

Researchers' Artificial Intelligence Expert System Rule-Based Decision Making Using Visirule

Ismail Olaniyi MURAINA¹ and Imran Ademola ADELEKE²

^{1&2}Department of Computer Science, Adeniran Ogunsanya College of Education, Otto/Ijanikin, Lagos, Nigeria.



Abstract – The concentration towards the use of software applications to support decision making has been around for years. The past decades have witnessed a tremendous development in the graphical user interface, which facilitates the use of more advanced computational techniques to a wider group of users. As a consequence, several decision analytic tools have emerged in recent years. In many occasions, researchers get confused and perplexed when to select appropriate statistical designs and tools. Research design gives the researcher the direction of the study in terms of research questions or hypotheses formulation, use of the instrument and the analysis type. The study presents Research Design Selection for researchers using Expert System Rule-based decision tool (visirule). The Visirule software was used as a decision supporting tool, using Logic Programming Model to present RDS-Expert in a concisely and precisely way. The RDS Expert serves as a guide for researchers to use in making good decision regarding the type of research design fit their studies. The study serves as a guide for graduating students as well as researchers in helping them to solve the problem of selecting appropriate and relevant research design, instrument to collect data and data analysis tools for conducting an acceptable research projects, dissertations and theses. The study contributes to the body of knowledge by examining the problem which researchers, academicians and students have been facing for years.

Keywords – Research Design, Visirule, Expert System, Research Writing.

I. INTRODUCTION

Project writing is a writing across the curriculum program that offers students writers a chance to talk through their ideas with project supervision or peer writing assistant. These guided conversations lead to better learning, thinking and writing.

Writing skills are crucial in every profession. Good writing skills are therefore, valued in the academics and people who are good writers appear to be more capable, intelligent, responsible and credible compared to lazy ones. Good writing skills not only ease communication in the academic's field but also positively affect careers. It is paramount especially when the job at hand involves a lot of writing. When students are about to graduate from school, they are expected to have excellent writing skills as sine-qua-non to become a graduate. In project writing, selection of appropriate research design has become a great task for the students (both undergraduate and post-graduates). Work experience in teaching has shown that students do not see any good relationship between formulation of hypothesis and selection of relevant research design to solve the problem at hand. The study provides a framework for appropriate selection of research design that fit and in line with the instrument to use in collecting data for problem analysis.

II. REVIEW OF LITERATURE

Research design is the plan, strategy or procedure the researcher adopted in order to solve the problem under investigation [1]. To [2] "research design is a term used to describe a number of decisions which need to be taken regarding the collection of data before the data are collected. Research design is also seen as the blue print or plan for specific research study. It gives direction to

ways by which a researcher can collect and analyze data towards solving a particular research problem. Looking at it from another angle, research design means preparing conceptual model for solving a research problem in a systematic or scientific way within the capacity of the researcher. Research design is the overall plan for connecting the conceptual research problems to the pertinent (and achievable) empirical research. Therefore, research design articulates what data is required, what methods are going to be used to collect and analyze this data, and how all this is going to answer the research question(s). [3] said that the goal of a sound research design is to provide the results that are judged to be credible. To [4], research design is a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research strategy.

A research design is a systematic plan to study a scientific problem. The design of a study defines the study type (descriptive, correlational, semi-experimental, experimental, review, meta-analytic) and sub-type (e.g descriptive-longitudinal case study), research question, hypothesis, independent and dependent variables, experimental design, and if applicable, data collection methods and a statistical analysis plan. Research design is the framework that has been created to seek answers to research questions.

There are many ways to classify research designs, but sometimes the distinction is artificial and other times different designs are combined. Nonetheless, the below list offers a number of useful distinctions between possible designs

- ✓ Descriptive – (case-study, naturalistic observation, survey)
- ✓ Correlational – (case control study, observational study)
- ✓ Semi-experimental – (field experiment, quasi-experimental)
- ✓ Experimental – (experiment with randomization)
- ✓ Review – (literature review, systematic review)
- ✓ Meta-analytic – (meta-analysis using statistical methods for contrasting and counting result from different studies)

Let look at the below classification of research design:

Quantitative Research Method: this method leads to the generation of empirical data which carries numerical values. Under this we have:

1. **Experimental Research Design:** In this design, the researcher attempts to establish causes and effect relationship by deliberate controls and manipulates the conditions that determine the events under study.
 - **Independent variable:** This is the variable that can be manipulated by the experimenter.
 - **Dependent variable:** This is the variable that is being observed for effects caused by the manipulated variable.
 - **Intervening variable:** This is the variable that cannot be controlled or measured directly but can affect or modify the outcome.
 - **Extraneous variable:** This is the variables that are not manipulated by the experimenter but may have significant influence on the dependent variable.
- a. **True Experimental Design:** These designs make use of a control group against which the experimental group is compared.
- b. **Quasi-Experimental Research Design:** This is the design that the researcher did not have adequate control or manipulation to all the existed variables involved in an experimental study. No randomization applied to collection of data in the study.
2. **Non-Experimental Research Design:** This is the research design that does not involve the manipulation, random assignment or controlling of a variable in order to observe the variable.
 - a. **Descriptive research design:** This method requires the use of questionnaire or interview or self-report or observation for the collection of data.

