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Research procedures used by Master of Information Studies students at the University of Natal in the period 1982–2002 with special reference to their sampling techniques and survey response rates: A methodological discourse ☆

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Summary The study investigated the research procedures used by Master of Information Studies students at the University of Natal between 1982 and 2002 with special reference to their sampling techniques and survey response rates. Methods employed by researchers are key to the quality of their research outputs.

The results indicated that sample surveys dominated the research arena during the period under review. Many theses rarely defined the population of the studies. Some quantitative theses used ad hoc sampling procedures. The instruments of data collection were pretested before being used in the field. Questions of reliability and validity of the survey protocols were not adequately addressed. Response rates of the surveys were above average. Most of the theses ignored the evaluation of the research procedures.

The argument put forward is quite simple. For research in library and information science to contribute to theory and improve planning, practice and decision-making, it should rely on objective methods and procedures. Readers would make use of the findings and recommendations of LIS research if they have some degree of confidence in the quality of work described and the accuracy of conclusions drawn.

Introduction

Research is key to extending the frontiers of knowledge and assisting decision makers. The production of valid knowledge hinges upon the

☆The University of Natal is now called the University of KwaZulu-Natal as a result of the merger with the University of Durban-Westville in terms of the Higher Education Act (Act No. 101 of 1997) as amended.

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method of research used. Research procedures typically include the population and how it was obtained, sampling procedures, instrumentation used, procedures employed in gathering and processing data, and statistical treatment of data. Research results may be dependable if they are based on sound and justifiable research procedures that are clearly explicated by other researchers.

The consumers of the research products have a right to know how the study was conducted. Library and information science (LIS) researchers have tended to focus on the findings and implications of their studies without giving details of the methods used in their studies (Hernon & Schwartz, 1994). Social scientists in other fields are not an exception (Burton, 2000b). This also implies that, details of research procedures remain implicit and undisclosed. Equally neglected by most LIS researchers are issues of reliability and internal validity (Hernon & Schwartz, 1994). Some survey researchers do not even report potential sources of error relating to sampling, measuring instruments, response rates and coding (Hernon & Schwartz, 2002). Surprisingly, a study on the prevalent mistakes made by LIS master's degree candidates in eastern and southern Africa higher education institutions deliberately excluded ''matters like appropriateness of the methodology used, reliability and validity of data collection procedures, sampling techniques, appropriateness of statistics and so on'' (Kaniki, 2000). Yet sound research hinges upon some of these fundamental issues.

Polkinghorne (1983) underscored the importance of understanding the ''why'' of one's design and the ''how'' of carrying it out. Nachmias and Nachmias' (1984, p. 15) definition of a research methodology as ''a system of explicit rules and procedures upon which claims for knowledge are evaluated'' underlines the importance of making one's research procedures explicit.

Describing the methods used by a researcher is essential because it enables other researchers to replicate and test methods used in the study. A detailed and accurate account of research procedures may also enable readers to explain differences in findings among studies dealing with the same research question in terms of differences in procedure. Asking questions related to the methods used in a research process may check the researcher's claims to validity and reliability (Clough & Nutbrown, 2002). Furthermore, articulation of research procedures by the investigators demonstrates the degree of acquaintance with research methods used in social science research. Indeed, the University of Natal only awards a master's degree for a thesis that shows the candidate's knowledge of methods of research and their appropriate application (University of Natal (Pietermaritzburg), 2000).

The purpose of the study was to investigate the research procedures used by the Master of Information Studies students at the University of Natal between 1982 and 2002 in order to answer the following questions:

- What methodological perspectives did they use?
- How were the populations of the studies defined?
- What sampling procedures did they use?
- How were sample sizes determined?
- How was data collected?
- How were the questions of reliability and validity addressed?
- How were response rates evaluated?
- How data analysis procedures were explained?
- How the research procedures were evaluated?

Background and context: setting the scene

The Department of Library and Information Studies at the University of Natal was established in 1973. Over the years, the Department has attracted scholars from all over Africa and has been acclaimed as one of the leading library and information studies schools in Africa. Up until 2000, the Department accounted for a large part of graduate research in library and information science in South Africa (Ocholla, 2000). A large part of graduate research in South Africa is dominated by masters' work (82%) as opposed to doctoral work (18%) (Ocholla, 2000). According to Kaniki (2000) the majority of researchers in southern Africa are trained at master's level ''which is the level for future independent research work''.

Bearing in mind the points raised by Ocholla (2000) and Kaniki (2000) in relation to South Africa's LIS research landscape, this study confined itself to master's theses that were submitted and approved by the University of Natal during the period under review. The curriculum of most masters' programmes in Sub Saharan Africa includes research methods and thesis preparation (Rugambwa, 2001). It is evident that research study at master's level culminates in the production of a thesis.

Although terminology in higher education is not standardized the terms thesis and dissertation are sometimes used synonymous depending on one's background (Mauch & Birch, 1993; Wisker, 2001). In the context of this study, a thesis is regarded as ''a

product of a scholarly and professional study at the master's level by a graduate… student; usually a document in a format and style specified by a particular university''(Mauch & Birch, 1993, p. 5). In the case of the University of Natal, a master's degree may be awarded for a thesis alone or for a thesis plus course work. The current study made no distinction between mini and major theses and this was supported by the fact that the Information Studies Programme indicates equivalent standards for all masters' programmes and moreover, that all masters' students are required to design and conduct independent research.

Theses of masters' students were regarded as suitable for the study as they are supposed to meet basic empirical standards. Indeed, a set down number of credits or equivalent course in research design and methodology is one of the prerequisites for undertaking a master's degree. It is assumed that the course equips the students with tools that they can use to produce credible research products. In that regard, the theses were likely to give reliable information to answer the research questions outlined in the previous section. According to a number of research methodologists, one of the safeguards against getting unreliable information is ensuring that the units of analysis are capable of providing the required information with some degree of accuracy (de Vaus, 1996, p. 84; Babbie & Mouton, 2001, p. 234).

Methodology: the research story

The research story is divided into two sections. The first part deals with bibliometrics as a research methodology and studies that have employed the technique. The second part sketches the procedures used in data collection.

Bibliometrics as a research method

The study used bibliometric techniques to investigate the research procedures used at an institution of higher education in South Africa. Coined by Alan Pritchard in 1969, the term bibliometrics has been defined in various ways (Hertzel, 2003). For instance, Fairthorne (1969) described bibliometrics as a ''quantitative treatment of the properties of recorded discourse and behaviour appertaining to it''. On the other hand, Potter (1981) characterized it as ''the study and measurement of the publication patterns of all forms of written communication and their authors''.

