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A Framework for Research Supervision

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Abstract
One of the main challenges that are encountered in research development is the management of research activities. Supervisors often have difficulties in managing schedules, issues and supervision of different research activities. This is compounded by students' poor research skills. Consequently, in this paper, we propose a knowledge management framework to point out, track, and monitor various research supervision activities. The proposed framework consists of two layers, abstract and detail. The abstract layer consists of six stages which are; basement stage, review stage, data collection stage, data analysis stage, development stage, and testing and validation stage. These stages, according to our framework, are mandatory; in other words, any research must go through the stages. To complete the task of each stage, a number of steps are defined, which constitute the detail layer. A supervisor is able to pick up appropriate steps (and not all suggested steps) from the detail layer since the complexity varies from one research to another. We discuss the results of our findings in conceiving the framework.
Keywords: research development, development stage, research activities, supervision management

1. Introduction

The academic world is experiencing rapid increase in the number of students that are enrolled in postgraduate programs such as master and doctorate programs (HEA, 2014; PTHE, 2012; AUCC, 2011). According to the Patterns and Trends in UK higher education [27], there is a percentage increase of 32% between 2002–03 and 2010–11 for students registering for postgraduate study. Indirectly, this increasing trend raises some management concerns about the challenges in research supervision and development activities affecting supervisors and students. Some of these challenges include miscommunication between supervisors and students, ambiguities in research activities, and lack of effective tracking processes for status of different research activities.

From the literature, we have not discovered any similar framework of formal research supervision activities except some segments of processes that implement research supervision management activities (Yew, 2011; Ismail et al., 2011; Swanson & Watt, 2011). To fill this gap, we propose a knowledge management framework to identify, track, and monitor various research supervision activities. The proposed framework consists of two layers, abstract and detail. The abstract layer consists of six stages which are; basement stage, review stage, data collection stage, data analysis stage, development stage, and testing and validation stage. These stages, according to our framework, are mandatory; in other words, any research must go through these stages. To achieve the task of each stage, a number of steps are defined, which constitute the detail layer. A supervisor is able to pick up appropriate steps (and not all suggested steps) from the detail layer since the complexity varies from one research to another.

The objective of this project is two-fold: (i) To analyse the most efficient standard of research supervision activities, (ii) To propose a research supervision management framework. The outcome of this paper is a framework that enables supervisors in managing, supervising and monitoring students' research progress. The significance of this outcome contributes to a more efficient supervision and more qualified researchers.

The remainder of the paper is organized as follows. Section 2, discusses related works on research management activities. Section 3 presents the research development activities. Section 4 presents the results and discussions. Finally, Section 5 provides the conclusion and future works of this research.

2. Related Work

One of the main challenges faced in research development is research supervision (Wisker, 2005; Ward, 2013). The main aim of research supervision is to produce high quality researchers who will be able to conduct research based on the logical and academic research activities. However, new supervisors and researchers face difficulties in understanding and implementing various research activities. The differences between supervisors and students' levels of knowledge and skills further augment the difficulties of research supervision activities (Lee, 2007; Ward, 2013).

Table 1 summarizes several related works on research supervision. Lubega and Niyitegeka (2008) discovered that research supervision activities could be managed effectively using many methods such as E-mail,

forums and chat rooms. AlBar (2012) developed an electronic system to manage supervision activities in order to improve communication between the supervision stakeholders. Romdhani et al. (2012) developed a supervision system to manage research development activities that can be easily followed by undergraduate students. However, the proposed development processes are static for all students and supervisors cannot change the processes adaptively. Yew et al. (2011) mentioned that, supervision activities could be managed efficiently using agent-based systems such as expert systems. Ismail (2011) argued that students have many challenges in research development such as skills deficiency. Therefore, the research development processes should be clear and understood by the students in order to minimize the difficulties of research development.

