

Chapter Five

Conclusion

5.1 Introduction

This chapter is divided into two parts. The first part will examine the 101 doctoral theses accepted by the University of Malaya between 1971 and 1995. The findings based on information in the 'Acknowledgment' section form the first part of the study while the findings based on information in the 'Bibliography' section form the second part of the study. The study for the second part is based on 51 of the 101 theses, randomly selected.

5.2 Part 1: Summary of results and discussion

5.2.1 Distribution of theses submitted by discipline

A total of 101 theses were submitted during the 25-year study period. Research in the sciences is generally on the increase starting with 10 theses for the first 5-year period (1971-1975) to 26 theses in the last 5-year period (1991-1995). The highest number of theses submitted, however, was in the second 5-year period (1976-1980) with 31 theses which account for nearly one-third of the total theses submitted for the whole study period. This study is unable to ascertain the reason for this high number of theses for the said period (1976-1980). This study,

however, shows that there is a progressive increase in the number of theses submitted between 1976 and 1995.

The nine disciplines studied are Mathematics (QA), Physics (QC), Chemistry (QD), Geology (QE), Biology (QH), Botany (QK), Zoology (QL), Physiology (QP), and Microbiology (QR). Of the nine disciplines, Chemistry, Botany and Zoology are the only three disciplines to which postgraduate students have submitted theses in all the five 5-year periods. Theses in Mathematics and Physics were submitted from the second 5-year period (1976-1980) to the fifth 5-year period (1991-1995).

Based on the results, the study shows that the areas of concentration in research are in the biological sciences with 47 theses, chemistry with 15 theses, Physics with 12 theses and Mathematics with 11 theses. These areas of concentration revealed by this study is consistent with the study by MASTIC (Malaysian Science & Technology Centre) in 1996 with regard to research under its R&D activities. The MASTIC study also shows that the areas of concentration in research are in the biological, physical, chemical and mathematical sciences.

5.2.2 Distribution of theses submitted by gender and race

The study based on gender was included because traditionally, women have not been strongly represented in the sciences at the University of Malaya. The sciences have been male-dominated as shown by the findings of this study.

In the 1971-1995 period the number of theses submitted by the male postgraduate students was 71 (70.3%) as compared to 30 (29.7%) by the female postgraduate students. The study also shows that from 1971-1995 the number of theses submitted by the male postgraduates was much greater than the number submitted by the female postgraduates. It can, therefore, be concluded that more male postgraduates in the sciences received their doctoral degrees in the sciences as compared to the female postgraduates during each of the five 5-year periods from 1971 and 1995. The study also shows that the ratio of theses submitted by the male and female postgraduate students remained consistent throughout the study period with 70% from the male students and 30% from the female students.

With regard to racial composition, the present study shows that out of a total of 101 theses in the sciences received by the University of Malaya between 1971-1995, 62 were from the Chinese postgraduate students. This accounts for 61.4% of the total number of theses submitted by postgraduate science students. The number of postgraduate theses submitted by the Malay students was 11 (10.9%) and by the Indian students was 18 (17.8%).

The study conducted by MASTIC in 1998 at secondary school level on the racial composition, found 60% Chinese in the science stream, while 50% Bumiputras (mainly Malays) were in the Arts stream. This indicates that there were more Chinese students who were doing science in school and could be the reason for more theses submitted by Chinese postgraduate students.

The present study, however, shows an interesting development in that there has been an increase in the number of contributions towards scientific research by the Malay and Indian postgraduate students in the last five years (1991-1995). Each group submitted a total of seven theses each during the period of study. The study also shows an increase in the number of female students in the sciences in the last five years of the study. The slight increase in the number of female students and the number of Malays and Indians in scientific research in the last five years could be seen as an indicator of probable change in scientific research at the University of Malaya in terms of gender and racial composition.

