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APPRAISAL OF DATA COLLECTION FOR SCIENTIFIC REPORT IN CHEMISTRY

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INTRODUCTION

A scientific report is a document that describes the process, progress and/or result of a technical or scientific research or the state of a technical or scientific research problem, which might also include recommendation and conclusion of the research. One of the elements of a scientific report is the results, and it consists of data. Collecting data is a major part of any evaluation (Taylor-Powell and Steele, 1996). Before data collection, it is often necessary to check what information is already available. In chemistry, data may be collected through experiments, questionnaires or participant observations (Hox and Boieje, 2005). Methods of data collection could be quantitative, qualitative or mixed method. Data could be primary or secondary. The data collected should be as accurate as ever because they either form a baseline data or they are compared with existing values. Statistical analysis of data is usually carried out using software and training specialist statistics software such as SPSS (Statistics Package for Social Scientists).

SCIENTIFIC REPORTS

Scientific report is a document that describes the process, progress and/or result of a technical or scientific research or the state of a technical or scientific research problem, which might also include recommendation and conclusion of the research (http: //www.waikato.ac.nz). Unlike an essay, a report has a formalised structure (unilearning@uow.edu.au).

In writing scientific reports, research would have been conducted to answer either a particular question or certain questions. A good way to begin the analysis of a quantitative problem is to obtain some preliminary data (Harvey, 2000). Data collected can be characterized by measure of central tendency and a measure of spread. Errors associated with central tendency reflect the accuracy of the analysis, but the precision of the analysis is determined by those errors associated with the spread.

ELEMENTS OF A SCIENTIFIC REPORT

1. Title Page: It contains the title, authorship and date. The title should be short, specific and descriptive, containing the keywords of the report. The title is usually 4 – 12 words in length.

2. Table of Contents: It is only required for lengthy reports usually 6 pages or more.

3. Abstract: The Abstract is a self-contained synopsis of the report. It is an informative summary of what one did and what one found out. The abstract should include objectives, scope of the investigation, brief reference to the Materials and Methods and summary of the results and conclusions.

4. Introduction: This provides a summary of the analysis to be undertaken. The purpose of the introduction is to put the reader in the picture and place the research or experiment within a context. Introduction usually contains:

- Background about the analysis to be carried out.
- A brief review of previous research with the sources to support each statement.
- Reason/s why the research was undertaken.
- Statement of the hypothesis
- An explanation of the different techniques and why they are used
- A statement of the objective(s).

5. Materials and Methods: It is also called experimental. This involves a description of the materials and procedures used - what was done and how. It describes the process of preparation of the sample, specifications of the instruments used and techniques employed. Method should include such things as sample size, apparatus or equipment used, experimental conditions, concentrations, times, controls etc. The Method must be written in the past tense and the passive voice.

6. Results: This section states what you found. Included in this section are pictures, spectra, tables, graphs and brief statements of the results in the text.

7. **Discussion**: This section contains the interpretation of one's findings, perhaps comparing or contrasting them with the literature. It reflects on actual data and observations and explains outliers, giving possible sources of error and how they may have affected the outcome. The discussion must answer the question "What do the results mean?"

8. Conclusion: This is the summing up of one's argument or experiment/research, and should relate back to the introduction. The conclusion should only consist of a few sentences, and should reiterate the findings of one's experiment/research.

9. References: The reference list has an in-text citation, and every in-text citation has a full reference in the reference list at the end of your paper.

DATA COLLECTION

Data collection is simply how information is gathered. Data means original information which is collected, stored, accessed, used or disposed of during the course of the research, and the final report of the research findings (*unisa.edu.au*). There are various ways of data collection such as personal interviewing, telephone, mail and the internet. These can be used separately or combined.

METHODS OF DATA COLLECTION

There are two broad types of data collection methods. They are qualitative and quantitative methods (Hawe *et al*., 1990). Qualitative approaches aim to address the 'how' and 'why' of a program and tend to use unstructured methods of data collection to fully explore the topic. Qualitative questions are open-ended such as 'why do iron sheets get rust over time in the presence of air and moisture?' and 'how do soaps and detergents remove dirt from a material during washing?'. Quantitative methods on the other hand use a systematic standardised approach. They ask questions such as 'what is the effect of effluents of a chemical plant to the environment?'. Qualitative approaches are good for further exploring the effects and unintended consequences of a program. However, they are expensive and time consuming. Quantitative methods are easier to implement and are standardized, thereby making way for comparison as well as measuring the size of the effect (Hawe *et al*., 1990). Data collected through quantitative methods are often believed to yield more objective and accurate information because they were collected using standardized methods, replicated and analyzed using sophisticated statistical techniques unlike qualitative data. Mixed method involves the combination of both qualitative and quantitative research data, techniques and methods.

