Chapter Four

Results

4.1 Introduction

This chapter examines and describes the findings in the study based on the theses submitted by postgraduate researchers in the sciences between 1971 and 1995. The results of the study will give an indication of the trend of research activities of postgraduate students in the sciences at the University of Malaya. It would reveal the sources of information used by these postgraduate students.

The first part (Part 1) of the study is a descriptive one and looks into aspects relating to information obtained from the 'Acknowledgement' section of theses submitted. The areas studied in this part are the year of theses submission according to the different disciplines, scholarship and tutorship tenures, and submission of theses by race and gender of the researcher.

The second part (Part 2) of the study is based mainly on the references obtained from the 'Bibliography' section of the theses submitted. Areas investigated in this part are frequency of citations to types of sources of information (journals, books, theses and dissertations, conference papers and personal communication), currency of citations to journals and books and the language of the cited reference used (for journals only).

Both parts one and two will also attempt to answer the research questions mentioned in Chapter One. It is hoped that the findings will reflect the trend in research activities in the sciences at the University of Malaya from 1971 to 1995.

4.2 Part 1

A total of 101 theses from the sciences, covering a total of nine disciplines, will form the sample for this part of the study. The nine disciplines included in this part of the study are Mathematics (QA), Physics (QC), Chemistry (QD), Geology (QE), Biology (QH), Botany (QK), Zoology (QL), Physiology (QP), and Microbiology (QR).

4.2.1 Distribution of postgraduate theses in the sciences (1971-1995)

Table 4.2.1 shows the number of theses submission in the sciences from 1971 to 1995, a span of twenty-five years. The study has been divided into five 5-year periods from 1971 to 1995 as shown in Table 4.2.1. The total number of theses submitted for this period is 101. The first three 5-year periods, namely, 1971-75, 1976-80 and 1981-85, show a rather uneven distribution in the number of theses submission. The period during which the most number of theses submitted was during the second 5-year period (1976-80) where a total of 31 theses were submitted. The period with the least number of theses submitted was in the first 5-year period (1971-75) with a total of 10.

Table 4.2.1: Distribution of postgraduate theses in the sciences from 1971-1995

5-Year Period	Year	Theses N=101	Percentage of sample total
First	1971-1975	10	9.9
Second	1976-1980	31	30.7
Third	1981-1985	15	14.9
Fourth	1986-1990	19	18.8
Fifth	1991-1995	26	25.7
Total =25 years	**1971-1995**	**101**	**100%**

There is a slow increase in the number of theses submitted from the third 5-year period onwards from 15 theses (1981-85) to 19 theses (1986-90) to 26 theses (1991-95) in the third, fourth and fifth 5-year periods respectively. This finding shows an increase in research activity in the sciences in the 1980s and early 1990s.

4.2.2 Distribution of theses submitted by discipline

As with other faculties, some disciplines in the sciences command more interest among postgraduate science students than others. By studying the distribution pattern in the submission of theses, these disciplines can be identified.

This would be of importance to the policy makers at the university and the institutional library when planning their budget allocations.

Table 4.2.2 shows the distribution of theses submitted by discipline from 1971 to 1995 in 5-year periods. The disciplines are classified under the LC classification scheme for the sciences.

Table 4.2.2: Distribution of theses submitted by discipline

Year	QA	QC	QD	QE	QH	QK	QL	QP	QR
1971 - 1975	-	-	3	1	2	2	2	-	-
1976 - 1980	3	1	5	2	-	11	8	-	1
1981 - 1985	2	2	1	2	2	4	2	-	-
1986 - 1990	2	7	4	-	-	2	1	1	2
1991 - 1995	4	2	2	-	-	6	5	3	4
Total = 100	11	12	15	5	4	25	18	4	7
Percentage = 100	***10.9***	***11.9***	***14.9***	***4.9***	***3.9***	***24.8***	***17.8***	***3.9***	***6.9***

The table clearly shows the preference for certain disciplines in the sciences by postgraduate science students during the period studied (1971-1995). The discipline in which the most number of theses were submitted is Botany (QK) with 25 theses (24.8%) followed by Zoology (QL) 18 theses (17.8%), Chemistry (QD) 15 theses (14.9%), Physics (QC) 12 theses (11.9%) and Mathematics (QA) 11 theses (10.9%). The disciplines with less than 10 theses submitted during the 25-year period in descending order are Microbiology (QR), Geology (QE),

Biology (QH) and Physiology (QP) with 7 theses, 5 theses and 4 theses each for the last two disciplines respectively. Of the nine disciplines studied, Botany, Zoology and Chemistry were the only three disciplines in which theses were submitted by postgraduate students in each of the 5-year periods studied.

