

**An investigation into ways of encouraging the development of
higher level cognitive skills in undergraduate biology students with
reference to the Perry Scheme of Intellectual Development**

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Abstract

This project initially focused on a group poster presentation exercise which had the development of higher cognitive skills as its aims. A holistic approach was undertaken to the exercise which involved considering the relationship between all aspects of the instructional method with respect to the undergraduate biology students developing skills of analysis, synthesis, relating and applying knowledge, in addition, to their developing communication and group skills.

The project involved modifying, monitoring and evaluating a number of different aspects of the exercise over a period of four years including the assessment and instructional methods and level of staff support given to the students. The resultant instructional method involved students working in groups on a problem based challenge, using peer group assessments and undertaking peer group questioning and discussion sessions, the implications of which are discussed in this project.

A questionnaire measure of intellectual development was devised for this project, based on the Perry Scheme of Intellectual Development which aimed to investigate the different groups of students' approaches to the exercise and to match individual student's needs with the most appropriate staff support. The Perry Scheme describes how students develop from an absolute or simplistic stance on the nature of knowledge to one which is more pluralistic and contextual. These differing perceptions influence the role which students adopt and also the way in which they perceive the role of others within the learning environment. This research project tested both students undertaking the poster exercise and also students at different stages of their biology course over a period of two years.

This project identified a link between the roles which students adopted during the poster exercise and their stage of intellectual development. In addition, changes in individual student attitudes and preferences towards different teaching and assessment methods were identified which supported and complimented the descriptions outlined by Perry.

List of Contents

	page
Chapter 1 - Introduction	1
1.1 Background	2
1.1.1 Introduction	2
1.1.2 Higher level cognitive skills	3
1.1.3 Individual student approaches to learning	3
1.2 The development of higher level cognitive skills	5
1.2.1 The learning environment	5
1.2.2 Instructional design of courses	6
1.2.3 Teaching methods	7
1.2.4 Assessment methods	8
1.2.5 Study methods	9
1.2.6 Encouraging students to develop higher level cognitive skills	10
1.3 Group work	11
1.3.1 Group work as a method of developing higher level cognitive skills	11
1.3.2 Influencing factors on group work	11
1.4 Developmental models of learning	12
1.4.1 Introduction	12
1.4.2 Outline of the Perry Scheme of Intellectual Development	13
1.4.3 Transitions between stages in the Perry Scheme	15
1.4.4 Research into the Perry Scheme	16
1.4.5 Identifying students' stage of intellectual development	17
1.4.6 The reliability of measures of intellectual development	17
1.4.7 Intervention programmes	18
1.5 The research project	19
1.5.1 Aims of the project	19
Chapter 2 - The group poster presentation exercise (1990 - 1992)	21
2.1 Background to the poster exercise	22
2.1.1 Introduction	22
2.1.2 Aims and objectives of the Core Biology of the third year full time degree course at Napier University	22
2.2 Outline of the group poster exercise	23
2.2.1 Student groups	23
2.2.2 Poster challenges	24
2.2.3 Background instruction given to student groups	24
2.2.4 Poster presentation sessions	25
2.2.5 Assessment methods	25
2.3 Introduction to the poster presentation exercise (1990 -'91)	26
2.3.1 The organisation of the poster exercise	26
2.3.2 Obtaining student feedback	26
2.4 Results from the poster exercise (1990 - '91)	27
2.4.1 Staff assessment of the posters	27
2.4.2 Student feedback on the exercise from Questionnaire Q1	30
a) Student motivation and attitude	
b) Background instruction and support from staff	
c) Perception of the poster exercise	
d) Relevance and usefulness of the exercise scientifically	
e) Group dynamics	
f) Additional feedback from Questionnaire Q1	

2.5	Discussion on the poster exercise (1990 - '91)	32
2.5.1	Organisation of the poster exercise	32
2.5.2	Poster challenges	33
2.5.3	Poster exercise feedback	34
2.5.4	Group dynamics	35
2.5.5	Assessment methods	35
2.5.6	Student's performance in a social sciences honours poster in 1992	36
2.6	Modifications recommended for the 1991-'92 poster exercise	38
2.7	Introduction to the poster presentation exercise (1991-'92)	39
2.7.1	Background	39
2.8	Changes in procedure introduced during 1991 -'92	39
2.8.1	Introductory session at the beginning of the academic year	39
2.8.2	Student feedback and poster assessment methods	40
2.8.3	Challenge format	41
2.9	Results from the poster exercise (1991 -'92)	41
2.9.1	General observations of the poster presentations	41
2.9.2	Poster challenge types	44
2.9.3	Student feedback	44
2.9.4	Assessment methods	46
2.9.5	Group work	49
2.9.6	The scientific level of approach adopted by the groups of students	49
2.9.7	Two case studies	50
	a) Group 1 - ET Metabolism	
	b) Group 6 - Bone Fractures	
2.10	Discussion of the second year of the poster exercise (1991 -'92)	51
2.10.1	General comments	51
2.10.2	Organisation of the poster exercise	51
2.10.3	Assessment methods	52
2.10.4	Students' group dynamics	55
2.10.5	The scientific level of the poster contents	56
2.11	Modifications recommended for the 1992-'93 poster exercise	58
Chapter 3 - Development of a measure of intellectual development		59
3.1	Background	60
3.1.1	Introduction	60
3.1.2	Selection of a method of identifying student's stage of intellectual development	61
3.2	The development of the Perry Questionnaires	62
3.2.1	Production of Perry statements for use in Questionnaire P1	62
3.2.2	Pilot studies	64
	a) Questionnaire statements	
	b) Pilot questionnaire	
	c) Pilot carried out on the Life Sciences students	
3.3	Perry Questionnaire P1	66
3.3.1	Analysis of the Perry Questionnaire P1	66
3.3.2	Testing the reliability of the final eighteen statements of the Perry Questionnaire P1	66
3.3.3	Students tested during the academic year 1992 -'93	68
3.4	Perry Questionnaire P2	68
3.4.1	Introduction	68
3.4.2	Part 2 of the Perry questionnaire P2	69
3.4.3	Part 3 of the Perry questionnaire P2	70

3.4	<i>Perry Questionnaire P2 (cont.)</i>	
3.4.4	Students tested with the Perry Questionnaire P2 during 1992 -'93	71
3.5	Perry Questionnaire P3	71
Chapter 4 - The group poster presentation exercise (1992 -'93)		72
4.1	Background	73
4.1.1	Introduction	73
4.2	Changes in procedure introduced during 1992 -'93	73
4.2.1	The introductory session at the beginning of the year	73
4.2.2	Assessment methods	73
4.2.3	Staff feedback to students	74
4.2.4	Additional research feedback	74
4.3	Results from the poster exercise during 1992 -'93	75
4.3.1	General observations	75
4.3.2	Poster marks	75
4.3.3	Students feedback from Questionnaire Q 1	75
4.3.4	Group work	76
4.3.5	Staff and student end of year ratings of the posters	77
4.3.6	Students' intellectual approach to the poster exercise	78
4.3.7	Case Studies	80
	a) Group 3 - Dynamics of the endoskeleton of Wigetus poster	
	b) Groups 2 and 8 - Dragon metabolism and Bone Fractures posters	
4.4	Discussion of the poster exercise (1992 -'93)	81
4.4.1	Staff and student assessment of posters	81
4.4.2	Type of challenges and group performance	82
4.4.3	Assessment methods	82
4.4.4	Group work	83
4.4.5	Group selection	84
4.5	Perry approach to the exercise	85
4.6	Suggested modifications for the 1993-'94 poster exercise	88
4.7	Third Year student performance in the end of year Core Biology module examination during 1990-'93	89
4.7.1	Core Biology module assessments	89
4.7.2	End of year examination questions	89
4.7.3	Question selections by students in the end of year examination	90
4.7.4	Discussion about exam question selections made by students	90
Chapter 5 - The poster presentation exercise (1993-'94)		94
5.1	Background to the poster exercise	95
5.1.1	Introduction	95
5.2	Changes in procedure introduced during 1993 -'94	95
5.2.1	Introductory session at the beginning of the academic year	95
5.2.2	Assessment methods	95
5.2.3	Poster presentation sessions	96
5.2.4	Assessment procedures	97
5.2.5	Poster challenges	98
5.3	Results from the poster exercise 1993 -'94	98
5.3.1	Responses to Questionnaire G3	98
5.3.2	Modifications made to the poster exercise as a result of student feedback	98
5.3.3	General poster quality achieved in 1993 -'94	98
5.3.4	The influence of poster challenge type on poster performance	99

5.3	<i>Results from poster exercise 1993-'94 (cont)</i>	
5.3.5	Feedback on group poster feedback	100
5.3.7	End of year ratings by students and staff	102
5.3.8	Group work and group roles	104
5.3.9	Case Study	105
	a) Group 6 - Neural tube defects	
5.4	Perry approaches to the poster exercise in 1993 -'94	106
5.4.1	Introduction	106
5.4.2	Relationship between Perry group scores and poster marks	106
5.4.3	The group dynamics related to the Perry scores	109
5.4.4	Anticipated vs. actual roles adopted by students	109
5.4.5	The Perry scores of the Influencing / Non-influencing group members	110
5.4.6	Differences between Influencing and Non-influencing groups of students	110
	a) Significant differences identified in Perry questionnaire P2	
	b) Responses to Part 2 of the Perry Questionnaire P2	
	c) Responses to Part 3 of the Perry Questionnaire P2	
	d) Gender differences	
5.5	Influencing behaviour compared to relativist thinking	121
5.5.1	Introduction	121
5.5.2	High and Low Perry scoring students from the third year class of students taken from the Perry questionnaire P2	123
	a) Selection of groups	
	b) High Perry group characteristics	
	c) Low Perry group characteristics	
5.6	Discussion of the Poster presentation exercise	127
5.6.1	General comments	127
5.6.2	Organisation of the poster exercise	128
	a) Student questioning	
	b) Timing of the poster groups	
	c) Poster challenges	
	d) Feedback to students	
5.7	Group work	132
5.7.1	Group Selection	132
5.7.2	Group assessment	133
5.7.3	Group roles and Group skills	133
5.8	The relationship between Perry scores and group work	135
5.8.1	Perry scores and group work	135
5.8.2	Student conceptions of scientific levels of information	135
5.8.3	Group dynamics related to Perry scores	137
5.8.4	Characterising influencers' and non-influencers' attitudes	138
5.8.5	Determinants of group roles	139
5.8.6	Recommendations for future work	140
	Chapter 6 - Use of a measure of student Intellectual development	141
6.1	Introduction	142
6.1.1	Use of the Perry Questionnaire P1 during 1992 -'93	142
6.1.2	Use of the Perry Questionnaire P2 during 1993 -'94	142
6.2	Results from using the Perry Questionnaires	143
6.2.1	Student responses to Perry Questionnaire P1 (October 1992)	143
6.2.2	Student follow-up responses in Perry Questionnaire P1 (February 1993)	143
6.2.3	Individual changes in responses to the Perry Questionnaire P1 from October 1992 to February 1993 given by the first year students	147

6.2	<i>Results from using the Perry Questionnaires (cont.)</i>	
6.2.4	Student responses to the Perry Questionnaire P2 (October 1992)	147
6.2.5	Student responses to the follow-up testing in (February 1993)	150
6.2.6	Class responses to Part 2 of the Perry Questionnaire P2 (October 1993)	155
6.2.7	A comparison between the student responses given to the statements in Part 1 and 2 of the Perry Questionnaire P2 (October 1993)	160
6.2.8	Student responses to Part 3 of the Perry Questionnaire P2 (October 1993)	160
6.2.9	Differences between the 1st and 4th year full time degree students' preferences in Part 3 of the Perry Questionnaire P3	162
	a) Teaching methods	
	b) Assessment methods	
	c) Study methods	
6.3	A comparison between the questionnaire responses given by students obtaining the highest and lowest Perry scores	166
6.3.1	Introduction	166
6.3.2	Selection of High and Low groups	167
6.3.3	High and Low perry groups responses to Part 2 Perry Questionnaire P2	167
6.3.4	High and Low perry groups responses to Part 3 Perry Questionnaire P2	170
6.3.5	Follow-up testing of first year full time degree students (February 1994)	173
	a) Students' perception of science	
	b) Teaching methods	
	c) Assessment methods	
	d) Study Methods	
6.4	Discussion of the questionnaire responses during 1992 -'94	176
6.4.1	Course trends observed from the October 1992 and 1993 testing	176
6.4.2	Course trends observed from the February 1993 and 1994 testing	177
6.4.3	Timing of the Perry Questionnaires	180
6.4.4	Course trends in response to statements in Part 1	180
6.4.5	Course trends in responses to Part 2	181
6.4.6	Course trend response indicated in Part 3	183
	a) Teaching methods	
	b) Assessment methods	
	c) Study methods	
6.4.9	Students' transitions between Perry's stages of development	188
6.5	Summary of findings	190
Chapter 7 - Discussion of the project		192
7.1	Introduction	193
7.1.1	General comments	193
7.2	Group poster presentation exercise	194
7.2.1	Clarification of staff aims and the objectives of the exercise	194
7.2.2	Development of higher level cognitive skills	195
7.2.3	Student peer group questioning	196
7.3	Group work	198
7.3.1	Use of groups	198
7.3.2	Selection of groups	200
7.3.3	Group composition	200
7.3.4	Group assessment methods	202
7.3.5	Group performance in the poster exercise	203
7.4	Perry Responses and Group Roles	204
7.4.1	Influencing and Non-Influencing roles within groups	204
7.4.2	Relationship between stage of intellectual development and group roles	204

7.5	Perry Scheme of Intellectual Development	207
7.5.1	Use of a measure of intellectual development	207
7.5.2	Findings from the Perry questionnaire analysis	209
7.5.3	Course trends in students' responses	210
7.5.4	The influence of the lecturer's role on student development	211
7.5.5	Peer group influences in determining developmental changes	213
7.5.6	Trends in the changes of students' approaches	214
7.5.7	Progression through the Perry scheme	215
7.5.8	Reasons behind students attending University	218
7.5.9	Relationship between Perry stages and students' approaches to their University education	218
7.6	Further Studies	220
7.6.1	Current studies	220
7.6.2	Group poster exercise	220
7.6.3	Poster presentation exercise	221
	References	223
Appendix 1	Poster challenges, student handouts, third year exam paper	
Appendix 2	Poster Questionnaires and Checklists	
Appendix 3	Perry Questionnaires and additional data from Perry work	

List of Figures

	page
Chapter 1 - Introduction	
1.1 Diagram of the Perry scheme of intellectual development	14
Chapter 3 - Development of a measure of intellectual development	
3.1 A comparison between the average percentage of A, B and C type positive responses given by the part time second and fifth year Life Sciences students to the pilot Perry questionnaire P1 in October 1992	67
Chapter 4 - Group poster presentation exercise (1992 -'93)	
4.1 A comparison between the individual and group responses given by the third year poster groups in responses to the Perry Questionnaire P1 in October 1992	79
Chapter 5 - Group poster presentation exercise (1993-'94)	
5.1 A comparison between the student ratings given in Checklist C5 for the posters obtaining the highest and lowest marks by staff during 1993-'94	103
5.2 The relationship between the mean percentage for A and C type positive responses for the poster groups from 1992 to 1994	107
5.3 A comparison between group poster performance and type of positive responses given by individual group members to the Perry questionnaire P2 in October 1993 by top, middle and bottom groups	108
5.4 A comparison between the percentages of A, B and C type positive responses given by individuals reported to be Influencers and Non-influencers groups during 1993 -'94	111
5.5 A comparison between the percentage of A, B and C type positive responses given by those students reported as being the most and least influential within the poster exercise in October 1993	112
5.6 A comparison between the type of percentage A, B and C type positive responses given Perry Questionnaire P2 by those students reported as being the most and least influential in the group poster work during 1993-'94	113
5.7 A comparison between the responses given to specific statements in Part 1 of the Perry Questionnaire P2 by students reported as being the most and least influential within the poster exercise during 1993-'94	114
5.8 A comparison between the responses given to Part 2 of Perry Questionnaire P2 by those students reported as being the most and least influential within the poster exercise work during 1993 -'94	116
5.9 A comparison between the teaching, assessment and study methods listed as being most preferred by the students reported as being the most and least influential within the poster groups during 1993-'94	119
5.10 A comparison between the teaching, assessment and study methods listed as being least preferred by the students reported as being the most and least influential within the poster groups during 1993-'94	120
5.11 A comparison between the responses given to the Perry Questionnaire P2 by the male and female students reported as being the most and least influential in the poster exercise during 1993 -'94	122
5.12 A comparison between the average A, B and C type responses given by the third year groups of High and Low Perry students to Perry Questionnaire Part 1 in October 1993 -'94	124

5.13	A comparison between the most preferred instructional methods selections made in Perry Questionnaire P2 by the High and Low scoring third year groups in October 1993	125
5.14	A comparison between the least preferred instructional methods selections made in Perry Questionnaire P2 by the High and Low scoring third year groups in October 1993	126
5.15	A comparison between the poster marks obtained for structured and unstructured challenges during 1991 - 1994	131
Chapter 6 - Piloting a measure of intellectual development		
6.1	A comparison between the class mean percentage of A, B and C type positive responses given by students to the Perry Questionnaire P1 during October 1992	144
6.2	A comparison between the trends of C to A type average positive responses given to the Perry Questionnaire P1 by different classes attending full and part time biology courses in October 1992	145
6.3	A comparison between the average C to A ratios and the A, B and C type positive responses given to the Perry Questionnaire P1 by the 1st, 2nd and 3rd year BSc classes in October 1992 and February 1993	146
6.4	A comparison between the percentage of A, B and C type positive responses given by the first year BSc full time students to Perry Questionnaire P1 completed in October 1992 and February 1993	148
6.5	A comparison between the class mean percentage of A, B and C type positive responses given by students to the Perry questionnaire in October 1993	149
6.6	A comparison between the October 1992 and October 1993 class mean percentages of A and C type positive responses given in the Perry Questionnaires P1 and P2 by full and part time biology students	151
6.7	A comparison between the average class percentage C to A ratios obtained in October 1993 and October 1992 from Part 1 of the Perry Questionnaires P1 and P2	152
6.8	A comparison between the type of positive responses given by the 1992 -'93 and 1993-'94 first year full time degree classes to Perry questionnaire P1 in October and February of those years	153
6.9	A comparison between the percentage of A, B and C type positive responses given by first year BSc full time students to Part 1 of the Perry Questionnaire P2 completed in October 1993 and February 1994	154
6.10	A comparison between the average number of students from different course years not justifying their decisions to statements in Part 2 of the Perry Questionnaire P2 in October 1993	156
6.11	A comparison between the percentage of students from the full time BSc degree classes not justifying their decisions in Part 2 of the Perry Questionnaire P2 in October 1993	157
6.12	A comparison between the number of students agreeing with statements 1,11 and 9 in Part 1 of the Perry Questionnaire P2 and agreeing with the statements (1, 3 and 6) in Part 2 in October 1993	161
6.13	A comparison between the most preferred selections for teaching, assessment and study methods made by the BSc first and fourth year classes in the Perry Questionnaire P2 in October 1993	164

6.14	A comparison between the least preferred selections for teaching, assessment and study methods made by the BSc first and fourth year classes in the Perry Questionnaire P2 in October 1993	165
6.15	A comparison between the mean percentage of A, B and C Type positive responses given by the sample of high and low Perry scoring students selected from all classes in Perry Questionnaire P2 in October 1993	168
6.16	A comparison between the responses given to Part 2 of the Perry Questionnaire P2 by the High and Low Perry scoring students in Part 1 of the Perry Questionnaire P2 in October 1993	169
6.17	A comparison between the most preferred selections for teaching, assessment and study methods made in the Perry Questionnaire P2 by the High and Low Perry samples taken from all years in October 1993	171
6.18	A comparison between the least preferred selecting for teaching, assessment and study methods made in the Perry Questionnaire P2 by the High and Low Perry samples taken from all years in October 1993	172
6.19	A summary of the opinions expressed in February 1994 in Part 2 of the Perry Questionnaire P3 by the first year full time BSc students used on their course after attending Napier University for four months	174

Appendix 3 - Additional Perry data

A3.1	A comparison between the type of positive responses given to Part 1 of the Perry questionnaire P1 by the first year full time BSc class of October and the first year full time BSc class of October 1992	vi
A3.2	A comparison between the type of positive responses given to Part 1 of the Perry Questionnaire P1 by the first year full time BSc class of October 1992 and the first year full time BSc class of February 1993	vii
A3.3	The changes of opinion shown by first year BSc students to specific statements in the Perry Questionnaire P1 Part 1 in February 1994 when compared to the same students responses in October 1993	viii
A3.4	A comparison between the mean percentage of A, B and C type positive responses given by the poster groups in 1992 -'93 and 1993 -'94	ix
A3.5	A comparison between the mean percentage of A, B and C type responses given by the third year male and female students reported as being the most and least influential during the poster exercise in 1993-'94	x
A3.6	A comparison between the average number of students from each class agreeing with A type statements in Part 1 of the Perry Questionnaire P2 in October 1993	xi
A3.7	A comparison between the average number of students from each class agreeing with B type statements in Part 1 of the Perry Questionnaire P2 in October 1993	xii
A3.8	A comparison between the average number of students from each class agreeing with C type statements in Part 1 of the Perry Questionnaire P2 in October 1993	xiii
A3.9	A comparison between the average class preferences shown for small group work with the lecturer present and individual study in Part 3 of the Perry Questionnaire P2 in October 1993	xiv
A3.10	A comparison between the average class preferences shown for discussion /descriptive essays and problem type questions without clear-cut answers as assessment methods in Part 3 of the Perry Questionnaire P2 in October 1993	xv

A3.11	A comparison between the average class preferences shown for multiple choice and short answer type questions as assessment methods in Part 3 of the Perry Questionnaire P2 in October 1993	xvi
A3.12	A comparison between the class average most preferred study methods as indicated in Part 3 of the Perry Questionnaire P2 in October 1993	xvii

List of Photographs

	page
Chapter 2	
2.1 Section of Chromosomal abnormalities poster 1990 -'91	29
2.2 Motor neuron disease poster 1990 -'91	29
2.3 Dragon metabolism poster 1991-'92	43
2.4 Extraterrestrial Metabolism poster 1991 -'92	43
2.5 Bone fractures poster 1991 -'92	43
Chapter 4	
4.1 Tissue Repair mechanisms poster 1991 -'92	86
4.2 Tissue Repair mechanisms poster 1992-'93	86
4.3 Parkinson's disease poster 1992-'93	86
Chapter 5	
5.1 Human Limb development poster 1993-'94	101
5.2 Neurodegenerative diseases clinic poster - 1993-'94	101
5.3 Neural tube defects poster 1993-'94	101

List of Tables

	page
Chapter 1	
1.1 The nine positions of the Perry Scheme of intellectual development	14
Chapter 2	
2.1 Background description of the posters and groups during 1990-'91	26
2.2 Poster Titles, group sizes and marks awarded during 1990 - '91	28
2.3 Poster topics, challenge titles and group numbers during 1991-'92	41
2.4 A comparison between the group poster marks obtained during 1991 - '92	42
2.5 A comparison between students' perception of the level of background instruction given by staff prior to the poster exercises in 1990-'91 and 1991 -'92	45
2.6 A comparison between the questionnaire responses given to specific statements in Questionnaire Q1 during 1990-'91 and 1991-'92	46
2.7 A comparison between the staff and student end of year ratings for the poster with the best design, integration of subjects and the highest scientific level (1991-'92)	48
Chapter 3	
3.1 Descriptors for the Dualist, Multiplist and Relativist stages used as a basis for the Perry Questionnaire P1	63
Chapter 4	
4.1 A comparison between the student responses given to the questions relating to the development of higher level cognitive skills in Questionnaire Q1 (1990- '93)	76
4.2 Shifts in student opinion (> 15 %) from October '92 to May '93 A comparison between student responses given to the group questionnaire G 1	77
4.3 A comparison between staff and student end of year ratings of the poster presentations given in response to Checklist C3 in 1992- '93	78
4.4 A comparison between the students selection of examination questions in the biology end of year exam and their poster topic preference	91
4.5 A comparison between the average mark obtained by the third year class for the five biology topics in the end of year examinations during 1991 -1993	92
Chapter 5	
5.1 Staff and student end of year ratings of the poster presentations given in 1993 - '94 to Checklist C3	104
5.2 A comparison between the student's pre and post exercise responses to the Group questionnaire G2	105
5.3 Reasons behind the preferences given to Part 3 of the Perry questionnaire by students considered to be Influencers and Non-Influencers within groups	117
5.4 A comparison between responses to parry Questionnaire P2 given by third year Influencing and Non-influencing poster group students in October 1993	118
Chapter 6	
6.1 A selection of student comments from Part 2 of the Perry Questionnaire P2 in October 1993	158
6.2 A comparison between the responses given in Part 3 of the Perry Questionnaire P2 by the full time first year class which were significantly different from the fourth year degree classes' responses given October 1993	162
6.3 The preferences indicated in Part 3 of the Perry Questionnaire P2 showing a significant difference between the high and Low Perry scoring groups from Part 1 of the questionnaire	170

6.4	A summary of the study methods used in preparing for assessments as listed by first year students in the Perry Questionnaire P3 in February 1994	176
Chapter 7		
7.1	A comparison between the type of average positive responses given to Perry Questionnaire P2 by full time degree students in October 1993	210
7.2	A comparison between the type of class average positive responses given by first, second and third year full time students to the perry Questionnaire P2 Part 1 in October 1992 and October 1993	211

Chapter 1

Introduction to project

1.1 Background

1.1.1 Introduction

During the last few years, many universities have been reviewing their instructional methods as part of their internally and externally directed academic audits and quality assessments. These initiatives, along with recommendations from many prospective employers, such as the CBI, have led teachers to consider ways in which they can produce graduates not only with a body of knowledge, but also with additional abilities such as good communication and group skills and the ability to think creatively and imaginatively (Hendel, 1990; Entwistle *et al.*, 1991).

A move towards using more innovative instructional methods as a means of broadening the range of the students' experience and improving the quality of student learning has come from various sources including the Oxford based C.N.N.A. project directed by Gibbs (1992) and the MacFarlane report from the Committee of Scottish University Principals (1993). In addition, projects have investigated ways of matching students' individual learning characteristics and cognitive preferences to appropriate instructional methods with the aim of encouraging and motivating students to develop higher cognitive level skills by adopting effective learning strategies (Parker and Lawson, 1978; Shayer and Adey, 1981; Entwistle and Tait, 1990; Duckworth *et al.*, 1991; Finster, 1991; Meyer, 1991; C.N.N.A., 1992).

However, although many courses list the development of Bloom's (1956) higher level cognitive skills as an intended aim (Kurfiss, 1977), there is often a mismatch between the course aims and the way in which the courses are taught and assessed (Entwistle, 1987; Bowden, 1988; Kember, 1991). Many departments still prioritise the accumulation of factual knowledge (Entwistle and Percy, 1974) at the expense of students' understanding of the subject (Tobin and Gallagher, 1987) and the development of students' higher level cognitive skills such as the ability to analyse, synthesis and apply information (Ramsden, 1986). A number of factors have been shown to affect both students' motivation and ability to develop higher level cognitive skills (Biggs, 1979; Hofstein and Kempa, 1988). These include the perceived learning environment (Entwistle and Wilson, 1977; Ramsden, 1979, Thomas *et al.*, 1991), assessment methods (Becker *et al.*, 1968, Miller and Partlett, 1974; Laurillard, 1979; Thomas and Bain, 1984), teaching methods (Marton and Saljo, 1984; Boreham *et al.*, 1985; Tobin *et al.*, 1988), perceived relevance (Johnstone *et al.*, 1981) and a student's intellectual developmental stage (Perry, 1970; Heath, 1978;

Kitchener and King, 1990).