Derivatives of bibliometrics include, librametrics, scientometrics, informetrics, technometrics and webmetrics (Wormell, 1998). Although it has been argued that among all these terms, informetrics attempts to embrace all derivatives and purports to study the quantitative aspects of information in any form (Bar-Ilan & Peritz, 2002), this study used the traditional quantitative bibliometrics method. The emerging consensus is that bibliometrics is concerned with the study and analysis of all forms of written communication by countries, authors, languages, words, formats, research methodologies, articles, obsolescence and distribution of authors in literature (Borgman & Furner, 2002; Broadus, 1987; Sengupta, 1992; Lawani, 1981).

Many researchers investigating research trends and methods in LIS have used bibliometric methods for data collection and analysis (Abdoulaye, 2002). In that regard, the bibliometric research method was considered appropriate for the study. The population of the study was 81 Master of Information Studies theses submitted and approved by the University of Natal during the period under review.[1] In some related studies Anwar (1982) analysed 56 theses submitted to the University of the Punjab between 1975 and 1981. In 1988, Tejomurty (1988) analysed 100 theses submitted to Vikram University between 1972 and 1987. Oppenheim and Smith (2001) analysed the citations of 60 final year undergraduate assignments from the Department of Information Science of Loughborough University, submitted in the years 1997, 1998 and 2000. Recently, Abdoulaye (2002) used a population of 20 theses to investigate research trends in library and information science at the International Islamic University Malaysia.

The population of a study refers to a set of objects whether animate or inanimate which are the focus of research and about which the researcher wants to determine some characteristics (Bless & Higson-Smith, 2000; Ravichandra Rao, 1983; Rowley, 2002). For example, a set of records or theses, or an event, or institution, or people could constitute a study population. Depending on the size of the population and the purpose of the study a researcher may study the whole universe or subset of the population, which is referred to as a sample (Kish, 1965, p. 6).

[1]Two theses that were written in Afrikaans, a language that the author did not understand, were excluded from the study. One of the theses was written in 1981 and was the first that the Department produced, and the other was produced in 1992. A complete list of the theses that were studied is available from the author or the SABINET database at http://www.sabinet.co.za/.

Although, it is desirable to study the whole population, sometimes cost and time considerations make it impossible (Williams, 2003, p. 74; Hammersley & Atkinson, 1995). Usually, a census is used for small populations. A census eliminates sampling errors and provides data of all units of analysis in the population. All the theses that were written in the language accessible to the author were included in this study. Eight-one units of analysis were identified as discussed below. It is generally agreed that there is little point in sampling populations of less than 100 (Gay, 1996b) although, Henry (1990) put the figure at 50.

Data collection technique

The 81 units of analysis of the study were identified from the University of Natal graduation ceremony lists and the study done by Bell (1999). The lists were validated by checking the Information Studies website (Information Studies, 2003) and the University of Natal Library's online public access catalogue (OPAC) (University of Natal, Pietermaritzburg Library catalogue, 2003). The University of Natal Library was considered to be the most reliable source of information because students are not awarded their degrees and certificates until they have deposited two bound theses for the Library. The OPAC also gave accurate information regarding the imprint of the theses. The dates of the theses used in this study correspond to those in the Library OPAC.

Each thesis in the population of the study was perused in order to determine the methodological perspectives used, definition of population of the study, sampling procedures used, data collection techniques, questions of reliability and validity, response rates, data analysis procedures and evaluation of the research procedures. The following sections present and discuss the findings of the study based on the outlined variables.

Methodological approaches used in the theses under study

There are no agreed upon classification schemes for categorizing research methods used in social sciences (Powell, 1999). For instance, Sarantakos lists many types of social research (Sarantakos, 1998). However, it is generally agreed that they are two broad approaches, namely quantitative research and qualitative research. The strengths and limitations of these approaches are beyond the scope of this article. However, the major traits of these approaches are briefly discussed in order to relate them to the assumptions and methodology adopted by the current study.

Quantitative studies rely on statistical and mathematical techniques. According to Powell (1999) and Kim (1996) quantitative research includes descriptive studies, exploratory and/or explanatory studies, operation research studies, citation analysis, bibliometrics, experiments and quasi-experiments.

On the other hand, qualitative research is concerned with the qualities that things have (Williams, 2003, p. 5). Qualitative studies are usually confined to in-depth studies of small groups or individuals. The data collection methods for this approach include unstructured in-depth interviewing, focus group interviews and observation. Qualitatively driven strategies include case studies, bibliographical and historical methods, grounded theory, ethnography, symbolic interactionism or semiotics, phenomenology and other interpretive practices, hermeneutics and discourse analysis (Powell, 1999).

According to Patton, "nothing better captures" the difference between the qualitative and quantitative paradigms than "the different logics that undergird" sampling procedures (Patton, 2002, p. 230). Sampling within the qualitative paradigm is purposive or judgement whereas quantitative traditions rely on probabilistic sampling (Patton, 2002, p. 230). Sample sizes in qualitative research are generally small when compared with quantitative research (Bradley, 1993). In essence, there are no rules for sample sizes in qualitative research (Patton, 2002, p. 244). Statistical generalizations are difficult if not impossible in qualitative research. Statistical representativeness is not an important consideration in qualitative research, especially when the researcher chooses to research the setting she or he is in. Sampling procedures as they relate to the quantitative approach are discussed in the subsequent sections of this article.

The framework discussed in the preceding paragraphs of this section was used to classify the research methodologies used in Master of Information Studies theses submitted and approved by the University of Natal between 1982 and 2002. The major objective behind categorizing the research methodologies was to identify the number of theses that utilized quantitative approaches. The reason for specifically identifying theses that used quantitative strategies was that the emphasis of this article is on statistical sampling procedures and response rates used by the researchers under study.