Table 1: Related Work of Research Supervision

Source	Title	Aim	Significance findings
Lubega and Niyitegeka (2008)	Integrating E-Supervision in Higher Educational Learning	Discuss a pedagogical model for E-supervision that is facilitated by the available technology instead of traditional supervision activities.	There are several methods that are being adopted to enhance the traditional supervision. The methods include use of e-mails, discussion boards, forums, telephony, chat rooms, Wiki, blogs and e-research group.
AlBar (2012)	An Electronic Supervision System Architecture in Education Environments	To build an educational collaborative environment between supervisors and teachers which include several kinds of tasks to perform such as skill development, experience sharing, group meeting and tasks, and discussion on teaching and administrative strategies.	E-Supervision System (ESS) to electronically connect the supervisors in the Ministry of Education with schools teachers.
Romdhani et al. (2012)	Student Project Performance Management System for Effective Final Year and Dissertation Projects Supervision	Develop integrated and collaborative online supervision system for Bachelor final year and dissertation projects.	The system activities are: • Development of project proposal. • Development of problem description. • Following the objectives. • Presenting and analyzing the data. • Drawing conclusions and identifying future work. • Presenting and defending the work orally. • Development of the final version of the report.
Yew et al. (2011)	A Framework For Designing postgraduate Research Supervision knowledge Management Systems	Propose a conceptual framework that integrates supervision process, KM activities, and enabling information technology (IT) for designing such a research supervision KMS.	The research development could be supported by many KM processes; Knowledge creation, Knowledge application, Knowledge codification, Knowledge transfer. These processes can also be managed through IT systems such as expert systems and intelligent agent systems.
Ismail (2011)	Improving the Development of Postgraduates' Research and Supervision	To highlight postgraduate students' problems in research and supervision.	Graduate students sometimes experienced some difficulties in their research. Thus, this denotes that effective resources in research and supervision are essential to graduate students. Developing skills towards an effective supervision needs to be tackled in various ways.
Swanson & Watt (2011).	Good Practice in the Supervision and Mentoring of Postgraduate Students.	Theoretical review of the supervisors and postgraduate responsibilities of research developing in order to provide efficient monitoring of supervision activities.	Theoretical guideline.

According to related works, there are no clear reviews of processes of research supervision proposed by researchers in order to design the supervision activities based on dynamic processes rather than static processes. However, the researchers agree that there are difficulties in designing and managing the research development processes. As a result, the previous works have suggested various methods and systems to manage

supervision activities. The electronic methods are naturally considered as efficient approach to manage research supervision efficiently. However, the bold question here is: how can a supervisor manages the supervision activities of research development without an effective foundation of research supervision? The research supervision activities could be analyzed carefully to improve the supervision management.

3. Research Supervision Activities

Based on our review and analysis of the literature on various research supervision activities, we discover and hereby propose six stages of such activities; basement stage, review stage, data collection stage, data analysis stage, development stage, and testing stage.

3.1 Basement Stage

This stage determines the preliminary research directions such as problem statement, objectives, research questions, and etc. These directions support many methods such as a preliminary study to review previous theoretical studies that are related to the research problem (Krauss et al., 2009) and a pilot study to investigate the research problems through applicable methods such as interview or questionnaire to handle a current real situation of research environment (Krauss et al., 2009; Thabane et al., 2010).

According to Blasius (2011) and Mmuya (2007), there are other directions determined in this stage which are research scope, (i.e. domain or case study), research motivation (i.e. implications), the necessary activities to address the research objectives, the proposed time plan to complete the research activities, and the proposed methods that could be efficient to collect the research data, (i.e. quantitative and quantitative data methods). Figure 1 illustrates the components of the basement stage.