- i. **Survey Design:** This is the attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables.
 - ✓ **Sample Survey:** This selects part of the population through the use of randomization.
 - ✓ **Census Survey:** This uses the whole population for the study.
- ii. **Developmental Research Design:** This research design could either be cross-sectional or longitudinal. The study attempts to describe the nature and degree of change, growth, maturity of behaviors among the members of a group. In longitudinal study, subjects are usually studied within a given period and changes are observed and recorded. In cross-sectional study, large group are studied and assessed on a particular variable, not changes after a long period of time.
- iii. **Correlational Research Design:** This research design seeks to determine if there exist a relationship between two or more variables and if so to what extent the relationship is. It could be relation or prediction studies.
- iv. **Case Study Research Design:** This research design is geared to single out and study a given social unit, which could be individuals, groups of individuals, institutions or communities.
- b. **Casual Comparative Research Design:** This research design is also known as ex-post facts research design, this design attempts to determine the factors that are associated with certain occurrences, outcomes, conditions or types of behavior by examining and tracing back of already existing conditions for information and available data for probable casual factors.
- c. **Historical Research Design:** This research design attempts to establish facts and arrive at conclusions concerning the past. It is design to investigate into past developments, experiences and events in a systematic and scientific way. Its main purpose is to discover generalizations that may assist in the understanding of the past and present phenomenal, to limited extent.

Qualitative Research Method: This method is based on a holistic picture and depth of understanding rather than a numerical analysis of data. Qualitative research design is primarily used to gain an understanding of underlying reasons, opinions and motivations.

- a. **Ethnography Research Design:** This is when the researcher immerse himself in the target participants' environment to understand the goals, cultures, challenges, motivations and themes that emerge. The researcher studies the shared problems of behaviors, language and actions of an intact cultural group in a natural setting over a prolonged period of time, data collection often involves observations and interviews.
- b. **Narrative Research Design:** This approach weaves together a sequences of events, usually from just one or two individuals to form a cohesive story. The researcher studies the lives of individuals and asks one or more individuals to provide studies about their lives [5].
- c. **Phenomenological Research Design:** This uses a combination of methods, such as conducting interviews, reading documents, watching videos or visiting places and events, to understanding the meaning participants place on whatever's being examined. The researcher derives a general abstract theory if a process, action or interaction grounded in the views of participants. This design involves using multiple stages of data collection and the refinement and interrelationship of categories of information [6] & [7].
- d. **Grounded Theory Design:** this looks to provide an explanation or theory behind the events. Researcher uses interviews and existing documents to build a theory based on the data. The researcher derives a general, abstract theory of a process, action or interaction grounded in the views of participants. This design involves using multiple stages of data collection and refinement and interrelationship of categories of information [6] & [7].
- e. **Case Study Research Design:** This involves a deep understanding through multiple types of that source. It can be explanatory, exploratory or describing an event. The researcher develops an in-depth analysis of a case, often a program, event, activity, process of one or more individuals. Cases are bounded by time and activity data collection involves using a variety of procedures over time [8] & [9].

Mixed Method: This method involves combining or integration of qualitative and quantitative research and data in a research study. Qualitative data tends to be open-ended without pre-determined responses while qualitative data usually includes closed-ended responses such as found on questionnaire or psychological instruments

- Explanatory Sequential Mixed Design:** The researcher first conducts quantitative research, analyzes the results and then builds on the results to explain in more detail with qualitative research design.
- Exploratory Sequential Mixed Design:** the researcher first conducts with a qualitative research phase and explores the views of participants. The data are then analyzed, and the information used to build into a second, quantitative phase.
- Convergent Parallel Mixed Design:** The researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem.