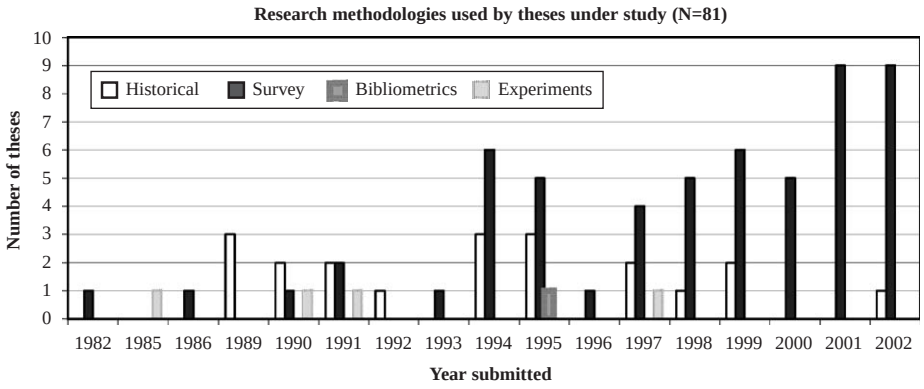

Figure 1 Research methodologies used by theses under study ($N = 81$).

Fig. 1 summarizes the results of the research methodologies used by the theses.[2] Of the 81 theses that were submitted and approved by the University of Natal, 61 (75.31%) used the quantitative approach. The survey method accounted for 56 (69.14%), 4 (4.94%) employed the experimental method and bibliometrics was used in 1 (1.23%) study. Studies that used the qualitative paradigm accounted for 20 (24.69%). In a related study Powell (1999) found that 56.1% of the dissertations submitted between 1973 and 1981 used the survey methodology; the historical method was pegged at 15.4%, at 8.1% was citation and content analysis and the experimental method was used in 5.3% of the cases.

It is evident that Masters students in Information Studies at the University of Natal predominantly used the survey research methodology during the period under review. The surveys were mostly cross-sectional as they investigated units of analysis at a particular point in time. The theses were supposed to be completed in a limited time frame. Sample surveys are considered to be the quickest means of providing statistical data on a varying range of subjects (Kalton, 1983, p. 5).

The observation by Powell (1999) that qualitative research methods are enjoying an increased popularity cannot be sustained by the current findings in relation to research trends at the University of Natal. In fact, the research trends of the theses that were analysed do not show any significant growth in the use of qualitative methods. Hernon and Schwartz (2000), and Rochester and Vakkari (2004) also confirmed the dominance of survey research within library and information science research during the period covered by the current study. Based on the results of the current study, one could be justified to conclude that, "the serious cultivation of the potential of qualitative research has yet to emerge" at the University of Natal (Bradley & Sutton, 1993).

Having established and classified the research methodologies used by theses under study the rest of this paper is devoted to the analysis of the theses that used the quantitative paradigm. The discussion mainly focuses on the survey methodology because it was used by the majority, (that is, 56), of the theses, confirming the observation that it is one of the most fully developed and extensively used of social science methods (Manheim & Rich, 1981).

Research methodologists recognize that both qualitative and quantitative methods have something to offer (Creswell, 2003; Payne & Payne, 2004, p. 178), but the qualitative theses presented in Fig. 1 were excluded for practical reasons. Based on the literature, this study recognized that quantitative and qualitative methods represent distinctive approaches to social research (Burns, 2000; Punch, 2000). Quantitative research uses standardized measures that eliminate quirkiness that characterizes many qualitative studies (Pawar, 2004; Knoblauch, 2004). The research findings of quantitative research are of a different nature than "the interpretive observations of small-scale interactions that typify the work of the qualitative social worker" (Payne & Payne, 2004, p. 183). The other attraction of the quantitative theses was that they were based on a research paradigm that has provided "a significant part of the foundation on which the social sciences have been erected" (Locke, Silverman, & Spirduso, 1998, p. 124) Indeed:

> The visibility of much of the technical process (sampling designs, questionnaires, code-books), and the potential this gives for subsequent

[2] No masters theses were submitted in 1983, 1984, 1987 and 1988.

replication of studies by other researchers, is used to substantiate a case that quantitative methods provide the basis for a social *science* (Payne & Payne, 2004, p. 183; also see Schroder, Drotner, Kline, & Murray, 2003).

In a nutshell, the standardized nature of the quantitative processes and the visibility of the procedures used by the methodology made it easy for this study to use predetermined categories of analyse the manner which the selected studies were conducted.

Survey research

Although survey research is clouded by a lot of methodological controversies most survey researchers are agreed on the standards of research design, sampling, questionnaire construction and data analysis (Williams, 2003, p. 51). Sampling is very critical in survey research (Leedy & Ormrod, 2001, p. 219). In fact, sampling is key to the effective description of the characteristics of a population. According to Niemi,[3] "the foundation of survey research…lies in sampling procedures. No matter how good the questions asked and no matter how elegant the analysis, little knowledge will be gained if the sample itself is poorly designed and executed". The sampling plan and sample size used by researchers ultimately affects the type, level and generalizability of the results. Stated differently, the sampling techniques employed by a study have crucial implications for generalizations that can be made and the confidence that could be assigned to those generalizations.

Generalizability is the hallmark of quantitative studies and it is normally achieved by the use of statistical sampling procedures. The following section discusses sampling principles in relation to the Master of Information Studies theses that were analysed.

Sampling procedures

Although a survey usually involves some sampling (Jolliffe, 1986), only 30 (49.18%) of the 61 quantitative studies investigated a sample of the target population. By studying the sample it is hoped to draw valid conclusions about the larger group. Probability and non-probability or judgement selection are the major types of survey sampling procedures (Carpenter & Vasu, 1978, p. 30; Saunders, Lewis, & Thornhill, 1997, p. 126). Probability sampling procedures comprise simple random sampling, systematic random sampling, stratified random sampling, proportional stratified random sampling, and cluster sampling (Leedy & Ormrod, 2001, pp. 214–216).

Of the 30 theses informed by the survey design, six (20%) used non-probability sampling and 24 (80%) used probability sampling. Non-probability samples depend on judgement selection of "typical" or "representative" elements (Deming, 1950, p. 11). Thus, objective statistical inferences are difficult to make when non-probability sampling is used. The commonest non-probability sampling methods are quota, snowball, convenience or accidental and purposive or experience sampling. The six theses mentioned above used purposive sampling.

On the other hand, in probability sampling, every element in the population has an equal chance of being selected. Out of the 24 theses that used probability sampling, 10 (41.67%) used simple random sampling, one (4.17%) utilized systematic random sampling and 11 (45.83%) applied stratified random sampling techniques. Two (8.33%) used a sample, but did not explain the sampling procedures that were used to determine the subset of the target population that was studied. Researchers should be encouraged to report their sampling techniques because the appropriateness of the sampling strategy has a bearing on the validity of the research output.

