1 Introduction

Quantitative measures can be useful for analysis and comparison of different systems and methods. However, there are certain properties that are difficult to define with a numerical value, such as the behavior of complex systems. Human behavior, in particular, is difficult to quantify. For these types of systems, it is often necessary to record information in words or pictures, rather than in numbers. This is known as qualitative data.

The notion of qualitative models and descriptions in scientific fields is not new. Newell and Simon present an overview of the laws of qualitative structure in a number of sciences [5]. Qualitative descriptions are used to define the terms of scientific study in a variety of scientific fields. Some examples from the paper include the cell doctrine in biology and the germ theory of disease. The idea is that many categorizations are qualitative in nature.

Qualitative data can provide more information than quantitative data, however this can also make gathering and analyzing it more difficult. Seaman presents a detailed method for collecting and analyzing qualitative data through experiments with human participants [6]. Qualitative data can be collected through observation and interviews. Data can be translated to numerical values through a process called coding. However, some of the information in the qualitative data is abstracted away with this technique. Another use for the data is through categorization, assigning different labels to different types of data. This is useful for determining patterns or trends in particular types of data. This qualitative data can then be used to generate or validate theories. Seaman points out, however, that it is important to understand the influence of the analyst, either as an observer or interviewer, on the participants of the study and the resulting data.

Many researchers consider qualitative data and methods to be inferior, because qualitative data can be either objective or subjective. It is important to follow good scientific methods in any research involving qualitative data in order to demonstrate the objectiveness of the data. [4] provides a good example of this. This particular study coded the qualitative data (the list of exceptions handled by each program) into numerical scores. The paper not only describes the hypothesis and results, but it also explains in detail the experimental design, participant selection, procedure, and evaluation criteria for the experiment, as well as a statistical analysis of the results. More research as rigorous as this will help qualitative methods gain acceptance throughout the research community.
References


[Generalization/Characterization, Qualitative Model, Persuasion/Assertion]
This paper presents a qualitative characterization of programming languages. Examples of categories include Language Regularity and Uniformity, Portability of a Language, and Control Facilities. Each category, in turn, has a number of subcategories. This allows a more systematic comparison of features between programming languages. The paper, however, does not attempt to validate the characterization (neither by example nor through experience).


[Generalization/Characterization, Specific Solution, Analysis (Empirical Model)]
This paper presents the results of an empirical study of the use of a particular software application in a real development environment. The empirical study used the qualitative methods of observation and interviews to gather the data. They then coded the data (categorized it) to find interesting patterns.


[Evaluation/Analysis of an Instance, Report, Experience]
This paper presents the qualitative observations of an empirical study, in the form of “rules of thumb” for code inspections. The paper explains the experimental setup, but does not provide details about the method used to collect the qualitative data. It is interesting because the original experiment did not include a method to gather and analyze the qualitative data involving participant evaluation of the techniques. This was only added after the researchers observed the usefulness of such data.


[Method of Development, Technique, Analysis (controlled experiment)]
This paper presents a tool (a fishbone diagram of exception types) that can be used during development to help improve exception handling. It provides a thorough explanation of the experimental method, including experimental design, participant selection, the procedure, and the evaluation criteria. It also provides a statistical analysis of the results.


This paper provides examples of how empirical inquiry is used in computer science. The first example is the development of the notation of a symbolic system, and the second is the development of the notation of heuristic search. Also included in the paper is an explanation of the
laws of qualitative structure. The cell doctrine of biology, plate tectonics in geology, the germ theory of disease, and the doctrine of atomism are all examples of useful characterizations that are qualitative in nature.


[Generalization/Characterization, Technique, Example] This paper outlines a technique for collecting and analyzing qualitative data to incorporate it into empirical studies. Data can be collected by participant observation or by interviews. Qualitative data can be transformed into quantitative data through coding. Qualitative data is used to generate theory, or to confirm it.