In Physiology it is observed that no research was done from 1971-1985. However from 1986-1995 there appears to be a slight increase in interest as shown by the increase in the number of theses submitted. Similarly it is observed that in Microbiology there seems to be a slight increase in interest in the last 10 years (1986-1995) of the study period as reflected by the progressive increase in theses submitted. Generally, there is a very uneven distribution in the number of theses submitted in all disciplines in the sciences during the period of study.

4.2.3 Gender distribution in the submission of theses

Table 4.2.3 shows the number of theses submitted by male and female postgraduate students in the sciences, in five 5-year periods. The number of theses submitted by the male postgraduate students far outnumbers those of their female counterparts. Gender distribution in the sciences at the University of Malaya is an interesting factor as the sciences seem to have generally been a male domain. This can be seen in Table 4.2.3.

Table 4.2.3: Gender distribution

Year	Total number of students	Male		Female	
		N = 71	%	N = 30	%
1971 - 1975	10	7	70	3	30
1976 - 1980	31	24	77.4	7	22.6
1981 - 1985	15	9	60	6	40
1986 - 1990	19	13	68.4	6	31.6
1991 - 1995	26	18	69.2	8	30.8

The study shows a vast difference in the number of theses submitted by the postgraduate male and female students. The highest number of theses submitted by the male postgraduate students is 24 in the 1976-1980 period and the lowest number of theses submitted was 7 in the 1971-1975 period. The highest number of theses submitted by the female postgraduate students is 8 in the 1991-1995 period and the lowest is 3 in the 1971-1975 period. The general trend in the submission of theses by the female postgraduate students is more consistent compared to the male during the entire study period.

The ratio of distribution of male to female theses as shown in the 5-year period breakdown remains quite consistent with 60%-70% being male and 30%-40% being female Only for the 5-year period 1976-1980 is the male-female ratio different with 77.4% male and 22.6% female. On the whole, the proportion of male-female ratio appears to be consistent throughout the period of study.

4.2.4 Distribution of theses submitted by race

This part of the study is also divided into five 5-year periods. Table 4.2.4 shows the distribution in the submission of theses by race during the 25 years (1971-1995) in five 5-year periods. Figure 4.2.4 portrays a graphical view of the findings by race.

The sample in this study is divided into four ethnic groups namely the Malays, Chinese, Indians and Others (students who do not belong to any of the three groups mentioned). The table shows an uneven distribution of theses submitted by race throughout the period of study.

The total number of theses submitted by the four racial groups of postgraduate students, are Malay (11), Chinese (62), Indian (18), and Others (10).

Table 4.2.4: Distribution of theses submitted by race

Year	Malays		Chinese		Indians		Others		Total number of students
	N =11	10.9%	N =62	61.4%	N =18	17.8%	N =10	9.9%	N=101
1971 - 1975	-	-	7	70	2	20	1	10	10
1976 - 1980	1	3.2	21	67.7	4	12.9	5	16.1	31
1981 - 1985	2	13.3	9	60	3	20	1	6.7	15
1986 - 1990	1	5.3	15	78.9	2	10.5	1	5.3	19
1991 - 1995	7	26.9	10	38.5	7	26.9	2	7.7	26

The table 4.2.4 shows the total number of theses submitted by the Chinese is 62 (61.4%) which is more than half the total number of theses submitted by the postgraduate science students in the period of the study. This is clearly highlighted in Figure 4.2.4.

While the highest number of theses submitted by the Chinese is 21 (20.8%), the highest number submitted by the Indian and Malay postgraduate students is 7 (6.9%) each and Others is 5 (5%). The lowest number of theses submitted by the Chinese researchers which is 9 (8.9%) is still higher than the highest number of theses submitted by the other three racial groups.

Between 1971-1990, the Chinese submitted between 60%-78.9% of all the theses submitted. This indicates that the Chinese contributed nearly two thirds of total theses submitted. The trend reversed in the period 1991-1995, when the Chinese accounted for only 38.5%, which is only about one third of the theses submitted.