Since the external validity of a study is intimately linked to the sampling procedures (Struwig & Stead, 2001), the concept of validity is going to be briefly examined before we continue with our discussion. Validity has been generically defined as the degree to which a test measures what it is supposed to measure (Gay, 1996a). In that regard, if the meaning of validity were to be posed as questions, one would ask: Has the research measured the phenomenon of interest in a manner that accurately reflects its characteristics? To what extent was the sample appropriately drawn? Is the sample a true reflection of the population? Can the results from the research help in determining something about the population? If the sampling technique were ambiguous, it would be difficult for the research to achieve what it would have set out to do. It would be equally impossible to establish whether the sample represents the population or not. Unequivocal conclusions about the population would be difficult to make if the sampling strategy were nebulous. The level of representativeness of the sample can limit the applicability and generalizability of findings. In addition, the trustworthiness of the results may be

[3]Niemi, R. G. cited in Kalton (1983, p. 4).

questionable, and that would ultimately threaten the external validity of the research.

Although sampling without replacement is the widely used procedure in social research (Smithson, 2000, p. 72), all the theses that were studied never informed the reader whether the sampling was done with replacement or without replacement. Equally, ignored was explaining on how randomized the samples were. Only four theses reported using the randomizing devices such as tables of random numbers or pseudo-random numbers generated by computer software. Of the four theses, only three mentioned that each unit in the sample frame was given a unique identifier and was included in the sample after being randomly selected.

It is evident that most of the samples that were used in most of the theses that utilized quantitative approaches had a selection bias. Selection errors may ruin research studies because they distort sample estimates and undermine the researcher's claim to accurately characterizing the population from which the sample came (Smithson, 2000, p. 96). In that regard, researchers should use tested and laid down procedures for drawing random samples (for procedures for drawing random samples see Howell, 2002; Powell, 1997, pp. 70–73; Saunders, Lewis, & Thornhill, 2000, pp. 159–161).

However, it is important to note that random samples have advantages and pitfalls (Sapsford, 1999, pp. 66–78; Kalton, 1983, p. 56). Although every member has an equal, non-zero chance of being selected and protection against bias is increased, the randomization does not guarantee he drawing of a representative sample. For instance, the sampling frame might contain names of members who are no longer available, or not contain names of the other members of the population (Kalton, 1983, p. 56; Kish, 1965, p. 384). The sample may also be distorted by the fact that some population elements might have more than one listing. In addition, randomization may not pick up all the elements that are of interest if, for example, the population is not homogenous or if there are rare elements. Little knowledge may be gained by society from findings based on biased sample frames.

Ultimately, the decision to use randomization in drawing up a sample from a population will be largely determined by the characteristics of the target population, availability and precision of the sampling frame, the research question and the degree to which the results can be generalized. Researchers should bear in mind that non-response may negatively affect the sample's representativeness even when randomization is used (Burton, 2000a).

Sample frame: a major ingredient of the overall sample design

One of the major steps in survey design is to define the population according to the survey objectives. It is important that the investigator carefully and completely defines the population before collecting the sample, including a description of the elements to be included. Out of the 61 theses that used quantitative strategies only 29 (47.54%) clearly defined the population and outlined how the population was determined.

Kish (1965, p. 7) asserted that the population should be described in terms of content, units, extent and time. In that regard, statements found in some theses that were analysed echoing sentiments such as "registered members of the library were surveyed" or "all members of staff of the University library were surveyed" or "the head gave an indication of the size of the population to be surveyed" or "1995 psychology students were investigated" or "all library employees were surveyed" do not say a lot about how the population was identified and located. For instance, the readers need to be fully informed whether or not there was a source such as a database or directory or mailing list or register that was used to determine the population of the study.

Defining the population and having a sample frame are fundamental to sample design. Of the 29 theses that clearly defined the population of the study, only 22 of the 24 theses that used probability sampling were considered in this section. Two theses were excluded in discussions in this section although they used a probability sample because they neither explained the sampling procedures nor gave details of sample sizes. Unlike quantitative research, qualitative based studies do not strictly rely on probabilistic samples. In that regard, only those theses that used probabilistic samples are considered in the subsequent sections.

Sample surveys usually deal with finite populations. The device or material used to have access to the target population is called a frame or the sampling frame (Särndal, Swensson, & Wretman, 1992, p. 9). The sampling frame or list is the foundation on which the selection process is designed (Kish, 1965, p. 53; Särndal et al., 1992, p. 11; Williams, 2003, p. 75). Lists that contain every member of the population are an exception rather than a norm. For instance, some elements might be missing from the list or are duplicated (Kish, 1965, pp. 53–59). Accordingly, Williams (2003, p. 76) defined a sampling frame as "any comprehensive list of the population of interest and

many samples are of smaller populations with particular characteristics''. In that light, researchers should evaluate the sample frame for comprehensiveness and the probability of selection of each element that is being sampled. Two theses evaluated the sample frame and highlighted its limitations. The ability to generalize from a sample is limited by the sample frame (Fowler, 2002, p. 14). Therefore, when reporting results researchers are obliged to tell the readers who was or was not given an equal chance to be selected, and the characteristics of those who are excluded.

Having established and evaluated the sampling frame, determining an appropriate sample size is another crucial part of study design. In order to make any generalizations and objective statistical inferences about a population, a sample, that is meant to be representative of the population, should be studied. The subject of the 'representativeness' of samples used in social research is highly contested [4] and its discussion is beyond the scope of this paper. However, appropriate sample sizes may help researchers to get results that reflect the target population as precisely as needed. Researchers should give the rationale for the proposed sample size. The following section elaborates on sample sizes.

Determining sample sizes: to be or not to be representative is the question

Determining sample sizes is a major problem for many researchers. In planning a sample survey, a decision must be made about the size of a sample. A sample that is too large could result in a waste of resources (Cochran, 1963, p. 71). On the other hand, a sample that is too small diminishes the utility of the results. A large sample is likely to be representative and may give the researcher the confidence that the findings truly reflect the population.

According to Cochran researchers only started to pay much attention to the problem of obtaining good samples and drawing sound conclusions from the results from about the third decade of the twentieth century (Cochran, 1963, p. 1). The method by which the sample is obtained is key to validity and reliability of conclusions made by a researcher. Ad hoc or arbitrary sampling procedures may exclude some of the elements that comprise the target population.

When determining the size of a sample it is sometimes presumed that a sample should be based on some percentage of the population from which it is drawn. Seaberg (1988) and Grinnell and Williams (1990) stated that a 10% sample should be fine in most cases. Neuman (2000, p. 217) argued more or less along the same lines. Such assertions might have influenced some theses that were studied to use sample sizes ranging from 10% to 50% of the target population. The view that there is a percentage often thought to be around 10% which can be applied when sampling populations of all kinds and sizes is quite wrong (Chisnall, 1981; Fowler, 2002, pp. 34–36; Powell, 1997, p. 84).