Quantitative information is obtained from research methods such as surveys or experimental procedures. When recording the data it is important to include detailed information like dates and places of collection, methods of measurement and units of measurement, so as to avoid confusion. Numerical data are usually recorded on printed datasheets, then stored in spreadsheet format. In some cases, data may initially be recorded by handheld computers or specialised data recorders which can later be downloaded to more secure devices. Data recorders can often be set up to record data remotely, without the requirement that researchers be present. Such techniques are frequently used in meteorological research, industrial chemistry and in space research. Qualitative information (non-numerical) information may be recorded during interviews with human participants, often on video or audiotape, possibly with supporting notes, and may be transcribed into written form later. Other qualitative information describing and interpreting texts or artefacts may also be recorded in written form and stored on index cards or as Word files. This material may be coded for themes using software programs (e.g Nvivo) that search for keywords or strings, or it may be done manually (*unisa.edu.au*).

The choice of method for data collection could be affected by credibility of findings, staff skills, costs and time constraints. In the educational community, many stakeholders are often skeptical about statistics and clumsiness of numbers that they consider the richer data obtained through qualitative research to be more trustworthy and informative. Qualitative methods, including indepth interviewing, observations, and the use of focus groups, require good staff skills and considerable supervision to yield trustworthy data. On the other hand, some quantitative research methods can be mastered easily with the help of simple training manuals. Qualitative methods may be more time consuming than quantitative methods because it encourages the exploration of new evaluation questions.

The debate with respect to the merits of qualitative versus quantitative methods is still ongoing in the academic community, but when it comes to the choice of methods in conducting project evaluations, a pragmatic strategy has been gaining increased support. Respected practitioners have argued for integrating the two approaches by putting together packages of the available imperfect methods and theories, which will minimize biases by selecting the least biased and most appropriate method for each evaluation subtask (Shadish, 1993). Others have stressed the advantages of linking qualitative and quantitative methods when performing studies and evaluations, showing how the validity and usefulness of findings will benefit from this linkage (Miles and Huberman, 1994).

To collect data, scientists make use of a number of different data collection strategies. In chemistry, data are mostly collected through experiments and observations, and sometimes through the use of questionnaires alone or in conjunction with experimental results. A questionnaire is a series of questions asked to individuals to obtain statistically useful information about a given topic. Experiments are important because they typically involve a research deign that involves strong casual inferences. Surveys using structured questionnaires are important because they involve collecting data on a large number of variables from a large and representative sample of respondents (Hox and Boieje, 2005). Data can be primary or secondary.

PRIMARY DATA

Primary data is original data collected for a specific research goal. Primary data adds new data to the existing store of knowledge. One major primary data collection strategy in Chemistry is the experiment. In an experiment, the researcher has full control over what chemicals to use in the experiment. The researcher manipulates one or more independent variables following a planned design and observes the effects of the independent variables on the dependent variable. The essence of an experiment is that the research situation is one created by the researcher and it permits strong control over the design and the procedure. A major problem here is the ecological validity, which is the extent to which we can generalize the results of our study to real-life situations.

SECONDARY DATA

Secondary data is data originally collected for a different purpose but reused for another research question. By virtue of being archived and made available, primary data can serve as secondary data. Secondary data presents researchers with a number of characteristic problems. First is locating data sources that may be useful to the research problem. Secondly, is being able to retrieve the relevant data and thirdly is evaluating how well the data meet the quality requirements of the current research and the methodological criteria of good scientific practice.

The main sources of information are the official data archives e.g Qualitative Data Service at the UK data archive; internet. Secondary data contained in an official data archive are easy to retrieve. They may be obtained as files through the internet or as data files on CD-ROM or DVD data discs (Hox and Boieje, 2005). Data are usually subjected to statistical analysis like mean, median, mode, t-test, correlation coefficient, etc.

The major fields of chemistry are organic, inorganic, analytical and physical chemistry. It should be noted that each field of chemistry brings a unique perspective to the study of chemistry. In analytical chemistry for example, there is an analytical approach to solving problems. This involves conducting an experiment so as to gather data and analyse the required data (Harvey, 2000). The most visible part of the analytical approach occurs in the laboratory. The selected samples are then analyzed and the raw data recorded. The raw data collected during the experiment are then analyzed. A statistical treatment of the data is used to evaluate the accuracy and precision of the analysis and to validate the procedure. These results are compared with the criteria established during the design of the experiment, and then the design is reconsidered, additional experimental trials are run, or a solution to the problem is proposed.

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