Table 1: Comparison of Quantitative, Qualitative, and Mixed Approaches

	Quantitative Approach	Qualitative Approach	Mixed Approach
Scientific Method	Deductive or “top-down” Test hypothesis and theory with data.	Inductive or “bottom-up” Generate new hypotheses and theory from data collected.	Deductive and Inductive
Most common research objectives	Description Explanation Prediction	Description Exploration Discovery	Multiple objectives
Focus	Narrow-angle lens Testing specific hypotheses	Wide and Deep-angle lenses. Examine the breadth and depth of phenomenon to learn more about them.	Multi-lens
Nature of study	Study behaviour under artificial, controlled conditions. context or condition	Study behaviour in its natural environment or context.	Study behaviour in more than one
Form of data collected	Collect numeric data using structured and validated instruments (closed-ended survey items, rating scales, measurable behavioral responses)	Collect narrative data using semi- or unstructured instruments (open-ended survey items, interviews, observation, focus groups, documents)	Multiple forms
Nature of data	Numeric variables.	Words, images, themes, and Categories	Mixture of numeric variables, words, and images.
Data analysis	Identify statistical relationships.	Holistically identify patterns, categories, and themes.	Statistical and holistic
Results	Generalizable findings. General understanding of	Particularistic findings. In-depth understanding of	Corroborated findings that may be generalizable.

	respondent's viewpoint. Researcher framed results.	respondent's viewpoint. Respondent framed results.	
Form of final report	Statistical report including correlations, comparisons of means, and statistically significant findings.	Narrative report including contextual description, categories, themes, and supporting respondent quotes.	Statistical findings with in-depth narrative description and identification of overall themes.

Adapted from [10]. *Educational Research: Quantitative, qualitative and mixes approaches*, 2nded. Boston: Allyn & Bacon.

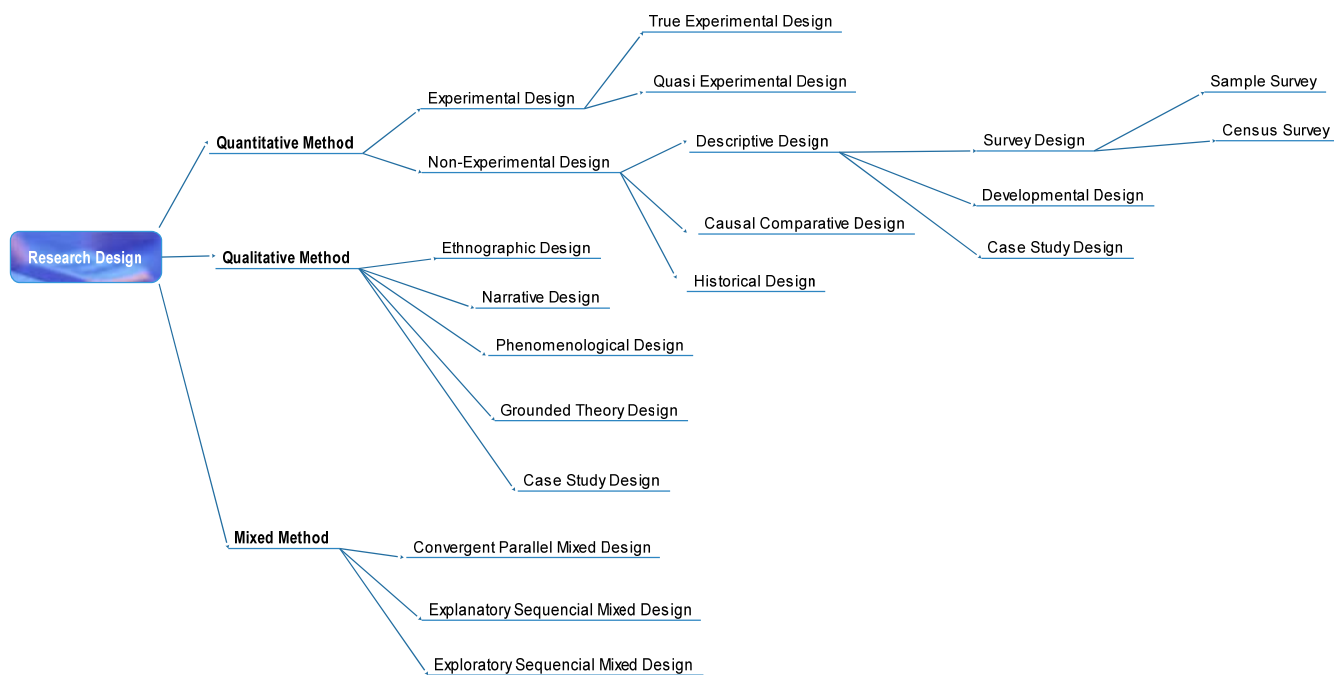


Fig. 1: Showing Research Design paths

Use of Visirule

The use of visirule was based on structures, we have 82 boxes altogether and precisely 24 questions were involved which related to structural analysis relevant to data collected and which depicted in yellow single choice box. White boxes (40) indicating the options to be taken by the preceding questions. Also, red boxes (17) serve as conclusion or outcome of the actions performed. These red boxes always terminate series of inferences. The only green box signified the starting point of the structure. The use of the visirule only covers the classification based on this study, which serves as the limitation of this study. In applying the visirule, the researcher just needs to run the code and follow the questions as they appear to him/her. At the end, a condition or many conditions are tending to be satisfied based on the choice of the researcher.