5.2.3 Distribution of scholarship and tutorship tenure by discipline

The findings show an uneven distribution in the allocation of scholarships and tutorship tenures across the nine disciplines in the 1970s. The two disciplines with the most number of scholarships are Botany (14) and Zoology (13). The number of tutorship tenures also shows similar findings with 7 and 3 respectively. The study also shows that in the last 10 years (1986-1995), scholarships have been given for the first time for Mathematics (3) and Chemistry (4). It is also noted that tutorship tenures have only been allocated to four disciplines namely Botany, Zoology, Microbiology and Chemistry.

The present study also shows that there is a shift in the priority of award of scholarships from Botany and Zoology to include the other disciplines of

Chemistry, Physics and Mathematics. This is reflected in the last ten years of the study period (1986-1995) where the allocation of scholarships have been quite proportionate in the five disciplines mentioned.

5.3 Part 2: Summary of results and discussion

5.3.1 Distribution of citations by discipline

A total of 10386 citations from 51 theses were analysed to determine the characteristics of the types of documents used by the science researchers. This sample was randomly selected to ensure proper representation of the total.

The present study shows that researchers in Biology and Chemistry cite more documents in their theses with an average of 455 and 300 citations per thesis, respectively. Mathematics researchers cite the least number of documents per thesis with only 46 citations followed by Physics researchers with 90 citations per thesis.

The study by King (1987) shows that mathematics theses usually "have less than 10 citations". She further adds that citing depends on the field of study.

The findings of the present study are consistent with the study by King in that Mathematics is the discipline with low citations. Similarly this study also concurs with the study by Zhang and Zhang (1996) in that Biology and Chemistry are the disciplines that have more cited papers.

5.3.2 Distribution of citations by discipline and by type of document

Postgraduate science students were found to use a variety of documents such as journals, books, theses and dissertations, conference papers, standards, patents, preprints and reports. The study shows that the type of document most cited in the sciences is the journal with 7800 (75.1%) citations from a total of 10386 citations used in this study. The next most cited type of document, which is a distant second, is the book with 1227 (11.8%) citations.

The findings of this study are also consistent with earlier studies. Nweke (1988) in his study on Zoology researchers found that 77.8% of the total citations were to journals and only 10.6% were to books. The study by Hurd (1992) on interdisciplinary research in the sciences also showed that the most number of materials cited by chemists were to scientific journals (87%) and that citations to books (6.32%) was the second most important. Madkey & Rajyalakshmi (1994) in their study on the Ph.D. theses submitted by Neeri (National Environmental and Engineering Research Institute) scientists, ranked journals as the "most used" with 67% citations followed by books 18.51%. Markusova et al (1994) concluded in his study that scientific journals are "the principal medium of written communication". Mubeen (1996) in her study on doctoral dissertations in Chemistry states that 73% of the citations were to journals and 11.48% were to books. Shonam (1998) in her study on Israeli academic researchers also cited that

the "professional journal" is still the "most important tool" for obtaining information.

The findings of this study are consistent with all the earlier studies mentioned above. The hypotheses made by this study that postgraduate researchers in the sciences used journals as their main source of information is confirmed.

5.3.3 Currency of journal/ book citations by discipline

The analysis of citation used by science postgraduate researchers shows that they have used documents that date as far back as the 1830s. This is especially so in Botany (QK) and Zoology (QL). From a total of 7800 citations, 3204 (41.1%) are citations that are less than 10 years and 4596 (58.9%) citations more than 10 years. A breakdown by disciplines shows that nearly 60% of citations in the disciplines of Biology (QH) and Microbiology (QR) have cited both book and journal references that are less than 10 years. Nearly 60% of all other disciplines made references to books and journals which are more than 10 years.

The study by Mitra (1972) on literature cited by Indian scientists show similar results to the present study. In the study, the assumption that earlier researchers referred more to recent literature is only valid with respect to certain disciplines in the sciences. His study further shows that references to literature

prior to 1900 were made more by botanists (6.8%), zoologists (5.9%) and mathematicians (4%).

This view by Mitra is further complemented by a study by Glanzel & Schoepflin (1995) in which seven journals representing different scientific fields found that the currency of citation is specific to the field rather than to the individual journal.

The study by Vimala & Reddy (1997) on the currency of citations of books and journals in Zoology shows that more than 27% of journal citations are 7 years or less in age and 50% between 8 and 12 years in age.