The Malays have only contributed to 10.9% of the total theses submitted for the study period 1971-1995. However, it is observed that for the period 1991-1995, the ratio of theses submitted by the Malays as compared to the other ethnic groups had increased to 26.9%.

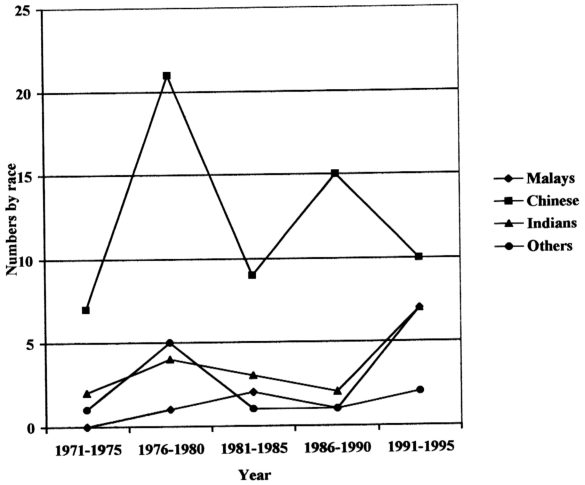

Figure 4.2.4: Distribution of theses by race

The Indians, in comparison to the other groups in the study, seem to be quite inconsistent in the number of theses submission, with alternate years of increases and decreases. The 'Others', in comparison to the other three ethnic

groups, seem to be consistent in theses submission ranging from 5.3%-16% for all the 5-year study periods between 1971-1995.

4.2.5 Distribution of scholarship and tutorship tenure by discipline

It is felt that the study on the distribution of scholarship and tutorship tenure by discipline would, indicate the degree of importance of the different disciplines in the sciences to the university in meeting with the research needs of the country.

Tables 4.2.5a and 4.2.5b show the distribution of scholarship and tutorship tenures respectively during the five 5-year periods. Figure 4.2.5c shows a graphic representation of the total number of scholarship and tutorship tenures awarded according to discipline.

A total of 47 scholarships and 13 tutorship tenures were awarded during the period of the current study. The highest number of scholarships was awarded in the 1976-1980 period with 16 (34%). More scholarships were awarded to disciplines such as Botany with 14 (29.8%), followed by Zoology with 13 (27.7%). The disciplines with the least number of scholarships were Physiology and Microbiology with 1 (2.1%) each. An interesting point to note is that the highest number of scholarships (16) was given in the 1976-1980 period and was concentrated in the 2 disciplines, Botany (7) and Zoology (8). The last three 5-year periods 1980-1995, however, show a more even distribution of the

scholarships among the disciplines. There is also a shift in the priority of award of scholarships from Botany and Zoology to include more disciplines, namely, Chemistry, Physics and Mathematics.

The tutorship tenure again shows a concentration in two disciplines with Botany taking up 7 tutorship tenures (53.8%) and Zoology with 3 (23.1%). It is also noted that from the period 1986-1990 there was no tutorship tenures alloted. Both Botany and Zoology have recorded the most number of scholarships and tutorship tenures during the entire period of the study.

Table 4.2.5a: Distribution of scholarship by discipline

Year	QA	QC	QD	QE	QH	QK	QL	QP	QR	Total N=47	%
1971 - 1975	-	-	-	1	1	-	-	-	-	2	4.3
1976 - 1980	-	-	-	-	-	7	8	-	1	16	34.0
1981 - 1985	-	1	-	1	1	3	1	-	-	7	14.9
1986 - 1990	1	4	3	-	-	2	-	1	-	11	23.4
1991 - 1995	2	1	1	-	1	2	4	-	-	11	23.4
1971 - 1995	**3**	**6**	**4**	**2**	**3**	**14**	**13**	**1**	**1**	**47**	**100%**
Percentage	***6.4***	***12.8***	***8.5***	***4.3***	***6.4***	***29.8***	***27.7***	***2.1***	***2.1***	***100%***	

Table 4.2.5b: Distribution of tutorship tenure by discipline

Year	QA	QC	QD	QE	QH	QK	QL	QP	QR	Total N=13	%
1971 - 1975	-	-	-	-	-	2	2	-	-	4	30.8
1976 - 1980	-	-	-	-	-	2	1	-	1	4	30.8
1981 - 1985	-	-	-	-	-	2	-	-	-	2	15.4
1986 - 1990	-	-	-	-	-	-	-	-	-	-	-
1991 - 1995	-	-	1	-	-	1	-	-	1	3	46.1
1971 - 1995	-	-	**1**	-	-	**7**	**3**	-	**2**	**13**	**100%**
Percentage	-	-	*7.7*	-	-	***53.8***	***23.1***	-	***15.4***	***100***	

