

Experimental design issues in conducting quantitative research

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ABSTRACT

This study presents the analysis of ethical concerns, validity of variables, data collection methods and measurement scales used in conducting quantitative research and it also presents the importance of experimental design elements that are an important part of exploring correct results. The study is limited to analysis of ethical concerns, validity, data collection and measurement scales. This study will help to build up the understanding of the utilization of experimental design elements by different researchers.

Key words: Ethical concern, validity, measurement scales, experiments, research, scientific methods.

INTRODUCTION

Science is based on many different pillars that combine to provide the methods of reasoning, logic, and ethics to conduct research. Based on the research methods, the foundation of all the research is scientific reasoning. Science is based on experiments, and it involves variables to conduct any experiment and find out the results. The variables have more importance in the research than the experiment itself. The variables chosen must be related to the theoretical framework supporting the research. The variable must be used in controlled manner, it is not only about measuring it but can be manipulated according to different research criteria. There are different types of variables and can be categorized into Binary variable, categorical variable, dependent variable, ordinal variable and independent variable.

The variables are then operationalized by finding a measurable, valid and quantifiable index for the variable including both independent and dependent variables and can be used for manipulating variables at two or more levels. Operationalization of variable is important as not all the variables can be easily measured. Subjective factors are difficult to measure than the objective ones. It also helps down to define the exact variable increasing the quality of variable and efficiency of design.

Operationalizing also makes the hypothesis strong, clear and standardizes the variables being used in the research. A failure in the process is meant to have weak, non-standardized variables and can lead to further errors in the research. The variables are then further classified on the basis of research experiments. The experiments are usually based on laboratory and field experiments with controlling, manipulating the variables of the validity of experiment's.

LITERATURE REVIEW

The research first needs to be categorized into further types based on mainly two kinds of research. Experimental research (John, 1998) is focused on manipulating the independent variables and then inspecting the effect of the change on the dependent variable. It is beneficial for identifying the cause and effect between different variables. The independent variables are easily to be manipulated in experimental research. The variables that are used mostly in research are dependent and independent variables (Daniel, 2012). Independent variable is often called as experimental or predictor variable. It is manipulated most of the time to

observe the effect on the dependent variable. The dependent variable is simply a variable that depend on the independent variable. The dependent variables are affected by any change in the independent variable. The variables can be validated through different types of validation techniques based on internal and external validation. There is a balance between external validity of variables that have an effect on different factors consisting of history, maturation, testing, instrumentation, selection and morality effects. The validity of experimental designs further depends on three kind of experimental designs, consisting of quasi experimental, true experimental and ex post factor designs. The variables can be validated through simulation of the experiments to check the correct variables before real time implementation. The experimental design research also involves a number of ethical issues based on unethical practices especially in laboratory design experiment.

The ethical issues involves putting pressure on people to participate in experiments, problems of self-respect, physical or mental stress, changing the procedures in research, exposing participants to harmful environment, not briefing participants after the experiment is completed, privacy issues, benefits issues and management of tasks. The issues are common in most of the experimental research designs and must be avoided to conduct a fair research.

EXPERIMENTAL DESIGN ELEMENTS

According to Creswell (2002), Quantitative research is the process of collecting, analyzing, interpreting, and writing the results of a study, while qualitative research is the approach to data collection, analysis, and report writing differing from the traditional, quantitative approaches. Research is most of the time mistaken for gathering information, documentation of facts and finding and managing the information (Leedy and Ormord, 2001). The ethical issues must be a concerned in the research and have been widely accepted by discussion (Engel and Schutt, 2009; Nelson, 1994; Rubin and Babbie, 2008). Patrick (2010) faced ethical issues related to sampling the data due to the involvement of the social workers and volunteers. The generalized results are generated by selecting the smallest representative sample having a balanced population. It is an ethical issue to conduct research on the very small or very large sample. The participant's right, sample size and generalized results are focused to manage the ethical concerns in the research. To sort out the issues, sample external validity must be done in order to obtain the random sample. The limitations of the random sampling to external maximize external validity is presented. The solution is based on having unbiased sample design to select a set of

elements that accurately depict the attributes of the whole population. The data collection is done by research questions and defined measurements using planned missing data design strategy that is based on seeking information from the participants against other participants and its cost for providing the information. It is also called two method measurement designs. The research has used the standardized scale of measurement in order to collect complete data, but the limitation of the model is that it requires planned structural equation modeling (Muthe et al., 1987).