Each field in science has its own characteristics of use of old and new literature. The assumption that researchers referred more to recent literature is only valid to certain disciplines in the sciences. This present study shows that seven out of the nine disciplines have cited books and journals which are more than 10 years. This finding thus, does not support the hypothesis made by this study that science researchers depend on current journals. It however concurs with the earlier findings (mentioned above) that the currency of reference is specific to "certain disciplines in the sciences".

5.3.4 Distribution of journal citation by language of publication

The present study shows that of the total of 7800 citations, 7535 (96.6%) citations were to publications in English. Citations to English journals formed

96.6% of the total citations followed by those from the foreign language publications (3.4%). Bahasa Melayu, which is the national language and the language used as the medium of instruction in schools and institutions in Malaysia has only one citation out of the 7800 citations studied. All disciplines cited more than 94% from English Language publications except for Biology with 89.9%.

This study shows that the postgraduate researchers in the sciences preferred scientific literature in English. This popular use of the English Language journals supports the hypothesis made in this study that English is the preferred language of science researchers at postgraduate level at the University of Malaya.

Similar studies on postgraduate researchers in the humanities (Goi, 1997) and education (Sapiah, 1997) at the University of Malaya, also indicate that postgraduate researchers prefer English Language documents. The study by Goi (1997) on research trends in the humanities at the University of Malaya shows that 66% of the total citations were to those in the English Language, with Bahasa Melayu the "next preferred language" with 18.5% of the total citations. The study by Sapiah (1997) on theses and dissertations in education at the University of Malaya, noted that English is the "dominant language" and that it showed its importance as a "communication language" in the field of education. The citation to English documents constitutes 80.22% and to Bahasa Melayu 16.17% of total citations.

Nweke (1988) studied the language of literature used by Zoology research scholars at the University of Ibadan in Nigeria. His study shows that "English was by far the most used language for Zoological literature" with 91.8% citations in English.

In the study by Liu (1990) on Chinese physicists, it was found that "English is by far the most frequently used" language (74.3%) and Chinese although "the native tongue is least used" (4.6%). She however, contends that physics researchers in China who are among the world leaders do not get their work disseminated soon enough due to the language barrier. This claim by Liu is supported by Garfield (1976). His study concludes that it takes five times longer for an article written in any language other than English to have an impact equivalent to that of an English article (cited by Michel, 1982).

Although English is the most widely used language in science research, researchers do need to use foreign language sources if they are not to overlook important contributions to their fields.

Thus it can be concluded that the results of the present study is consistent with the earlier studies on the importance of the English Language as an important medium of communication of scientific information. The hypothesis that English is the preferred language of science researchers at the postgraduate level at the University of Malaya holds true.

5.4 Limitations of the study

When considering the results and conclusions of this study, it is important to bear in mind the following limitations.

1. This study examines the research trends in the sciences at a single university. This focus severely limits the degree to which the results can be viewed as being representative of the research trends in the sciences in the country. The disciplines offered in the sciences may vary with different universities. The degree of concentration or emphasis in the areas of research may also differ with different universities. Thus the results of the study cannot be taken to represent the research trends in the sciences in universities in this country.
2. The calculation of the age factor in journals was based on the year of submission of the theses. It was noted that researchers in some cases had begun work on the thesis a few years (about 4-5 years) ahead of the year of submission of the thesis. As such the reference cited at the time of study would have been more recent. This would have created more citations with currency of less than 10 years. However, this was not the case except for Biology and Microbiology which had 60% citations with a currency of less than 10 years. Having made this observation it must be mentioned here that it could be looked upon as a limitation in this study even though it did not affect the results of the study much.

5.5 Suggestion for further research

Based on the analyses and findings of this study, the following is a suggestion for further research.

1. It would be useful to carry out similar studies to the other institutions of higher learning. Such studies could look at the differences and similarities of citing behaviour in the various science disciplines. This would add to knowledge about the overall citing behaviour of postgraduate researchers in the sciences in institutions of higher learning.