1.1.2 Higher level cognitive skills

Ausubel (1968, 1975) has described meaningful learning as a process by which individuals associate new information into existing conceptual frameworks of knowledge which are of an hierarchical structure (McKeachie, 1974; Gibbs *et al.*, 1982; Gilbert *et al.*, 1982). Most of the basic concepts which form the foundations of this framework are developed in an individual's early life (Piaget, 1951) and the way in which the framework is constructed is determined by an individual's cognitive style (Vernon, 1972; Messick, 1976). Research has shown that the development of higher level cognitive skills requires both the prerequisite cognitive skills and also a willingness to use them (Fordyce, 1987). The ability to think creatively depends on the validity of the interconnections established within the framework and the ability to move from fundamental cognitive structures to more abstract concepts (Broadbent, 1975; Fisher, 1980; Glaser, 1984; Labudde *et al.*, 1988; Fisher and Aufschnaiter 1993). However, blockages in different constructs can occur through student lack of interest or motivation to learn (Fransson, 1977; Saljo, 1987; Klauer, 1988; Hegarty-Hazel and Prosser, 1991; Chinn and Brewer, 1993).

Marton (1981) has suggested that courses should be designed in a way that students are taught the fundamental concepts of the subject area rather than concentrating on the build up of an accumulation of factual material. Some students do not always grasp the basic concepts of a subject because they are seeing the information in a unrelated and disjointed way and this is later reflected in problems in retrieving information in a meaningful way (Bartlett, 1932; Craik and Lockhart, 1972; Broadbent, 1975). Others (Dahlgreen and Marton, 1978; Eylon and Lynn, 1988) have also recommended that for more quality learning, subjects should be taught more in depth rather than for the breadth of knowledge as often is found in science courses (Entwistle and Percy, 1974; Ramsden, 1986; Bierzychudek and Reiness, 1992).

1.1.3 Individual student approaches to learning

Students entering science courses can vary considerably in both their motivation and approach to study (Partlett, 1970; Bieri, 1971; Entwistle and Wilson, 1977) and these differences are reflected in the way in which they learn within an instructional context. With the desire to investigate ways in which students can be encouraged to engage in more meaningful learning

many research projects have focused on how student approaches influence the quality of their learning.

At the most fundamental level, researchers have described student approaches as being within two categories, both of which relate to a student's intent to learn. The first can be considered to be a **transformational** approach when the student sets out to understand any new material which they then actively relate to their previous knowledge and experience. The second approach is considered to be a **reproductive** approach. Here the student does not make the same effort to understand any new material and they simply comply with course requirements in a fairly routine way. This results in information remaining disjointed, unrelated and if necessity arises, subsequently being passively reproduced.

The most frequently used descriptions of these two approaches in the literature are the 'Deep' and 'Surface' approaches as identified and described by Marton and Saljo (1976, I and II), but there are similar distinctions (of different intents to understand) made between the 'generative' and 'reproductive' approaches by Wittrock (1974), 'comprehension' and 'operation' approaches by Pask (1976), 'transformational' and 'reproductive' approaches by Biggs (1982), 'holistic' and 'atomistic' approaches by Svensson (1977) and 'elaborative' and 'fact retention' approaches by Schmeck (1983). There is evidence that when each of these approaches is used exclusively, different types of learning occur (Marton and Saljo, 1976; Pask, 1976; Svensson, 1977; Biggs, 1979).

Research into the constancy of students' approaches had produced contradictory results. Svensson (1977) has reported that students remain constant in their approaches. In other words, a student identified as adopting a transformational approach is likely to always attempt to do so. Other studies (Hakistan, 1971; Fransson, 1977; Newble and Jaeger, 1983; Thomas and Bain, 1984; Ramsden, 1984; Laurillard, 1987) have found that students adopt an approach according to the demands of the learning situation, for example, a student would use a variety of strategies when preparing for different types of course assessments. For example, students adopted a reproductive approach when preparing for objective type tests and more of a transformational approach when preparing for essay type assessments.

Longitudinal studies have also shown mixed trends (Wentz *et al.*, 1986; Duckworth *et al.*, 1991; Geiger and Pinto, 1991), with some studies indicating that students change only some aspects of their learning styles,

but not their approaches and other studies showing students as gradually changing their approaches but not their learning styles as a course progresses (Biggs, 1982; Watkins and Hattie, 1985). Despite these contradictory findings, research has shown that students will usually adopt reproductive approaches to their learning if an instructional method is perceived as being threatening, uninteresting, irrelevant, or if their workload is perceived as being too high or they are unsure of what is expected of them, in for example, an assessment procedure (Broadbent, 1975; Ramsden, 1984; Saljo, 1982; Entwistle *et al.*, 1989).

Therefore, if students are to be expected to be motivated to undertake an active and meaningful approach to their learning then they should be provided with both an appropriate environment and adequate support in order that they might be encouraged to undertake that type of learning (Ashby, 1973; Elton and Laurillard, 1979; Rogers, 1979; Biggs, 1982; Tobin and Gallagher, 1987; Klauer, 1988; Nickerson, 1988-9; Hofstein and Kempa, 1988; Finster, 1991).

1.2 The development of higher level cognitive skills

1.2.1 The learning environment

A number of studies have shown that factors associated with the learner, the modes of instruction and assessment are influential in determining how actively involved students become in their learning. The level of active involvement affects the level of thinking which the student attains and the way any new material is stored and this subsequently retrieved (Boreham *et al.*, 1985; Bligh, 1986; Fordyce, 1987; Gayford, 1988; Tobin *et al.*, 1988).

The emphasis which many science departments place on course content has been shown to affect the way a course is taught and the way in which the students approach this particular discipline (Ramsden, 1979; Ploger and Harvey, 1988; Confrey, 1990; Sheppard and Gilbert, 1991). Generally, science lecturers are employed for their expertise in a research area and have been shown to be more content bound than lecturers in arts based subjects (Entwistle and Hounsell, 1975). The completion of academic work, particularly in science courses is, therefore, often at the expense of the students' understanding (Tobin and Gallagher, 1987).

Many students and teachers attracted towards science subjects appear to have particular attitudes and approaches to learning by being more 'object

orientated' rather than 'people orientated' individuals and more convergent thinkers than those attracted to arts subjects (Hudson, 1966; Collings and Smithers, 1984). With lecturers tending to teach in the same way that they themselves were taught (Young and Kellogg, 1993), a particular way of thinking or way of approaching a subject is likely to be perpetuated unless some method of intervention or re-evaluation of instructional methods is made by science teachers, perhaps at the teacher training level (Dart and Clarke, 1991; Turnbull and Slack, 1991). Conversely, Hurd (1971) has described how often by concentrating too much on the instructional methods, scientific educational research does not take into account the effects which different instructional strategies have on the differing interactions which occur between learners and the learning environment (Kempa, 1976).

Science departments have also been shown to have a tendency towards lecture and classroom study rather than for individual study, in comparison to for example arts based departments (Ramsden, 1979). The relationship between staff and students is usually found to be more formal in science departments, with many of the lecturers being encouraged to remain heavily involved in scientific research (Entwistle and Wilson, 1977). Students often perceive the workload for science subjects as being high with the emphasis being on learning large quantities of factual material (Ramsden and Entwistle, 1981), resulting in students experiencing feelings of anxiety and lack of motivation, which can in turn lead to the adoption of reproductive learning strategies (Marton and Saljo, 1976; Svensson, 1977).

If a learning environment is formally based (Ramsden, 1979; Ramsden and Entwistle, 1981) and the lecturer is seen as being not very approachable or distant, then a student is also not so likely to become actively involved in his/her learning and might have difficulties going on to become an autonomous learner (Boud, 1988; Powell, 1988). In addition, if, as has been shown, many students entering universities are deficient in some of the skills required for engaging in autonomous study, (Thomas *et al.*, 1991) a supportive learning environment would appear to be of even greater importance if students are to be expected to undertake any form of independent learning.

1.2.2 Instructional design of courses

The complex range of variables affecting the quality of student learning in higher education (Astin, 1968; Baron, 1975; Ramsden, 1979;

Wilson, 1981; Richardson, 1983; Siegal, 1990) would seem to recommend a more holistic approach to instructional design by teams of lecturers collectively planning their teaching and learning approaches (Parker and Lawson, 1978; Davis *et al.*, 1993). Then, perhaps a balance could be achieved between instructional methods whereby students can attain the necessary background knowledge, but at the same time be given the opportunity to develop higher level cognitive skills, viewing knowledge as something which can be drawn upon and used (Richardson *et al.*, 1987; Boud, 1988; Gayford, 1988; Jiminez-Aleixandre, 1992; Grieve, 1992). Learning environments, for example, which encourage students to adopt transformational approaches have been shown to be more likely to encourage students to produce higher quality thinking than those environments which discourage students to adopt reproductive approaches (Trigwell and Prosser, 1991). The desirability of students being able to operate at different cognitive levels can perhaps be best exemplified in medical training where students are expected to learn the skills of diagnosis and at the same time, to be able to identify the most appropriate treatments (Boreham *et al.*, 1985; Newble and Jaeger, 1986).

1.2.3 Teaching methods

A number of teaching methods have been identified which encourage students to develop more meaningful or more transformational approaches to their learning. Those relevant to this research project have included : group discussions (Miller and Partlett, 1974; Beard *et al.*, 1978; Ruddock, 1978; Abercrombie, 1979; Powell, 1981; van Ments, 1990), problem based activities (Laurillard, 1984; Newble and Clarke, 1986; Boud, 1988), small group projects, (Beach, 1974; Magin, 1982; Webb, 1983; Goodwin *et al.*, 1991) reflective thinking exercises (Labudde *et al.*, 1988; Calderhead, 1989), peer group questioning (Webb, 1989; King, 1990), use of anomalous data in problems (Chinn and Brewer, 1993) and debating (Green and Klug, 1990).

The way in which a course is taught is influential in determining the level of approach adopted by a student (Entwistle and Percy, 1974; Newble and Clarke, 1986; Adey, 1988; Constable and Long, 1992) and Biggs (1982) has suggested that if the aim is to encourage students to think metacognitively then a course should be taught metacognitively. However, whatever instructional strategy is used, students will be more likely to adopt a transformational approach to their learning if they are interested in the subject area, perceive the work as relevant (Johnstone *et al.*, 1981; Entwistle

and Ramsden, 1983) or feel stimulated by the content (Eysenck, 1977; Biggs, 1982).

The onus is often placed on the lecturer to encourage students to develop their own independent understanding of a subject. Although it is possible to evoke transformational approaches in students in a traditional lecture format, (Hodgson, 1984), many innovative methods of teaching involve lecturers taking up a new role, such as that of a facilitator of learning, within the instructional context. These new roles can sometimes create a problem in that they are more emotionally and intellectually demanding and teachers sometimes do not feel confident in adopting what might be considered to be an unfamiliar approach (Fransson, 1977; Collier, 1985; Turnbull and Slack, 1991; Constable and Long, 1992). However, in a study carried out by Entwistle and Ramsden, (1983) the strongest influences on the depth of approach taken by students were the assessment method, the freedom given in learning and 'good teaching'. From student questionnaire evaluations, Marsh (1987) and Entwistle (1987) have identified, interest and relevance of content, enthusiasm about a subject and clearly structured material as constituting 'good lectures' however, Janssen (1992) has underlined the importance of lecturers also providing students with a focused approach towards the assessment requirements of a course.

1.2.4 Assessment methods

If students are to value the development of higher level cognitive skills then this should be reflected in the grading systems (Tobin and Gallagher, 1987). However, many current assessment practices still reward recall or declaration of procedural knowledge (Biggs, 1978; Boud, 1990) and there is often little indication of the quality of a students' thinking or understanding of a subject (Fleming and Chambers, 1983, Heywood, 1989; Hendel, 1990).

If students are going to be assessed on their reproduction of material in exams, they do not tend to take up approaches to study which develop higher level cognitive skills (Marton and Saljo, 1976 (I and I); Entwistle and Ramsden, 1983; van Rossum and Schenck, 1984). The influence which assessment has on the direction and focus of the students' learning has been demonstrated by Becker *et al.*, (1968), Miller and Partlett (1974), Laurillard (1978), Thomas and Bain (1984), Rountree (1989), Williams (1992) and Beaty *et al.*, (1990). This tendency highlights the necessity for matching assessments with desired outcomes as many current assessment practices

have been shown to undermine transformational approaches and are incompatible with the goals of student independence and autonomy (Miller and Partlett, 1974; Van Rossum and Schenck, 1984; Boud, 1988; Rowntree, 1989; Nickerson, 1989; Wagoner, 1990).

In addition, a number of different types of assessments have been described as favouring different learning styles. For example, Biggs, (1973) has argued that objective tests favour convergent thinkers while essays favour opportunists who capitalise on the teacher's preferences. Therefore, if students are going to be encouraged to develop their own learning styles, he advocates use of a marking system which counts only the top marks from all assessments rather than one which averages out marks from all the assessments.

1.2.5 Study methods

Much attention has been focused on which teaching and assessment methods would encourage students' adoption of a transformational or deep approach to their learning and Bucat and Williams (1989) have described how students can miss out the overlying concepts of a subject by concentrating on obtaining factual material even at the stage of taking notes in a lecture. However, Entwistle *et al.*, (1991) have suggested that it is not so much what students are doing within the classroom that is important but what the students are doing outwith the classroom, with respect to study methods and study behaviour has been shown to be different between faculties (Biggs, 1979).

Several investigators have recognised what is described as a strategic approach being adopted by some students. This approach is not so much related to a student's intentions to learn material, but to the way in which students feel motivated to work the educational system because they either want to obtain success at University or because they have a fear of failure (Miller and Partlett, 1974; Entwistle, 1979; Biggs, 1982; Ford and Tebbut, 1993). Often, learning environments can become very task related (Becker *et al.*, 1968) and students will sacrifice their understanding of the material in the attempt to obtain good grades, by looking to the lecturer for 'cues' (Miller and Partlett, 1974). Problems arise when students misinterpret the signs, and discrepancies occur between the staff and student perceptions, as to course requirements.

Entwistle and Wilson (1977) have described how students in natural sciences courses often do not have clearly defined guidelines as to their

course requirements, such as the way in which they are being assessed, which Biggs (1973) suggests can often lead to students carrying out unchannelled behaviours and undertaking rather directionless study. Although, clearly defined learning outcomes might assist in removing some of the ambiguities of the learning environment, Biggs (1973) has recommended that 'teaching to the test' could also remove the flexibility of a course to the extent that students might be denied the experience necessary to attain higher level cognitive skills (Tobin *et al.*, 1988; Sheppard and Gilbert, 1991).

1.2.6 Encouraging students to develop higher level cognitive skills

A number of interventionist studies have been carried out with the aim of encouraging students to adopt more 'meaningful' approaches to their learning. These have had varying success. Programmes have included involving students in structured questioning sessions (Marton and Saljo, 1976), teaching study skills strategies to students (Ramsden *et al.*, 1986), and teaching study methods and approaches to students perceived to be at risk during their first year at University (Parsons and Mayor, 1990).

Marton and Svensson (1979) have claimed that only radical interventions in instructional methodology will affect changes of approach in students because students are a relatively homogeneous group in terms of academic ability. Some interventionist programmes, however, have been shown to change students' approaches (Parker and Lawson, 1978; Parsons and Meyer, 1990). But the resultant changes in approach have generally been determined by the mode of assessment utilised on the particular course involved. For example, in the Ramsden study (1986) where students had a number of different study methods described to them, but without prioritisation, students strategically developed a more efficient reproductive approach because a reproductive approach was rewarded in the end of year assessments.

Although Entwistle and Tait (1990) consider students' study skills as being the determinants and indicators of approach, students with good study skills can go on to be poor achievers and vice versa. Therefore, it has been argued that simply identifying the study methods of high achievers and trying to make all students adopt the same approaches might be counterproductive; rather, it is advisable to reward higher level cognitive skills within the grading systems (Tobin and Gallagher, 1987).

1.3 Group Work

1.3.1 Group work as a method of developing higher level cognitive skills

Group work has been shown to have the potential for heightening motivation and increasing student interaction as opposed to that experienced in a lecture format (Beard, 1970; DeVries and Edwards, 1973; Beach, 1974; Magin, 1982; Brophy, 1983; Brewer, 1985; Collier, 1985) with students developing a stronger commitment towards other group members. Small groups have also been shown to benefit students who might otherwise be average or low achievers (Bennet and Cass, 1988; Webb, 1982, 1989).

Peer group interaction through the use of group discussions and projects can also allow students to work through or to develop new concepts or ideas in a way which should encourage more meaningful learning or a deeper approach (McKeachie, 1974; Hare, 1982; Tobin *et al.*, 1988; Garrett, 1989; Robinson and Niaz, 1991; Lating and Raffoul, 1991). Although most teaching methods are measured by the product, the process of working in a group can be important in developing the quality of the students' thinking (Steiner, 1972; Webb, 1982; Newble and Clarke, 1986; Ramsden 1987).

1.3.2 Influencing factors on group work

It is generally acknowledged that groups function at two different levels : that of performing an overt task and that of functioning as a group (for example, Bion, 1961, 1970; Bales and Strodtbeck, 1968; Biggs, 1984; Baron *et al.*, 1992). Tuckman and Jensen (1977) have described several different potential stages in the group process :

1. **Forming** the initial stages of a group when group members are most concerned about being accepted
2. **Storming** when members confront their various differences
3. **Norming** when groups develop a consensus regarding roles, status and procedures
4. **Performing** when there is less conflict and emotion as the group works together
5. **Adjourment** when group activities stop and group goals are reached and a group exercise has been completed.

Many studies have been carried out which have investigated the influencing factors upon this group process, group norms and effects on

group performance. These have included : the influences of student characteristics (McGrath and Altmann, 1966; Latting and Raffoul, 1991), separating groups into problem-solvers and non problem-solvers (Davis and Restle, 1963; Olsen and Davis, 1964; Bar-Haim, 1988), group cohesiveness (Cartwright and Zander, 1968), group size (Shaw, 1964), effects of co-operation and competition (Deutsch, 1968), group motivation (Davis, 1969), group rewards (Slavin, 1978), peer interaction (Webb, 1989) and previous experiences of working in a group (Bion, 1961).

A group task or project can be obstructed, diverted or assisted by the group dynamics (Bion, 1970; Brandstatter *et al.*, 1978; Brewer, 1985) and many research projects have investigated the influential factors on group dynamics and group's different stages of development including those of Cartwright and Zander (1968), McLeish *et al.*, (1973), Penland and Fine (1974), Collier (1980, 1983), Webb (1983) and Jacques (1991).

1.4 Developmental models of learning

1.4.1 Introduction

Investigations have shown how student attitudes and perceptions of knowledge can change while undertaking a higher education course (Sanford, 1956; Heath, 1964; Heath, 1968; Perry, 1970; Riegall, 1973; Kurfiss, 1977; Fischer, 1980; Kitchener and King, 1990, Sternberg and Berg, 1992; Labouvie-Vief, 1992). These changes are reflected not only in the way that students approach instructional methods and the quality of their thinking but also in their attitudes towards other people within the learning environment. With each individual student perceiving and interpreting the external world in different ways, (Vernon, 1972; Messick, 1976; Witkin, 1976; von Glaserfeld, 1983) these changes have been described as being indicative of structural changes in students' cognitive frameworks paralleled by changes in the way the students process, store and retrieve any new information (Piaget and Inhelder, 1973, Broadbent, 1975; Brown and Desforges, 1979).

Many of the basic principles from Piaget's (e.g. 1977) constructivist theory of developmental changes in children have been used as a basis for further research into the ways in which adults develop intellectually and have been used to describe and explain maturational cognitive changes which occur in students in higher education (Churchman, 1971; Broughton, 1975; Cobb and Steffe, 1983; von Glaserfeld, 1983; Bradeck, 1984; Fischer and

Aufschnaiter, 1993; Good, 1993; Fosnot, 1993).

1.4.2 Outline of the Perry Scheme of Intellectual Development

One of the most influential theoretical schemes of adult cognitive changes was developed by William Perry (1970). The Perry Scheme of Intellectual Development originated following a series of interviews carried out with students, predominantly male, at Harvard and Radcliffe Universities during the 1950s and 1960's. The transcripts from the interviews revealed a continuum of developmental stages, characterised by different ways of thinking and behavioural patterns (Perry, 1970, 1977, 1981). The methods of progression through the scheme have many of the characteristics observed in the transitions of Piaget's stages (Flavell, 1971)

Perry's original scheme describes a series of nine stages or positions through which a student may pass while at college (Table 1.1 and Figure 1.1). Generally, this progression is indicated by a move from an absolute or simplistic stance on the nature of knowledge to one which is more pluralistic and contextual (see Perry (1970), for a full description of these stages). The first 5 stages of the scheme are related to epistemological and intellectual development whereas the stages 6 - 9 are related more to ethical and moral issues. Perry (1970) and others (Knefelkamp and Slepitzka, 1976; Parker and Lawson, 1978; King, 1978; Finster, 1989) have grouped the nine positions together into four stages for descriptive purposes :

Dualism	(positions 1 and 2),
Multiplism	(positions 3 and 4),
Relativism	(positions 5 and 6),
Commitment in Relativism	(positions 7 to 9).

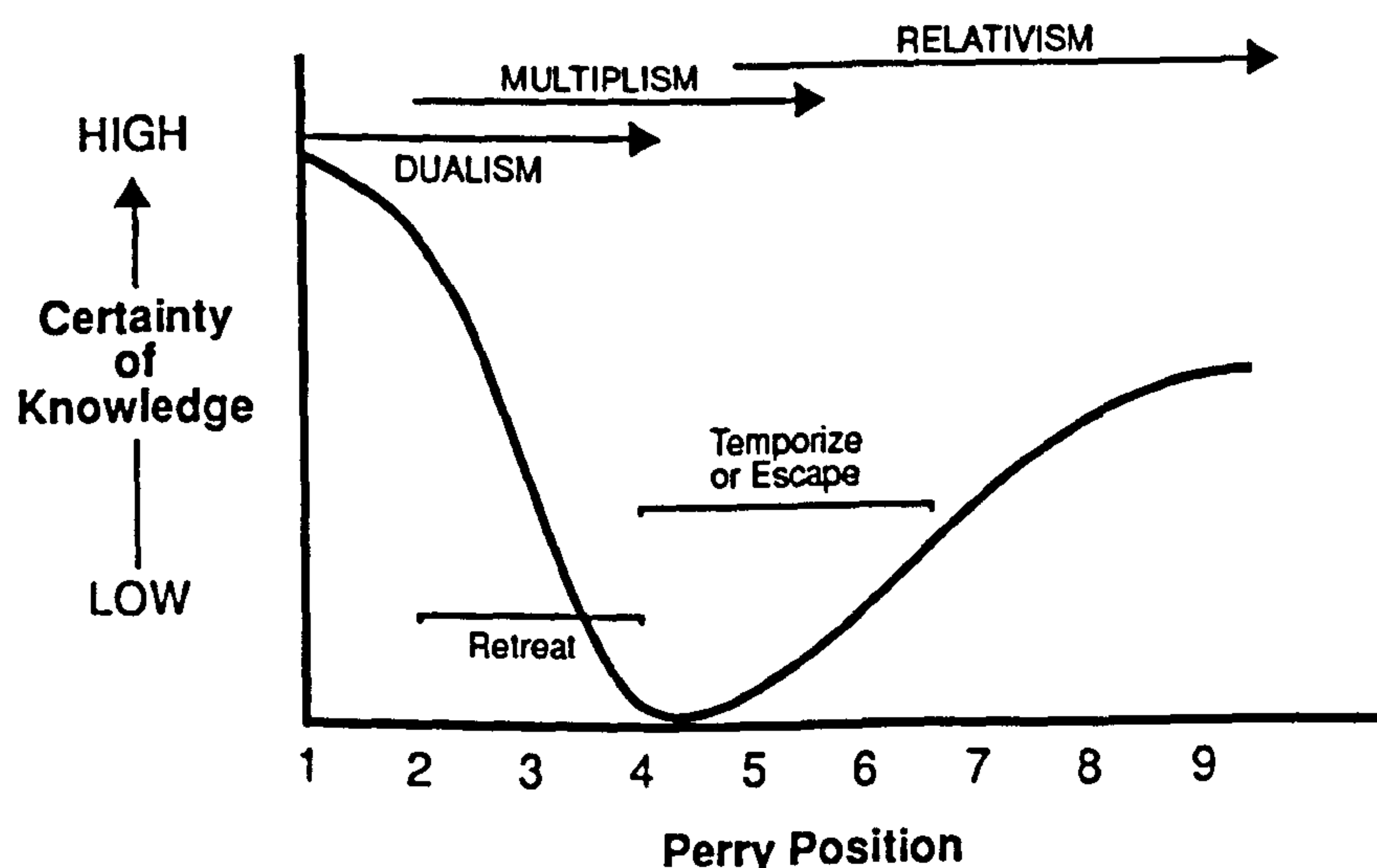
Others (Widick, 1977; Erwin, 1983; Baxter-Margolda and Porterfield, 1985) have combined the Dualist and Multiplist stages together and described the scheme in total as three stages : Dualism, Relativism and Commitment in Relativism. These differences in descriptions have primarily related to the anticipated usage of the scheme. The Perry Scheme also describes three transitional periods :

- Retreat** (between Dualism and Multiplism), when there is an avoidance of the stage of Multiplism, by regressing back to Dualism,
- Escape** (between Multiplism and Relativism), when individuals avoid making a commitment in relativism and abandon responsibilities
- Temporising**, when students will remain at a particular stage for a year or so

Table 1.1
The William Perry Scheme of Cognitive and Ethical Development
 (adapted from Perry, 1970)

Position	Student perception
1	The world is seen in Dualistic terms of good or bad, right or wrong. Right answers exist to every problem in the Absolute. It is Authorities role to teach the 'right answers' to students. 'Rightness' in exams is assessed by quantitative measures
2	Diversity of opinion and uncertainty exists. Confusion is created by poorly qualified Authorities who set exercises in order that students can find the 'right answers'
3	Diversity and uncertainty exist but only temporarily because Authority has not found the right answer yet. Assessment standards become puzzling.
4a	Diversity and uncertainty are extensive but considered legitimate everyone has the right to one's own opinion- but Authority still operates in a Right / Wrong system
4b	Qualitative contextual reasoning is recognised but as a requirement of Authority to give them 'what they want' and to 'think how they want'
5	All knowledge and values are contextual and relativistic however, a Right / wrong value system can still operate within certain contexts
6	The necessity for making some form of Commitment within a Relativistic world is recognised
7	Some form of Commitment is made in an area
8	The implications of Commitment and issues of responsibility are felt
9	There is an affirmation of identity among multiple responsibilities and Commitment is recognised as an expression of a changing lifestyle

Figure 1.1
Diagram of the Perry Scheme of intellectual development
 (Adapted from Finster, 1989)



Perry (1970) suggests that it is the interaction between the learning environment and the exposure to the uncertainties and contradictions within Higher Education which challenges students to develop but that there must be some incentive or drive which makes these transitions between stages in some way desirable changes to make. Other investigators have identified how students undergo changes at university which are different to maturational changes occurring outwith a university environment (Sanford, 1966; Kitchener and King, 1990) and a study carried out by Strange and King (1981) found there was no significant difference between the Perry positions of a traditional aged group and a group of mature students (over 30 years old) entering University for the first time suggesting that it is some aspect of the academic environment which seems to initiate change or a particular type of approach which is adopted by those undertaking a university type education.

Generally, first year students have been found to be at Positions 2 - 5 and final year students found to be at Positions 4 and above (Perry, 1970; Blake, 1976; Kurfiss, 1977; Meyer, 1977). Perry (1981) has indicated that progression through the scheme is an innate response but requires both an interaction and support within the academic environment if a relativistic way of thinking is to be achieved and that not all students make the transition to Relativism, while at university. This might indicate that either students do not have 'the state of mind' that appears to accompany the transitional stages of development, that they are not stimulated or challenged to make such a change or that there is not the requirement for them to change as Relativistic thinking is not rewarded.

1.4.3 Transitions between stages in the Perry Scheme

Finster (1991), Nelson (1989) and Thoma (1993) among others have emphasised the importance of encouraging students to make the transitions between the four stages and King (1978) has commented on how transitions might be encouraged by discovering what causes these cognitive disequilibriations or personal decentrings and using these to in some way to stimulate students' changes or to speed up the progress through the scheme towards more Relativistic thinking.