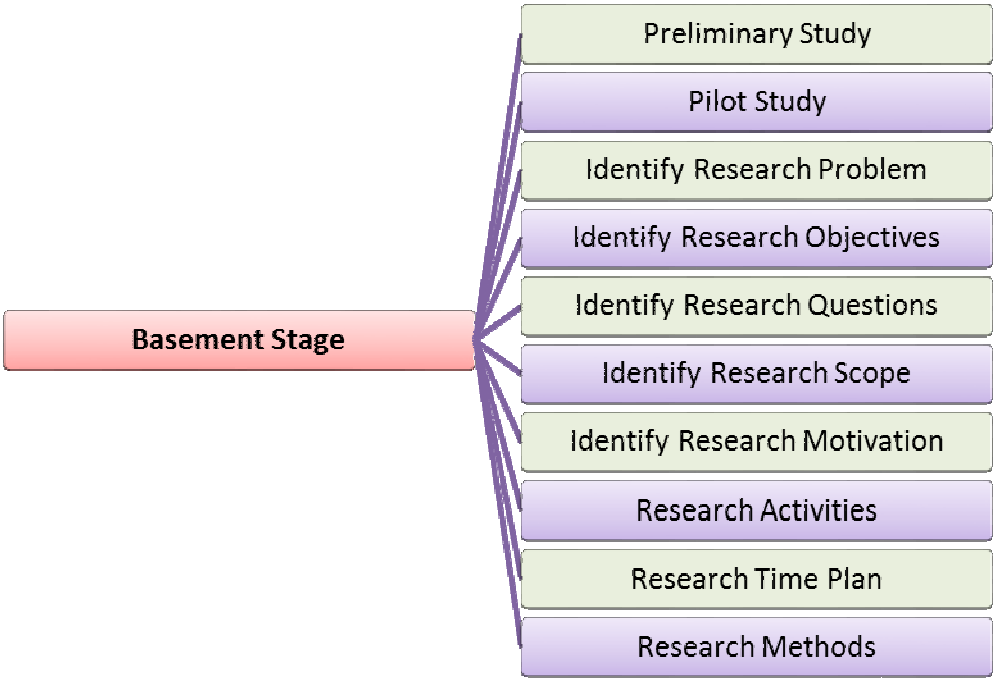

Figure 1: Components of Basement Stage

3.2 Review Stage

This stage represents the literature review process, which is necessary to justify the research directions and activities (Blasius, 2011; Krauss et al., 2009). Thus, this stage entails effective practical and theoretical visions of related works. In other words, this stage builds a logical and scientific map to clarify the research dimensions and aspects. The following are the phases that could be adopted in this stage:

- Field History Development: aims to explain the historical development based on theoretical visions of the main research fields such as theoretical review of security, knowledge management, and cloud computing fields (Hagen-Zanker & Mallett, 2013; Walker et al., 2013).
- Idea History Development: aims to explain the historical development based on theoretical visions of the research specific ideas such as social networks privacies or knowledge sharing (Hagen-Zanker & Mallett, 2013; Walker et al., 2013).
- Concepts Definitions: aim to define the research concepts from different perspectives to clarify the research contents i.e. privacy definitions or knowledge definitions (Hagen-Zanker & Mallett, 2013; Walker et al.,

2013).

- Field Aspects: involve clarification of the aspects of the research field. For example, the privacy field has many types and classifications and E-learning field has many dimensions and types (Hagen-Zanker & Mallett, 2013; Walker et al., 2013).
- Field Directions: based on the previous phase, this phase identifies the exact field directions that the research focuses on. The research problems and scope effect on select the field directions. For example, the privacy of social network has two main directions; privacy settings and privacy policies (Hagen-Zanker & Mallett, 2013; Walker et al., 2013).
- Review theoretical related works: based on the previous phase this phase could be efficient to review the theoretical related works of research directions (Law, 1998; Denzin & Lincoln, 1994).
- Review Practical related works: could be efficient to review the practical related works of research directions (Law, 1998; Denzin & Lincoln, 1994).
- Critical analysis of theoretical related works: could be effective to analyze the critical data needed to support the research development from theoretical perspectives. This phase connects directly with the phase of review theoretical related works (Law, 1998; Denzin & Lincoln, 1994).
- Conceptual Vision: summarizes the researchers' conceptual visions of their research i.e. predictive visions (Hagen-Zanker & Mallett, 2013).
- Hypothesis: gives the proposed hypotheses of the research to structure the research development based on these hypotheses (Berg, 2004).

Figure 2 illustrates the components of review stage.