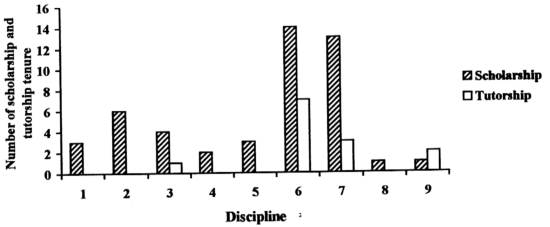

Figure 4.2.5c: Distribution of total number of scholarship and tutorship tenure by discipline

The numbers in the graph represent the following disciplines.

1-QA, 2-QC, 3-QD, 4-QE, 5-QH, 6-QK, 7-QL, 8-QP, 9-QR

4.3 Part 2

The second part of this study is based on the references in the 'Bibliography' section. Areas that have been investigated in this part of the study include the frequency of citation to the types of sources of information (journals, books, theses and dissertation, conference papers and personal communication), currency of citations to journals and books and the language of the cited references used (journals only).

A citation is a reference to previously published works considered relevant to the argument the author makes (Baird & Oppenheim, 1994). The sample for this part of the study, which will study citations, is confined to 51 of the 101 theses in the sciences submitted to the University of Malaya between 1971-1995.

As the theses cover nine disciplines, the study would employ the stratified sampling method. Since each discipline consists of different numbers of theses, a proportionate stratified sample will be used. About half of the theses are taken from each discipline resulting in varying numbers of theses from each. These theses (which will form the sample) will be chosen by the simple random method, as this allows for each thesis to have an equal chance of being sampled. It would also be self-weighting in that the sample size is weighted according to the relative size of the number of theses in each discipline or stratum. As 10,386 citations from a total of 22,218 would be studied, it is felt that a desired degree of precision

and accuracy would be achieved, while at the same time ensuring that the sample is representative of the total.

A total of 10,386 citations from 51 theses randomly selected from across nine disciplines will form the raw data for this part of the study.

4.3.1 Distribution of citations by discipline

The data collected from the 'Bibliography' section show that the number of references cited in the sciences vary rather unevenly across the nine disciplines. Table 4.3.1 shows the total number of citations per discipline and the average number of citations per thesis by discipline.

The table shows that the discipline with the most number of citations is Botany (QK) with 2800 (27%) citations, a sum that is slightly more than a quarter of the total citations (10386). Two disciplines with more than 20% citations are Chemistry (QD) 2401 (23.1%) citations and Zoology (QL) with 2078 (20%) citations each. All other disciplines have less than 9 % of the total number of citations. The disciplines with the least number of citations are Geology (QE) with 231 (2.2%) citations and Mathematics (QA) with 273 (2.6%) citations.

It is interesting to note that Biology (QH) has the most number of citations per thesis with an average of 455 citations. The other discipline with a high average citation list is Chemistry (QD) with 300 citations.

Table 4.3.1: Distribution of citations by discipline

Discipline	Number of theses	Number of citations	Percentage of citations (%)	Average citation per theses
QA	6	273	2.6	46
QC	6	540	5.2	90
QD	8	2401	23.1	300
QE	2	231	2.2	116
QH	2	910	8.8	455
QK	13	2800	27	215
QL	9	2078	20	231
QP	2	452	4.4	226
QR	3	701	6.7	234
Total	***51***	***10386***	***100***	

Four other disciplines with an average ranging from 200 to 300 citations are Microbiology (QR) 234, Zoology (QL) 231, Physiology (QP) 226 and Botany (QK) with 215 citations. The disciplines with average citations of less than 100 are Physics (QC) with 90 citations and Mathematics (QA) with 46 citations.

4.3.2 Distribution of citations by type of document

A variety of sources of information (types of documents) have been cited by the postgraduate students in the sciences. Table 4.3.2 shows the different types of documents used by these students in the period studied.