Some theorists, including Perry himself (1970), have indicated that the transitions within the Perry scheme are irreversible (see also Fischer, 1980; Kitchener and King, 1990), however, Heffernan, (1975) has suggested that the scheme is cyclical in nature and throughout life individuals can be

going back through the scheme with different learning situations encountered.

Changes to another stage occur gradually with individuals starting to exhibit behaviours which are characteristic of the next stage. Once at the next stage of development, individuals do not operate at the full potential of that stage, rather they exhibit some of the characteristic behaviours. Perry (1970) has also observed how students also can exhibit behaviours indicative of different stages of development at one time, for example a student might respond relativistically in a Humanities class and dualistically in a Science class.

Finster (1991) has described how science students respond to different aspects of the learning environment during different developmental stages. For example, Dualist students would tend to adopt passive roles in their learning, feeling that it is the responsibility of the lecturer to give them all the facts, the Multiplist students look with uncertainty to the lecturers for direction towards the right answers and the Relativist students tend to be more autonomous learners. Saidla (1990) has speculated as to how students at different stages of intellectual development would respond differently within, for example, group work exercises, with Dualist students feeling threatened by another student's leadership of a group and Multiplist students either opposing or adhering to a leader's authority. A Relativist student would be more likely, she speculates, to look for meaning from the 'group experience'.

1.4.4 Research into the Perry Scheme

A number of researchers have reported use of the Perry model as a basis for identifying and explaining various strategies which students adopt while at college (Rohwer *et al.*, 1974; Stephenson and Hunt, 1977; Widick, 1977; Kurfiss, 1977; Touchton *et al.*, 1977; Richardson, 1978; Parker and Lawson, 1978; Fischer, 1980; Champaigne, 1982; Baxter-Margolda and Porterfield, 1985; Kitchener and King, 1990; Tedesco, 1991). Other theorists have described schemes or similar cognitive models describing differing stages of epistemological development for example, 'The Reflective Judgement model' (Kitchener and King, 1990) a theory of cognitive development (Fischer 1980), stages of cue awareness (Miller and Partlett, 1974), levels of didactical, multilevel modes of thinking (Riegall, 1973) and Heath (1964) has described a non-stage model of cognitive development.

1.4.5 Identifying students' stages of Perry development

There have been a number of methods devised which have been used to identify students' scheme of Perry development. These have included: interviews (Perry, 1970; Blake, 1976; Meyer, 1977; Kurfiss, 1977; Belenkey *et al.*, 1986; Kitchener and King, 1990), interviews and ill-structured problems (Moore, 1982 - Measure of Intellectual Development [MID]; Baxter-Margolda and Porterfield, 1985), item scale ratings and descriptive score (Heffernan, 1975), sentence stems and essays - KneWi scheme (Widdick, 1974; Knefelkamp, 1974), justification of statements (Gibbs and Widaman, 1982), measures of text comprehension (Ryan, 1984) and a defining issues test, DIT (Rest, 1973).

Other researchers have used types of pen and paper instruments of testing for example, short statements in questionnaires (Kurfiss, 1977; a 119 statement Scale of Intellectual Development [SID] - Erwin, 1983; Measure of Epistemological Reflection [MER] - Taylor, 1983) and sentence stems in questionnaires (Harvey, Hunt and Shroder, 1961). Baxter-Margolda and Porterfield (1985) have highlighted the importance of developing a measure which could allow a more extensive usage of the Perry scheme in practice and could therefore provide educational environments appropriate for particular classes and which, in turn, could promote intellectual growth.

Different measures of Perry's stages have been used on students from a variety of disciplines including English Literature (Knefelkamp, 1974; Widdick, 1977), Mathematics (Copes, 1974), Engineering (Culver and Hackos, 1981) and Science (Blake, 1976) as well as to provide information for curriculum design (Kovacs, 1977), student career development (Knefelkamp and Slepitz, 1976) and advising adult learners (Chickering, 1969).

1.4.6 The reliability of measures of intellectual development

Although results from a number of those methods of measuring the Perry schemes, listed above, have been compared, and with a degree of validity (see King, (1978) for comparisons) a cross - validation of all the methods of rating students has not been made. With the phenomenon of decalage, described by Piaget, (1977) problems have arisen in categorising students exhibiting a range of behaviours, particularly when researchers are trying to discriminate between behaviours from nine different developmental positions. However, the evidence from the many studies carried out has supported the theory that developmental changes are occurring while students are at university and that these are not due to

maturational changes (see King, 1978 for a review).

Ambiguities in the identification of students' stages of development have led to criticisms of the Perry scheme with the argument that students will naturally adopt different strategies according to their perception and the context of the learning task rather than because of their developmental stage (Entwistle and Hounsell, 1975; Entwistle and Marton, 1984). Belenky *et al.* (1986) have criticised the model as being a description of male changes of development as the original interviews were carried out with predominantly male students. Belenky *et al.* have, as a result, put forward a scheme relating to women's experiences at university and others have supported their descriptions (Gilligan, 1977; Clinchy and Zimmermann, 1981; Crawford, 1989; Tedesco, 1991).

Several comparisons have been made and similarities been drawn between the stages in the Perry scheme and domains of student development (Laurillard, 1978; Wilson, 1981) between relativism and some deep approaches (Saljo, 1982) descriptions of students' capabilities of handling of abstractions and levels of learning outcome (Marton and Saljo, 1976, Biggs, 1979) and to the Serialist and Holist styles of Pask (Entwistle and Hounsell, 1975).

1.4.7 Intervention programmes

Studies have been carried out to investigate ways in which differing instructional methods might influence changes in students' stages of intellectual development. Finster (1991) has developed Perry's original suggestions (1970, 1981) into ideas as to how science students might be both be supported within their stage of development and how they might be challenged to move to the next stage. Other researchers have experimented with different teaching methods (Widick and Simpson, 1978; Parker and Lawson, 1978), teaching at levels which were either supportive or challenging to students' stages of development (Knefelkamp, 1974; Widick, 1977) and carrying out intervention programmes in order to encourage students to progress through the Perry scheme towards a more relativistic approach (Stephenson and Hunt, 1977). Generally, teaching at a level which challenges students' intellectual way of thinking has proved to be productive in encouraging a move through the Perry scheme. However, the studies previously listed have also emphasised the importance of the selection of an appropriately challenging level of instruction and also the provision of an adequate support system.

Although criticisms have been made about the Perry scheme researchers have acknowledged that at least an awareness of the model and in particular the transitional stages is important as a useful method for planning teaching programme goals, planning steps and for the implementation and evaluating of instructional programmes.

1.5 The research project

1.5.1 Aims of the project

This project aimed to investigate ways of facilitating the development of higher level cognitive skills (Bloom, 1956) in undergraduate biology students. The research work initially focused on a recently implemented teaching and learning exercise used in a third year undergraduate Core Biology module, which had the development of higher level cognitive skills as one of its intended aims. This exercise involved groups of students working together on a challenge or problem and presenting their work in the form of a poster to the rest of their class as part of a question and answer presentation session. See Section 2.2 for a full description of exercise.

As the group poster exercise was in its formative stages, the staff involved were interested in monitoring and evaluating this innovative instructional method. Consequently, by involving this project, it was hoped that the exercise could be developed to its full potential during the subsequent years of its utilisation and that the majority of students would be encouraged to develop group and communication skills in addition to higher level scientific thinking abilities through the staff providing the most appropriate support for the students' needs.

The range of variables affecting student approaches and the quality of their learning (see previous sections) suggested that rather than considering only one aspect in isolation, it might be more appropriate to consider the learning environment as an integrated whole in order to explain differing levels of student attainment (Parker and Lawson, 1978; Ramsden *et al.*, 1986; Tobin *et al.*, 1987; Entwistle, 1987). As the staff teaching team involved in the poster exercise were supportive in that they desired that more students should develop higher level cognitive skills, it was anticipated that a certain level of control could be exerted over some of the variables involved in the exercise, such as the assessment methods and/or the level of staff support given to students and that the effects of any annual changes could be

monitored and evaluated over a period of four years.

Using the Perry scheme as a basis for identifying student's attitudes also allowed the recognition of a range of non-subject content related students' behaviours and to benefit from the research carried out by other investigators as to methods of developmental instruction and appropriate support in order that students might be encouraged to develop higher cognitive level or more relativistic approaches to the exercise (Sanford, 1966; Knefelkamp, 1974; Widick, 1977; Stephenson and Hunt, 1977; Finster, 1990). Although the research work of these others had suggested that the third year students undertaking the poster exercise would be within the Perry positions 2 - 5, it was decided that this research project would also attempt to develop a measure of intellectual development based on the work of Perry. Once developed, it was anticipated to use this measure in combination with the student and staff feedback from the poster exercise in order that the most appropriate support could be provided for the students which, it was hoped would result in the majority of the class being encouraged to develop a more relativistic approach to their poster work and perhaps to other parts of their course.

Chapter 2
The group poster presentation exercise
(1990 - 1992)

2.1 Background to the poster exercise

2.1.1 Introduction

This research project initially focused on a group poster presentation exercise which is used as part of the third year Core Biology module of the full time degree course in Biological Sciences at Napier University. This degree course comprises various mandatory core modules in both biology and social sciences and, from the third year onwards, students' selected specialist modules. Among other aims, the syllabus is designed to develop students' knowledge of these core module subjects as the course progresses.

2.1.2 Aims and objectives of the Core Biology third year module of the third year full time degree course at Napier University

By the third year of their course, students are expected to have developed an understanding or a firm contextual framework (Gibbs *et al.*, 1982; Gilbert *et al.*, 1982; Hegarty - Hazel and Prosser, 1991) of the Core Biology topics. This understanding should, therefore, be reflected in students' ability to apply, analyse and synthesise scientific material, alternatively classified as higher level cognitive skills (Bloom, 1956). The aims of this third year Core Biology module are more specifically listed in the syllabus as being:

- to extend the studies of and to enhance the students' understanding of biology attained in the first two years by study in depth of topics of importance in modern biology and
- to demonstrate the integral relationship of cell and human biology by a study of selected areas of biological significance.

The Core Biology module is divided into five topics which run sequentially throughout the year : 1. Metabolism 2. Homeostasis 3. Development 4. Support Systems and Membranes and 5. Brain. Two lecturers are responsible for each of the topics and can, for the most part, decide on the instructional methods utilised during the teaching of their subject area. As a result, a variety of both teaching and assessment methods are used throughout the year.

The group poster exercise was, however, an instructional method common to all topics and the mark obtained for the poster comprised 25 %

of the total coursework mark for the whole Core Biology module. In this exercise, students were required to work together, in a group, on a specific task or challenge, on a subject associated with one of the five topics of the module. The groups, subsequently, presented their work to the staff and the rest of the class in the form of a poster. As the exercise was common to all topics, all five of the module teaching team were involved in the overall planning and co-ordinating required for the implementation of the exercise. However, the specific challenges which the groups worked on, were devised by the two members of staff involved in teaching the particular topic.

The aims of the group poster exercise were in line with the aims of the Core Biology module, namely that of encouraging students to relate and integrate the cellular and physiological aspects of the five topic areas through an active involvement with the scientific material (Biggs, 1982; Fordyce, 1987; Tobin and Gallacher, 1987). Initially, the exercise was introduced because staff hoped that the novelty of the instructional method would increase students' interest in the subject areas, develop their group and communication skills and also encourage the application of material from the taught component of the module into a problem based context (Boreham *et al.*, 1985; Byrne and Johnstone, 1987). In addition, the peer group interactions with other students, who had different skills and knowledge from their own, were anticipated as being of benefit to those within the class who might be considered to be average or underachievers (Collier, 1980; Bennet and Cass, 1988; Webb, 1989).

Although, the cognitive objectives of the poster exercise had been clearly defined at the beginning of the academic year, 1990 - '91, staff foresaw that there might be some aspects of the poster exercise which would require some modification, but that these would be identified once the exercise was underway. This research project, therefore, was planned to assist in the evaluation of the different stages of the exercise from both the staff and students' perspectives, in order that the instructional methods could be improved in their efficacy in attaining the intended objectives.

2.2 Outline of the group poster exercise

2.2.1 Student groups

At the beginning of the academic year, the class was split alphabetically into groups of five or six students and allocated their poster topic, but not the specific details of their task. For example, Group 1, was told

that their poster was on an aspect of Metabolism, the first Core Biology topic to be covered. At the beginning of the relevant taught component, the group would be given a more specific task or challenge on which they were expected to work and eventually to produce their poster.

2.2.2 Poster challenges

The challenges for the poster exercises were intended to encourage the students to integrate the physiological and cellular aspects of their particular topic. Initially, the challenges fell into two categories which could be described as being either of a structured and unstructured format.

A structured challenge contained a problem or case study for the student groups to work on. For example, one group working on the topic of Metabolism was asked to formulate the metabolism of an extraterrestrial which would theoretically be able to inhabit the planet described on their task sheet. This necessitated the group considering how influential the various listed factors were, with respect to the evolution of the creature's metabolic functions, at both a cellular and physiological level. Although structured, at the same time such a task potentially gave the group a level of flexibility in the way in which they approached the problem by allowing the students to exert their own level of creativity and imagination to the project.

An unstructured problem, however, gave the students a far wider scope in which to work. Groups were not given a specific task, in these instances, but rather a broad title or subject area in which to work. For example, for the topic of the Brain one of the groups was given the title of '*Motor Neurone Disease - causes and effects*'. Therefore, the students working on this type of challenge were expected to decide the level and the range of their poster subject matter.

The lecturers involved in teaching each of the 5 biology topics decided on the type of the challenges given to the students groups (examples of both types of challenges are given in Appendix 1).

2.2.3 Background instruction given to the poster groups

Basic instructions on the design of visual media, that is to say on the use of graphics and the layout of text, were given to the class at the beginning of the year by one of the members of the teaching team. The student groups were expected to produce their posters within the Biology Department's Resource Centre, although this was not mandatory. This Resource Centre, for both staff and students' use, is an open access facility

which provides a wide range of multi media, including equipment and materials suitable for producing the posters for this particular exercise, such as computers, exhibition boards and stationery items. Locating the group activities in the Resource Centre, where my own work is based, was useful to this research project because it meant that I was able to unobtrusively observe the students at work on their posters and to provide staff with some feedback on the way in which the groups had worked together.

Students were given the responsibility of managing and organising their group work on their poster, outwith the timetabled classes. If the group was having difficulty with the challenge, they could discuss their work with the appropriate teaching team, however, this assistance was expected to be limited to general directional advice rather than advice on how to undertake the task.

2.2.4 Poster presentation sessions

The groups had five weeks to work on their posters before the required poster presentation session on the last Friday of the taught component of their topic. During the poster presentation session, the students were expected to defend their work by answering questions from both staff and students on their poster content.

2.2.5 Assessment methods

Once each poster presentation session was completed, the Core Biology module teaching team met together to discuss the group's presentation and to agree on an approximate mark which was afterwards given as feedback to the group, in addition to some general comments on their poster design and content. At the end of the year, all the posters were displayed in an open forum, to which all the class, the teaching team and other members of staff and students from the department were invited. The teaching team had a meeting immediately after the open forum to discuss the relative quality of the groups' presentations and to allocate a final collective mark for each group's poster. In the first year of the exercise, 1990-'91, each member of a group was awarded the same mark, irrespective of their level of contribution to the work.

2.3 Introduction to the first year of the poster exercise (1990 -'91)

2.3.1 The organisation of the poster exercise

This research project became involved in the group poster exercise half way through the academic year 1990 -'91, after four of the groups had completed their poster work.

During this year, there was one group for each of the five topics and an individual member of a group was allowed to switch groups with another student, if the change was sanctioned by the Core Biology teaching team. However, there had been little control exercised over these changeovers during the year with the result that two groups had five members, two had six and one group had eight members. The poster topics, title and numbers in each group, during the pilot year are listed in Table 2.1 for reference. A full page description of poster challenge 1. Extraterrestrial metabolism (a structured challenge) as it was given to students in this year is shown in Appendix 1. During this year, the other four poster 'challenges' were given verbally to the students, by the teaching teams involved, therefore, no written record is available. However, staff indicated that these groups were given challenges which were of the unstructured type described in Section 2.2.2. During 1990 -'91, students were not been given any specific guidelines with respect to poster size or the quantity of material to be presented.

Table 2.1
Background description of the posters and groups during 1990 -'91

Ref. No.	Topic	Poster challenge title	No./group
1	Metabolism	Extraterrestrial metabolism .	6
2	Homeostasis	Bone dynamics	5
3	Development	Cell development abnormalities	8
4	Support systems/membranes	Cell movement	5
5	Brain	Motor neuron disease	6

2.3.2 Obtaining student feedback

As this research project had become involved in the poster exercise during the later stages of the academic year 1990 -'91, the students' feedback was retrospective, in some instances, groups were remembering back to

experiences which had happened several months previously. After the open session at the end of the year, individual students completed an anonymous four page questionnaire for this research project : Poster Questionnaire Q1 (see Appendix 2). This questionnaire was designed not only to investigate the students' individual perceptions of the poster exercise, but also to enable a comparison to be made between staff and student perceptions of the exercise. Five aspects of the poster exercise were covered :

- a) the students' general motivation and attitude towards the exercise
- b) the level of staff support and background instruction
- c) the attainment of the staff aims of the exercise
- d) the relevance and usefulness of the exercise, scientifically
- e) how an individual group had worked together

In addition, at the end of the year, after the final exhibition of the posters, staff and students met together to discuss the poster exercise and ways in which the exercise might be improved in subsequent years.

2.4 Results from the poster exercise (1990 -'91)

2.4.1 Staff assessment of the posters

The staff generally appeared happy with the posters produced by the students during the first year of the exercise, although they felt that there was a wide variation in both the quantity of material and the scientific level of the poster contents produced by the students.

During 1990-'91, staff had marked the posters by assessing the overall quality of the work produced, rather than by use of specified criteria. A mark was allocated to each group as a measure of the quality of the scientific content as well as the artistic quality of the poster. Group 1, who worked on the structured challenge '*Extraterrestrial metabolism*' achieved 80 % for their poster, the highest mark awarded. Group 3, the largest group with eight members, only obtained 48% for their work, an equivalent third class honours award. The other three groups attained marks within the equivalent second class honours range. The poster titles and final marks are listed in Table 2.2 overleaf:

Table 2.2
Poster titles, group sizes and marks awarded during 1990 - '91

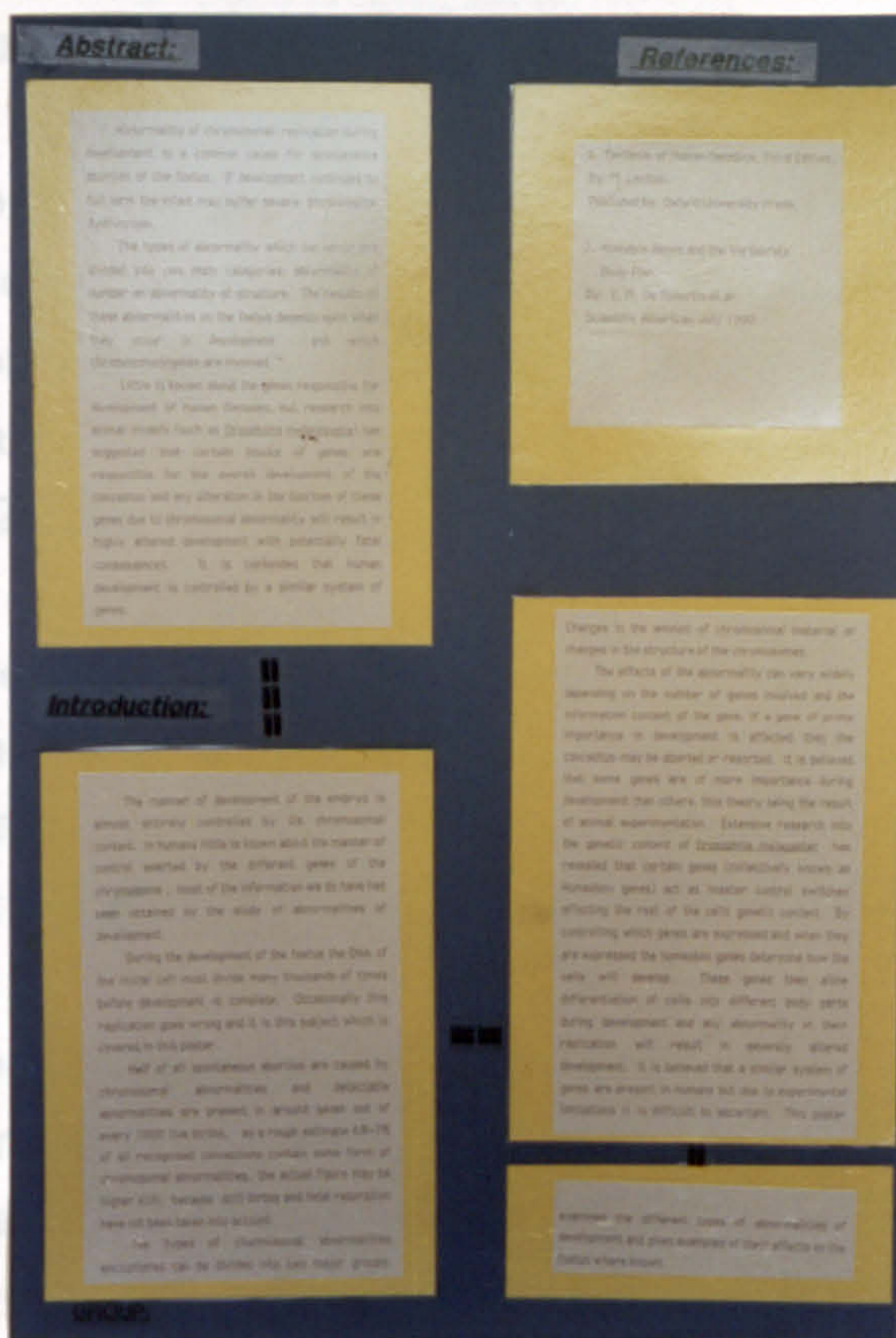
Group	Poster Title	Students/group	Mark (%)
1	Extraterrestrial metabolism	6	80
2	Bone Dynamics	5	62
3	Cell development abnormalities	8	48
4	Cell movement	5	62
5	Motor neurone disease	6	69

The high mark (80%) given to Group 1, working on Extraterrestrial Metabolism, reflected the staff's assessment of the level of originality and quality of the students' presentation, both in the poster content and in their capability of responding to questions. Their poster contained a pictorial representation of the Extraterrestrial and examples of the metabolic pathways which would exist within their hypothetical creature. Visually, the scientific material appeared interrelated through the use of connecting arrows and diagrams and staff felt that the group gave the impression that they had thought about the creature's different levels of cellular and physiological functions in a very integrated way. Although the staff assessed Group 1's poster very highly, the students who had produced the poster, estimated the quality of their work less highly and were quick to point out areas which they felt were inadequately covered and to put forward changes which they would make, had they to repeat the exercise.

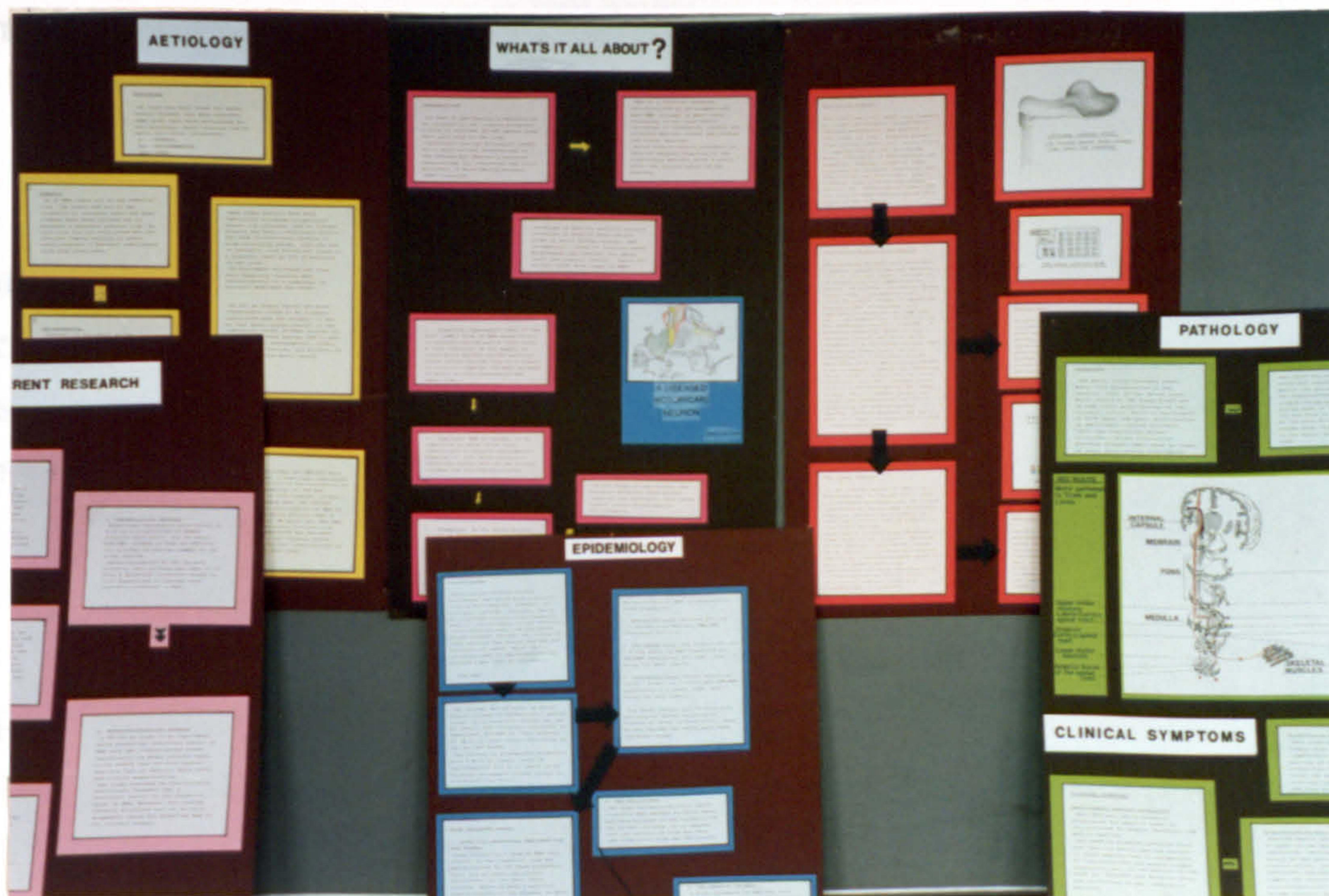
In contrast, Group 3, who had worked on Cell development abnormalities, produced an overly large, text heavy poster which staff felt showed little evidence of any original thought or the integration of ideas. When speaking to Group 3 students they appeared to have little interest in either the poster or in answering questions and they generally gave the impression that they had a negative attitude towards the exercise. The way in which this group approached the exercise is perhaps exemplified in the section of their poster shown in Photograph 2.1.

In the same way as Group 3, the other three groups, (Groups 2, 4 and 5), also produced posters which included large amounts of information. Group 5, for example, produced five boards, of 3 by 4 feet, in addition to a

Photograph 2.1 - Section of Chromosomal abnormalities poster - 1990 -'91



Photograph 2.2 - Motor neuron disease poster - 1990 - '91



title board. The material selected for inclusion by these four groups was judged by staff as being at a low scientific level and thought to cover too broad a subject base, without having any particular focus (Photograph 2.2). The way in which these groups approached their challenge and subsequently answered questions was also reflected in the general appearance of the posters which comprised small unrelated chunks of information on different pieces of paper with meticulous attention to artistic detail. For example, one group had cut out two different colour co-ordinated backing sheets for each of 20 pieces of text, 13 drawings and 13 headings.