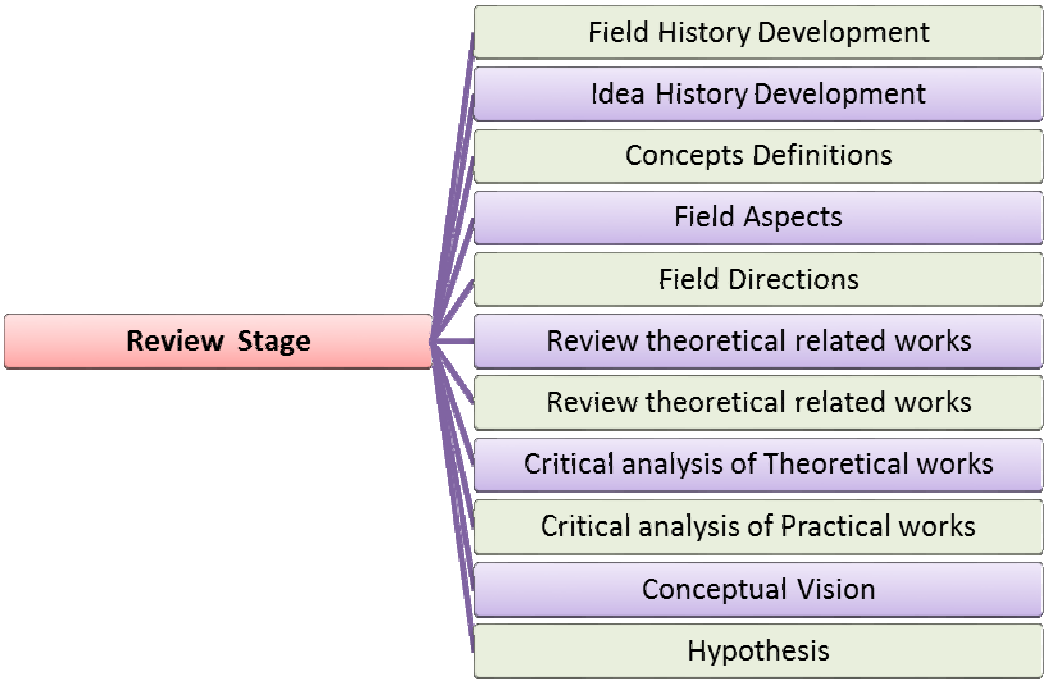

Figure 2: Components of Review Stage

3.3 Data Collection Stage

This stage entails the collection of the necessary data that are needed to develop the proposed research. There are many types of data that can be collected to support the research development which are:

- Questionnaire Data: collected using scaled answers (Margaret Sanger Center International, 2009; Marshall & Rossman, 2006).
- Interview Data: collected using interview open answers. The interviewed persons could be experts in the research field (Margaret Sanger Center International, 2009; Marshall & Rossman, 2006).
- Expert Data: collected from experts in the research field to confirm many research issues, i.e. validity of research methods and outcomes (Margaret Sanger Center International, 2009; Marshall & Rossman, 2006).
- Experimental Data: collected from experimental methods such as physicals laboratory experiments (Marshall & Rossman, 2006; Powell & Steele, 1996).
- Real Data: collected from real sources such as financial markets and companies' reports (Marshall & Rossman, 2006; Powell & Steele, 1996).

Figure 3 illustrates the components of data collection stage.

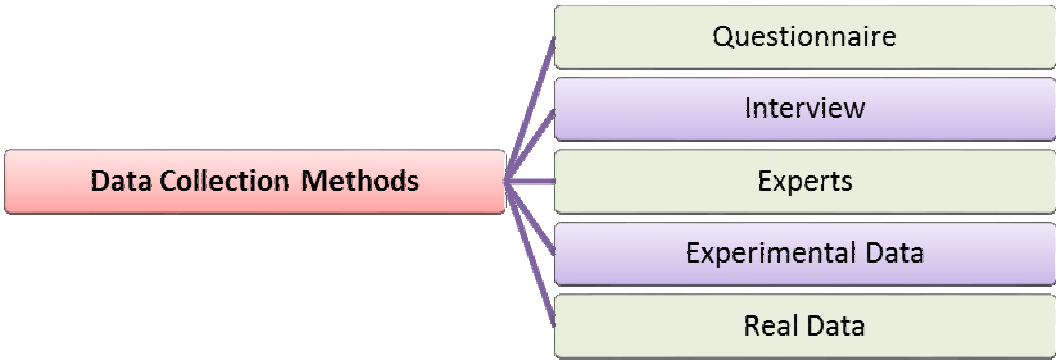

Figure 3: Components of Data Collection Stage

3.4 Data Analysis Stage

This stage involves analysis of the collected data using one or multiple methods of the previous stage. The data analysis can be addressed based on the research hypothesis or concepts covered in the review stage. The following data analysis methods could be followed:

- Quantitative Analysis methods: the questionnaire survey is considered as a quantitative data method. Many tools are efficient to analyze the quantitative data such as SPSS (Waters, 2002).
- Qualitative Analysis methods: the data of interviews, expert persons, experimental tests and real data are considered as qualitative data. There are no clear standard tools to analyze these data types. However, these data types could be justified and analyzed logically within the research context (Krauss et al., 2009).
- Programming Analysis: this analyzes the data for the purpose of developing programs using prototyping. The data may be collected from structured and unstructured resources (Nielson, 1999; Wögerer, 2005).
- Simulation Analysis: this analyzes data for the purpose of simulating the real environments, i.e. build labs simulations (Ekberg, 1999).

Figure 4 illustrates the components of data analysis stage.

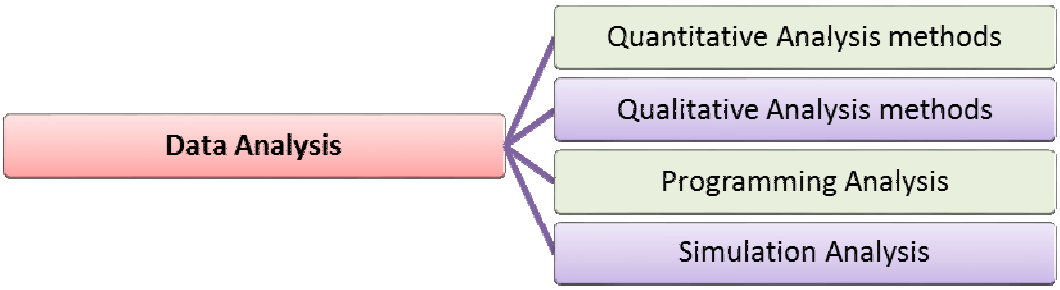

Figure 4: Components of Data Analysis Stage

3.5 Development Stage

The development stage is based on the analysis of data in the previous stage.

- Theoretical Development:
  - Technique Development: it develops a description of processes as a solution for a specific task (French et al., 2012).
  - Model Development: this develops a solution description of many related tasks within the same environment (French et al., 2012).
  - Framework Development: develops a solution description of many related tasks of various environments (French et al., 2012).
  - Strategies Development: develops a case description to improve the tasks or process performances inside an environment (Davies et al., 2012)

- Practical Development
  - Equations Development: develops mathematic equations as a solution for a specific case (Hubalovsky, 2010).

- Algorithms Development: develops practical descriptions and specifications as a solution for a specific case (Hubalovsky, 2010).
- Ontology Development: develops new datasets to support specific tasks (Russomanno et al., 2005).
- Module Development: develops a practical tool using build up technology, e.g. PowerPoint presentations (Moon, 2002).
- System Development: develops practical functions and methods to support many tasks (Hubalovsky, 2010; Moon, 2002).

Figure 5 illustrates the components of development stage.

