

Quest for Research Excellence On Computing, Mathematics and Statistics

Editors

Kor Liew Kee

Kamarul Ariffin Mansor

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**Quest for Research Excellence on Computing,
Mathematics and Statistics**

Chapters in Book

The 2nd International Conference on Computing, Mathematics
and Statistics (iCMS2015)

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**Technology Assistance for Kids with Learning Disabilities:
Challenges and Opportunities**

*Suhailah Mohd Yusof, Noor Hasnita Abdul Talib, and Jasmin Ilyani
Ahmad*

CHAPTER 4

Research Paradigms in Computing Disciplines: A Review

Nor Hafizah Abdul Razak, Noor Hasnita Abdul Talib, and
Jasmin Ilyani Ahmad

Abstract. Computer Science is the study of the phenomena surrounding computers. Computer science research can be one of these approaches; quantitative, qualitative and mixed method. For these approaches, researchers can apply one or more research paradigm in conducting their research work. Research paradigm is an assumption or belief system that guide the researches in completing their task. Since, there are many research paradigms underpinning of different research fields, this paper aims to provide an overview for computer science researchers in selecting an appropriate research paradigm for their study. Related papers have been examined in order to find the most commonly used research paradigms in CS/IS/IT/SE.

Keywords: Qualitative, Quantative, Research Paradigm, Positivist, Post Positivism, Critical Theory and Constructivism

1 Introduction

Computer Science is the study of the phenomena surrounding computers [1]. Computer science research can be one of these approaches; quantitative, qualitative and mixed method. Quantitative research concentrates and focuses on what can be measured. Quantitative research methods were originally developed in the natural sciences to study natural phenomena [2]. It involves collecting and analyzing objective data, and some form of mathematical including statistical, calculus and discrete. Qualitative research concentrates and focuses on collecting and analyzing subjective data. Usually people perceptions are involved. The intention is to enlighten perceptions and get knowledge. Referring to [1] researches are mostly qualitative rather than mathematical. The realization of the inherent limitations of quantitative and qualitative approaches results in the emergence and use of an alternative research design, namely mixed-methods research. The Mixed-methods research integrates and combines both quantitative and qualitative methods to investigate the same underlying phenomenon in one single study [3].

This paper continue to discuss relevant research paradigms related to the specified approaches stated in the above paragraph.

2 Classification of Research Paradigm

A paradigm can be define as “a basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways” [4]. It is simply a belief system (or theory) that guides the way we do things, or more formally establishes a set of practices. This can range from thought patterns to action. Researchers normally start a project with certain assumptions about how they will learn and what they will learn during their inquiry. These might be called paradigms, philosophical assumptions, epistemologies, and ontologies [5]. Philosophically, researchers make claims about what is knowledge (ontology), how we know it (epistemology), what values go into it (axiology), how we write about it (rhetoric), and the processes for studying it (methodology).

Disciplines tend to be governed by particular paradigms, such as positivism (e.g. experimental testing), post positivism (i.e. a view that we need context and that context free experimental design is insufficient), critical theory (e.g. ideas in relation to an ideology - knowledge is not value free and bias should be articulated) and constructivism (i.e. each individual constructs his/her own reality so there are multiple interpretations. This is sometimes referred to as interpretivism). Researchers base their work on certain philosophical perspectives; it may be based on a single or more paradigms, depending on the kind of work they are doing. Identification of research

paradigms or assumptions is a fundamental step in doing a research. How the research is going to be executed is depending on the chosen paradigm.

According to [6] based on fig. 1, there are several core assumptions, or paradigms: Positivism, Realism, Interpretivism, and Criticalism. Based on [7], paradigms are divided into two part: descriptive paradigms (evaluative-deductive or positivist paradigm, evaluative-interpretive or interpretive paradigm, evaluative - critical or critical paradigm, etc.) and formulative paradigms (formulative model, formulative – process, method, algorithm, etc.) These paradigms adjust base on nature of research problem: scientific or engineering.

In Software Engineering, two research problems were identified, scientific and engineering. Scientific research problems, evaluative paradigms are the most used, either positivist paradigms (used in empirical sciences) or interpretive or constructive paradigms, used in social and cultural problems [7]. Easterbrook et al. characterized for dominant philosophical stances in Software Engineering which is positivism, constructivism, critical theory and pragmatism.

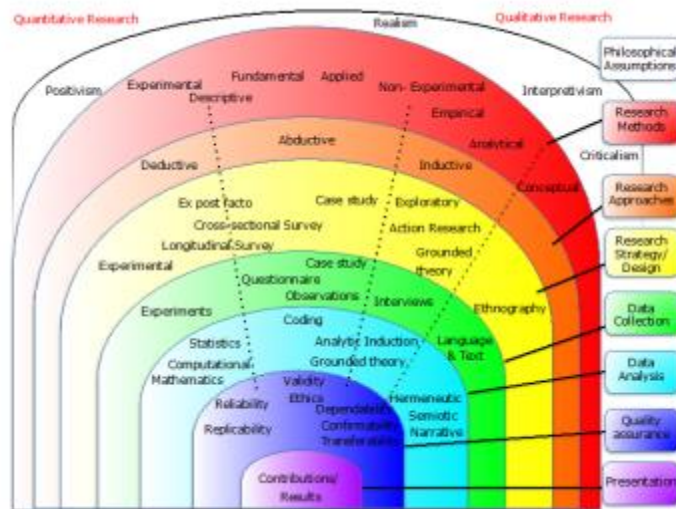


Fig. 1. The Portal of Research Method and Methodologies (sources adopted from [6])

In the next chapter we tend to focus our study on three widely used research paradigms in computer science (CS), information system (IS), information technology (IT), and software engineering (SE) area, [7] and [8].