Table 4.3.2: Distribution of citations by type of document

Types of documents	Total number of citations	
	Number	Percentage
Journals	7800	75.1
Books	1227	11.8
Theses and Dissertations	144	1.4
Conference papers	253	2.4
Private Communication	19	0.2
Others	943	9.1
Total	***10386***	***100%***

The table shows the breakdown of the sources of information (types of documents) used by the postgraduate science students in the period studied. The table shows that the type of documents most cited by the postgraduate students is the journal. The total number of citations for the journal is 7800 (75.1%). This figure is nearly three-quarters of the total number of citations studied. The other

types of documents which add up to 24.7% of the citations studied are books with 1227 (11.8%), conference papers 253 (2.4%), theses and dissertations 144 (1.4%) and others (comprising those not mentioned above such as patents, reports, surveys, standards and incomplete citations) 943 (9.1%). The wide difference between the use of journals and other sources of information shows that the postgraduate students in the sciences at the University of Malaya (1971-1995) depended more on journals. The results of the above findings support the assumption that research scholars use more journals than any other source of information. The result is also consistent with earlier findings that researchers in the sciences depend more on journals (Nweke, 1988; Shoham, 1998).

4.3.3 Distribution of citations by discipline and by type of document

Analysis of the citations to the different disciplines in the sciences shows that the source of information (types of documents) most often referred to is the journal. The other sources include books, conference papers, theses and dissertations, private communication and 'others' such as patents, standards, reports, surveys and preprints. The total number of times each document was cited was taken. These figures have been tabulated as shown in Table 4.3.3. The table shows the type of sources of information used by the postgraduate science researcher and is divided into journals, books, conference papers, theses and dissertations, private communication and 'others'. The 'others' includes all other

types of sources of information not included in the earlier mentioned five categories.

The type of document most heavily used by postgraduate science researchers at the University of Malaya between 1971-1995 is the journal with 7800 (75.1%) citations from a total of 10386 citations. The next most cited type of document, which is a distant second, is the book with 1227 (11.8%) citations.

Table 4.3.3: Distribution of citation by discipline and to type of document

Discipline	Journals	Books	Theses	Conferen -ce papers	Private Communi -cation	Others	Total citations
QA	169	71	3	9	1	20	273
QC	357	80	27	17	9	50	540
QD	1890	196	11	32	8	264	2401
QE	130	35	7	6	-	53	231
QH	734	61	7	17	-	91	910
QK	2067	426	36	53	1	217	2800
QL	1488	279	49	94	-	168	2078
QP	401	32	2	9	-	8	452
QR	564	47	2	16	-	72	701
Total	*7800*	*1227*	*144*	*253*	*19*	*943*	*10386*

Botany is the discipline with the largest number of journal citations (2067). The other disciplines in which researchers cite journals heavily are Chemistry (QD) with 1890 and Zoology (QL) (1488). Disciplines with the least number of journal citations are Mathematics (QA) and Geology (QE) with 169 and 130 citations, respectively.

The disciplines that cited books most are Botany (426), followed by Zoology (279) and Chemistry (196). These are also the same disciplines that use journals most.

Conference papers and theses and dissertations are not heavily cited, and have less than 1% in each of the disciplines. Only four disciplines in the sciences, Physiology (QP), Chemistry (QD), Mathematics (QA) and Botany (QK) show that researchers have informal communication cited in the 'Bibliography' section. All other science postgraduate researchers have acknowledged their lecturers and supervisors from both local and foreign universities in the 'Acknowledgment' section. These include advice and help (informal communication) rendered during the course of the research.

4.3.4 Currency of journal/ book citations by discipline

Earlier findings (Chen, 1972; Gupta, 1987; Khorevin, 1995) show that most researchers in the sciences have a strong preference for journal articles over other sources of information for current information. The present study is

conducted to see if the postgraduate science researchers at the University of Malaya show a similar preference.

As journals and books are documents that are more often referred to by the science researchers, the currency span is studied for both sources. The currency span is divided in two: journals/ books with a recency of less than 10 years and the other, journals/books with a recency span of more than 10 years. The currency is counted from the year of submission of the theses by the students. The currency counts are then tabulated in Table 4.3.4a (for journals) and 4.3.4b (for books) for all nine disciplines.