Social science researchers should bear in mind that the sample size does not entirely depend on the size of the population (Braunstein, 2003). According to Dillon, Madden, and Firtle (1994), the adequacy of a sample depends on its relationship to the population being surveyed. Sample sizes for homogenous populations might be smaller while heterogeneous ones may require larger samples. Only seven out of twenty two theses that used probabilistic sampling bothered to discuss the degree of variability or diversity of the population. Readers are inclined not to question sample sizes in cases where the degree of accuracy required and the characteristics of the population are explained by the researchers.

The accuracy of a sample may also be assessed through the relationship between the confidence level and the amount of error (Williams, 2003, p. 78). The following paragraphs discuss the concept of confidence levels, margin of error and the framework of determining sample sizes.

Although there are no absolute criteria for sample sizes and margin of error, sampling survey theory provides a framework for developing methods of sample selection and estimation (Cochran, 1977; Kothari, 1990). Statistical formulas for calculating sample sizes are based on the sampling survey theory. Nowadays, one does not have to be a statistician with some knowledge of sampling theory to estimate sample sizes for survey populations. A variety of tools are at the disposal of LIS researchers. Researchers should note that these tools assume that data are collected from all cases in the sample. The tools include statistical power analysis software packages and tables of determining sample sizes of given population sizes found in the research methodology literature.[5]

[4] For some insights into the debate, see Sapsford (1999, pp. 155–156).

[5] For tables used to determine sample sizes, see Cohen et al. (2000), Krejcie and Morgan (2000), Powell (1997, p. 80), Saunders et al. (2000, p. 156).

Statistical power analysis software packages such as Power and Precision® may also be used for the calculation of a sample size for a defined population (Power and precision, 2003). The Sample Size Calculator of Creative Research Systems (Creative Research Systems, 2003) and that one of the Department of Statistics at the University of California, Los Angeles (UCLA) (UCLA Department of Statistics, 2002), and nQuery Advisor® of Statistical Solutions (Statistical Solutions, 2003), are examples of software packages that may be used to determine appropriate sample sizes for research studies. Thomas & Krebs (1997) reviewed some versions of these statistical power analysis softwares and concluded that they gave relatively reliable sample sizes. Although all these tools for determining sample sizes are at the disposal of social scientists, the optimum sample size also hinges on factors such as the nature of the target population (that is, homogeneous versus heterogeneous) and the type of research design (Rossouw, 2003).

It is evident from the theses that were investigated that the researchers used ad hoc or haphazard sample sizes that were lower than the minimum sizes recommended in the literature with the exception of two. The two theses that used sample sizes reported in the literature were the only ones that made explicit the relationship between the sample and the population. The relationship was discussed in terms of the confidence level and the margin of error. The confidence level, that is, the level of certainty that the characteristics of the sample represented the target population was pegged at 95%. The margin of error or degree of precision required between the sample and the target population was also adequately addressed. They used sample sizes with a 5% degree of accuracy.

It is important that researchers should provide information on the precision and level of certainty associated with the sample sizes they use by giving the desired confidence interval, the margin of error they can tolerate and the variability of the population. Researchers have to determine how confident they need to be that their results are representative. A common rule of thumb is a 95% confidence level so that the results are accurate to within $\pm$3% (Carpenter & Vasu, 1978, p. 39; Saunders et al., 1997, p. 128). A sampling error of 3% and a 95% confidence level means that we can be 95% confident that the population would resemble the sample, $\pm$3% sampling error.

Sampling errors arise because the data are collected from a part, rather than the whole of the population. The sampling error is an estimate of the margin by which the "true" score for a sample could differ from the reported score for one reason or another. Put simply, the margin of error in a sample is equivalent to one divided by the square root of the number of elements in the sample. Increasing the number of respondents relative to the total population reduces the sampling error. For instance, a sample of 100 people or objects gives a margin of error of $\pm$10% whereas a sample of 2500 people gives it as $\pm$0.2%. All theses that were analysed ignored discussing the sampling error.

The findings revealed that most of the theses that were analysed used small samples. It has been argued that the margin of error increases when a small proportion of the total target population is sampled (Saunders et al., 2000, p. 156). It is very difficult to escape the conclusion that most of the samples that were used in the theses were not representative of the total population, especially if we take into consideration the fact that response rates to the survey instruments used by the theses were not always 100%. The situation is not peculiar to the University of Natal, a review of the state of research methodology in African librarianship revealed that one of its major weaknesses was in the use of sampling techniques (Manda, 2003).

Instruments of data collection

Reliability and validity are the major technical considerations that researchers take into account when constructing and evaluating instruments of data collection (Babbie & Mouton, 2001, p. 119). Reliability is a necessary precondition of validity (Cohen, Manion, & Morrison, 2000, p. 105; Neuman, 2000, p. 171; Schutt, 1996, p. 100). On the other hand, measurement validity is a necessary foundation for social research. If a piece of research lacks validity then it does not add value to society's knowledge base. Only 17 (27.87%) out of the 61 quantitative theses discussed issues related to reliability and validity. That omission may give the readers the impression that the quality of data was not a central concern of most theses.

Although it is difficult to assess the quality of the data that one collects (Litwin, 1995, p. 3), it is possible to assess the accuracy of the survey tools used to collect data in any investigation. An assessment of the collected data hinges upon determining the reliability and validity of the survey instruments. Research findings are considered to be reliable if they are repeatable, to the extent that repeated measurement would yield constant results (Cohen et al., 2000, p. 117;

Powell, 1997, p. 37; Sapsford, 1999, pp. 155–156). LeCompte and Preissle (1993) suggested that replication is the main tenet of quantitative research. The assumption of this assertion is that in a quantitative approach, instrumentation, data and findings are controllable, predictable, consistent and replicable. While it is not debatable that, all measurement is imperfect, a measurement is generally considered to be reliable if it is consistent and accurate in its collection of data (Litwin, 1995, p. 5; Powell, 1997, p. 41).

In order to get consistent answers to consistent questions, all the 61 quantitative-based theses used standardized data collection procedures. The data gathering techniques included questionnaires and structured interviews. Questionnaires were self-administered and they constituted the principal means of gathering information in 56 (91.80%) of the theses that were analysed. Twelve theses used more than one data collection method.