2.4.2 Student feedback

The feedback Questionnaire Q1 (Appendix 2), used after the final exhibition of the posters, investigated the student's retrospective perceptions of the exercise. Five areas were investigated as outlined in Section 2.3.2.

a) *Student motivation and attitude*

The responses from the questionnaire indicated that both group dynamics and subject matter were important factors in determining the students' motivation and approach to the exercise. Although 79% of the class responded that they had enjoyed the experience of producing a poster, and that next year's students would benefit from undertaking such an exercise, the groups with the lowest scoring marks recorded negative comments to the majority of questions relating to interest and attitude.

b) *Background instruction and support given by staff*

Seventy two percent of the class felt that they had received inadequate instruction prior to and during the exercise in particular in the required background areas of science. Researching and obtaining material for the poster was the only area thought to have been covered by the majority of the class (61%), an area not taught by the Core Biology module teaching team.

c) *Perception of the exercise*

Out of the six staff aims of the exercise, listed in Questionnaire Q1 (Appendix 2), half the class responded that four of these had been not been attained. The aims considered not to have been achieved were :

That the poster exercise had not

- made them (the students) think more about their topic
- encouraged them to relate the cell biology / physiology of their topic

the poster had not (cont.)

- given them the opportunity to assess each others work
- made the subject more interesting

All of the students in Group 3 (the lowest scoring group) responded that these four aims had not been achieved. There was no particular trend shown by the other four groups, with some students responding positively and others negatively. The only two aims which the majority of the class felt had been achieved by the exercise were :

- to give students the experience of working in a group (93 % agreed)
- to give students the experience of producing a poster (97 %)

d) Relevance and usefulness of the exercise scientifically

The class was split evenly as to whether the exercise had helped them to integrate the cellular and physiological aspects of their topics. The questionnaire responses indicated that half the class felt that working on the posters had made them relate the topics, think about the relative importance of information and that anticipating questions helped them to think about the relative importance of material. Fifty three percent of the class did not feel capable of answering questions about their poster and the same number indicated that the scientific material in some of the posters was difficult to follow.

e) Group Dynamics

A number of groups had experienced difficulty working together on their posters, with 54% percent of the class commenting that there had been unequal participation within their group, 37 % feeling that their group had been 'inconsiderate' and 39 % of the students commenting that they would have preferred to have worked by themselves. There was no apparent link between the students commenting that some of their group members deserved more marks and commenting that there was an unequal level of participation within their group : Group 1, for example, had responded that some of their group deserved more marks, but at the same time recorded an equal level of participation during their poster work.

f) Additional feedback from Questionnaire Q1

Despite 70 % of the class indicating that working on the poster exercise had been a novel and enjoyable experience, many of the class had responded negatively to other statements throughout the questionnaire

such as the background instruction for the poster. However, the class appeared predominantly positive to the statements in Poster Questionnaire Q1 relating to the general concept of the exercise.

All groups felt that their workload for other courses had affected the amount of time they could spend on the exercise, and that it had been difficult to assess other student's work. When asked to comment about the most important thing that they had learned during the exercise, 'how to work in a group', was the most commonly listed, although some students felt that they had also developed cognitive and poster producing skills. Suggestions about how to work better in a group, how to produce a better poster and recommendations that the groups should start their poster work early, were the most common pieces of advice that they would give to other students about to undertake the same exercise. These student comments were used in the introductory session given to students in the following year (see Section 2.8.1).

The decision to have the questionnaire completed anonymously was justified by the responses to a question asking whether or not this anonymity had been important. Fourteen percent of the class indicated that all of their responses would have been affected had they been required to include their name and 21 % indicated that some of their responses would have been different.

2.5 Discussion on the poster exercise (1990 - '91)

2.5.1 Organisation of the poster exercise

All the groups produced their posters in the Biology Resource Centre during this first year of the exercise. Although I was also working in the Resource Centre at the same time as the groups, I was only superficially involved in the poster presentation exercise, being responsible for providing assistance in the use of the equipment on the production side of the exercise. This meant that for the first year, much of the evaluative information obtained was retrospective and was gained primarily from viewing the final posters, speaking to staff and students and from the questionnaire responses given by students at the end of the year. The feedback, however, from both staff and students, suggested that the feelings towards the concept of the poster exercise were generally positive. The staff were particularly happy with the poster presentation given by Group 1 working on Extraterrestrial metabolism.

Group 1's poster had included what was considered by staff to be an appropriate quantity of material whereas the other four groups had created posters including large quantities of fairly low level scientific material (see Photographs 2.1 and 2.2). As there had been no formal guidelines given to students with respect to, among other specifications, size of poster and range of subject to be covered, this had resulted in students trying to cover as much of the subject as they thought was necessary. Therefore it was decided, that in the future guidelines should be set to poster size and consequently, the quantity of material produced. The size of Group 1's poster (3 poster boards of 3 X 4 feet) was selected by staff to be an appropriate poster size. It was hoped that limitations on size would encourage students to be more selective about their poster content and to try and summarise and integrate the scientific material within their posters.

In addition, both staff and students seemed very positive about having an end of year discussion after the final exhibition of posters, when students were given an opportunity to make comments about both the organisation of the exercise and how they felt about their own group work and that of the rest of their class.

2.5.2 Poster challenges

During 1990-'91, the high mark obtained by Group 1 working on the structured challenge suggested that perhaps a problem type challenge might be more successful in encouraging students to integrate the physiological and the cellular aspects of their topic together. Students obtaining an unstructured type of challenge, being given only a title and subject area to work on, seemed to adopt what was considered by staff to be a comparatively low level approach scientifically. The additional lack of poster guidelines might have also resulted in the vast quantities of material produced by those groups given a broad subject area. Whereas Group 1, the group working on the structured challenge could be considered to have been given only a limited area to cover which was thought to have perhaps contributed to this group producing a more appropriate quantity of material.

The average group marks for other assessments on the Core Biology modules showed little difference between the groups, in terms of academic ability in 1990 - '91 (data not shown), however, the top group Group 1, had been the only group to produce a poster which demonstrated the integration of cell biology and physiology and to respond to questions in a way in which the staff had intended. Although, other skills such as group and

communication skills rather than just cognitive skills can be considered to be prerequisites for attainment in this type of group exercise (Davis and Restle, 1963), the success of Group 1 working on a structured problem suggested that this kind of challenge might be more intellectually and creatively stimulating and should be recommended for increased usage in subsequent years.

2.5.3 Poster exercise feedback

Retrospective questionnaires are perhaps going to give a slightly different viewpoint than would be found had the questionnaires been completed immediately after students had completed the poster exercise. Groups 2 and 3, for example, having had attitudinal and motivational problems both with their group co-ordination and their allocated subject area, subsequently responded negatively throughout most of Questionnaire Q1 to all aspects of the exercise, with their bad group experiences seeming to affect their perception of the background instruction from staff and their general impression of the poster exercise.

The amount of time elapsing between completing the questionnaire and undertaking the poster exercise is also likely to have affected the responses received. Group 1, for example, was having to recall experiences five months previously. This might explain why so many of the groups had indicated that the background instruction had been inadequate. This was the only year to have a majority of students indicate that the background instruction was inadequate (see Tables 2.5 and 4.1)

In addition, many of the class had indicated that they had not seen the point of the exercise and had rated the workload for other classes as too high. Such a negative approach, lack of interest or feeling of a lack of relevance, might have resulted in a lower cognitive level approach to the exercise by four of the groups (Broadbent, 1975; Johnstone *et al.*, 1981; Saljo, 1982; Ramsden, 1984). In addition, if the aims of the exercise were not clearly defined then discrepancies might have occurred between staff and students' perceptions of the anticipated learning outcomes (Biggs, 1973; McKeachie, 1974; Laurillard, 1979).

As the poster exercise was being used for the first time, some aspects of the exercise were perhaps not as clearly defined during the introductory session given by staff as they might have been. This might have resulted in the wide variation in the poster qualities and the dissatisfaction expressed by some groups about some aspects of the poster exercise.

2.5.4 Group dynamics

A number of the students had reported problems while working in their groups during the 1990-'91 poster exercise. Group 3, in particular, a group with eight members, had responded negatively throughout the questionnaire to statements relating to group work and this poor co-ordination in group activities might, in part, have contributed to their attaining such a low mark for their poster. Having more than six in a group has been shown to result in more group conflicts (Feldman and Arnold, 1983; Jalajas and Sutton, 1984-5) and the quality of peer group interaction has been seen to reduce as group numbers increase from two to eight members (Patton and Griffin, 1973). The quality of interaction between group members is viewed as being important in group performance (Johnston and Johnston, 1982; Bennet and Cass, 1988; Webb, 1989).

The effect of negative group experiences might have also affected the way in which the students viewed their topics for their posters. Groups 2 and 3, both had negative group experiences, as identified by their questionnaire responses and both groups indicated a dislike for their poster topic. Group 2 contained 2 students who went on to obtain First Class Honours degrees in the following year, however, in a group with other students they obtained the second lowest poster mark of the year. This relatively poor performance perhaps reinforces the importance of other factors, such as motivation and peer group interaction rather than potential cognitive skill in determining a group product, in this instance the poster (McLeish, 1973; Biggs, 1982; Collier, 1985; Kempa and Ayob, 1991).

Group composition has been shown to be influential in determining group product (Deutsch, 1968; Webb, 1983; Latting and Raffoul, 1991) and heterogeneous group compositions have been identified as being beneficial in some group tasks but not to others (Webb, 1989). For example, a task requiring a range of skills, such as the poster exercise, it could be speculated that a group of students with a range of abilities would be advantageous.

It was agreed during the end of year discussion with staff that in the following year, groups would again be selected alphabetically, but that more control would be exerted over the number of students in a group in order that all groups would contain either five or six members and that students would not be allowed to change between groups.

2.5.5 Assessment methods

A particular problem which seemed to be paramount from both the

staff and student's perspectives during 1990-'91 was the issue of how each poster was to be assessed. Assessment methods have been shown to be influential in the way in which students approach an instructional method by Laurillard (1979), Becker *et al.*, (1968), Rountree (1989) and Thomas and Bain (1984). If the students were unsure of what was expected of them during the first year of the poster exercise then, although a group might have the capability of working at a high cognitive level, they might instead be adopting a lower level approach (Entwistle *et al.*, 1989; Ramsden, 1984).

As a poster might be considered to be characteristically assessed by its aesthetic quality rather than by its scientific content, then the students could be working towards their concept of what constituted a good poster, by worrying about the artistic quality of illustrations. Likewise the staff, accustomed to scientific research posters, had perhaps not at this stage clearly defined the criteria which should be set for this type of poster and were perhaps more intuitively assessing the students work. Without clearly defined assessment criteria, it is possible that the staff and students were operating within different value systems for the exercise and as a result students might not have understood why some posters had obtained higher or lower marks than others.

Jalajas and Sutton (1984-5) have shown that conflicts are more prevalent in groups if the lecturer's reward system is not appropriate to the instructional method. Traditional assessment schemes which award group marks rather than individual marks for group contributions can result in students being given the same marks irrespective of their level of contribution to the group work (Johnston and Johnston, 1982) and students not developing interpersonal skills (Falchikov, 1986). Although the students had indicated in Questionnaire Q1 that the experience of working in a group was a positive experience, over half the class felt that there had been an unequal level participation within their group. Therefore, it was decided by staff that a method of apportioning marks between group members should be introduced during the next years poster exercise.

2.5.6 Students' performance in a social sciences honours poster in 1992

Although, learning how to work in a group had featured highly in the group questionnaires as being the most important thing learned in the poster exercise, it was decided to find out whether or not the students' experiences during their work on the third year poster exercise would influence the way in which the students responded to a similar exercise

during the next year.

In their fourth year of their course, the biology students were required to undertake a group poster presentation exercise as part of the Social Sciences module. Students were allowed to select their own groups for this exercise however, the remaining basic components of the fourth year exercise were the same as those during the Core Biology module of the previous year: students worked together in a group to produce a poster on a given subject, the contents of which they had to defend to staff to other students during an open session of all the posters.

Following the exercise, the students completed Questionnaire Q2 (Appendix 2) for this project which asked whether or not their poster work in the previous year had in any way influenced their approach to their poster work during their fourth year. Although the group compositions were different for the social sciences poster, out of the 29 students completing the questionnaire, 23 commented that the previous year's work had influenced the way they had approached the exercise, particularly in the way they designed their poster, worked as a group, and how they selected material for inclusion in their second poster.

In the previous years' Questionnaire Q1, over half the class had reported (Section 2.4.2) that they had experienced difficulties while working in their groups, through for example, unequal participation and 'inconsiderate' group members. This follow-up study suggests that the students had still benefited from these 'negative experiences' and were able to apply what they had learned to a similar form of exercise. The most frequently given comments in the post social sciences Questionnaire Q2 related to improved group organisation and level of intra group participation. The comments, for example, about the organisation and delegation of work suggested that this difference in attitude was not solely due to the groups being self selected but were due, in part, to the students having learned from their experiences in the previous year.

2.6 Modifications recommended for the 1991-'92 poster exercise

- **The staff objectives and the assessment criteria of the exercise should be clearly outlined to the students prior to their work on the exercise**
- **The challenges given to the students should aim to be more relevant, creatively stimulating and appropriate to a poster exercise**
- **The level of individual students' participation within groups during the poster preparation should be taken into account in the marking system**
- **More control should be exercised over group selections and numbers**
- **Guidelines should be given to students regarding poster specifications and production**

2.7 Introduction to the poster presentation exercise (1991-'92)

2.7.1 Background

In October 1991, prior to the start of the Core Biology module, I joined in a course team meeting to discuss ways in which certain aspects of the poster exercise might be improved in the second year of its implementation. Using the findings from 1990-'91 poster exercise and the student feedback, a number of changes were suggested with respect to challenge format, assessment and student participation in the exercise. With these recommended modifications, the second year of the poster exercise differed in a number of aspects.

2.8 Changes in procedure introduced during 1991-'92

2.8.1 The introductory session at the beginning of the academic year

At the beginning of the 1991-'92 academic session, the Core Biology 'Introduction to the course' session was extended to cover the poster exercise more extensively : the course team outlined the staff aims and objectives of the poster exercise, clarifying some of the areas which had been identified as being problematic during the previous year, in particular, the way in which the posters were to be assessed. Emphasis was given to the weighting which would be given by staff to the scientific content of the posters, the selection and prioritisation of material and the students' ability to respond to questions during the presentation session. All groups were told that their posters should comprise 3 exhibition boards (3 X 4ft) and students were advised to limit the quantity of text on their poster and to prepare for questions from both staff and students. I was also present in this introductory session both as an observer and as the person who would provide the groups with assistance with their poster production in the departmental Resource Centre.

A list of the questionnaire responses given by the previous year's students to '*What piece of advice would you give to students about to undertake the poster exercise ?*' (Appendix 2) was also handed out to the 1991-'92 students. The class was then asked to categorise these under four headings of their choice. Once compiled, the chosen headings were used as a starter for a discussion. It was hoped that the 1991-'92 students would benefit more from carrying out this exercise than by being handed a sheet containing the comments or being told by the lecturers that they '*should*

plan their work, start early and organise their group work

The class comprised 54 students during 1991-'92, twenty four more than in the previous academic year. This necessitated splitting the class alphabetically into 10 groups and having 2 poster challenges for each of the topics. This resulted in six groups of 5 students and four with 6 members.

2.8.2 Student feedback and poster assessment methods

After the poster presentation session, the two poster presenting groups completed the four page Questionnaire Q1 developed for the previous year's exercise (Appendix 2). They were then asked informally, as a group, by one of the course team whether they felt that there had been an equal level of participation by all their group members during the exercise and whether one or more individuals deserved more marks. A record of the students' responses was kept, by one member of the teaching team involved, until the end of the year when the final poster marks were awarded and the comments were taken into account. The students noted as not participating in the exercise received a proportionately lower mark than the rest of their group.

Staff and students were asked to complete Checklist C1 (Appendix 2) after they had looked at each poster and had asked the presenting group about their work. Checklist C1 included questions relating to the poster design, content and level of complexity of the material used and was introduced both to provide feedback to this project and as a mechanism for encouraging class participation on the day of presentation. The feedback from the checklist also enabled a comparison to be made between staff and student assessments of various criteria considered to be important in the staff evaluation of the posters and also, it was hoped, encouraged students to evaluate and learn from other group's posters. During the presentation session, the class was encouraged to ask questions and to join in with the discussion round the posters between staff and the poster presenting groups.

At the end of the year, all ten posters were exhibited in an open forum and students completed Checklist C2 and staff were asked to complete Checklist C3 (Appendix 2), which asked respondents to vote for the one poster they considered to be best in a number of different categories, such as design and scientific level. The students' Checklist C2 asked some additional questions about staff support and the influence which the poster work might have had on other aspects of their course, such as examination question selection.

2.8.3 Challenge format

With the structured type of poster or the problem based challenge proving successful during the previous year, four out of the five lecturers involved in the poster exercise decided to set this type of challenge during 1991-'92. This resulted in eight out of the ten groups working on a structured task and two working on an unstructured task (see Section 2.2.2 for description of challenge types and Appendix 1 for the full page outline of some of the challenges). For reference, the topics and titles of the challenges for the posters during 1991 -'92 are listed below :

Table 2.3
The poster topics, challenge titles and group numbers during 1991 -' 92

Ref. No.	Topic	No. / Group	Challenge
1	Metabolism	5	The Metabolism of an Extraterrestrial
2		6	The Metabolism of a Dragon
3	Homeostasis	5	Homeostasis & Control
4		6	Calcification disorders
5	Development	6	Haemoglobin Variants
6		5	Wound Healing
7	Support Systems	5	Bone Fractures *
8		6	Loch Ness Monster as a Slime Mould
9	The Brain	5	Brain differences between men & women
10		5	Causes and Effects of Parkinson's disease *

* indicates an unstructured challenge

The staff team also decided that groups should receive an information sheet which would include a reiteration of the aims of the exercise and the methods of assessment at the same time as they received their challenges, prior to commencing their poster work.

2.9 Results from the group poster exercise (1991-'92)

2.9.1 General observations of poster presentations

The general quality of the posters produced during the second year of the exercise was considered, by staff, to be much better than that of the previous year. The artistic quality, in particular, was very high and the level of the scientific content on almost all the poster topics had shown a significant improvement.

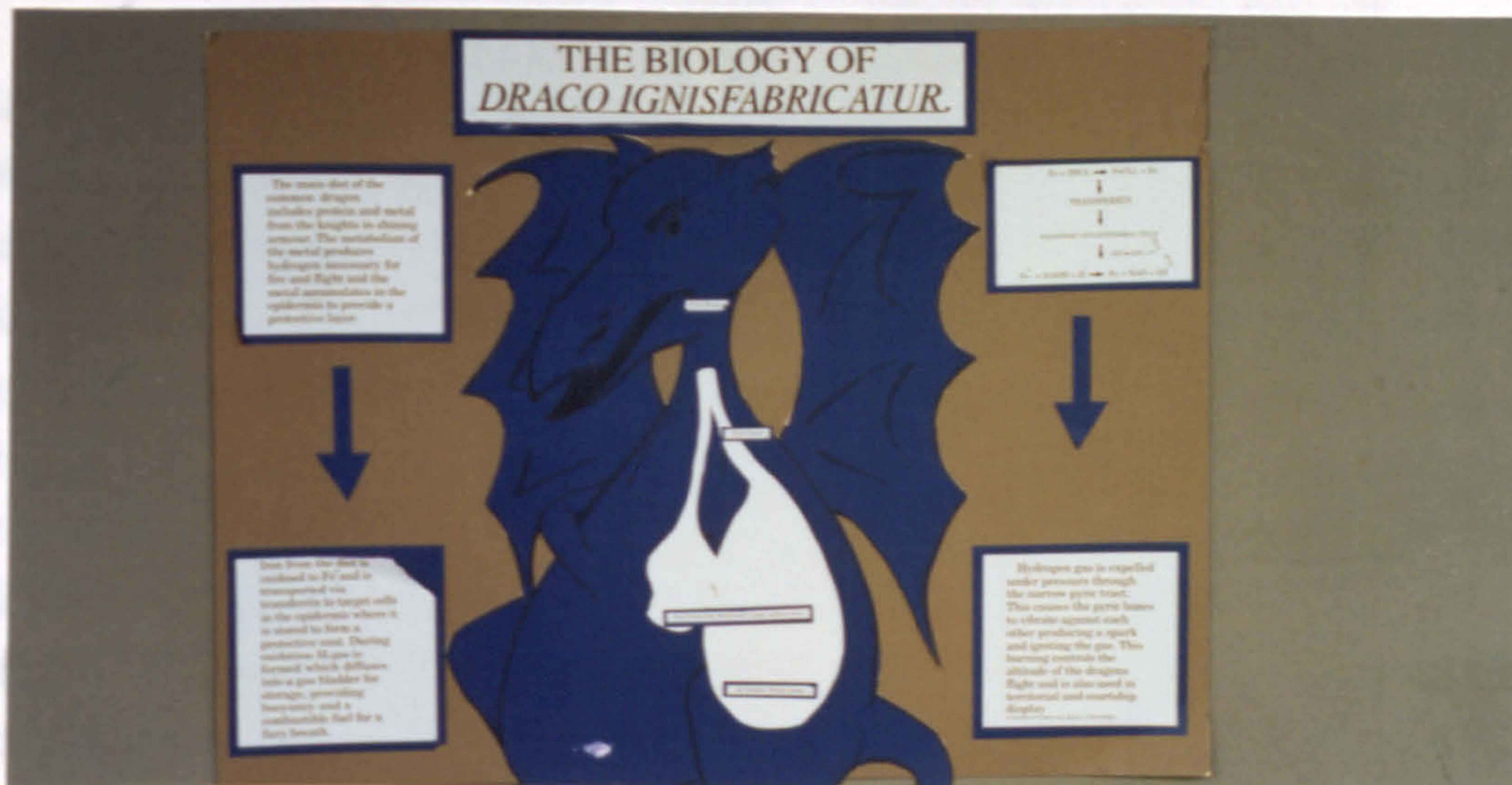
The previous year's heavy text bias had also changed, with some of the groups using only a few sheets of information by way of a summary and leaving much of their research work to come out during the staff and student discussion on the presentation day (see Photograph 2.3). However, some of the groups still seemed to be concentrating more on the artistic aspects of the exercise rather than the scientific content of their poster. For example, Group 7, who had worked on the topic of Bone Fractures, produced a poster which was considered by staff to be very well designed but pitched at a scientific level equivalent to a school Higher Grade (Photograph 2.5).

Unlike 1990 - '91, most of the posters followed a similar design format, with the perceived success of one of the first of the groups, the Dragon Metabolism poster, seeming to set the trend for most of the subsequent designs. This resulted in almost all the following posters having a central illustration board and text included on the two boards on either side. The final poster marks are listed in Table 2.4.

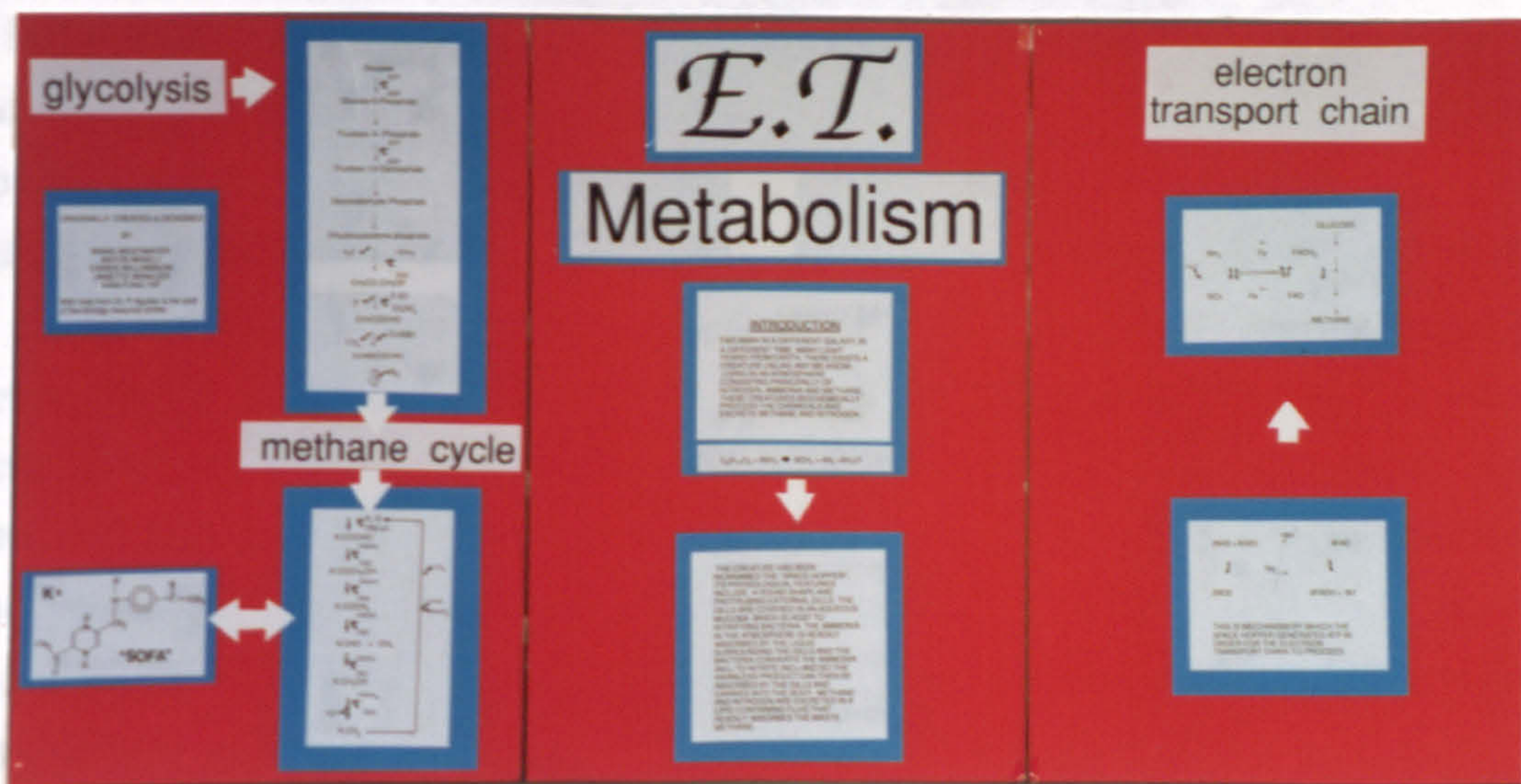
Table 2.4
A comparison between the group poster marks obtained during 1991- '92

No.	Poster Title	Mark %	No.	Poster Title	Mark %
1	E. T. Metabolism	56	2	Dragon metabolism	62
3	Homeostasis	54	4	Calcification disorders	68
5	Tissue Repair	76	6	Haemoglobin Variants	60
7	Bone Fractures *	52	8	Loch Ness Monster	76
9	Sex Brain Differences	54	10	Parkinson's Disease *	65
unstructured poster challenge *					

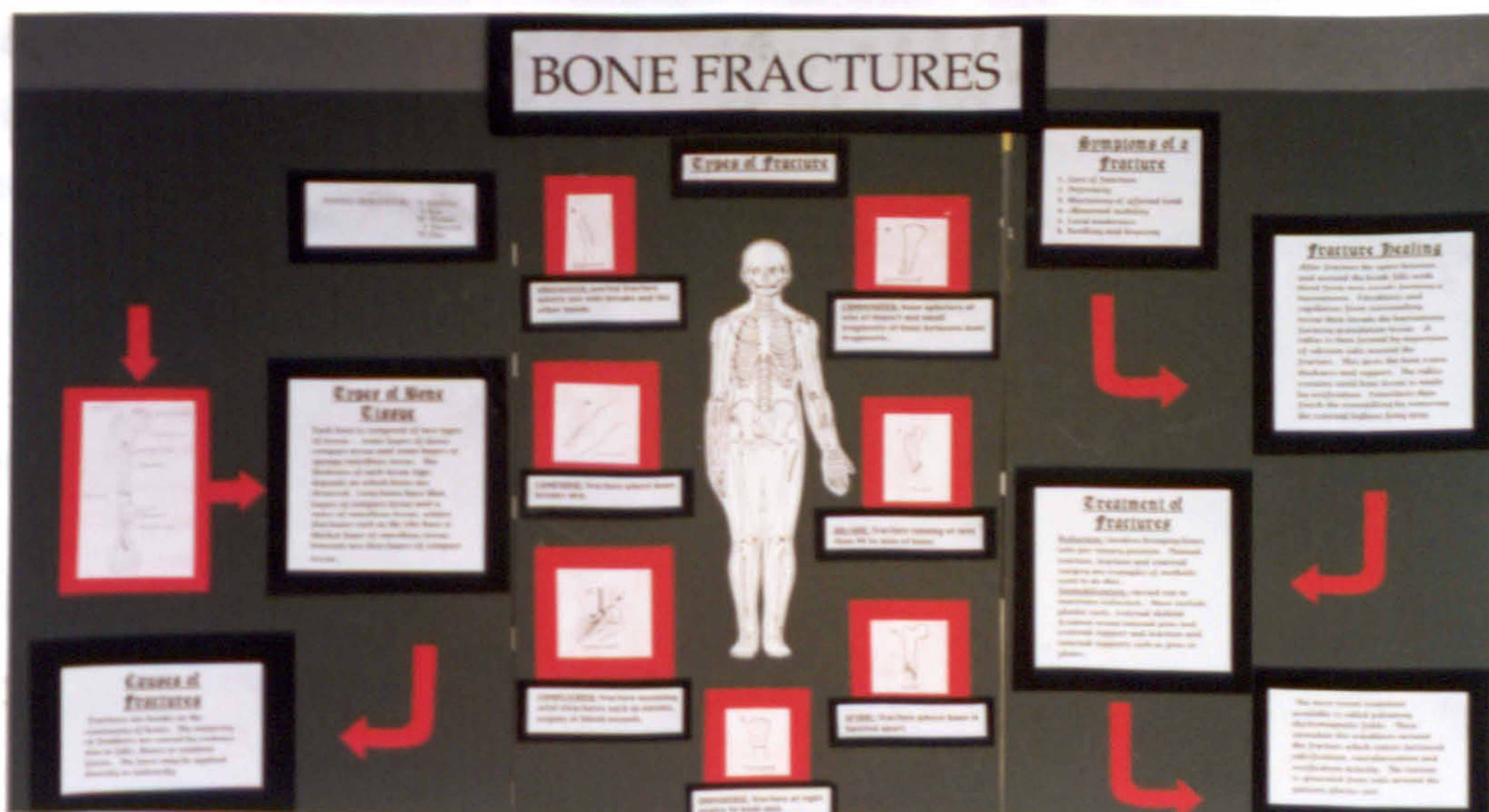
Photograph 2.3 - Dragon Metabolism poster - 1991 -'92



Photograph 2.4 - Extraterrestrial Metabolism poster - 1991 - '92



Photograph 2.5 - Bone Fractures poster - 1991- '92



2.9.2 Poster challenge types

The course team had decided before the beginning of the academic year that students would be given background instruction sheets prior to their poster work, which would give the groups information about how to select their poster material and the scientific level at which they should pitch their poster contents. However, in addition to a different type of challenge being issued to the student groups, there was also a difference in the type of instructions issued by the different course teams. For example, the 1991 - '92 Extraterrestrial group, Group 1, with the same structured challenge as given to the previous year's students (see Section 2.2.2 for outline of challenge type and Appendix 1 for full description) were encouraged to work together on their challenge as a group. However, they were also instructed that they could discuss their ideas with the teaching team or gain some directional advice should they run into difficulties. Conversely, Group 10, working on an unstructured problem on the subject of Basal Ganglia, were instructed in their accompanying sheet that 'once they had selected their topic and approach' they should inform the lecturer who would try and obtain some suitable background material for their poster. Reference was also made to a poster being '*a way of presenting information, in an eye-catching and arresting fashion*' - and not being '*so successful for presenting complex analysis or reasoning*'. Group 7, working on Bone Fractures, another unstructured challenge, obtained the same type of instructions as Group 10 as both challenges were issued by the same lecturer. The rest of the groups were given similar instructions to those given to the Extraterrestrial Metabolism Group (see Appendix 1 for examples of instruction sheets).