The findings show that nearly 60% of citations in the disciplines of Biology (QH) and Microbiology (QR), have cited both books and journal references that are less than 10 years old. Nearly 60% of all other disciplines use citations of both books and journals which are more than 10 years. This indicates that researchers in Microbiology and Biology are the two groups of researchers who use journals and books that are more current. Thus, the finding seems to concur with earlier findings (Chen, 1972; Gupta, 1987; Khorevin, 1995) on the preference for more current journals only in Biology and Microbiology.

A total of 3204 (41.1%) journal citations are less than 10 years and 4596 (58.9%) have citations of more than 10 years. The total number of book citations that are less than 10 years is 473 (38.5%) while the total number of book citations

that are more than 10 years is 754 (61.4%) indicating that the science researchers at the University of Malaya use older journals and books.

Table 4.3.4a: Currency of journal citations by disciplines

Disciplines	Currency <10 years		Currency >10 years		Total number of citations	
	N=3204	41.1%	N=4596	58.9%	N=7800	100%
QA	58	34.3	111	65.7	169	
QC	127	35.6	230	64.4	357	
QD	677	35.8	1213	64.2	1890	
QE	49	37.7	81	62.3	130	
QH	445	60.6	289	39.4	734	
QK	819	39.6	1248	60.4	2067	
QL	534	35.9	954	64.1	1488	
QP	140	34.9	261	65.1	401	
QR	355	62.9	209	37.1	564	

Table 4.3.4b: Currency of book citations by disciplines

Disciplines	Currency < 10 years		Currency > 10 years		Total number of citations	
	N=473	38.5%	754	61.4%	1227	100%
QA	22	31	49	69	71	
QC	27	33.8	53	66.3	80	
QD	60	30.6	136	69.4	196	
QE	12	34.3	23	65.7	35	
QH	41	67.2	20	32.8	61	
QK	159	37.3	267	62.7	426	
QL	111	39.8	168	60.2	279	
QP	13	40.6	19	59.4	32	
QR	28	59.6	19	40.4	47	

4.3.5 Distribution of journal citations by language of publication

This is an interesting area of study. Most postgraduate science students in the sample studied have been through a schooling and undergraduate education system where Bahasa Melayu is the medium of instruction with English as a subject only. Yet the study of the citation counts show that all theses submitted to the University of Malaya in the period studied, were written in English. Also,

most of the journals and books cited by this same group of postgraduate students were those in the English Language. The table shows the results of the findings.

Table 4.3.5a: Distribution of journal citations by language of publication

Languages	**Number of citations**	**Percentage (%)**
English	7535	96.6
Bahasa Melayu	1	0.01
Foreign languages	264	3.4
Total	***7800***	***100***

The table shows that most journal citations are those from English language publications. Of the total of 7800 citations, 7535 (96.6%) citations are to publications in English, 264 (3.4%) citations are to foreign language publications and 1 (0.01%) citation was made to Bahasa Melayu publications.

It is interesting to note that although Bahasa Melayu is the medium of instruction in all levels of schooling and undergraduate level of education, postgraduate researchers in the sciences use more English Language journals.

Table 4.3.5b shows citation counts of the different languages by publication in the nine disciplines of sciences being studied. The table shows that all disciplines have cited an overwhelmingly large number of citations of more than 94% from the English Language journals except for Biology which shows

89.8%. The discipline with the highest percentage for the foreign language journals is Biology with 10.2% citations.

Table 4.3.5b: Distribution of journal citation by language of publication and by discipline

Disciplines	English		Bahasa Melayu		Foreign languages		Total number of citations	
	N= 7353	96.2 %	N=1	0.01 %	N= 264	3.4%	N= 7800	100%
QA	160	94.7	_		9	5.3	169	
QC	351	98.3	_		6	1.7	357	
QD	1871	99	1	0.01	18	0.95	1890	
QE	127	97.7	_		3	2.3	130	
QH	659	89.8	_		75	10.2	734	
QK	1984	96	_		83	4	2067	
QL	1426	95.8	_		62	4.2	1488	
QP	397	99	_		4	1	401	
QR	560	99.3	_		4	0.7	564	

Although most citations are from English Language journals, postgraduate students have also made references to foreign language journals. It should be noted that foreign language journals do carry abstracts and translations in the

English Language. Russian journals usually have cover-to-cover translations in the English Language (Holmstrom, 1962; Marshakova-Shaikevich, 1993). Of the nine disciplines studied, Chemistry (QD) is the only discipline with reference to the Bahasa Melayu journal.