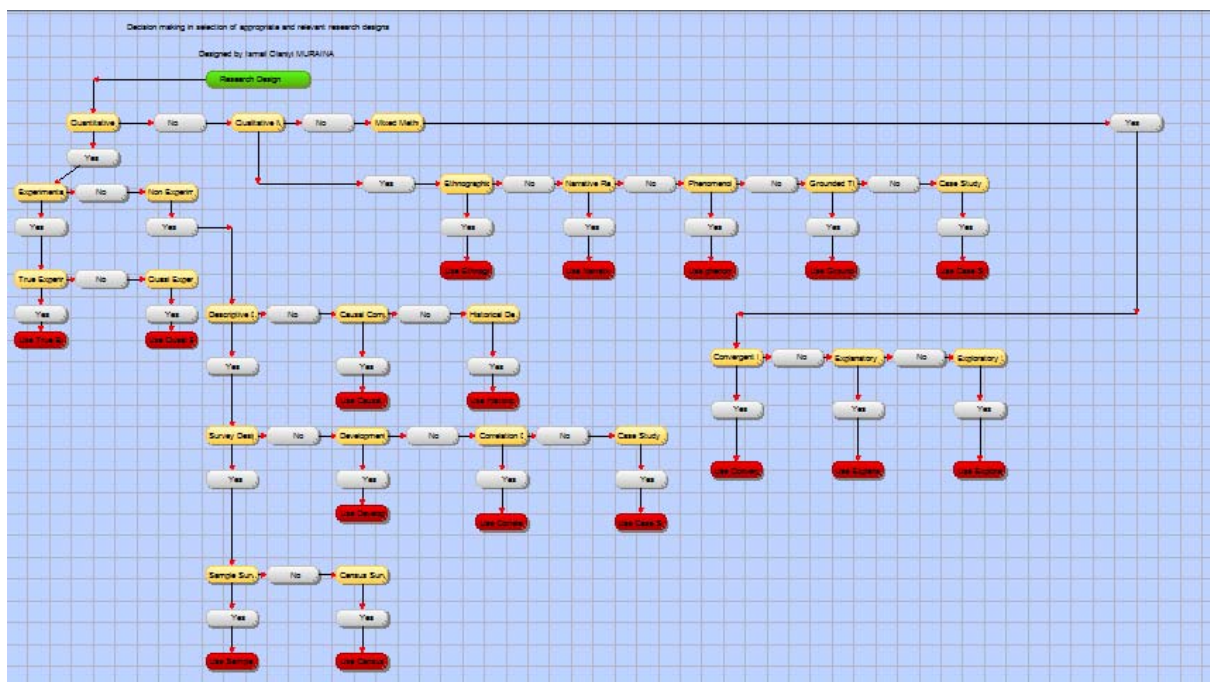


Fig. 2: Screenshot for Visirule Application and implementation

Generated code <pre> flex code: do ensure_loaded(system(vrllib)) . relation ' Research Design'(Conclusion 'q_Quantitative Method'(Conclusion) . relation 'q_Quantitative Method'(Conclusi the answer to 'Quantitative Method' is check('Quantitative Method', 'q_Experimental Design'(Concl relation 'q_Quantitative Method' the answer to 'Quantitative M check('Quantitative Method', </pre> Compilation messages: <pre> do relation prove relation Research relation q_Quantitative Method relation q_Quantitative Method </pre> Start goals: Research Design Use True Experimental Design	Generated code <pre> flex code: do ensure_loaded(system(vrllib)) . relation ' Research Design'(Conclusion 'q_Quantitative Method'(Conclusion) . relation 'q_Quantitative Method'(Conclusi the answer to 'Quantitative Method' is check('Quantitative Method', 'q_Experimental Design'(Concl relation 'q_Quantitative Method' the answer to 'Quantitative M check('Quantitative Method', </pre> Compilation messages: <pre> do relation prove Research relation q_Quantitative Method relation q_Quantitative Method </pre> Start goals: Research Design Use Causal Comparative Design
Suggesting True Experimental Design	Suggesting Causal Comparative Design
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Suggesting Quasi Experimental Design	Suggesting Sample Survey Design