Some of the new challenges introduced during this year produced work of a very high level, in particular, from Groups 6 and 8 working on two structured challenges. As in year 1990 -'91, the poster marks could have not been predicted from the average group's performance in all Core Biology assessments (Data not shown). There did not appear to be the same differences in 1991- '92 between the scientific levels attained working on the structured and unstructured challenge types as had been observed in 1990 -'91, with two groups working on structured problems scoring 56 and 54 % and one of the groups working on an unstructured challenge scoring 65 %.

2.9.3 Student feedback

The Questionnaire Q1 responses obtained during 1991-'92,

immediately after the poster presentation session, were very different in attitude from the retrospective comments to the same questionnaire given in the previous year. In particular, all staff aims of the exercise were considered, by students, to have been met except that of the poster exercise *'giving students the opportunity to assess other students' work'*. In comparison to the responses to the 1990 -'91 questionnaires there was a marked improvement in the students' perception of the adequacy of the background instruction for the exercise (Table 2.5)

Table 2.5

A comparison between students' perception of the adequacy of background instruction given by staff prior to the poster exercise (1990- '91 and 1991- '92)

Type of background instruction given	% of class indicating adequacy	
	1990 - '91	1991 -'92
Working in a group	54	58
The scientific material for the poster	29	65
Researching material for use in poster	64	86
Selecting material for use in poster	29	60
Designing and producing the poster	29	60
Producing text and graphics for poster	25	34
Assessing other students work	43	30

If statements from Questionnaire Q1 which relate to scientific aspects of the poster exercise are considered in isolation, there is also an increase in the level of agreement given by students in 1991-'92 as compared to 1990 -'91 (Table 2.6)

Table 2.6
A comparison between the questionnaire responses given to specific statements in Questionnaire Q1 during 1990 -'91 and 1991-'92

	% students agreeing	
	1990 - '91	1991 -'92
1. Attainment of staff aims		
Did the students feel that the exercise had		
Made them think more about cell biology & physiology	64	84
Encouraged them to relate the two topics	46	86
Made the topics more interesting	61	84
2. General comments		
Had deciding on poster content helped them to think about the relative importance of material	61	81
Had anticipating questions helped them to think how the subjects related together	46	63

2.9.4 Assessment Methods

The introduction of Checklist C1 with which students could assess other group posters during the presentation sessions was initially very successful but student interest waned when the workload for other parts of the course increased. By the end of the year, many of the students attending the presentation were taking only a quick look at the posters before completing the checklist and then leaving. By not become actively involved in the round poster discussion between staff and the poster presenting groups, those students probably gained little from the presentation sessions and as a result, the discussion was advantaging only the poster groups. In addition, if posters contained less accessible scientific material such as metabolic pathways a cursory glance would not be likely to afford an individual more than a limited, if any, understanding of the poster work. Many of the students who did attend the sessions did not ask the groups any questions or were solely interested in various aspects of the poster production and not in the scientific content. The feedback remarks at the end of the Checklist C1 also reflected this bias, with most comments suggesting that the group might improve their poster by changing design features such as illustrations, colour, and text size.

The use of identical checklists for both staff and students enabled a comparison to be made between the two perceptions of different aspects of the poster presentations. This comparison revealed a difference between

ratings of what constituted good design, and also what constituted a high or low level scientific level of poster content. Students assessed posters which included metabolic or chemical pathways as being of a higher level than that of posters which included complex and well integrated ideas explained in simple language. One poster, in particular, on Extraterrestrial Metabolism (Photograph 2.4), was considered by students to have depicted complex ideas, but following the viewing and questioning of the group, was considered by staff to have been a fairly limited presentation. Posters were generally rated as being *very good* or *good* by the students in the checklist with only four posters (1, 8, 9 and 10) attaining any *mediocre* assessments.

Staff would, from time to time, respond differently in Checklist C1 and in the poster discussion session after the group's presentation. These changes sometimes resulted from their short attendance at the poster sessions due to other teaching commitments. For example, a member of staff attending late on in the session would sometimes assess a group higher because of the students' ability in answering questions which had already been discussed with other members of the teaching team.

Most of the work rated highly during the year in Checklist C1 was also rated highly in the end of year Checklists C2 and C3 completed during the end of year exhibition of all the posters by students and staff respectively (Appendix 2). These checklist asked respondents to indicate which out of all the posters they would rate most highly on a number of categories such as scientific level and design. Again, there was an evident difference between the staff and students' ranking of posters in the same categories. Table 2.7 (overleaf) shows the difference between the posters obtaining the highest and lowest number of votes from staff and students for these three categories.

Table 2.7

A comparison between the staff and student end of year ratings for the poster showing the highest and lowest level scientific content (1991 -'92)

	Highest rated		Lowest rated
	Staff	Students	Students
Poster Design	7	2	1, 5
Integration of subjects	4, 8	3	8, 10
Low scientific level	7	2	6

Key to poster numbers above		
1. ET Metabolism	2. Dragon Metabolism	3. Homeostasis
4. Calcification Disorders	5. Tissue Repair	6. Haemoglobin Variants
7. Bone Fractures	8. Loch Ness Monster	10 Parkinson's Disease

The students' opinions differed from those of the staff as to which group had best integrated the subjects of cell biology and physiology in their poster or were assessed as having contents with the highest scientific level (Table 2.7). Posters which had contents seemingly more accessible to students, for example, the posters on Homeostasis and Calcification disorders were rated most highly. The Loch Ness monster poster rated joint first by the staff was rated lowest for the integration of subjects by the students.

The general comments about the poster exercise from students at the end year ranged from being very positive about the learning experience of working together on a group task to being very negative. Complaints ranged from 'some challenges being irrelevant' to 'the amount of work involved being too much for the small value of the mark' (25 % of the coursework mark for the Biology Module).

The introduction of two groups for each topic during 1991-'92 added another dimension to the poster exercise, by providing students with an opportunity to make a more direct comparison between their own challenge and group dynamics and that of another group, also working in the same general subject area. One of the two groups for each of the first four topics and both of the final groups reported problems and made remarks about how the other challenge was 'easier' or 'better' than their's. Some of these differences between poster challenges seemed less obvious to those not involved in working on the actual posters, for example, Group 1's comments that their poster on ET metabolism was more difficult than that

of Group 2 working on the Metabolism of a Dragon. However, the difference between the challenge of depicting the Loch Ness Monster as a Slime Mould given to Group 8 and the task of Bone Fractures - Causes and effects given to Group 7 seemed more apparent (Appendix 1). During 1991-'92 with each of the topics, one group attained a high mark while the other achieved a low mark. This difference was not related to the topic, challenge format, group dynamics or group student performance in other assessments, for example the end of year Core Biology module examination.

2.9.5 Group work

Poster Questionnaire Q1 completed immediately after the poster presentation exercise revealed that the group's experiences fell into two distinct categories, with four out of the ten groups indicating that they had all got on well together and the remaining groups indicating the opposite. However, this had not seemed to have determined the overall success of the poster as the two top marks had been awarded to groups who had reported problems. Groups recording negative responses in the questionnaire had been observed as not having got on well while working in the Resource Centre.

In Poster Questionnaire Q1, over half of the class commented that they had enjoyed working in a group, but only two groups felt that there had been an equal participation by all their members. When asked, verbally and collectively as a group, by staff, about the final mark allocations, only one out of the 'problem' groups, Group 3, wanted the final marks to be apportioned in a way that three students obtained more marks. The remaining groups decided that the marks should be shared out equally between the group members. Group 3, however, did not contain the established groups of friends which the other 'problem' groups did. The staff also decided, after discussion amongst themselves, that two of the class, known not to have made any contribution to the group work, should not receive any marks for the exercise. The individuals concerned, complained about this allocation of marks. However, the other members in their groups were happy about this recognition of their unequal level of participation.

2.9.6 The scientific level of approach adopted by the groups of students

The level of approach at which the groups tackled the exercise was again considered by staff to be evident both by the way they had designed their posters and their ability to respond to questions. Groups, who had

integrated the cell biology and the physiology of their topic well, produced posters showing interrelationships between the poster contents, using arrows and flow diagrams while others showed dissociated unlinked pieces of scientific material. In addition, the groups which had shown a more integrated approach to their poster were also considered by staff to have responded better to questions during the discussion session than had the groups which included chunks of unrelated material in their posters.

2.9.7 Two Case Studies

a) *Group 1 - ET Metabolism (Photograph 2.4)*

This group encountered difficulties when working on the scientific material for their poster Extraterrestrial Metabolism (a structured challenge). Their class marks for other assessments were average for the class, but the scientific level at which they approached their poster topic seemed to cause them endless problems. At one stage, two of the group members were considering leaving the course if the rest of the course content was going to continue at such an advanced level.

The group continually sought help from staff with respect to the compilation of a series of metabolic pathways which they felt the necessity to complete, with each part of the poster being checked to find out if it was 'right'. Their final poster comprised a series of complex pathways with very little text and no illustrations. In addition, the students spent time in the Resource Centre learning up the poster content in preparation for questions. The group was very unhappy with their final mark of 56 % (Table 2.4), commenting that with the difficulty of the challenge and the amount of work they had undertaken, they deserved the award of higher marks.

b) *Group 6 - Bone Fractures (Photograph 2.5)*

This group reportedly worked well together on their poster subject Bone Fractures - ways of repairing and treating these injuries, (an unstructured challenge). Their challenge sheet gave them a list of topics and suggested they focus into one aspect of the subject area which lent itself to drawings. This group had the benefit of viewing the six preceding posters and the way in which each of these was assessed. However, the group selected an approach, subsequently rated by staff equivalent to that of a school Higher Biology level. They spent a long time working on the artistic side of their poster and were also very resentful when they only obtained 52% (Table 2.4), commenting that their challenge had been too simple and

that they had carried out what they had felt was demanded by the exercise. The member of staff concerned remained adamant that he had told the students to work at a high scientific level and to try and integrate the cell biology and physiology of their poster topic together. In the end of year questionnaire, the rest of the class rated this poster second lowest in the high scientific level category and second top with respect to the low scientific level category.

2.10 Discussion - of the poster exercise (1991- '92)

2.10.1 General comments

The student feedback from the Questionnaire Q1 was far more positive about the exercise during 1991 -'92 than that from previous year's class. Although this trend might have been as a result of students completing the questionnaires immediately after their poster presentation rather than at the end of the year, the staff felt that their had also been a genuine enhancement in the quality of the posters in 1991-'92. However, some aspects of the instructional method remained problematic and required further refinement including the challenge format, assessment methods and the level of student involvement in the poster presentation session.

2.10.2 Organisation of the poster exercise

The new poster guidelines and restrictions set at the beginning of the year had resulted in the majority of the posters containing what was considered by staff to be an appropriate quantity of textual and graphical material in more aesthetically pleasing designs. However, the provision of background instructions had not appeared to have helped define the required scientific level of all the posters with the poster contents ranging in level from what was considered to be school Higher level up to the appropriate junior honours standard.

In the previous year, a possible explanation for this variation had seemed to be the type of challenge set for the groups with a problem-based structured challenge resulting in the highest level of scientific work. This hypothesis was not supported during 1991-'92, as two groups working on structured challenges had attained lower marks than two who had worked on unstructured ones. However, in part due to the complaints from some students about the 'fairness' of having different types of challenges the

course team discussed the possibility of using challenges of one type only during the following year. However, the team were not able to compromise as to the type of challenge which should be set (either structured or unstructured), with some individuals remaining adamant that their format most benefited the students. At that stage, it could have been argued that both forms, structured and unstructured, were of benefit to different groups of students within the class. The group working on the poster could be considered to benefit most from the experience of working on the more structured problems. Whereas the rest of the class subsequently viewing the poster could be considered to benefit more from the less esoteric challenges which contained what students perceived as 'more useful' information.

The lack of involvement by students during the presentation sessions throughout the year remained a matter for concern during 1991-'92, however, the introduction of a checklist had increased the number of non-scientific questions asked of the groups. It is possible that students were afraid to ask scientific questions with the staff present and felt that more would be gained by listening to the discussion. A students' session prior to the staff's attendance might have helped to increase student participation. However, the increasing lack of attendance as the year progressed suggested that the students seemed to feel that there was little to be gained by their attending the presentation sessions. The comments in the students' checklists and questionnaires suggested that many of the students thought that poster topics about mythical beasts were not as relevant to their course (assessments) as those on subjects like Calcification and Homeostasis. These feelings were also reflected by the students' end of year ranking of the posters with the Homeostasis poster being considered by students as having the most scientifically integrated content and the Dragon Metabolism poster considered as having the lowest level scientific approach of all the posters. As the groups, at this stage, were producing the posters for staff rather than student assessment, the students perhaps felt an increasing lack of involvement with posters other than that of their own group, and possibly that of the other group working on the same topic.

2.10.3 Assessment methods

Although students had indicated, by their questionnaire responses, that they were not sure about assessing other students' work, all students attending the poster presentation sessions completed the checklist assessments of the posters. Asking staff and students to complete the same

checklist C1 was useful in that it enabled a comparison to be made between the two different assessments, however some of the questions were not so appropriate for staff to answer, for example the statement about whether they had found the poster interesting to read. Therefore, it was decided that a separate checklist be developed for staff's use in the following year.

Nevertheless, the comparisons between the students and staff Checklist C1 assessments and the complaints of unfair marking made by some groups and supported by the rest of the class, suggested that the students were not evaluating the posters in the same way as the staff, and that students perhaps did not have a clear idea of what the intended aims of the exercise were. Although the adoption of a lower scientific level approach to an undefined challenge might have been perceived by some groups as an easier option or less work, the complaints of unfair marking by some groups, could be an indicator that students had not fully understood, or wanted to understand, what was expected of them.

Although the first poster seemed to set the trend with respect to design layout, a large central graphic surrounded by text, the students did not appear to learn in other ways from the preceding posters, with later groups not showing a higher scientific level of approach. More emphasis and feedback to the rest of the class, after each presentation as to the level of the group's performance might have been helpful to later groups. Perhaps, some students did not have a way of gauging the scientific level required at this stage of the course or did not know how to adopt an appropriate approach to the task without guidance from the teaching team. This further supported the idea that examples of the previous year's posters could be used as part of the 'Introduction to the Course' instruction session and that more explanation could be given about what constituted 'good' and 'bad' posters.

With the differing types of poster challenges and groups being provided with what might be considered to be conflicting sets of instructions, it is perhaps not surprising that students had difficulty in knowing what were the assessment criteria. Complaints that Groups 7 and 10 (unstructured challenges) should obtain some form of compensation for their type of challenge might in part be justifiable during this year, considering the instructions that they had been given on their challenge sheets which had almost encouraged a lower level of scientific approach (see Appendix 1).

During 1991-'91, in addition to the competition felt between student groups working on different challenges on the same topic, an element of

competition had also begun to emerge amongst staff with respect to the groups working on posters on their subject area. This, in turn, produced another unquantifiable variable in the exercise, namely the level of staff support given to the groups. Although, using teaching staff as a resource rather than using textual material, might be considered as demonstrating initiative, the type of support obtained by the groups is obviously of importance. For example, can a group who had produced a very good poster, but had received substantial assistance be directly compared to one, which was not so good, but which was produced with negligible or no help from the teaching staff? However, the contrast between the resultant posters produced by Groups 7 and 1, who had both consulted staff at various stages of their work, suggested that with this form of exercise, the level of assistance is not as important as the way in which the groups put this assistance to use.

Staff discussed each group's poster after the presentation sessions and then gave each group an indication of their mark during 1991-'92. The groups' final mark was decided after the end of the year exhibition of the posters. Although different aspects of the poster presentations were discussed on both occasions, there were no formalised assessment criteria. This method of marking did raise some problems in its implementation. For example, with both staff and students attending the presentation sessions at different times, sometimes the staff were gaining different impressions of the groups' presentations depending on the time at which they attended as students generally became more adept at answering questions later on in the session. Although a second or third set of questioning was probably useful to the poster groups, a session where all staff attended at one time would have given everyone a more representative idea of the group's knowledge as well as providing the students with a wider range of questions.

In addition, some of the teaching team changed their opinion following the discussion with other members of staff which meant that the checklist responses given in the presentation sessions were not always indicative of a final opinion. During the post - presentation discussions, the decision on the final poster marks to be awarded to the groups, was also influenced by the group dynamics of the staff team involved and in some cases, could be considered to be a result of the strength of opinion of some of the lecturers. Although, this discussion method could provide a fairer more objective assessment to the students, sometimes there was a variation of a

grading band between staff members and agreement was obtained by the same one or two members backing down, rather than a compromise being obtained.

The final session at the end of the year was therefore important in that it allowed a comparison to be made between the work of the groups. The end of year marking also took into account any influential factors such as poster timing and particular student problems on the groups' performance' during the year. The introduction of specified marking criteria for a group's work, including, for example, poster design, group work and scientific content might have been easier for staff to use and have provided more informative feedback to students than having a single mark.

2.10.4 Student group dynamics

During 1991-'91 the majority of groups experienced problems working together and felt that instruction and more support should have been given in this area. However, 'how to work as a group' still featured highly as being one of the most important things learned during the exercise. As the class was split into groups alphabetically, one of the reasons for these problems might be that the students had been accustomed to working with the same individuals throughout their course and were starting this exercise with preconceived opinions of the abilities, personalities and probable level of participation of their fellow students. With six out of the ten groups experiencing difficulties in relation to the process of working together as a group, some form of instruction in improving group efficiency and rectifying group problems would have perhaps been beneficial. In addition, the development of a more suitable marking scheme for peer group assessments would remove the awkwardness of having to allocate marks verbally to individuals, in particular friends, while they were present. For this reason, staff decided that in the following year it would be a good idea to introduce a method of peer group assessment in which students could individually write down their allocation of marks for other group members contribution and that this should assist in students being awarded a more accurate apportioning of marks. In addition, if the intended method of assessment was outlined during the Introductory instruction session, students' prior knowledge that they were to be assessed in this way, would hopefully encourage a more equal level of participation in their subsequent group work.

2.10.5 The scientific level of the poster contents

Through discussion and observation of the groups working together, the scientific level at which the groups worked during the exercise seemed to be to a certain extent determined by what the individuals felt was expected of them by staff, and this level seemed to be set from the beginning of their time working together.

Differences of approach perhaps can be seen more clearly when comparing Group 1 and 2's work on a similar type of challenge in a similar subject area namely the metabolism of a mythical beast, than when comparing groups' working on dissimilar challenges (Photographs 2.3 and 2.4). For example, Group 1 focused their efforts on the factual details of their task, which they considered to be a requirement of their type of challenge, but although they were continually checking their work with staff, they seemed to gain little overall understanding of their topic. Their lack of poster illustrations suggested that their work on the metabolism of the creature, was dissociated from the existence of the creature as a whole. Conversely, Group 2 began by gaining an overall understanding of the challenge topic and then selected the scientific material necessary to explain the basic concepts and show relationships between the cellular and physiological aspects of the metabolism. This group did not actively seek out the lecturer for guidance but rather worked as a more autonomous unit. The difference between the ways in which these two groups responded to the staff questions further exemplified these different approaches.

A number of researchers (for example, Fransson, 1977; Ramsden, 1979; Laurillard, 1979; Thomas and Bain, 1984) have shown that students will naturally adopt different strategies according to their perception of the learning task. Although, for example, group problem based activities and small group projects have been shown to encourage students to adopt more transformational approaches to their learning (for example Beach, 1974; Abercrombie, 1979; Webb, 1982; Newble and Clarke, 1986; Boud, 1988) student approaches are frequently influenced by the way in which they are assessed (Becker *et al.*, 1968; Thomas and Bain, 1984; Rountree, 1989) and by looking to the lecturers for 'cues' as to the direction of approach (Perry, 1970; Miller and Partlett, 1974)

Therefore, giving students a task, such as one of the challenges given to Groups 1 and 2, which directs students to a higher cognitive level and subsequently rewards attainment of that particular level should encourage students to undertake a transformational form of learning, providing they

have the prerequisite cognitive skills and feel motivated to use them (Fordyce, 1987). The work produced by both Groups 1 and 2, however, suggested that these groups had approached the exercise with an intent to understand and both had undertaken what might have been considered to be a 'transformational' approach to their work. However, the groups' final presentations indicated a difference in the way in which the students had selected and used the scientific material. Group 1 had concentrated on the factual and procedural detail of their poster challenge whereas Group 2 had considered the overall relationships between the cell biology and physiology within the metabolic pathways.

These two approaches could be compared to the Serialist and Holistic approaches described by Pask (1976). However, observing the groups working together in the Resource Centre suggested that these descriptions of approach did not fully explain the differences. Rather, Group 1's approach, with their search for the 'right' steps within their metabolic pathways (these had to be verified with staff members) and their concentration on factual detail for their posters seemed to exemplify a perception of knowledge and approach characteristic of the Dualist stage of the Perry Scheme of Intellectual Development (Perry, 1970). Group 2's more autonomous approach, without lecturer feedback, had investigated relationships and interconnections between the cellular and physiological aspects of their posters and suggested a concept of knowledge and general approach which was more Relativistic in nature (see Section 1.4) for a description of Perry's stages).

These differences in approach, between Groups 1 and 2, were the more evident because both groups were working on similar types of challenges and on the same topics. However, other groups during 1991 - '92 had shown differences in approach to the exercise which were difficult to explain by considering solely intent or depth or level of activity taking place in the process of producing their poster. The characteristic ways of thinking described in the Perry Scheme of Intellectual Development seemed to provide an explanation of some of the students' behaviours and the differences in approaches observed during the poster exercise suggested that groups were not functioning at the same conceptual level. Without the relevant knowledge about poster groups', it was not possible to know whether individual students' stages of intellectual development were influencing the way in which groups responded during the poster exercise. In addition, any changes in perception which might occur while the

students were working on the exercise could not be monitored nor could the most appropriate support be provided for the students in order that they might develop a more relativistic approach. Therefore, it was decided to try and develop a questionnaire based method of gaining more information about individual student's stage of intellectual development, using the Perry Scheme as a model. It was hoped that a prior knowledge of where the third year class and individual students 'were' in terms of the Perry Scheme at the beginning of the year would enable this project to monitor subsequent responses and any changes which occurred during the year. In addition, students' responses to particular instructional methods and level of staff support could be investigated which could provide the staff involved in the poster exercise with information about ways in which they might encourage more students to develop towards or maintain a more relativistic approach while working on the group poster exercise.

2.11 Modifications recommended for the poster exercise 1992 -'93

a) *Introductory session to include :*

- Use of the 1991-'92 posters to demonstrate examples of good/bad practice
- Description of assessment schemes and weightings
- Instruction in improving group efficiency
- Students to be issued with more extensive written task descriptions in the same format

b) *Assessment Methods :*

- Checklist C1 to be revised and a checklist also to be developed for staff
- A more appropriate method of peer group assessment to be introduced

c) *Measure of student attitude :*

In addition, it was decided to try and produce a method of identifying students' stages of intellectual development using the Perry Scheme as a model.

Chapter 3

Development of a measure of intellectual development

3.1 Background

3.1.1 Introduction

Initially this project planned to monitor and evaluate the development of students' higher level cognitive skills such as their ability to synthesise and analyse scientific information and to think creatively. The group poster exercise described in Chapter 2, which had the development of higher level cognitive skills as one of its intended aims, was used as the basis for the research. The staff defined objectives of the poster exercise were that students should demonstrate their higher level cognitive skills through the way in which they integrated the cellular and physiological aspects of different topics together in their poster content and in the way in which they defended and answered questions on their work.

There are a number of factors which have been shown to influence the approaches to, and the level of, student thinking in small group work. These have included the students' group interaction (Webb, 1989; Cartwright and Zander, 1968; Kempa and Ayob, 1991), the learning environment, (Tobin and Gallagher, 1987; Biggs, 1982), the way in which learners are to be assessed (Thomas and Bain, 1984; Rountree, 1989) and the individual student's attitude or approach to the exercise (Perry, 1970; Miller and Partlett, 1974; Fordyce, 1987). With such a range of variables likely to influence the quality of poster presentations, a means of explaining or predicting group performance is problematic. Despite the relative homogeneity of the groups in terms of academic ability and experiences at University, during the first two years of the poster exercise (1990 - '92) the groups of students working on the poster exercise had shown a diversity of approaches and group behaviours, a wide range of scientific levels in their poster material and had sought variable levels of directional input and assistance from the teaching team involved.