The use of two or more methods to study a phenomenon is called triangulation (Cohen et al., 2000, p. 112). Triangulation has various meanings, including but not limited to the use of multiple methodologies and use of multiple measures of a construct. The rationale of using multiple methods is that although ''no single method is perfect,'' if different methods lead to the same answer, then greater confidence can be placed in the validity of one's conclusions (Cohen et al., 2000, p. 112). Thus many studies advocate methodological triangulation because it bridges issues of reliability and validity (Hammersley, 1992).

It is encouraging that 45 (73.77%) of the 61 theses that used the quantitative paradigm pretested the instruments before using them. One of the commonest sources of errors in questionnaire construction is the lack of pretesting (Mouton, 2001). Narins (2001) emphasized the fact that the pretest is an element of the survey process that is essential. Pretesting questionnaires or interview schedules is one of the tools that may be used for content validation. Accordingly, no questionnaire should be considered ready for use until it has been pretested (Schutt, 1996, p. 285; Peterson, 2000, p. 119). In fact, without a pretest even experienced researchers can administer a faulty survey, putting into question any results. According to Churchill, ''The researcher who avoids a questionnaire pretest…is either naïve or a fool. The pretest is the most inexpensive insurance the researcher can buy to assure the success of the questionnaire and the research project'' (Churchill, 1992).

Thirty-five (77.78%) used a sample of the target population whilst the rest used a convenience sample to pretest the survey protocols. Scholars are not agreed on the exact composition of a sample for pretesting questionnaires. The school that advocates the ''warm bodies'' approach argue that any person who is literate can be used for the pretest (Peterson, 2000, p. 116). Another school of thought supports the use of a sample composed of individuals selected from the potential respondents in the population to be studied (Fowler, 1998). Each school of thought has merit. However, the use of a convenience sample to pretest a questionnaire is the most employed approach (Peterson, 2000, p. 116).

The questionnaire and the rigour of pretesting may influence the validity and reliability of survey data and the response rate. The following sections elaborate on response rates and data analysis before turning to the issues related to evaluating research techniques used in the theses that were investigated.

Survey response rates: colecting data from sampled elements

According to Fowler (2002, p. 40), ''the response rate is a basic parameter for evaluating a data collection effort''. Thus, reporting response rates and non-response has become an accepted responsibility for better surveys. Only 41 theses out of 61 theses based on the quantitative paradigm discussed their response rates. However, they only gave response rates without discussing in detail non-response resulting from non-observation. The following paragraphs explicate non-response resulting from non-observation.

Generally speaking, non-response is a major problem in surveys (Williams, 2003, p. 99) and it is one of the major sources of errors. It has been classified as a non-sampling error that occurs as result of non-observation. Non-response occurs at two levels, namely unit and item non-response (Kalton, 1983, p. 63). Unit non-response occurs when some elements that would have been selected for the survey turn out to be non-observations due to refusal, language limitations and unavailability of the respondents or incapacity to participate (Särndal et al., 1992, p. 17; Kalton, 1983, p. 64). Loss of completed questionnaire in the post may contribute to unit non-response. As a result no information would be gathered from the units of analysis. Item non-response results from the respondents failing to answer all the survey questions. Incomplete questionnaire that are unusable could also be regarded as non-response.

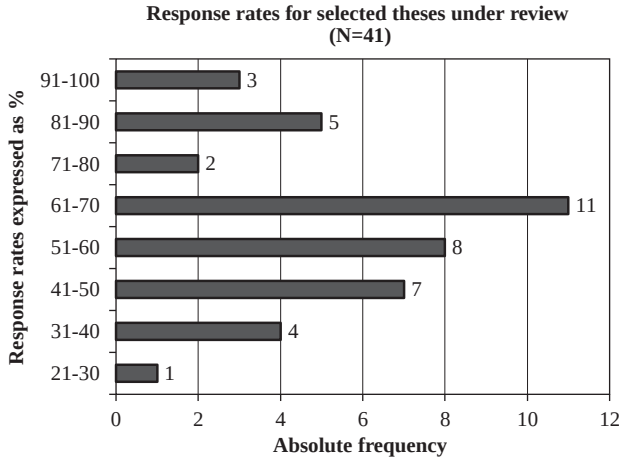

Figure 2 Response rates for selected theses under review ($N = 41$).

According to Church (1993) and Williams (2003, p. 99), postal surveys have low response rates. However, authorities are not agreed on what constitutes an adequate response rate. For instance, Dillman (1978) reported response rates of between 50% and 92% for questionnaire surveys. In a survey of 500 Australian companies Lin and Pervan had 69 responses representing a net response rate of 13.8% (Lin & Pervan, 2003). Neuman (2000, p. 267) argued that anything below 50% is considered to be poor and over 90% as excellent.

On the other hand, Shipman (1997) argued that, although Hite (1994) used a response rate of 4.5% in his study, the normal figure is between 20% and 30%. However, Babbie and Mouton (2001, p. 261) asserted that a response rate of 50% is adequate for analysis while responses of 60% and 70% are good and very good respectively. It is evident from Fig. 2 that the theses that were analysed had response rates ranging from good to very good, that is, assuming that the typology of Babbie and Mouton, (2001, p. 261) were used as a benchmark.[6] Furthermore, based on the standard deviation calculations explained below one may argue that 95% of the response rate fell between 62.36% and 74.36%.

The mean (average) response rate of the theses was 67.80%. The mean serves to locate the centre of the distribution, but it does not reveal how the items are spread out on either side of the centre. While the measures of central tendency such as the mean, mode and median give the typical score of the class, measures of dispersion such as the range, quartile deviation, mean deviation, variance and the standard deviation are useful in demonstrating how scores are spread out on either side of the mean.

The standard deviation is the most popular measure of dispersion (Srivastava, Shenoy, & Sharma, 1989; Powell, 1997, p. 188). It helps researchers to determine with considerable accuracy where the values of the frequency distribution are located in relation to the mean. Irrespective of the shape of the distribution, at least 95% of the scores fall within plus and minus two standard deviations (Srivastava et al., 1989). A large standard deviation indicates that the data are very spread out, while small dispersions indicate high uniformity in the scores as the data would be concentrated around the mean. Thus, a large standard deviation means that the mean cannot be taken as reliable indicator of a central value in a distribution. The standard deviation for the response rates of the theses that were analysed was 2.72%. The dispersion is low and it shows that the response rates were relatively uniform.