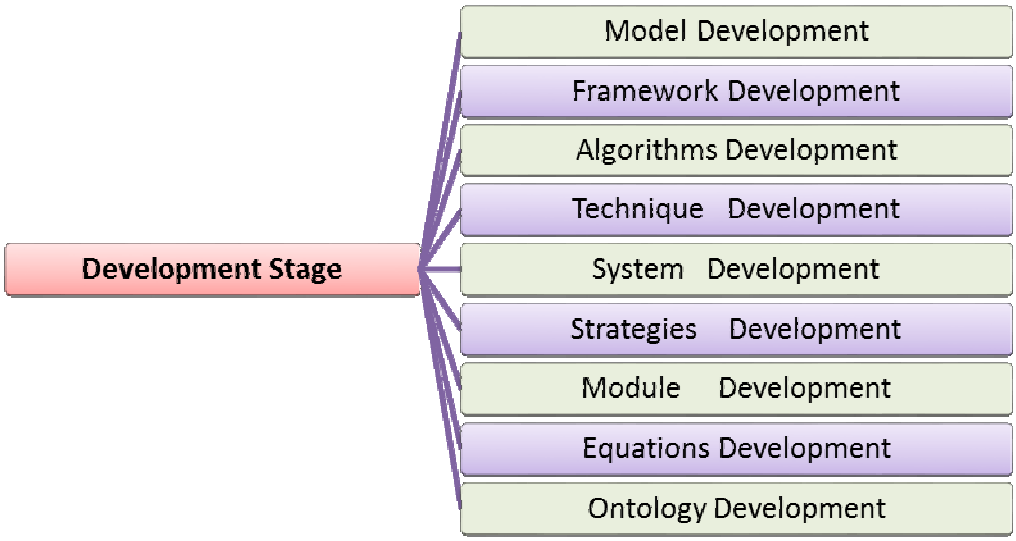

Figure 5: Components of Development Stage

3.6 Testing and validation stage

The main aim of this stage is to validate the research outcomes developed through the previous stage. Several methods can be adopted to test the research outcome performances which include the following:

- Hypotheses test: executed through efficient tools such as SPSS to test the proposed hypotheses of the research (Wilcox, 2012).
- Acceptance Test: to ensure a research outcome acceptance, i.e. questionnaire with environment, people (Chuttur, 2009).
- Simulation Test: to ensure that the simulation criteria that are developed in labs (Cooke, 1999).
- Real Test: to ensure that the real criteria that are developed are based on critical analysis of research environment, i.e. real systems (Kit, 1995).

Figure 6 illustrates the components of testing and validation stage.

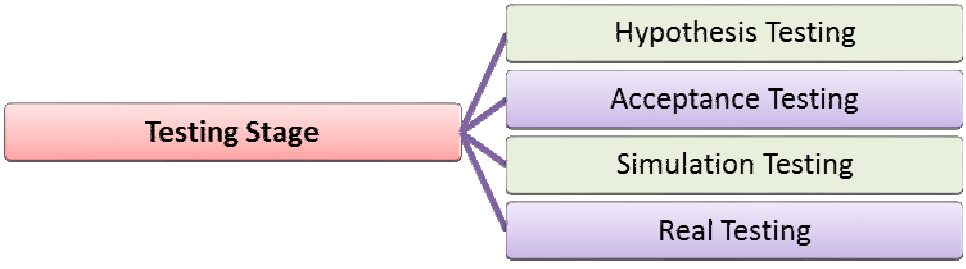

Figure 6: Components of Testing and Validation Stage

4. Results Discussion

The literature reveals a host of activities for research development. We propose that these activities can be divided into two layers; abstract and detail. As shown in Figure 7, the abstract layer consists of six stages, and the detail layer consists of numerous steps. The stages are basement stage, review stage, data collection stage, data analysis stage, development stage, and testing and validation stage (Thabane et al., 2010; Blasius, 2010; Krauss et al., 2009; Marshall & Rossman, 2006; Waters, 2002).

It is essential for a supervision team to mandatorily follow the abstract layer stages. However, several appropriate steps (and not all the suggested steps in Figure 7) can be adopted from the detail layer since the complexity varies from one research to another. The following sections discuss the details of the proposed stages and steps.

We show the validity of this framework by proposing the stages and steps that are selected for a Master research program, with the following requirements:

- The Master student is given 12 months to complete a dissertation based on the topic that is relevant to the Master program.
- The title of the research project selected by the student is "Development of a Hybrid Cloud Computing Model for Multi-campus Universities."
- The main aim of the thesis is to develop a cloud computing model for multi-campus universities to reduce the cost of current IT resources, and manage the services and information gathered among university workers to speed up the working activities.

Based on Figure 7 and our analysis and understanding of the research title and its description, we suggest the following stages and steps for the research work (the bolded steps in Figure 7):

- Basement Stage: In this stage, the research problems, objectives, questions, and motivations are identified based on the preliminary study.
- Review Stage: In this stage the literature are reviewed to identify cloud adoption directions. The tasks that belong to this stage are field history development, concepts definition, review and analyze the theoretical and practical works, and formulate the conceptual vision.
- Data Collection Stage: The data collection is based on two main methods which are quantitative using questionnaire and qualitative using interview.
- Data Analysis Stage: The quantitative and qualitative data analyses are the main tasks of this phase.
- Development Stage: The main task in this phase is model development.
- Testing Stage: In this phase, the validity of the proposed model is confirmed through interview with an expert panel.