The way in which the students had approached the exercise seemed to be exemplified by the way in which they perceived the scientific material with which they were working. Some groups had appeared to think of their topics as being factually based and comprising a series of unassociated and discrete units, whereas other groups had related their topics together, seeming to look for relationships and interconnections. These approaches appeared separate from the students' level of motivation, their intent to understand the material or the way in which the group had worked together. One possible explanation for student's differing views of knowledge has been suggested by a theoretical model of intellectual

development described by William Perry (1970). The Perry scheme of intellectual development describes a series of nine stages or positions through which students may progress while at University (see Section 1.4. for description). Progression is indicated by an individual's move from a Dualist or a simplistic stance on the nature of knowledge to a Relativistic way of thinking which is pluralistic and contextual.

Each of Perry's nine stages have been characterised by different ways of thinking and behaviours within the learning environment, and some of Perry's descriptions of student approaches seemed to resemble those demonstrated by the student groups working on the poster exercise. The theoretical model of development was considered to be particularly applicable to this project because in the same way that there are a range of variables influencing group performance in the poster exercise, the model describes behaviours which not only related to students' approaches to the material being studied, but also in the way they perceived their own, the lecturers and their peer group's role within the learning environment.

Developing a method of identifying students' stages of intellectual development was deemed to be useful to this project for a number of reasons.

- a better understanding of students stages of development could be obtained by monitoring their attitudes and outcomes in the poster exercise
- a comparison could be made between the composition of different groups on the quality of outcome
- the most appropriate challenge/support could be given to students in order that they might adopt a more Relativistic approach to the poster exercise
- a predictive model for similar group exercises could be developed by relating students' stages of intellectual development to an analysis of group dynamics

3.1.2 Selection of a method of identifying students' stages of development

There have been a number of projects which have used the Perry scheme as a basis for their research these have included Widdick and Knepfelkamp (1975), Blake (1976), Kurfiss (1977), Meyer (1977), Erwin (1983), and Taylor (1983). However, many of the methods developed to measure of students' stages of intellectual development have been both time

consuming, subjective and limited in their usage with a large number of students, such as structured interviews (Perry, 1970; Blake, 1976; Kurfiss, 1977; Meyer, 1977), ill-structured problems (Baxter-Margolda and Porterfield, 1985; Moore, 1990) and essay type questions (Widick 1977; Knefelkamp, 1974).

This research project decided to use a series of statements in a Likert format questionnaire as a method of identifying a student's stage of intellectual development. Several studies have used statements in a questionnaire format in order to determine student stages but most of these have attempted to place students in one of the original nine Perry positions (Kurfiss, 1977; Erwin, 1983; Rest, 1973). However, as students have generally been found at stages 2 - 6 of the Perry scheme (Perry, 1970; Kurfiss, 1975; Meyer, 1975; Blake, 1976), it was decided to develop a questionnaire which would test for attitudes characteristic of these stages only. These six stages relate to students' epistemological and intellectual development, whereas stages 6 - 9 relate more to ethical and moral development (Table 1.1).

The use of a questionnaire has a number of advantages namely large numbers of students can be tested at one time, the subjectivity of assessment is removed and the relatively short time taken to complete a questionnaire enables a larger number and a wider range of students to take part in the study. However, it was anticipated that the questionnaire would be used as a precursor to structured interviews and would therefore be used to identify students with characteristic behavioural approaches from not only the third year degree students but from students from a range of courses and stages of their study. Follow-up interviews with selected students could help validate the questionnaire as a means of establishing an individual's stage of intellectual development.

3.2 The development of the Perry questionnaires

3.2.1 Production of Perry statements for use in the Questionnaire P1

The stages 2 to 6 of the Perry scale encompass part of the Dualist, Multiplist and Relativist stages but not the Commitment in Relativism stage (Perry, 1970, see Section 1.4). Finster (1991) has developed the original Perry model descriptors and applied these to an instructional setting of a university chemistry department by describing various characteristics of these three stages within a science context. These characteristics are related to student approaches to the subject area, students' perception of their own role and both that of the lecturer and their peer group within the learning

environment. In the first stages of the 'Perry' questionnaire development, these sets of descriptions were used to compile a set of descriptors which distinguished one of the Perry stages from another. These were as follows :

Table 3.1

**A list of the descriptors selected to discriminate between the 3 stages of Dualism, Multiplism and Relativism and used as a basis for the Perry Questionnaire P1
(Adapted from Finster, 1989)**

A. Dualism Stage

Knowledge is a collection of facts
The teacher is 'Authority' and the student is a passive receiver of facts
Exams should be clearcut/objective
Hard work and memory should be rewarded

B. Multiplism Stage

Knowledge is incomplete and uncertainty of facts exists
The teacher is 'authority'
The teacher's responsibility is to direct the student to the
'right' answers
Long answers in exams demonstrate knowledge

C. Relativism Stage

Knowledge is contextual
The teacher and students are 'sources of expertise'
Quality in exams outweighs quantity in exams
The student is responsible for his/her own learning

For simplicity and brevity, these three stages were changed from Dualism, Multiplism and Relativism and are classified as A, B and C type behaviour respectively.

The characterisations described above were then used to compile a list of statements with which only a student at that particular stage would agree. For example, a student at the Dualist (A) stage might be expected to agree with the statement '*A good thing about learning science is the fact that everything is clearcut : either right or wrong*' whereas a student at a more

advanced stage of development might be expected not to agree with it.

A total of thirty three statements were compiled for this project. These statements were then reviewed by a team of people familiar with the Perry scheme of Intellectual Development. This team agreed that the statements appeared to reflect individual characteristics of the three stages of Dualism, Multiplism and Relativism and were likely to be potential discriminators between the selected three stages.

3.2.2 Pilot studies

a) *Questionnaire statements*

Each of the 33 statements was written separately on a piece of white card and a number was written on the reverse of each card. There was no relationship between number and type of statement.

Twelve students at different stages of their education, from Napier University, were asked to go through these cards and to select out the five statements they most agreed with and the five they least agreed with. The individual's backgrounds ranged from having just left school to being about to start a Ph. D. The students followed the protocol developed for the pilot study (Appendix 3). These instructions recommended that the students go through all the statements and to select out the ones they immediately agreed with and those they immediately disagreed with. They were then advised to make their final selections from these two piles of cards, and to write down the numbers on the reverse of the cards under the appropriate headings on the sheet provided. This pilot study was used to eliminate nine statements which were not selected by any of the students as being their most agreed or least agreed with choices. Some of the statements had also been very similar in content but were phrased in different ways. This initial study also helped to identify the most appropriate of these statements for use in the questionnaire, and to eliminate those which were not as discriminating.

b) *The pilot questionnaire*

The 24 statements remaining from the card selection study, were used to provide the basis of the first 'Perry' Questionnaire developed by this project in order to try to identify an individual student's stage of intellectual development.

The instructions on the version 1 pilot questionnaire used a Likert format as a means of identifying student opinion towards 24 selected

statements. A 6 point scale was used, 6 signifying strongly agree, 5 - agree, 4 - probably agree, 3 - probably disagree, 2 - disagree and 1 - strongly disagree. There was no mid point on the scale, as it was hoped that this would encourage students to make a decision rather than opting for a 'don't know' category. The questionnaire instructions also recommended that an immediate response to the statements should be given, emphasising that there were no right or wrong answers and that questionnaire responses would not in any way affect any other part of their course.

c) Pilot carried out on the Life Sciences Students

The draft questionnaire was piloted on the second and fifth years of the Part time course in Life Sciences. This is a part time one day release course which is usually attended by individuals in employment wishing to upgrade their formal qualifications. The Life Sciences course was primarily selected for the pilot study of the questionnaire because the starting date of the academic year in 1993 (mid - September) was earlier than that of the Full time Degree and Diploma courses. It was also hoped that by piloting the questionnaire at this stage, a more 'valid' questionnaire could be produced in time for use with the full time degree course in October during the first week of their academic year.

The responses from the second and fifth year students, identified a number of statements which were non discriminatory in a questionnaire format : all students agreed or disagreed with them. These statements were eliminated from the questionnaire as were the less discriminatory statements which were of a similar nature to each other for example, the statement *'In an exam, I like to answer essay type questions, which allow room to show ideas of my own'* was taken out in preference for *'I like exams which give me an opportunity to show that I have ideas of my own'*. Removing such statements resulted in a final questionnaire comprising eighteen statements, with six of each of the three types. This version of the questionnaire is referred to as Perry Questionnaire P1 (see Appendix 3).

The full range of the six point scale for each of the statements was used by the Life Sciences students. Of the few who hadn't selected any of the six points, one or two of the students did not indicate any preference and one student had circled both the 3 and 4. These selections were not counted in that questionnaire's total. The way in which the Life Sciences students responded to the questionnaire was useful in determining how the questionnaires should subsequently be analysed.

3.3 Perry Questionnaire P1

3.3.1 Analysis of the Perry questionnaires

Only the positive responses were taken into account in the scoring of the questionnaire as it was considered that students at different stages might disagree with statements for different reasons particularly with the B Type or Multiplist type statements, which were intermediate between the A and C type responses. All the positive responses were counted when scoring the questionnaires. This meant including the strongly agree, agree and probably agree categories. Although this might be including some rather half hearted opinions when students didn't feel very strongly, either one way or another, about a statement, this was balanced by the number of students who had expressed a large number of their preferences as either a 3 or a 4 rating with only one or two, if any, at the higher level of 1 or 6. Eliminating the middle numbers, therefore, would have resulted in only taking into account those voicing strong opinions. This decision was subsequently supported during the following year, 1993 -'94 (see Section 6.2.7) when some of the students scoring 3 or 4 had gone on to justify their decision very strongly, suggesting that some students were not so happy in committing themselves to a strong opinion rating.

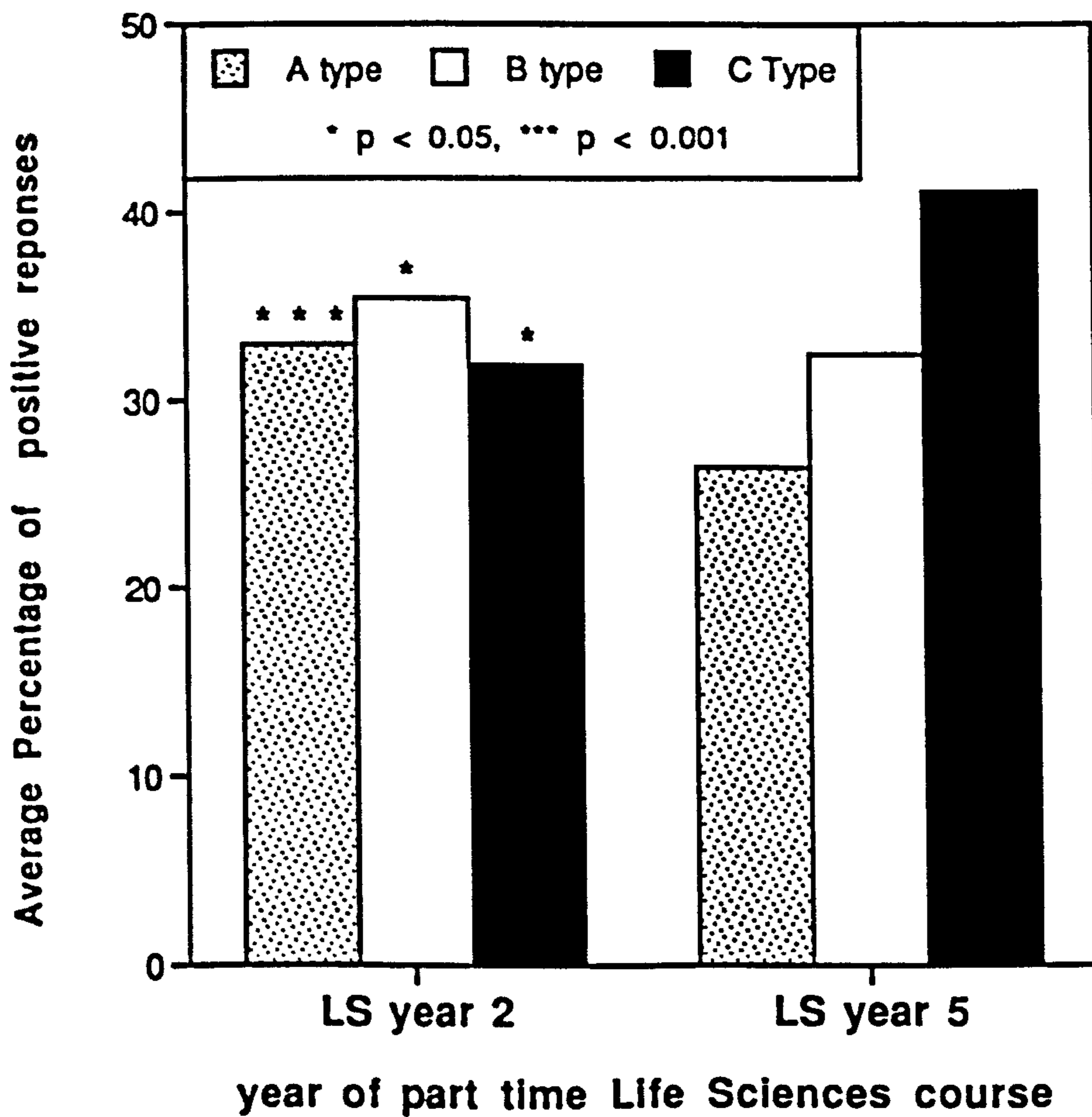
As the Life Sciences students had shown a variation in the total number of positive statements given in the questionnaires, it was decided that the proportions of positive responses falling into the three categories would be used as the method for calculating student's individual scores. This meant that, for example, a student agreeing with 1 out of the 6 A type statements, 2 B type and 2 out of the C type would be given a 'Perry score' of 20 % A, 40 % B and 40 % C. The average percentage of A, B and C type positive responses given by the second and fifth year students are shown in Figure 3.1. The average class responses for each type of statement were shown to be significantly different from each other in a Mann-Whitney test.

3.3.2 Testing the reliability of the final eighteen 'Perry statements'

As a method of verifying the original classification and the discriminatory potential of the eighteen questionnaire statements, a panel of fifteen individuals familiar with the Perry scheme were also asked to go through the Perry Questionnaire P1 and to categorise the statements

Figure 3.1

A comparison between the average percentage of A, B and C type positive responses given by the part time second and fifth year Life Sciences students given to the pilot Perry Questionnaire in October 1992



(groups were shown as significantly different using the Mann - Whitney test)

according to whether they felt a student at a Dualist, Multiplist or Relativist stage would agree or disagree with each of them. A description of the characteristic approaches from each of these stages was included with the instructions for these validations. The panel agreed with this projects' original classification of which students would agree with each of the statements but not with which type of students would disagree. This supported the original decision only to count the positive responses when collating the questionnaires.

In case there might be any bias in responses due to the order of statements in the questionnaire, two versions of the Perry questionnaire P1 (Appendix 3) were used throughout this study. Version 1 had statements 1-9 on the front page and 10-18 on the reverse side and version 2 had statements 10-18 on the front and 1-9 on the back. The type of statements was alternated throughout both questionnaires in the order : one A Type then one B Type then one C Type.

3.3.3 Students tested during the academic year 1992 - '93

The Perry Questionnaire P1, in the above format, was used to test the third year poster groups in October 1992 and enabled a comparison to be made between student intellectual development and the quality of the posters produced. A knowledge of the Perry Scheme of intellectual development also provided a theoretical model with which to explain some of the student approaches to the exercise during this year. The findings from this study are outlined in Chapter 4.

In addition, students enrolled on all the Biology part time and full time courses were tested in October 1992 and the first, second and third year students on the Full Time Degree course were also tested in February 1992. The findings from this study are outlined in Chapter 6.

3.4 Perry Questionnaire P2 - Introduced in October 1993

3.4.1 Introduction

Although, Perry Questionnaire P1 containing eighteen statements was useful in identifying the changes in attitudes of both individual and classes of students, the 'Perry scores' were limited in their usage. As might have been predicted, students were responding positively to a range of different types of statements. A phenomenon of 'decalage' or individuals exhibiting behaviours from a range of developmental stages, has been

described by Piaget (1977) and this has been supported by Perry (1981) and others (Widick, 1977; King, 1978; Finster, 1989).

In addition, the proportions of agreement to the three different types of statements showed distinct trends on all the Courses tested (see Section 6.2.1) and the profiles of Perry scores for some of the poster groups (see Section 4.3.7) suggested that the group members' stages of intellectual development might be influencing the way in which the students were approaching the exercise. However, with the range of variables influencing the cognitive level at which the students were working, in particular, their group dynamics (Brewer, 1985; Bion, 1961) any conclusions about the link between the Perry scores and the quality of the poster was purely speculative during 1992-'93. It was hoped that by finding out more about the way in which the group worked together (see Section 5.4.3) during the following year would provide more useful information about the influence of students' stage of intellectual development on their poster presentations.

A second and third part were added to the Perry Questionnaire P1 in October 1993 which were planned to cover some other aspects of the students' stage of development. It was anticipated that the questionnaire responses could be used in combination with the information gained about the way in which students worked together during the group poster exercise, for example, the levels of interaction and group roles would be considered. Finster (1991) has suggested a number of ways in which students at different stages might be encouraged to progress through the Perry scheme of intellectual development. Others (Knefelkamp and Sleipitza, 1976; Widick and Simpson, 1978; Parker and Lawson, 1978) have used various intervention programmes and teaching methods in order that students might be encouraged to become more relativistic thinkers. With the third year group poster exercise having the potential to allow students to develop such an approach, it was hoped that the identification of individual student's stage of development and the subsequent analysis of group profiles of behaviour would enable a more effective method of both challenging and supporting students to become more relativist thinkers.

3.4.2 Part 2 of the Perry Questionnaire P2

Part 2 of Perry Questionnaire P2 asked students to justify their decisions about particular statements rather than simply circling a number to indicate their opinion. Sentence stems and moral dilemmas have been used as methods of identifying students stages of development by various

researchers (Rest, 1973; Knefelkamp, 1974; Widick, 1974; Stephenson and Hunt, 1977). Six statements, 3 from Part 1 and 3 new statements were selected for Part 2 and questionnaire respondents were asked to justify their decisions of 'agree' or 'disagree' in approximately 3 or 4 sentences (Appendix 3). The 6 statements (and their classification) are :

- 1 (A) A good thing about science is the fact that everything is so clearcut - either right or wrong
- 2 (A) Scientists will eventually be able to solve every medical problem, it is only a question of time
- 3 (B) There sometimes seems to be so many ways of looking at scientific subjects, I feel confused about what is right and wrong
- 4 (C) A scientific fact cannot have meaning if considered in isolation; meaning is only gained by context
- 5 (B) You can never be completely sure of any scientific fact : uncertainty will always exist
- 6 (C) I usually think about how any new scientific information relates to other subjects and topics on the course

Statements 1 and 3 (nos. 1 and 11 in Part 1 of the first Perry Questionnaire P1) were selected because they had been the most discriminating of the A and B type statements during the 1992-'93 study. C type Statement 6 (No 9 in Part 1) was selected as almost all questionnaire respondents during 1992-'93, even those with high A type positive scores, had agreed with the statement and it was thought that perhaps there was some ambiguity in the wording and that students were agreeing for different reasons.

In addition, three other statements, nos. 2, 4 and 5 in Part Two of the questionnaire were used as further discriminators between the three stages of development ie Dualism, Multiplism and Relativism. Statement 2 - was used in order to investigate the student's concepts of Authority and 'truth' and the continuing search towards 'answers'. It was also anticipated that this subject area would provoke opinions from all students. Statement 4 was included to investigate the students' concept of what constituted a 'scientific fact' and how they perceived information and 'knowledge' structurally. Statement 5 aimed to investigate the student's idea of uncertainty as related to their concept of a scientific facts. Are facts absolute and irrefutable and as defined by 'authority' or are they contextually determined and/or theoretically evolving ?

3.4.3 Part 3 of the Perry Questionnaire P2

Part 3 was added to the Perry Questionnaire P2 (Appendix 3) in order to investigate whether a student's preferences or dislikes for particular instructional methods related to their Perry scores from Part 1 of the questionnaire or vice versa. A range of teaching, assessment and study methods were selected, which it was hoped would cover a range of levels of student and lecturer participation within the learning environment. Students were again asked to justify their least and most preferred selections.

3.3.4 Students tested with the Perry Questionnaires during 1993 - 1994

Students enrolled on all the Biology part time and full time courses were tested in October 1993 using Perry Questionnaire P2 and a follow-up testing was carried out of the first year students on the full time degree course in the following February. This enabled comparisons to be made between individual and class Perry scores from both years of testing. The findings from these studies are outlined in Chapter 6.

In addition, the information gained on the third year poster group class from Perry Questionnaire P2 in October 1993 was compared with the information gained from staff descriptions of the students work and the student reports on their group dynamics during their work on their posters. These findings are reported in Chapter 5.

3.5 Perry Questionnaire P3

In February 1994 the first year students were tested using Perry Questionnaire P3. This questionnaire comprised Part 1 with the eighteen statements in addition to a second part which asked the students about their perceptions of 'Science' and their attitude to the teaching and assessment methods used on their course (Appendix 3). The findings from this study are included in Section 6.3.4.

Chapter 4
Group poster presentation exercise
(1992-1993)

4.1 Introduction to the group poster exercise (1992-'93)

4.1.1 Background

The poster presentation exercise followed the same general procedure as in the academic year 1991 -'92, outlined in Section 2.8. The class was of a similar size as were the number of groups and the range of challenges, that is to say, eight were of the structured type and two were unstructured (see Section 2.2.2 for description and Appendix 1 for outlines). The same types of challenges were set by the same members of the teaching team as in the previous year. However, several new features were introduced during 1992-'93 which related to the background instruction, the assessment methods and staff feedback to students.

4.2 Changes in procedure introduced during 1992 - '93

4.2.1 The introductory session at the beginning of the year

During the introductory session at the beginning of the year, staff again emphasised the importance of the scientific content of the posters and the way in which students responded to questions in the final allocation of the marks for the posters. The previous year's posters were again used to illustrate examples of good and bad practice in terms of poster content.

4.2.2 Assessment methods

Staff completed a Checklist C4 (Appendix 2) and students completed a Checklist C1 (Appendix 2) after each of the group's poster presentation sessions. After presenting their own posters, students also completed a peer group Assessment Sheet GA1 (Appendix 1) which asked students to apportion fifty marks between the rest of their group according to their level of participation within the exercise. There was no instruction given to the students as to how they should complete this form or how they might assess different types of contribution to the poster work.

The final mark allocated to each poster was determined by the staff's assessment of the poster's design and scientific content, in combination with the staff's assessment of the group's responses to questions and student's level of participation within the groups : for example, did all the students respond to the staff's questions during the presentation session or were the answers given by only one or two students from each group. In addition, the group work mark took into account the feedback from the observations

made within the Resource Centre and the peer group Assessment Sheet GA1 feedback from the students. Separate marks were not awarded for different aspects of the exercise, so that the students did not know what the final staff mark's weighting towards scientific content was to be, in comparison to for example, poster design, while they were working on their posters.

4.2.3 Staff feedback to students

More extensive staff feedback was given to groups about their posters immediately after they had given their presentation. For example a group might be told that they had been awarded high marks for poster design and fewer marks for the way in which they had responded to questions. Some ideas as to how the group might have improved their presentations was also given. This was followed at the end of the year by written comments about each group's presentation in terms of their poster design and scientific content, group work and their ability to respond to questions. For the three groups during 1992-'93, where there had been an observed and reported unequal level of participation, individual marks were listed, otherwise only a group mark was listed.

At the end of the year, after the exhibition of all the posters, there was a staff and student discussion regarding the organisation, staff support and usefulness of the poster presentation exercise.

4.2.4 Additional research feedback

In October 1992, immediately after the background instruction session, students were asked to complete Perry Questionnaire P1 and group work Questionnaire G1 (Appendix 2). The Perry Questionnaire P1 was used to calculate individual Perry scores as described in Section 3.3.1. The group work Questionnaire G1 asked students about their feelings towards group work and also their opinion as to determinants of group efficiency.

After each of the groups had given their poster presentations they were asked to complete a second group work Questionnaire G1, in addition to Questionnaire Q1 about the poster exercise as had all the other poster groups during the previous two years.

4.3 Results from the poster exercise during 1992-'93

4.3.1 General observations

The staff again indicated that they felt that the general quality of the posters in 1992-'93 was an improvement on the previous year's work. The poster designs continued to be a large central graphic with surrounding text and all, except two posters, included very high quality hand drawn illustrations.

4.3.2 Poster marks

The groups working on the structured challenges continued to show a wide range of approaches with four such groups scoring over 65 % and four scoring marks in the range 50 - 59 %. Both groups working on the unstructured challenges attained equivalent to lower second class honours marks. In the three years from 1990 to 1993 all groups working on unstructured challenges had been awarded less than the mean poster mark obtained by the class.

The marks obtained by the groups did not appear to relate to the way in which the groups had worked together, with two of the highest scoring groups reporting difficulties in working together and the lowest scoring group indicating that they had all got on well together while working on their poster.

4.3.3 Student feedback from Questionnaire Q1

Although a number of groups had experienced difficulties in group co-ordination, the trend continued towards students feeling that they had fulfilled the staff aims of the exercise as indicated by a general trend upwards in positive responses from the first year to the third year of the poster exercise with respect to statements relating to the development of higher level cognitive skills (see Table 4.1).

Table 4.1

A comparison between the student responses given to questions relating to development of higher level cognitive skills in Questionnaire Q1 (1990- 93)

	% of class agreeing	
	1990-1	1992-3
1. Attainment of staff aims - Had exercise		
Made them think more about cell biology & physiology	64	76
Encouraged them to relate the two topics	46	90
Made the topics more interesting	61	80
2. General comments		
Had deciding on poster content helped them to think about the relative importance of material	61	89
Had anticipating questions helped them to think how the subjects related together	46	88

Two of the aims listed in the questionnaire namely, '*did the students feel that the exercise had given the experience of working in a group*' and '*had the exercise given them the opportunity of assessing other student's work*' were perceived as being unfulfilled by just under half the class. Students had expressed the same opinions about these two aims in the previous two years of the exercise. It is perhaps a reflection of the number of students who had experienced problems within their groups, in all years tested, that the poster exercise was not perceived as giving students 'a group experience'.

During 1992-'93, there was a change in the type of skills listed in response to the open question "*What was the most important thing you learned while working on the exercise ?*" A large number of the skills reported related to dealing with problems which were encountered within the groups. For example, students made comments about learning how to be assertive, to co-operate with others, compromising and dealing with awkward classmates as well as learning more about the subject area and gaining more understanding about the subject.

4.3.4 Group work

The responses from the group work Questionnaire G1 (Appendix 2) also indicated that the students' opinions about what would determine group efficiency had changed during the academic year 1992 -'93 and following their group work on the poster.

The completed questionnaires indicated that, following the exercise,

more students felt that a group's efficiency would be improved by each of the following: working together co-operatively, delegating to each individual a different type of work, working with people you don't know well and having a group of people with mixed abilities (Table 4.2). The groups which had experienced difficulties tended to show a change in their response, either negatively or positively, to those questions relating to group conflicts such as *I try to keep out of group conflicts or arguments* or *I feel good when I win an argument*, whereas the groups which had not had problems responded to the questions in the same way in both questionnaires.