Lindsay et al. (2012) conducted research to find out the reliable and valid measure of pain impact on sleep. The research was based on the questionnaire to be solved by different participants. The ethical concern is that all the participants fill the questionnaire with accuracy. A proper measurement scale is needed to be devised for assessing the impact of the pain on sleep. Usually, the measurement scales used are based on a single item that lacks reliability and validity. The objective of the study is to investigate and improve the questionnaire. The questionnaire should be filled by the patients who have the symptoms of pain and sleep. For a reliable and valid data, it is being collected from nine different independent, blindly randomized controlled clinical trials conducted through over a period of 10 years. A cross validation approach is adapted to find out the conformity of the data under the current lying structure of the measurement scale. The internal consistency and reliability is ensured through Cronbach's alpha coefficient. The treatment changes are deducted by using the mean score index. The data is collected through sample of 605 patients including both male and female. Correlations between data are made through the validity of the data and variance based on other health related measures. The results from the measurements helped to revise the scoring to three item index for the impact of pain. The index validity was achieved through criteria and structural based support.

Jean-Charles (2012) used balanced scorecard methodology and strategy planning on the ethical issues related to middle manager performance in the public sector. The competency of the managers working in the public is important as it has an effect on the business processes throughout a country. The data is collected through a questionnaire for identifying the implementation of strategic planning and balance score card. It was also discovered that using the methodology has a positive impact on the managerial competency. Both management systems have a deep impact on the organization. The concern is to balance the activities of managers in both strategic management systems. Most of the time managers are dealing with the operational issues and the present crisis in the organization. They are mostly taking brief decisions based on the pressure that minimizes the deep thinking approach on other

Decisions (Braguglia and Jackson, 2012). A set of policies is developed to ensure the responsibilities of the middle managers developed by the top managers. The middle managers plan an important role in the implementation of strategic policies. The research questions are based on both the strategic management systems. In order to measure the systems properly, hypothesis is devised to correlate both strategies to the idle managers. The questionnaire variables used to measure the data includes variables about the organization of middle managers, variables about the organization strategic planning process and outcome category of variables about the impact on performance. The questionnaire is further divided into five groups of questions for ensuring the validity and relevance to each specific organization domain. Total of 39 questions are developed. The samples are taken from the middle managers including both male and female. The overall difficulty in the research is limited sample size as for appropriate sample size factor analysis, the middle managers group should be at least 100 whereas it was 55.

Kay and Kanata (2012) conducted reflective analysis of teaching research through a project based approach. The ethical concern is related to the experiences of teaching research method courses to the undergraduate students. The variables used to measure the research are based on student, public and developed research experience. Data is collected for statistics, research methodology and organizational behavior to be taught in a sequence. The problem is based on selecting an appropriate topic selected by the students. The students brainstorm for the ideas and after finalizing, it is presented as a first section of their proposal. The data is validated through the number of students passing all the three subjects and their knowledge of all three. It is also measured to know the number of students presenting the publications to the department review committee after studying the subjects. Few students found employment after studying the subjects in sequence and working in their capacity.

SIMILARITIES AND DIFFERENCES BETWEEN THE APPROACHES

Most researchers are focused on deriving first the research questions and problems related to human behavior in the organization. Some of them have focused on internal attributes while others have focused on external attributes that can affect the results of the organization. The researchers have used different techniques for validation of the variables. Some have used well known methods such as balance score card, and others have validated through providing the research questions only to the desired audience for accuracy of the results. The data collection methods are same for

many of the research. Mostly questionnaire is used for collecting data from the audience whether internal or external to the organization. The sample size is also considered for having meaningful data collected for the research. Some of the researchers have used groups of questions whether others have used hypothesis first to devise the questions. The measurement of the data is different according to the type of the research. Some of the researchers have used nominal scales whereas others have used ratio scales depending on the data required to conduct the research. Some of the research require years of data such as medical trails, which requires data up to 10 years to devise results and to measure them properly.

Operationalizing Variables: Research area improvements

The main problem in devising the research questions, is knowing the type of the data required to conduct the specific research. The researchers most of the time collect data that is not meaningful for the research and less than the required sample size. Researchers first should analyze the required sample size for conducting specific research in order to devise conclusions on the basis of research. Also some researchers do not devise the questionnaires used in research or the samples were not provided to the audience for understanding the context of the research, rather than variables were directly declared as a sum of results. Researchers should focus on measurement scales for each of the questions and difference between the scales must be understood for extraction of results from the research. The important rule that should be followed is to know the measurement scales of the variables before using them in the research.

CONCLUSION AND RECOMMENDATION

The selection of variables is a confusing, and difficult task and researchers should be able to first understand and follow the concepts of the measurement scales before properly implementing the variables for the experimental needs. The study provides an overview of the different measurement scales defined in different domain areas by different authors. Further research can be conducted to analyze the impact of using wrong measurement scale for variables, on results that combined together in unethical process for the creation of results.

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