It is quite surprising that the response rates were above average when only 12 theses made follow-ups on the questionnaires and sent reminders to the respondents. Perhaps the respondents were well educated, motivated and felt that the information sought by the surveys was very important. Assurances of anonymity and confidentiality might also have improved the level of participation of the respondents. All the instruments of data collection that were appended to the theses assured the respondents about the confidentiality of the information they were going to give.

However, authorities are of the view that response rates may be improved by the use of a range of techniques such as pre-notification, persuading letters, design and incentives (Mehta & Sivadas, 1995; Sheehan & McMillan, 1999).

[6]Only 41 theses reported their response rates, and there were the ones that were considered in this section.

Reminders may stimulate mail survey responses (Dillman, 1978, pp. 160–199). Over-sampling is one way that researchers may use to deal with non-response (Williams, 2003, p. 99). Researchers are encouraged to use strategies of increasing response rates reported in the literature in conjunction with their own innovative ideas in order to enhance the validity and reliability of the results of their surveys.

Data analysis: dealing with collected data

According to Brewerton and Millward (2001, p. 143) data analysis forms the lynchpin of the research process. Data analysis may aid a researcher to arrive at a better understanding of the operation of social processes. A researcher may fail to interpret research data or to draw conclusions and make recommendations if s/he does not understand how to analyse data. In that regard, all social researchers should be able to understand and interpret data, irrespective of their theoretical or epistemological point of view (Rose & Sullivan, 1993).

There is no consensus about what data analysis entails (Coffey & Atkinson, 1996). The differences attached to the concept of data analysis are directly related to the qualitative and quantitative paradigms as well as the nature of the research question and design. For the purpose of this paper, data analysis entails categorizing, ordering, manipulating and summarizing data to find answers to the research question (Kerlinger, 1986).

All the theses that were examined prepared the data before analysing it. They all cleaned and evaluated the data. The purpose of the exercise was to check for ambiguity, completeness, comprehensibility, internal consistency, relevance, and reliability (Powell, 1997, p. 63). Of the 61 theses that used quantitative methods 45 (73.77%) explained that the reasons for examining the data was to look for extreme values, conflicting answers, handwritten notes, errors in recording, and other indicators that suggest unreliable measurements. All the theses coded the data to make it suitable for analysis. However, all did not indicate whether the data was pre-coded or post-coded, that is, coding after the data had been collected.

Although, there are many academically and commercially successful software packages for the analysis and presentation of quantitative data such as Microsoft Excel®, SAS® (Statistical Analysis System), Minitab®, EPI-Info®, Statistica®, Systat®, Statgraphics® QuatroPro® and SPSS®, 63.93% (39) of the theses used SPSS®, 29.51% (18) did not use any data analysis software as they opted for manual means, 3.28% (2) used SAS®, and Microsoft Excel® and QuatroPro® was used by two theses. The popularity of SPSS® may be attributed to the fact that it is the most widely used software in the University and all research methods modules offered in the Information Studies Programme use it in the practical classes for data analysis. Its popularity is not confined to the University of Natal. In fact, SPSS® is the most widely used statistical software in the academic community throughout the world (Foster, 1998; Moore, 2000). If SPSS® continues to enjoy the support it has it might end up dominating the market in the same way as Microsoft.

Tables, charts, graphs and statistical summaries are very popular ways of displaying and communicating research findings (Smithson, 2000, p. 52). The following paragraphs are going to discuss some of these ways of displaying data and demonstrate that the use of statistics to summarize and present data need to be cultivated among the LIS students at the University of Natal.

Data was presented in textual, tabular or graphical form. Textual data are rich and flexible, but much attention needs to be paid to their content and meaning if they are to be of any utility to the reader (Sharp, Peters, & Howard, 2002). Graphic analysis presents a visual picture of the data. Although graphic presentations include stem and leaf plot, line or arithmetic chart, bar chart, pictograms, histograms, pie charts and scatter diagrams, 2 (3.28%) theses employed line or arithmetic charts to portray survey data, 11 (18.03%) used pie charts, bar charts were utilized by 12 (19.67%), 51 (83.61%) made use of tables and all the theses used percentages and/or frequency distributions. Some of the theses exploited the advantages offered by tables, graphs and frequency distributions to present and display data in a variety of ways. LIS researchers at the University of Natal should be encouraged to use more graphs and figures. The cliché that a picture is worth a thousands words still holds. In some cases figures and graphs are more effective than word description in portraying relationships between variables. Substantial reduction in text may also be achieved through the use of figures.

Some authorities have encouraged researchers to avoid pie charts when presenting findings because they are hard to read when they have more than five segments and they only allow readers to "see crude proportions among a few elements that constitute 100% of a whole" (Booth, Colomb, & Williams, 1995). Four of the theses that used pie charts had diagrams with more than five segments.

Researchers should be careful when it comes to choosing the graphs to use in exploring and displaying their data to avoid generating what Robson (1993, p. 310) referred to as "elegantly presented rubbish". Line graphs that were used in two theses usually show trends and rough relationships among variables. They do not easily display precise values. The limitation of graphs in general is that, one cannot always display as much data in a graph as in a table. However, "[t]here is no single statistical tool that is as powerful as a well chosen graph" (Chambers, Cleveland, Kleiner, & Tukey, 1983, p. 1).

Tables are one of the best ways of presenting a set of data. While there are two types of tables, namely number tables and word tables, all the theses that were studied used number tables. Forty-five theses interpreted the tables to the readers, while the rest just repeated in words what the table presented in numbers. Although tables give the readers the possibility of drawing their own conclusions, researchers should interpret their tables.

In addition to graphics and figures, statistical tools are key to testing associational relationships in a population. Testing associational relationships is one of the basic purposes of survey research (Powell, 1997, p. 61). In that light, Alreck and Settle described data analysis as, "the use of statistical tools in order to reduce the amount of details in the data, summarizing it and making the most important facts and relationship apparent" (Alreck & Settle, 1995). According to Houser and Lazorick (cited in Wallace, 1985) library science like any other social science relies on empirical evidence to develop principles and theory, therefore researchers and readers should have some knowledge of basic statistics. Statistics help researchers to develop and apply methods and techniques for organizing and analysing quantitative data so that conclusions may be drawn (Powell, 1997, p. 179). Indeed, the important lesson that we were taught by Durkheim, Marx and Weber was that being numerate was one of the skills that social scientists needed (Rose & Sullivan, 1993).