2.1 Paradigm in CS/IS/IT/SE

Three selected paradigms discussed in this section are positivist, interpretivism, and critical theory.

Positivism paradigm is the oldest and involved with hypothesis and objective measurement. It is more on quantitative research approach. Stated in Auguste Comte writings, positivist research paradigm was an appropriation of the scientific method to the study of the human mind and the social world. It is an approach, which the methodology is relying heavily on experimental/manipulative methods and verification of hypotheses. According to [9], positivist was evidence of formal propositions, quantifiable measures of variables, hypotheses testing, and the drawing of inferences about a phenomenon from the sample to a stated population. These characteristics make this paradigm well suited in quantitative research area. This opinion also supported by article produce by [6], referring to Figure 1, positivism philosophical assumptions normally used in quantitative research area.

Second paradigm is interpretivism. As stated in figure 1, interpretivism is philosophical assumptions or paradigms that always used in qualitative research area. According to [9], interpretivism or constructive paradigm is a paradigm which intent of the research is to increase understanding of the phenomenon within cultural and contextual situations; where the phenomenon of interest was examined in its natural setting and from the perspective of the participants; and where researchers did not impose their outsiders' a priori understanding on the situation. According to [2], Constructivism paradigm or interpretivism attempt to understand phenomena by exploring richness, depth and complexity, often in an inductive manner, to discover the meanings people assign to the phenomenon.

Lastly, critical theory paradigm adopts a more transactional and subjectivist epistemology where 'the investigator and the investigated object are assumed to be interactively linked, with the values of the investigator inevitably influencing the inquiry' [8]. Critical paradigm is one of subjectivism which is based on real world phenomena and linked with societal ideology. Knowledge is both socially constructed and influenced by power relations from within society. An important distinction of the critical research philosophy is its evaluative dimension. More than the positivist or the interpretive research perspectives, the critical researcher attempts to critically evaluate and transform the social reality under investigation [9]. The lettering in figures should use 10-point type. Figures should be numbered and have a caption which must be positioned *under* the figures. Please center the captions between the margins and set them in 9-point type. Distance between text and figure should be about 8 mm, the distance between figure and caption about 6 mm. In the printed volumes, illustrations are generally black and white

3 Discussion and Justification Choice of Approach

Based on research conducted for this assignment, we discovered a few research conducted in the area of IS/CS that applied previously discussed paradigms.

Referred to [10], outcomes of their research work has identified the most common research paradigm adopted in both US and Europe is positivist. Stated in his findings, 76% of US and European IS research applied positivist paradigm, where 20% comes from European journals and 56% contributed by US journals. As for interpretive research paradigm, noting in [10] article, 23% of US and European IS research applied interpretive paradigm. Meanwhile, only 1% of the research applied critical paradigm.

Studies conducted in [11] involved sampling papers from a number of major computing journals and classified papers identified major research approaches in IS are evaluative – deductive (positivist), evaluative – interpretive (interpretive), and evaluative – interpretive (critical). Table 1 shows the percentage of research approaches for three areas CS, SE and IS which comprises of CS (evaluative – deductive (positivist) – 1.1%, other – 9.9%), SE (evaluative – deductive (positivist) – 4.3%, evaluative – interpretive (interpretive) - < 1%, and evaluative – interpretive (critical) – 1.4%, other – 7.3%) and IS (evaluative – deductive (positivist) – 46.7%, evaluative – interpretive (interpretive) – 4.7%, and other – 15.4%).

Table 1. Research Methodology

Research Approach		CS	SE	IS
ED	Evaluative – deductive (positivist)	1.1%	4.3%	46.7%
EI	Evaluative – interpretive (interpretive)	-	<1%	4.7%
EC	Evaluative – interpretive (critical)	-	1.4%	-
EO	Evaluative – other	9.9%	7.3%	15.4%
		11.0 %	13.8%	66.8%

4 Conclusion

What knowledge is, and ways of discovering it, are subjective. Regarding CS/IS/IT/SE research area, the positivist paradigm seeks to determine, the interpretive paradigm seeks to understand, and the critical paradigm seeks to emancipate. Each paradigm has its own ways of achieving its aims. By

considering the philosophical assumptions that support each paradigm and how these assumptions manifest themselves within methodology and methods will assist researchers to better understand, question, and apply the research that they involved in.

There is no single research paradigm is better than any other paradigm [12]. Many researchers tend to combine a few research paradigms in order to improve the quality of their research work [13].

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