Table 4.2

**Questionnaire shifts in opinion (> 15 %) from October '92 to May '93 -
A comparison between responses given to the group work Questionnaire G1**

% shift towards agreement with statement
18 % - Groupwork is a good opportunity to get to know people better
16 % - I like participating in group discussions
45 % - I generally try to keep out of group conflicts or arguments
% shift towards disagreement with statement
21 % - I generally don't like working in groups
58 % - I sometimes feel excluded within a group
47 % - I don't like working in a group with someone I don't like
32 % - I prefer it when a group is told exactly what to do
24 % - I feel good when I win an argument

4.3.5 Staff and student end of year ratings of the posters in Checklist C3

The ratings of the posters in Checklist C3, as in previous years, continued to show differences in perception between staff and students, with respect to scientific level, design and what constituted a 'good poster presentation' (Table 4.3). In Table 4.3 the staff rating of the posters was taken from the final marks given to the groups. The student ratings are taken from the end of year Checklist C3, which asked for a relative rating of all the posters in terms of their high/low level of scientific content and their design, in addition, to a rating of the best poster which would take into account all the relevant assessment criteria. The votes for each of the posters were totalled to give an overall ranking of the posters, with 1

indicating the poster obtaining the highest number of votes and 9 the lowest.

Table 4.3

The staff and student end of year poster rankings calculated from the number of votes obtained in each category from Checklist C3 1992 -'93 (1 is highest ranking, 9 the lowest ranking, - no votes obtained)

		Staff	Student Rating			
Group	Poster Title	Final Rating	Design	High level	Low level	Best
1	Extraterrestrial Metabolism	2	-	6	4	6
2	Dragon metabolism	1	6	2	6	5
3	Homeostasis - Mermaid	5	2	1	6	1
4	Calcification - Wigetus	4	6	-	2	6
5	Tissue Repair	6	3	6	6	6
6	Haemoglobin Variants	8	5	3	3	4
7	Loch Ness Monster	9	1	6	5	3
8	Bone Fractures	9	6	4	2	-
9	Sex Brain Differences	2	5	5	-	2
10	Parkinson's Disease	7	-	5	1	

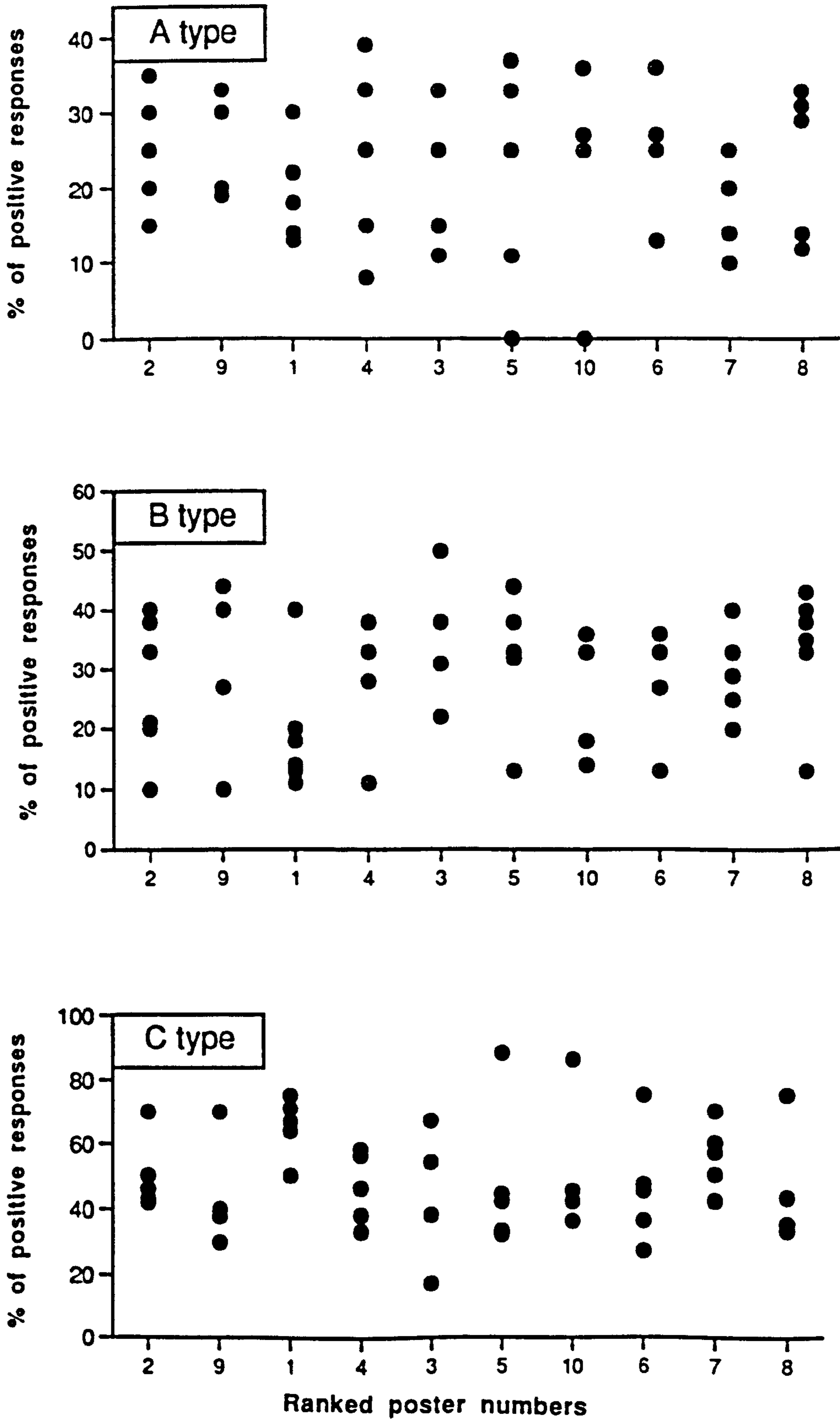
The poster assessed most highly by the students for high level scientific content, and second highest for design was assessed as fifth overall by the staff. As in the previous years, this discrepancy in ratings suggested a difference in the assessment criteria being used by staff and students.

4.3.6 Students' intellectual approach to the poster exercise.

As in the previous year there was no apparent link between the students' end of year group average or individual exam performance and their performance in the poster exercise (Data not shown) or if the individual Perry A, B and C type scores for each group are compared (Figure 4.1). All the poster groups showed a range of A type scores, however, their C type scores tended to be more clumped together with one individual being higher or lower than the rest. There was no information obtained during 1992-'93 about the different roles which the students had undertaken while working on the exercise and therefore, no conclusions can be made between the Perry scores and the group dynamics as such. However, the groups 2,1,4 and 10 which had reported severe problems during the poster exercise had the widest ranges of A Type scores from all the groups and perhaps it might

Figure 4.1

A comparison between the individual and group responses given by the third year poster groups in response to the Perry Questionnaire P1 in Oct '92



be speculated this diversity in student approaches had resulted in problems.

4.3.7 Case studies

a) *Group 4 - Calcification - Wigetus poster*

This group had a wide range of characters who were not established friends. The group was unhappy with the final marks allocated to their group because they had not gained any additional marks for their group work and they felt that they had compromised their final poster's scientific content by spending time working through group problems. This feeling of dissatisfaction was primarily due to their perception of the way the peer group marking scheme seemed to operate by rewarding individuals in other groups who had done little to encourage group cohesion. The students' discontent being founded in the reasoning that two individuals in one group had gained additional marks after excluding the rest of their group from the exercise. In previous years (see Section 2.8.2) students who had contributed less had obtained less than their group's poster mark. However, in 1992-'93, the staff were apparently awarding separate marks for student's contributions towards the group work aspect of the exercise, which were added onto the group's mark for the poster itself. This resulted in some students being awarded a higher mark for their higher level of participation. Perhaps separating the group's final collective marks formally into the four marked criteria (poster design, content, question responses and group work) might have helped to alleviate Group 3's feeling that their efforts at group co-operation had gone unrewarded.

b) *Groups 2 and 8 - Dragon metabolism and Loch Ness monster posters*

Group 2, the highest scoring group of the year, had one or two individuals in their group who were reported in Questionnaire Q1 as having excluded other members from the poster work, by dominating the discussions and putting down any suggestions that they put forward. The additional comments given by those 'excluded' individuals in the questionnaires gave an indication of the depth of feeling aroused by the experience. Group 8, however, the lowest scoring group of the year had all reported in Questionnaire Q1 that they had got on well together. Both groups had individuals with a wide range of abilities as measured by their performance in other Core Biology assessments. If the individual Perry scores, taken from Perry Questionnaire P1, for these two groups are compared (Figure 4.1), then Group 2 shows a range of A, B and C type scores,

whereas Group 8 shows clusters of high and low A type and a cluster of lower C type and one high C type scores. Without information about how the groups had worked together, it is not possible to establish which of these scores relate to the students who had perhaps taken on an influencing role within these groups and had perhaps directed the work. However, the findings from the following year's work (see Section 5.4.2), where the lowest scoring group had a cluster of high A and low C type Perry scores, it might be speculated that Group 8's work was being influenced by the group of students with the high A and low C type Perry scores shown in Figure 4.1.

4.4 Discussion of the poster exercise 1992 -'93

4.4.1 Student and staff assessment of posters

Despite the inclusion of a session at the beginning of the year in which examples of 'good' and 'bad' posters were used to demonstrate what constituted the integration and non integration of scientific information, the students continued to assess the posters in a different way from that of the staff. As the artistic quality of the posters had shown a continued improvement, it seems likely that this session was only serving to give an example of the artistic standards of the previous year's work, which the students were subsequently working to improve on. The final poster ranking (Table 4.3), however, indicated that the students had started to appreciate that the artistic quality of the posters was not of primary importance in the staff's assessment, with the student votes for the poster with the best design not directly corresponding to their votes for the best overall poster.

The small amount of time which many of the students had spent both looking at the posters and asking the poster presenting groups questions about their work might have resulted in the students not being able to discriminate between the scientific level of different posters. It was hoped that, by involving the students more in the poster presentation sessions in the subsequent year, by including a formalised question and answer session and providing more feedback on groups' poster work throughout the year, this problem might be rectified and a similar rating from the staff and students for the 'best poster' of the year might be produced. In addition, a method of increasing class involvement throughout the year was anticipated to make the student groups feel that their poster was more useful to the rest of the class rather than being a time

consuming exercise for only their group's and staff's benefit. However, giving the students in depth feedback on the posters throughout the year does also introduce the ethical problem of advantaging the groups undertaking the posters later in the year, who should gain from other group's 'mistakes'. However, in the three years 1990 -'93 this did not appear to be the case.

4.4.2 Type of challenges and group performance

There continued to be no clear reason why certain groups performed well in the poster exercise and others did not, for example, the type of challenge set, how well the group worked together or their collective performance in other Core Biology assessments did not appear to relate to the final poster marks awarded. However, giving a group an unstructured challenge without specific directions as to the type and level of approach seemed to encourage a group to adopt a lower level approach and several of the staff continued to feel that perhaps setting all groups in the subsequent year with a similar type of structured challenge might be perceived as being fairer from the student's perspective and also might encourage more of the groups to adopt a higher scientific level of approach to the exercise. There had up to this stage, from 1990 -'93, been one lecturer in the teaching team who preferred to set unstructured types of challenge, despite encouragement from the rest of the staff.

4.4.3 Assessment methods

During 1992-'93 each poster's design and content, the students' question responses and their group work was discussed separately by the teaching team and all these criteria were considered as contributing to the final mark awarded. However, there was no formal indication as to the weighting given to these criteria. Consequently, the staff's way of assessing the student's posters seemed to have remained unclear in students' minds. This lack of clarification was apparent in the continued discrepancy between the staff and student end of year ranking of all the posters. It was hoped that the introduction of a formalised marking system in the subsequent year would help rectify this problem, as groups would be awarded specific marks formally for each of the staff determined criteria.

In addition to the students apparently not understanding how the staff marking system of the posters operated during 1992-'93 there were also problems with the methods of peer group assessment utilised. It could be

argued that asking the students to allocate marks between their group members was not particularly useful if staff overrode the marks allocated by the students. For example, two students in Group 1 were, in effect, awarded higher marks by staff than their official poster group mark because they had contributed more to the exercise and 'their level of work had been brought down by the rest of the group'. As the individuals concerned had actively excluded the rest of their group, it is perhaps not surprising that this method of staff marking caused dissatisfaction in other groups who had worked through their group problems but had not been subsequently rewarded.

4.4.4 Group work

During 1992-'93, there seemed to be far more group related problems than in previous years. These problems seemed to be aggravated by the mechanisms used at the end of the year to assess the peer group. Most of the groups experienced problems while working together and some of the responses obtained in the Questionnaire Q1 used immediately after the exercise revealed the severity of the disputes. The inclusion of a peer group assessment which seemed to the class to have favoured certain individuals, considered to be disruptive influences within their groups, had resulted in a few of the students thinking very negatively towards the whole exercise and considering it to be a waste of their time. It was hoped that the introduction of more specific criteria in the peer group assessment scheme in the subsequent year would increase the value of other types of contribution to the group work, when students were marking the rest of their group members, such as the importance of group skills in co-ordinating group activities, for example. An exercise which is perceived by students as valuing cognitive rather than group or artistic skills through its marking system is probably likely to encourage the more 'intellectually able' students to exclude others considered to bring down the group product rather than to value their contribution with respect to other roles which they might fulfil within the group process.

The group Questionnaire G1, used to assess each student's opinion as to the determinants of efficiency within groups prior to and following their poster exercise was a useful method of identifying any changes in students' perceptions. The students who had shown the greatest change in their questionnaire opinions and had apparently learned most about group work were members of the most problematic groups.

Questionnaire G1, is perhaps limited as a predictor of performance in

other such exercises, as individuals are unlikely to respond in the same way on all occasions given different group compositions and different circumstances. However, use of this type of questionnaire could be considered to be a method of encouraging students to assess or to think more about how their group is working together and how they themselves are relating to the rest of their group, an aspect of the exercise, which they might not have otherwise have considered.

4.4.5 Group selection

The method of selection of alphabetic selection of groups, commonly used as a means of selecting groups from Year 1 of the Biology degree course, had resulted in the poster groups being made up of students who had worked with each other on several occasions. It might be argued that working with people you already know would have both advantages and disadvantages and might have meant that the groups did not go through the usual formative stages as might be expected at the commencement of such an exercise (Tuckman and Jensen, 1977). Rather, students started work in a group with an already pre-formed structure, with some members taking up uncompromising stances from the beginning.

If groups are to be expected to work well together then some advice at the beginning of the year about group work and, for example, methods of dealing with problematic individuals might be recommended. Support for groups experiencing problems could also be provided to assist in the progress of their work. A mid exercise session in which staff could obtain information on how the groups were working together could have perhaps helped reduce the problems encountered during 1992-'93, rather than assuming that the students intuitively 'knew' the best way of working together as a group.

With an assessment method which seemed to favour the more 'intellectually able students' the problems within the groups is hardly surprising as were the comments at the end of the year indicating that the class generally would have preferred to work either with individuals they 'didn't know' or 'hadn't worked with before' or that they should be allowed to select their own groups. The planned random selection of groups for the following year might also help to encourage better group co-operation.

4.5 Perry approach to the poster exercise

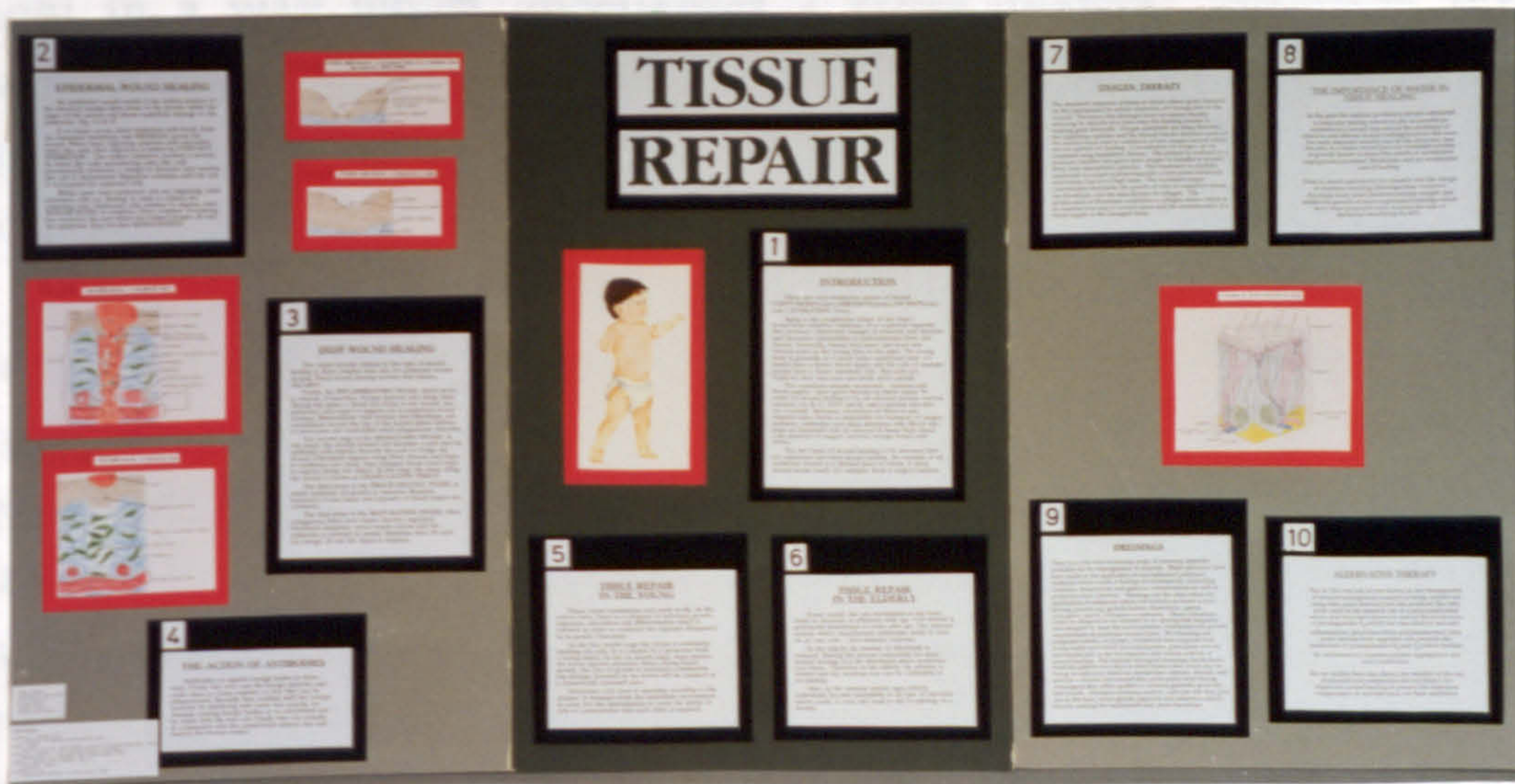
Some of the different approaches taken by groups during 1992-'93 reflected what could be considered to be characteristic of approaches adopted by students at Perry's different stages of intellectual development. For example, Group 5, working on Tissue Repair Mechanisms (see Photograph 4.1) had shown what might be considered to be a dualist level of presentation in their poster content : showing disjointed pieces of information which were not apparently related to each other. This type of approach is perhaps more obvious when compared with the previous year's poster working on the same challenge, when the group had shown a high level of integration of the subject areas (Photograph 4.2). In addition, Group 10 had expressed their surprise in the level of uncertainty which surrounded their poster content, when they discovered that the aetiology of Parkinson's disease might never be known, this realisation perhaps reflecting a transitional stage between a dualist to a more multiplist way of thinking (Photograph 4.3).

The selection of a lower level approach to their poster content and the subsequent lower marks obtained by groups working on an unstructured challenge might also in part be explained by the Perry Scheme. A group's unwillingness to tackle tasks which are not specifically lecturer directed supports a description of the type of attitude likely to adopted by students at the Perry stage of Multiplism, where students look to the lecturer for direction. As the students are well into their university education, the Perry Scheme, also supported by this project (Section 5.4) would predict that many of them would have been challenged to become Multiplist thinkers.

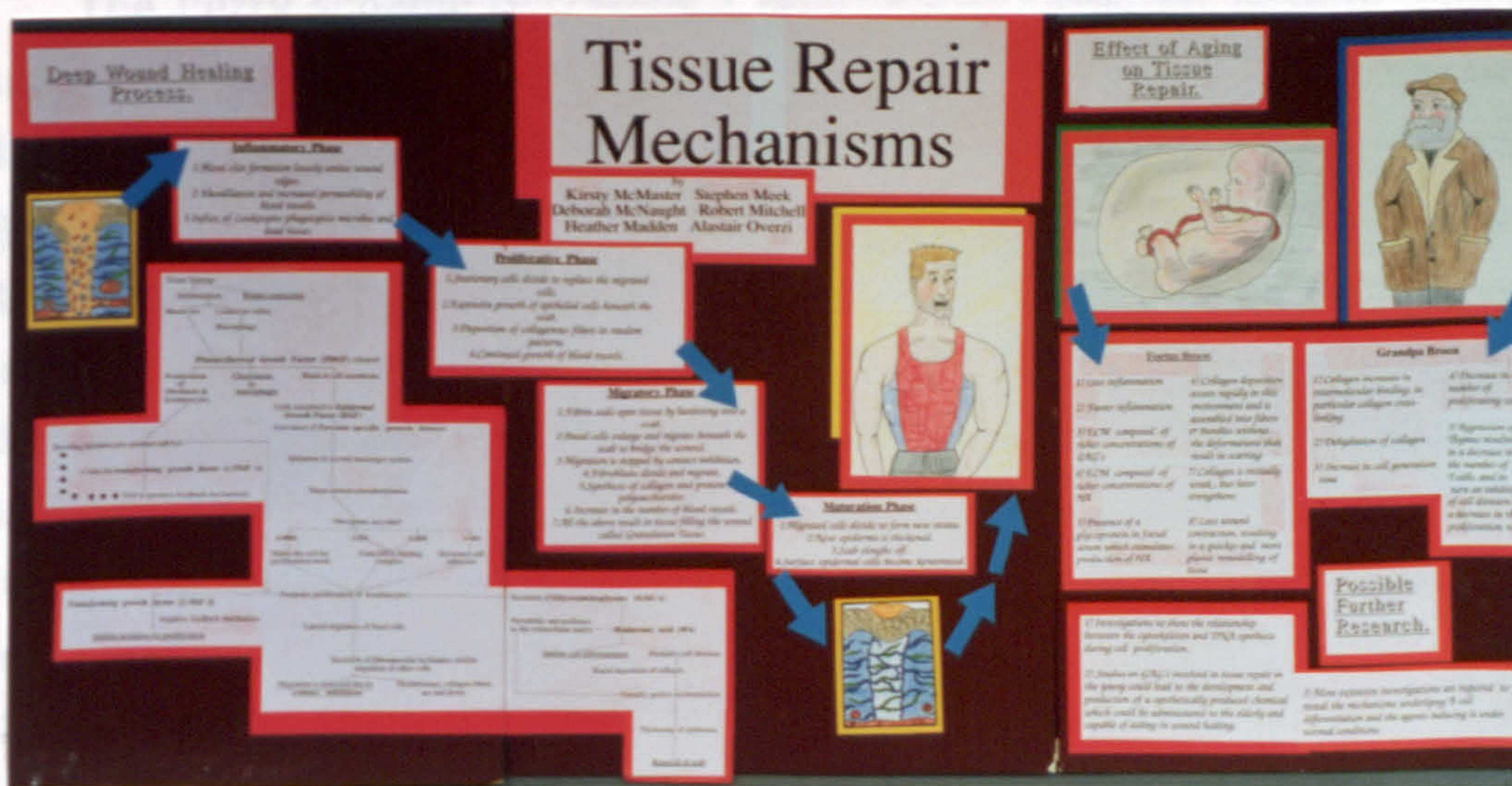
An exercise which leaves the direction and amount of work up to the students might, therefore, be considered problematic at this stage unless they are given a lot of accompanying support and encouragement. Seeing other students obtaining more clear cut problem solving exercises in the form of structured challenges could therefore be perceived as being unfair by those students obtaining unstructured challenges.

The way in which groups work together on the unstructured challenges are also likely to be affected if students are predominantly multiplistic thinkers or 'cue seekers' (Miller and Partlett, 1974) looking to the lecturer for specific directions, particularly if the group doesn't contain any influencing relativists. Such a group could therefore be expected to adopt a more dualistic type of approach or to retreat as has been suggested by Finster (1989). The Perry model predicts relativist thinkers will adopt an approach

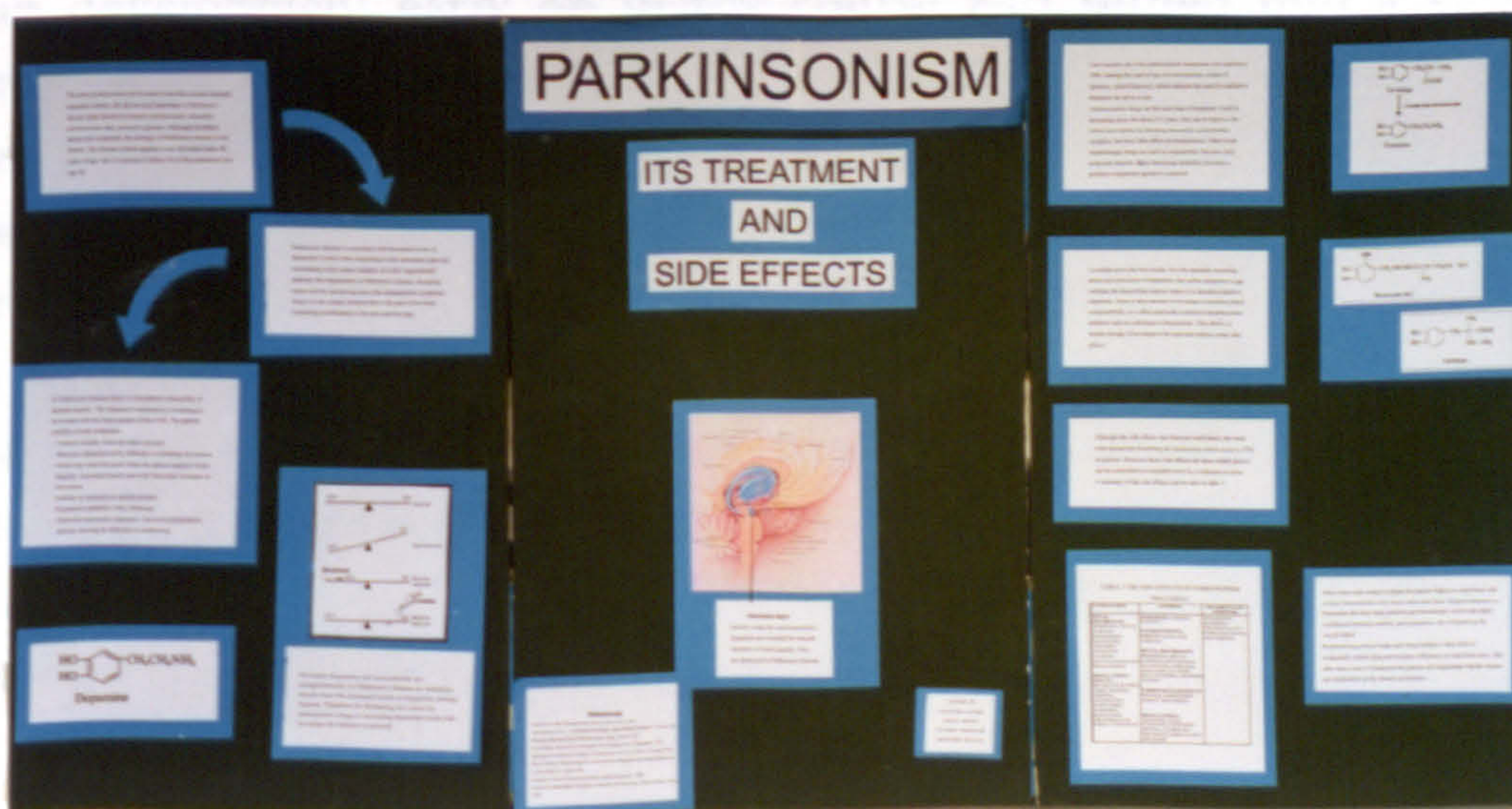
Photograph 4.1 - Tissue Repair Mechanisms - 1992-'93



Photograph 4.2 - Tissue Repair Mechanisms - 1991 -'92



Photograph 4.3 - Parkinson's Disease - 1992-'93



which is considered to be appropriate to the learning context. If a topic is taught in a way which encourages a more dualistic approach through assessments and teaching methods then the students are not going to be so likely to change their approach for only one exercise, the poster exercise for example.