The two major statistical tools used in analysing data in social science research are descriptive statistics and inferential statistics. Descriptive statistics are used to describe the characteristics of a population while inferential statistics are used to make some inferences about the characteristics of a phenomenon based on certain parameters. Inferential statistics can also be used for testing hypotheses. The two basic types of inferential statistics are parametric tests and non-parametric statistics. The parametric tests that were encountered in three theses included the Student's t-test and one-way analysis of variance (ANOVA). Of the five theses that stated a hypothesis, only one used inferential statistics to test the relationship between the null hypothesis and the alternative hypothesis. The chi-square test was the only non-parametric statistics that was found in one thesis out of 61.

On the other hand, the descriptive statistics that were found in all theses was the mean (average of all scores in the data). As other measures of central tendency such as the mode and median, the mean measures the typical score (de Vaus, 1996, p. 139). Only three theses used the standard deviation (a measure of dispersion) to demonstrate how spread out or clumped together were the scores. While the mean and the standard deviation are commonly reported in research articles (Aron & Aron, 1997), the theses under study greatly utilized the mean.

The scanty use of statistical tools may be indicative of the extent to which statistical expertise was at the disposal of the writers of the theses at the time. Researchers should be encouraged to use both descriptive and inferential statistics as they provide the basic tools for summarizing survey data and measuring the degree of association between variables and samples. Such an approach may also elevate the level of analysis that has been hitherto limited to the univariate method to bivariate analysis and perhaps to the multivariate method. Researchers should seek advice regarding statistical tools if they are in doubt about their use and suitability.

No method is perfect: evaluation of research methods

It is tempting to agree with Deming (1950, p. 24) that all surveys are imperfect to the extent that the idea of a perfect survey is a myth. In fact, Sproull (1995, p. 136) argued that: "No one type of research design is universally better or worse than any other. They are different and used for different purposes". Assertions such as these imply that it is mandatory for researchers to evaluate their investigation procedures.

Research methods should be evaluated in order to explain what information was needed, how it was got more accurately and cheaper and how it was analysed. Specifically, unexpected changes to the research design, limitations of the research design, the acknowledgement of shortcomings of the execution of the study and ethical issues are dealt with when evaluating research procedures.

Put differently, evaluation should explicate the errors, biases and difficulties that would have affected the gathering of data as well as its analysis. According to Deming (1950, p. 48) the exclusion of an adequate discussion of errors and difficulties encountered during the research process constitutes a serious defect in the data and may create false impressions about the data. Sources of errors include poorly designed questionnaire, using a biased sampling frame, sampling errors, rates of response and errors in response to questions, careless field procedures and errors in processing (Deming, 1944; Schofield, 1996).

Ethical considerations are also central to the evaluation of research procedures because a sound thesis is a product of ethically obtained and scientifically valid data (Debakey & Debakey, 1975). The adherence to ethical requirements while dealing with the units of analysis was totally ignored by all the theses that were analysed. Research ethics should be the guiding canon in carrying out any study because questions of access, power, harm, deception, secrecy and confidentiality are all issues that the researcher has to consider and resolve in any research context (Cohen et al., 2000, p. 246).

A mere 26.23% (16) of the 61 quantitative-based theses that were analysed attempted to do a methodological evaluation of the research procedures.[7] The question that begs an answer is: in the absence of the evaluation of the methodology used, how does the research community assess the scientific merits of applying certain research procedures? Researchers have an ethical obligation to the research community to give an accurate evaluation of their research recipes, otherwise future researchers can neither replicate the research nor evaluate its validity.

Conclusions and summary: drawing the threads together

This article discussed the research procedures used by LIS researchers at the University of Natal between 1982 and 2002. The research revealed that although the theses writers were committed to producing projects of a high standard they did not uniformly relate the research story. LIS researchers should give sufficient information for possible replication of the study or for re-analysis of the data obtained. That may enable readers to develop confidence in the methods used.

[7]The 20 qualitative theses were not considered in this section for the sake of consistency in presenting the results.

Various limitations under which the projects could have been carried out were not adequately narrated in the theses. The evaluation of the research methods used in the studies was an exception rather than a norm. Ethical issues relating to data collection were ignored. Readers were not given enough information to be able to estimate the reliability and validity of some of the research procedures used. The major threats to the internal validity of a piece of research such as instrumentation, selection bias and non-response were not adequately discussed. Possible sources of error need to be discussed so that readers may estimate the degree of the validity of the findings made.

In some cases readers were not told how the participants were identified and located. The characteristics of populations from which the samples were drawn were not fully discussed. Some studies did not indicate how large their samples were and how they were drawn. The sampling techniques (the frame, the size) were rarely evaluated and justified. The previous sections of this article demonstrated that the discussion of the criteria used in the choice of the sample size is very essential. The nature of a sample study and the method through which it was obtained should always be reported by a researcher together with the implications of these factors to the generalizations that can be made about the findings. Researchers should pay particular attention to using adequate sample sizes.

Some studies that were analysed pretested their survey protocols and also used mixed methods of data collection, which was highly commendable. Combining research methods in collecting data offers the promise of getting a ''complete'' picture in a way that a single method cannot achieve. Response rates to the surveys were quite high. The rationale behind selecting data analysis procedures was not always given. Data presentation was dominated by the use of tables, although other graphical and visual devices could have been used. The findings confirmed Manda's (2003) observation that research in African librarianship was weak in dealing with data analysis.

Although descriptive statistics have the potential to enhance the understanding of quantitative data, statistical tools were not adequately used in presenting and summarizing data. Admittedly, the level of statistical analysis depends on the level of measurements used by the survey protocols, but Brewerton and Millward (2001, p. 173) advised that at the minimum, researchers should use tests to show relationships between variables.

The shortcomings of the research procedures highlighted in this article are not meant to undermine the work that was done. The studies made their humble contributions to the pool of knowledge. Indeed, a perusal of the most recent theses shows a gradual improvement of the research standards. The findings should be read in the context of extension to the learning curve. The problems identified by this research are not confined to the University of Natal. According to Hernon and Schwartz (2003, p. 125–126), "[a]ny historical analysis of library and information science (LIS) research, or, for that matter, research in any discipline or profession, would reflect, over the past half century, an evolution from ugly ducking to wonderful swan."

To wrap up, let me quote from Mills (1959, p. 120–121) whom I believe sheds light on most of the concerns raised in this article:

> To have mastered "method" and "theory" is to have become a self-conscious thinker, a man at work and aware of assumptions and the implications of whatever he is about.... Without insight into the way the craft is carried on, the results of study are infirm; without a determination that study shall come to significant results, all method is meaningless pretense.

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