referred material but to write in own words the acquired information which is converted to knowledge.

4.2 Practical Considerations for Review of Related Work

As introduction focusses on the need of the research work in a general sense, whereas review of related work focusses the need of research work in a specific sense. Researcher must be aware of existing research related to proposed work, relevant methods and techniques, and software tools. Review of related research lets you know the state-of-the-art research in the proposed area in general and in the proposed problem in particular. Review is useful to establish that proposed research is required in view of existing research. This is possible by highlighting the issues or shortcomings in existing work. With extensive review, one can get sufficient background to claim that the proposed work is different, relevant and advantageous compared to similar existing work. Based on the proposed problem, review of related research can be structured into different parts; the parts may include review related to problem, techniques, tools, data sets, and verification methods.

4.3 Practical Considerations for Methodology

Once it is established that the proposed research is useful in view of existing research, the methodology to solve the problem is to be presented. This is possible by making high level design in which the modules used and the interconnection of these modules are depicted. The functionality of each module is to be described. In the low level design, the implementation of functionality of the modules and communication among the modules are to be mentioned. The methodology may also consist of a design in which high level and low level designs are combined. There may be many approaches to solve the problem. You need to provide logical justification for selecting a specific approach.

The design may consist of functionality design input/output design, and test case design. In presenting designs, along with diagrams, explanation of diagrams is essential. In functional design, algorithms proposed are to be explained, If the proposed method or algorithm is a modification of existing one, it is to be clearly mentioned how the proposed one is different from existing one, and how the modification contributes to improvement. Depending on the problem, data design may include details regarding input data used. For extensive testing of the results, test case design is required. Different test cases must be considered to cover all possible alternatives of the proposed methodology. For verification of the results different metrics such as signal to noise ratio and confusion matrix may be used. Metrics suitable for the problem are to be decided.

4.4 Practical Considerations for Testing and Verification

After proposed methodology is explained, experimentation with relevant data sets is essential for testing and verification of the proposed work. There may be standard datasets freely downloadable. Data set can also be obtained by collecting real time data or creating simulated data. Testing may be performed using both standard dataset and created data set and the results can be compared. Depending on the problem and depending on the algorithm the dataset size can be fixed. Testing with too less data is not desirable. The results obtained can be verified based on standard metrics already planned in the design. The results can be depicted in tables as well as graphically. Without tabular data, displaying a number graphs cannot serve the purpose. Careful and selective presentation of tables and well illustrated graphs contribute to good thesis. The detailed interpretation of results is essential as they contribute to research findings. Justification is to be provided to conclude that research findings contribute to literature. Findings that make a significant contribution to the field adds quality to research. The research findings are to be related and compared with what other researchers have already found with similar research.

4.5 Practical Considerations for Conclusions and scope for further work

The research work performed may be included briefly without much elaboration. Conclusions are to be made from the work performed and results obtained. Conclusions drawn are limited to the research findings. Conclusions are to be specific, but cannot be general. Based on the review of related work and analysis of results of proposed work, whatever observed can be mentioned in conclusions. Without proper basis, conclusions are not valid. Scope for further work may include a new methodology to be adopted, new techniques to be applied, or new datasets to be tested.

V. CONCLUSIONS

Quality is essential for PhD research. Originality, innovation, and systematic approach are some of the factors leading to quality in research. There must be connection and smooth flow of control among different parts of the thesis namely introduction, review of related work, methodology, testing and verification and conclusions. Thesis must reflect the work done for the solution of the research problem. As far as possible general statements must be avoided. Repetition of material and redundant matter make the thesis dull and create less interest; on the other hand, well explained diagrams, and tables improve the clarity and understanding. It is important to use appropriate metrics for verification of results. Thus, it is concluded that quality approach in each phase of the thesis results in quality research.

VI. REFERENCES

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