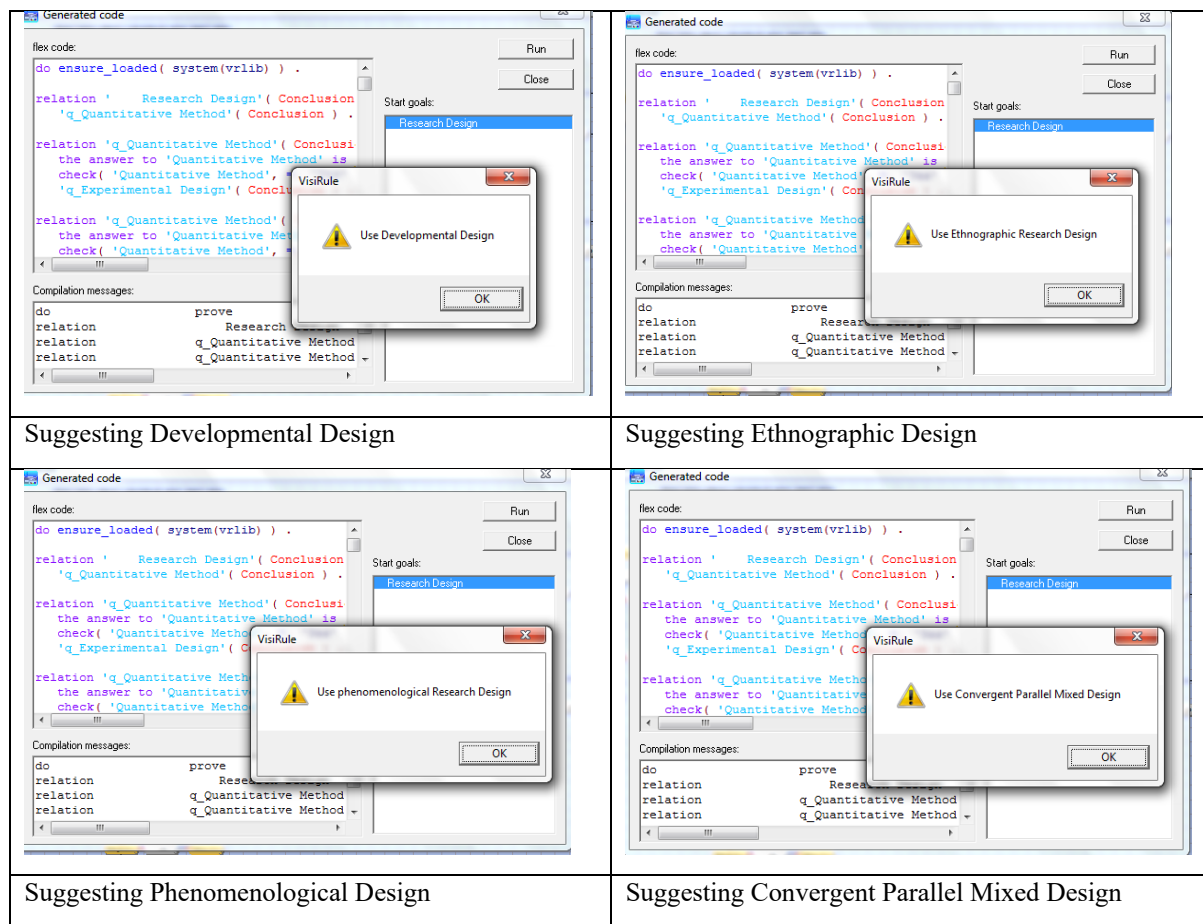


Fig. 3: Showing samples of the output of executed options and suggested results

III. CONCLUSIONS

This study prepared the mind of researchers to be at rest regarding the selection of appropriate research design for a particular study. In the same vein, the author enlisted the simple and clear classification of research design and embedded them into visirule software. The conditions and reasons or situation attached to the use of these designs were critically looked into. Major concentration is placed on quantitative, qualitative and mixed methods before relevant design will be chosen. To make it easy to use, a Visirule Decision Support Approach was used to assist in realizing this, by just selecting boxes rather than writing series of codes (programming).

Hence, the RDS-Expert will be invaluable to both lecturers and research students who at the end of their course would write project on their fields of study. It will also be helpful for the users with very limited knowledge of programming and research, since the use of graphics simplifies the understanding of choice of statistical design for a study. The study can be further improved by considering the limitation of this research.

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