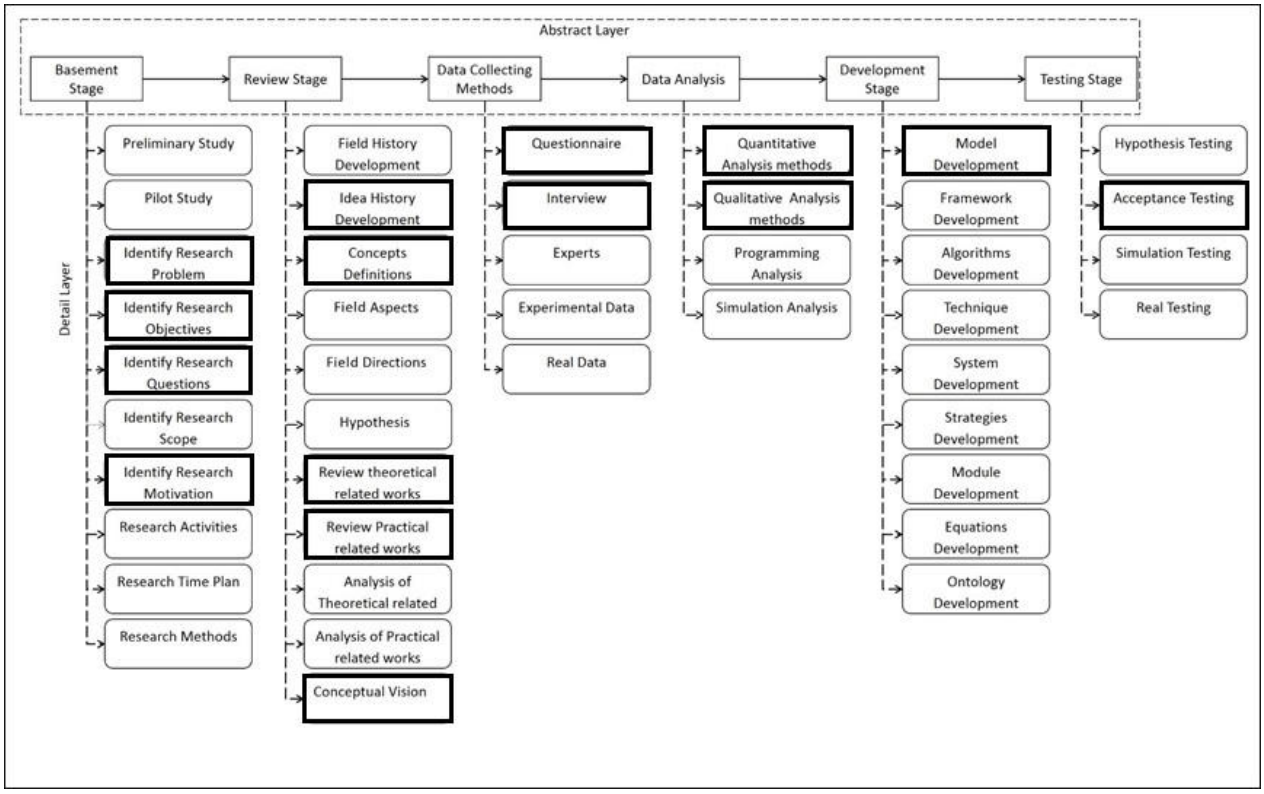

Figure 7: A framework for research development activities

5. Conclusion and Future Work

There are many stages useful to monitor the supervision of research development; basement stage, review stage, data collection stage, data analysis stage, development stage, and testing and validation stage. Each one of these stages contains many activities that can be selected by the supervisors to manage the research development

activities based on clear plan.

In our future work, we shall develop an electronic tool incorporating a multi-agent system to manage the research development activities based on effective online communication between students and supervisors. Thus, a supervisor can select the proposed research activities from various activities sets to provide clear activities' plan of research development for the students.

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