The lack of information about the way in which the groups had worked together during the poster exercise means that relating Perry scores to group performance is only speculative, unless all the group members show a similar score (see Section 5.4.2) and then they might be predicted to be more likely to show a particular type of approach. However, a knowledge of where the majority of the individual students are in the class is useful in determining the level of support which perhaps students would require before and during the poster exercise and also explaining why some groups responses during the exercise.

The Perry scheme describes a potential intellectual change which can result from the stimulation which is provided by the learning environment within university (Perry, 1970). This is, however, potential change and this project (see Section 6.2.1) has supported Perry's findings, that not all students undergo such a change. As the poster exercise takes place in student's third year of study, it might be speculated that some poster groups contain students who have and who have not changed intellectually. Tuckman and Jensen (1977) have described how groups go through different stages of development (see Section 1.3.2) resulting in the setting of 'group norms' and establishing of group roles. The practice of alphabetically dividing classes of students into groups is regularly used from the first year of courses at Napier University. As a result, the students from the poster groups, also selected alphabetically during 1992-'93, were likely to have worked together before and, it might be argued, to have gone through the formative stages of their group development early on in the course and settled into a structured definition of roles. If the influencing members of the group had not developed or been challenged to change their way of thinking past a Dualist stage, then they would be likely to direct their group's activities towards this their own particular level than letting the individuals, within their groups, who have changed, to have an effect on their groups' action. This would be more pronounced if groups were working on unstructured challenges without lecturer direction towards scientific levels. Conversely, a group containing students at different stages and influenced or directed by relativist thinkers would be expected to challenge or to encourage the

Dualist or Multiplist thinking students within the group to progress on to a further stage while working on the poster exercise, particularly if this level of approach is encouraged and rewarded by the teaching team involved. In addition the security of being within a group which works well together might be more supportive of change than other challenging methods of instruction where work is carried out as an individual.

4.6 Suggested modifications for the 1993-'94 poster exercise

The use of the Perry scheme and the findings from this year's work again suggested that if students were to be encouraged at this stage of their course to adopt a more relativistic approach, then a number of changes might have to be made to the exercise during the implementation of the next year's module:

a) *Introductory session*

- Groups could be selected randomly, in order that the group roles would not already have been established in previous years.
- The challenges could all be of the structured type

b) *Assessment methods*

- The method of peer group assessment could be reviewed in order that a more equal level of participation might be encouraged and seen to be subsequently rewarded.
- More feedback could be given to the class as to the level of approach taken by groups immediately after the exercise so that the following groups would be more aware of what was expected from them. The timing of the group's posters could be taken into account in the end of year marking.

c) *Poster presentation sessions*

- Students could be encouraged to take a more active involvement in the exercise, by both assessing and actively questioning their peer group

d) *Group work*

- Closer monitoring of the way in which group were working together during the poster exercise could be undertaken

Recommendations (cont.)**e) Perry research**

- An explanation of the Perry model at the beginning of the year might be a useful way of encouraging students to see the poster exercise as a means of self development
- Students could be asked to complete Perry Questionnaire P2 (Appendix 3) which could provide more information as to the course preferences of individual students and also their adopted roles within the groups.

4.7 Third Year Student Performance in the end of year Core Biology module examination during 1990-'93

4.7.1 Core Biology module assessments

During the three academic years 1990-'93, the third year poster group's performance and selection of questions in their end of year Core Biology module examination was monitored. The student's final Core Biology module mark is a combination of a coursework mark (comprising 30 %) and an end of year examination mark (comprising 70 %). The staff team involved in teaching the five topics throughout the year, decide on the type of coursework which is set for students and as a result, students are assessed using a variety of methods from essay and laboratory report writing to producing and presenting a group poster. The end of year examination involves answering three questions on different topics out of a total of ten: with a choice of two from each of the five topics.

4.7.2 The end of year examination questions

The style of questions set by the teaching teams for the five topics in the end of year examination during the first two years (1990-'92) were very different. For example in May 1992 (see Appendix 1 for examples from the 1992 examination paper), a question for Topic 1 on Metabolism requires the students to *critically discuss* the view that "*A detailed knowledge of metabolic pathways hinders rather than helps anyone wishing to gain an understanding of metabolism*". Whereas for Topic 4 on Support mechanisms a typical question was "*Compare cartilage and bone as support materials and consider how they are adapted to the forces acting on them*". By the phrasing of the questions, the inferred requirement from the students

appears very different : there appears to be a factual bias in the second type when both answering and marking because of the way the question is worded. Conversely, one would expect that a fairly high level discussion, using facts only by means of example, would be required when responding to the question on Metabolism. It might be speculated that if these questions are a reflection of the way in which these topics are taught, then this might also provide an explanation as to why students working on the challenges for these two topics adopted different levels of scientific approach in their posters as the rest of that topic was being taught in a different way.

In the third year of this project (1992-'93), due to the absence of one of the lecturers whose previous responsibility it had been to teach the topics of 'Brain' and 'Cell support and development', both the teaching and the setting of questions for the end of year exam on these topics were carried out by the teaching team responsible for the topic of Metabolism. This resulted in all the exam questions for that year appearing to be of a similar type and the staff concerned in marking them, describing the same criteria of assessment to me.

4.7.3 Question selection by students in the end of year examination

The student's selection of question topics and the marks attained were compared to their poster subject preferences, as indicated in the poster Questionnaire Q1, over a three year period (1990-'93). As would have been predicted the students' selection of questions and performance in the exam did not appear to be related to their group performance in the poster exercise or their subject preferences indicated in Questionnaire Q1 (Table 4.4).

However, there were some trends observed in the type of questions selected by the students over the three years (see Table 4.4). During the first two years almost all the students answered questions on the final two topics, which had been more of a descriptive nature. Although students were selecting to answer questions on the final topics in 1991 and 1992, this did not mean that they were gaining any higher a mark for doing so (Table 4.5). For example, the small standard deviation of marks from the mean mark awarded during each year suggests that the students would be more likely to obtain a lower mark if they answered a question on Topic 5 rather than on Topic 2, for example.

Table 4.4

A comparison between the students selection of examination questions in the biology end of year exam and their poster topic preferences in 1991 -'93

Year	Topic Number				
	1 Metabolism	2 Homeostasis	3 Development	4 Support systems	5 Brain
	Exam question selection expressed as a percentage of the class total				
1991	33	30	45	93	97
1992	20	46	48	98	80
1993	47	53	53	81	62
	percentage of total class indicating a poster preferences (Questionnaire Q1)				
1991	13	10	13	23	37
1992	19	15	28	13	4
1993	25	15	13	6	8

In 1992, only 20 % of the class had answered a question on Topic 1, Metabolism. However, in 1993 when the type of questions set for the examination were all of a similar type, the bias towards the final topics was reduced and a more even selection of questions was made by the students. Although more students were answering questions on the final topics, when asked in Questionnaire Q1 following the poster exercise, which of the poster topics they would have preferred to have worked on, their responses did not appear to reflect this preference. The most preferred topics selected in 1992 and 1993 were the poster topics which had been awarded the highest marks.

Table 4.5

A comparison between the average mark obtained by the third year class for the five biology topics in the end of year examinations during 1991 - 1993 (marks shown as averages + /- is the standard deviation about the mean)

Year	Topic Number				
	1 Metabolism	2 Homeostasis	3 Development	4 Support systems	5 Brain
1991	57 (mean) +/- 10 (st.dev.)	63 +/- 11	58 +/- 5	58 +/- 7	60 +/- 4
1992	59 +/- 14	57 +/- 10	57 +/- 10	56 +/- 12	55 +/- 7
1993	52 +/- 9	57 +/- 13	56 +/- 14	54 +/- 16	55 +/- 9

4.7.4 Discussion about examination question selection made by students

During 1990-'92 the trends shown from comparing students' selection of questions in the end of year examination suggested that students preferred to answer a particular type of questions in the end of year examination. Almost all the students in the third year class answered questions set by one examiner. In 1992-'93 when this particular lecturer was absent for most of this year due to illness, there was a more even spread of question selections over the three other topics although it might be argued that the selection of questions might be a result of a different classes' subject preferences.

However, if students were going to be strategically selecting questions in the exam then it could be argued that they would select a type in which they would expect to do well in. Although there was no significant difference between the mean marks for each of the topics, generally the average for the last two topics were less than those for the other three. Given the time constraints imposed within an exam, among other factors, perhaps a type of question which related to more factual recall would be preferable to that which required problem solving unless an individual felt confident and/or able to think fast under pressure. In addition, if the majority of the third year class is round about the multiplist stage of thinking (see Section 5.4.6) as the Perry scheme describes, the students might feel that the production of large quantities of material in an exam would demonstrate knowledge and would therefore deserve higher marks. A

question which infers the regurgitation of facts would as a result be the more likely preferred selection.

There was a wide range of marks given to those individuals who did answer questions on the first two topics. This, it might be speculated could be a result of two different groups tackling these questions : firstly students who are confident and feel able to answer more demanding questions and want to demonstrate their thinking skills and are correspondingly marked highly. Secondly, those students who do not have the prerequisite facts to answer a question from one of the other topics are forced into answering this type of question but lack the ability to respond to this subject at that level and therefore are marked down.

If, as the findings from the survey of study methods preferences carried out using Perry Questionnaire P2 in 1993-'94 suggest (Section 6.2.9), students at this stage are preparing for exams by practising questions from past papers, then this examination question selection study indicates that students were actively selecting the questions which were more of a descriptive nature during 1991 and 1992. In addition, the assessment method preferences given in Perry Questionnaire P2 would support this finding (Section 6.2.9 and Appendix 3) with classes in their later years of study showing a higher preference for descriptive essays than those of earlier years. The most preferred assessment method by the fourth year of the full time degree course was a descriptive essay. Biggs (1973) has described how students can adopt a reproductive strategy when preparing for essay type exams and Hakistan (1971) has found little difference in the way in which students prepare for descriptive essays and the way they prepare for short answer type questions. Taken at face value, this could suggest that students entering university with reproductive type approaches to their learning are not being encouraged to change to adopt a more transformational approach, as the course is continuing to reward this type of approach by setting assessments encouraging this particular type of approach. If students are to be encouraged to adopt a more relativistic approach, then it could be argued that they have to be required to undertake instructional methods which challenge them, like for example discussion type essays and problem solving exercises and not just those which are supportive of their way of thinking such as descriptive essays.

Chapter 5
Poster presentation Exercise
(1993 - 1994)

5.1 Background to the poster exercise (1993 -'94)

5.1.1 Introduction

A number of changes were made to the organisation and the implementation of the poster presentation exercise during 1993 -'94, following the problems encountered with group work and assessment methods during the academic sessions 1991-'92 and 1992-'93, and the implications of using the Perry model of intellectual development (see Section 1.4 for description) as a framework for determining the students' level of approach. I joined in with the course team's discussion before the beginning of the year to discuss ways in which the remaining problem areas might be addressed in such a way that a maximum number of students might be encouraged to develop a deeper and/or a more relativistic approach towards the poster topics.

5.2 Changes in procedure during 1993 -'94

5.2.1 Introductory session at the beginning of the academic year

More emphasis was made on the good and bad aspects of posters produced in the previous three years with respect to the ways in which some students had or had not integrated the scientific material of their posters. A wider selection of posters from discontinued challenges was available for the session with the introduction of new challenges for this year. The aims and objectives of the poster exercise were reinforced by giving students a summary sheet with information about the marking systems and the weighting of the assessments which would be used for the exercise (Appendix 1).

The class of 45 students was randomly divided up into groups of five students and the selection carried out by picking names out of a hat. This meant that most of the students had not worked with each other before. In addition, I gave the students a short talk about working in groups and asked the class to complete Questionnaire G2 about their attitude to group work and their initial feelings about the poster exercise (Appendix 2).

5.2.2 Assessment methods

A new method of peer group assessment was introduced during 1993 -'94 (Appendix 2). This involved students awarding their peer group marks

for a set of staff determined criteria, on Assessment sheet GA2. The teaching team had decided that, during this year, following the poster exercise, each student should award the rest of their group a mark out of ten for their contributions towards general group cohesion, the poster production, the background research and their question responses on the day of the presentation. This gave a potential total of forty marks from each group member. The marks awarded to individuals by the rest of their group were to contribute towards their group work mark as part of their final poster marks. A more clearly defined method of staff marking of each poster was also introduced which allocated a total of 40 marks for the poster content, 30 for the poster design, 20 for the groups' question responses and 10 for their group work. A list and description of these assessment criteria were handed out on an instruction sheet to each of the students (Appendix 1).

5.2.3 Poster presentation sessions

Each poster session was organised into a formal programme, which aimed to encourage more active student participation (Appendix 1). During each of these sessions, the whole class, not just those giving the presentation, worked together in their poster groups.

Following the showing of the poster(s), the class non-presenting groups were given half an hour to agree on two questions which could be put to the groups on their poster presentations. Examples of what would constitute 'good' and 'bad' questions were given to each of the groups which were to be used as guidelines (Appendix 1). In addition, when two posters were being presented on the same day, each group would be expected to compile questions for the other presenting group. When the class had completed their two questions, these were passed on to the staff teaching team. Once the staff had looked at them, the questions were passed on to the poster groups, who were given ten minutes to discuss, among themselves, how they might respond. The group did not know at this stage which two of the questions would be selected by the staff to initiate discussion, although having advance knowledge of the questions, they could prepare for general subject areas.

After the allotted time, the class reassembled for a general discussion about each of the poster topics. A member of the teaching team initiated the discussion by asking one of the poster groups to respond to what were considered by staff to be the two 'best' class questions. If the student's questions had two common themes, the teaching staff member leading the

discussion, would often summarise these into questions rather than use the specific wording given by one group alone. Afterwards, the discussion was extended to include the rest of the class, who were encouraged to continue asking the poster group questions, which they may or may not have prepared earlier. If a poster group was experiencing difficulty in responding or were unsure about a question, the teaching staff involved would facilitate the process by rephrasing or developing questions, but not to a level at which they were determining the area of discussion.

Once the discussion had come to a usually natural conclusion, the class individually completed Checklist C5 about the poster groups' presentation which included comments about the way in which they responded to the questions (Appendix 2). The poster group(s) also completed Checklist C5 about the other poster group's presentation, their peer group Assessment form GA2 and a Questionnaire G3 for this research project (Appendix 2). Questionnaire G3 includes questions about the student's perceptions of how their group had worked together, as well as how they felt about their poster subject area and the staff organisation of the exercise. The presenting group(s) were also asked to go through all the class questions which had been handed in and to decide which two they considered to be the best. The two groups who had submitted these questions each gained a bonus mark for their group, which was to be added to their final poster mark. Copies of the forms used in these presentation sessions are included in Appendix 1.

5.2.4 Assessment procedures

The staff met immediately after the presentation session to discuss the posters and to decide on provisional group marks, using the marking scheme already outlined (in Section 5.2.2). Staff completed Checklist C6 about each of the group's presentations (Appendix 2). After the staff meeting, the poster groups were given a rough idea of their mark and an indication of how these marks were allocated. For example, a group might be told that they had been awarded very high marks for their poster design, but that they had received fewer marks for their question responses. In addition, some general advice might be given to the students as to how they might improve their performance if they were to carry out a similar exercise in the future.

As had been the practice for the previous three years, there was a general staff and student discussion about the poster exercise following an

end of year exhibition of all the posters after which the final staff mark for each group's work was decided.

5.2.5 Poster challenges

All members of staff involved in the exercise during session 1993-'94 set challenges which were of the structured type (see Section 2.2.2 for descriptions). This meant that for the first time, the topic of Cell Support systems had 2 structured challenges.

5.3. Results from the Poster exercise 1993 -'94

5.3.1 Responses to Questionnaire G2

At the beginning of the year, after the introductory session on the poster exercise, the students had been asked to complete Questionnaire G2 (Appendix 2). It was hoped that the student feedback from the questionnaire would help staff to identify any shortfalls in the background instruction given to students prior to work commencement, and to establish the pre-exercise individual attitudes towards various aspects of the exercise such as group work and the use of posters. The questionnaire identified some discrepancies between the staff and student perceptions of the aims of the poster exercise. Fifty one percent of the class felt that the poster presentation exercise was aimed at developing students' group skills, 48% felt that the aim was to develop presentation or communication skills, but only 19% of the students felt that the exercise was about developing their scientific knowledge.

Almost a quarter of the class (23%) were unhappy with the idea of working in groups particularly with students they didn't know. A number of students expressed concerns about the time it would take to get to know people before starting to work on the poster work itself, and about not knowing whether group members would participate equally. The same number indicated that they would prefer to work alone with some commenting that they 'HATED' groupwork. Worry was also expressed, by 26% of the class, about how they would assess other students' work, commenting that they did not feel that they had the scientific competence to do so.

5.3.2 Modifications to the poster exercise made as a result of feedback

A number of changes were made to the exercise as a result of the

student feedback information from Questionnaire G2 in order to help to clarify the problem areas. These included the lecturers reiterating the aims of the poster exercise before the groups started work and again pointing out to students that the staff assessment was weighted towards the scientific content of the posters and the way in which the groups responded to the class questioning. In addition, at this point and because of the apparent confusion indicated in the student feedback, staff decided to compile summary sheets for the exercise so that all the students would be given examples of good and bad questions, suggestions about marking their peer group members and more specific outlines about how the staff would be assessing the posters on each of the poster presentation days (Appendix 1).

5.3.3 General poster quality achieved in 1993 -'94

Following the modifications made to the organisation of the poster exercise, the staff considered that the general quality of the posters had again improved, both aesthetically and scientifically when compared to the previous years work (Photographs 5.1 - 5.2). The mean poster mark had improved slightly to 68 % from the 62 % of 1991-'92 and 1992-'93. Two groups obtained marks in the mid eighties (85% and 86%), the highest marks ever achieved. Conversely, one group obtained the lowest mark ever awarded, 44%. In the first year that the poster challenge on Bones, for the topic of Cell Support Systems had been of a structured format (see Section 2.2.2 for a description of this type of challenge) the group working on that particular topic had obtained a first class mark of 73 %. In previous years, the poster challenges for Cell Support Systems had been of an unstructured type and the groups working on the challenges had consistently received marks under the class mean mark for that year (see Tables 2.2, 2.4 and 4.4).

5.3.4 The influence of poster challenge type on poster performance

Although, all the poster challenges from this year were of a structured type, there were still complaints from students about the differences between the types of challenges. Some students felt that some challenges for example 'The Neurodegenerative Diseases Clinic' (see Appendix 1) and the 'Human Limb Development' were more creatively stimulating than others and that their futuristic contents were in some way easier because you 'could make up' your answers. As had been found in 1992 and 1993, the poster challenges considered to be better or easier were those which had scored higher marks. Although, staff responded to the

students' complaints of the 'unfairness' of some challenges during the end of the year discussion with the class, by explaining that groups in previous years had found the same poster topics equally as stimulating as the others and that their preference was more likely an indication of personal choice rather than a reflection of the type of challenge. However, some of the groups remained dissatisfied.

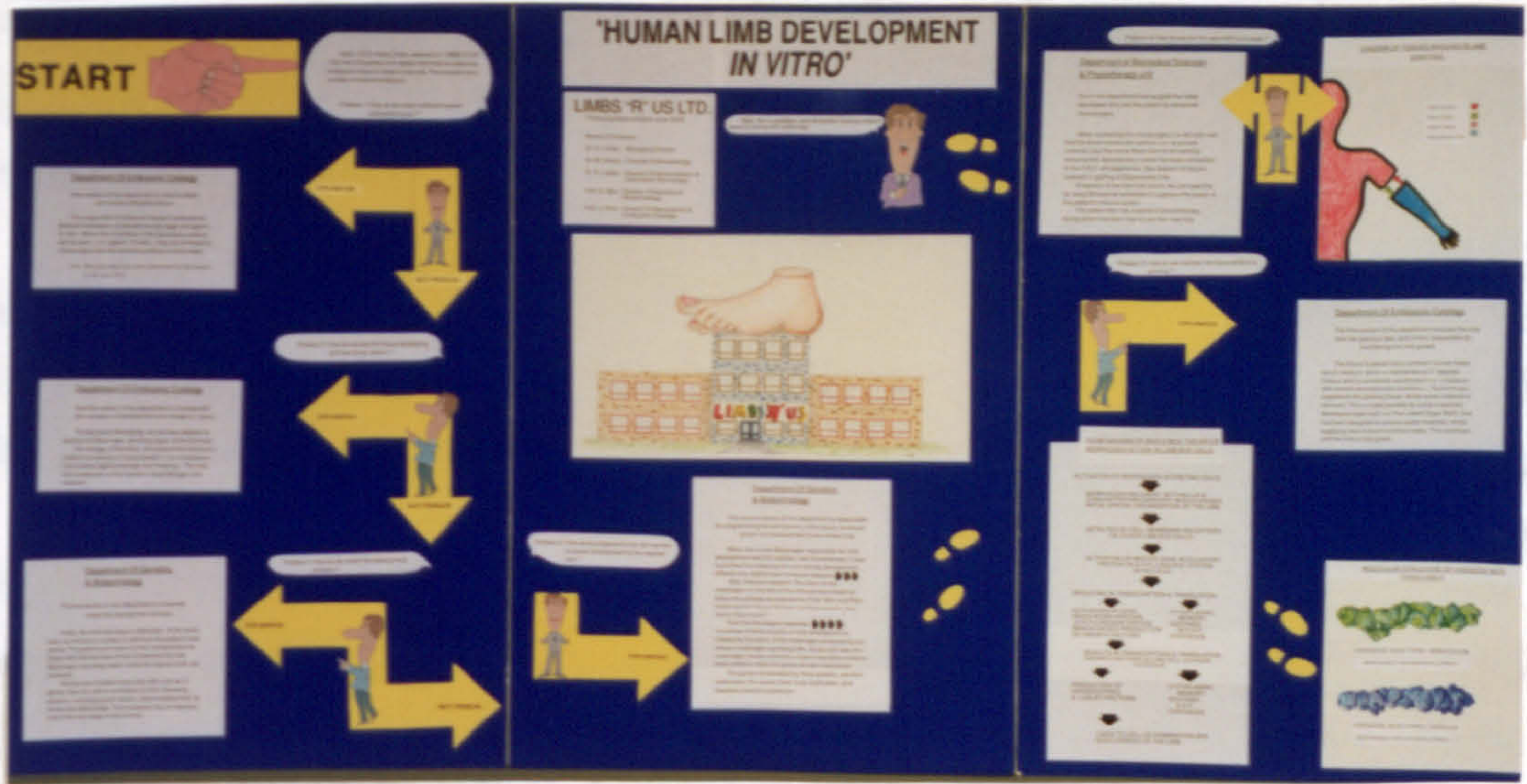
One group's complaint about their poster on the Flying Dinosaur 747 is however, of interest. This group was very enthusiastic about their challenge when they received it and some of the other poster groups voiced a certain degree of jealousy about the poster subject area. However, after about a week's discussion, the group became despondent because they had recognised that there was no way in which the dinosaur described in the challenge could be a feasible creation and, as a result, the exercise had in some way lost its meaning. This perhaps reinforces the problem of setting tasks for a number of groups, particularly at an intellectual stage when the concept of fairness in assessment procedures seems of increased importance. Although the group working on the Brontosaurus 747 had gained a first class mark for their work, again the challenge was blamed by the group as being responsible for them not obtaining the top mark of the class, rather than the students taking responsibility and considering ways in which they could have improved their poster.

As the questions had become a more significant part of the exercise, the groups spent more time preparing for this session, than they had done in previous years. This was usually done in the Resource Centre, in their group and round the completed poster. On the day, each of the groups responded in different ways : one or two students fielded all the questions, several members of the group took responsibility for different subject areas or the group discussed each question after each was asked, but one or two students responded.

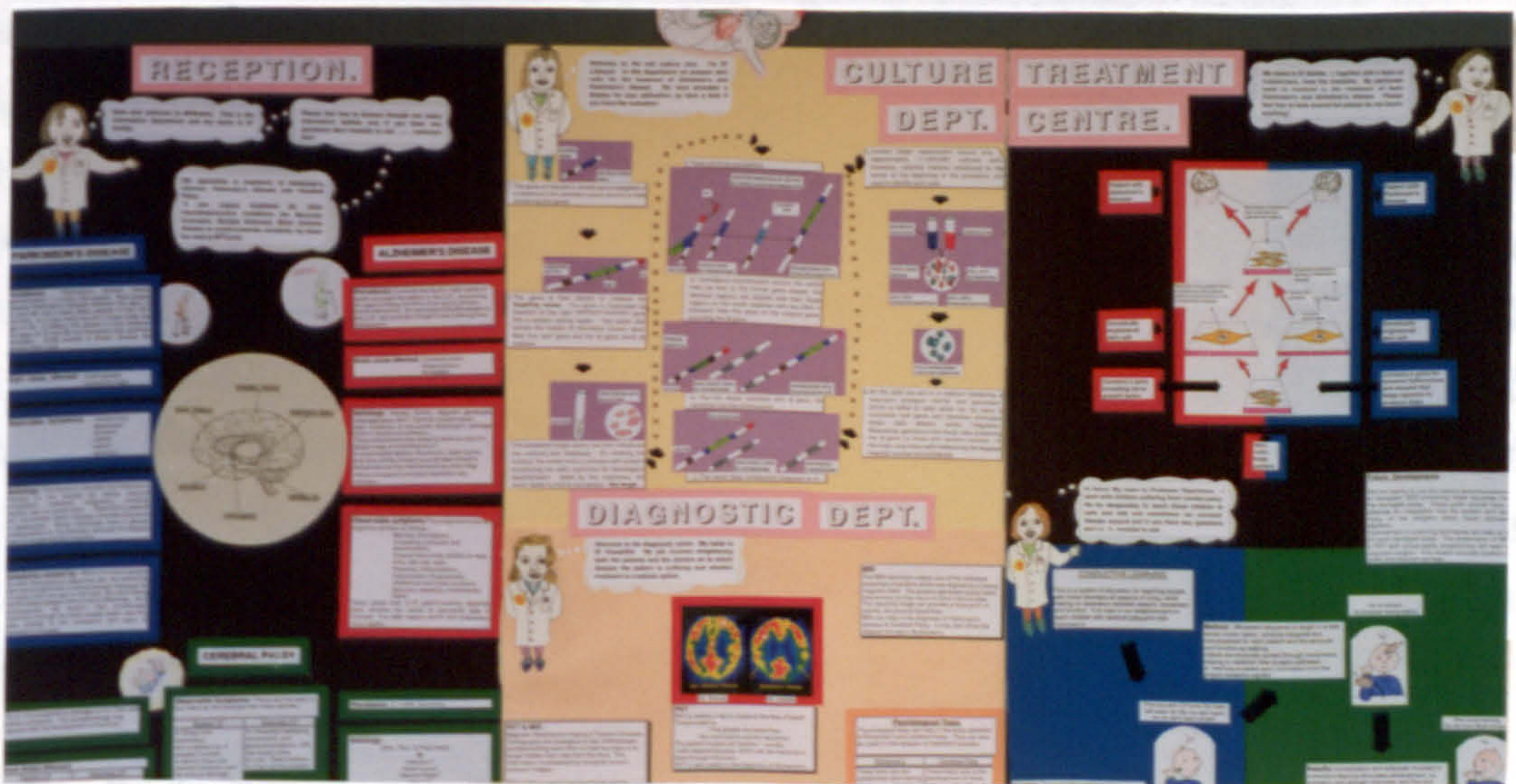
5.3.5 Feedback on the group poster exercise

The general feeling from the end of year final group discussion following the exhibition of all the posters, was very positive with the majority of the class feeling that the whole experience had been worthwhile and preferable to doing other forms of assessments such as a laboratory report or tutorials for the equivalent mark. The class was happy with the group selection process and the methods of assessment used which they felt were a fair method of marking such an exercise. Some students from the

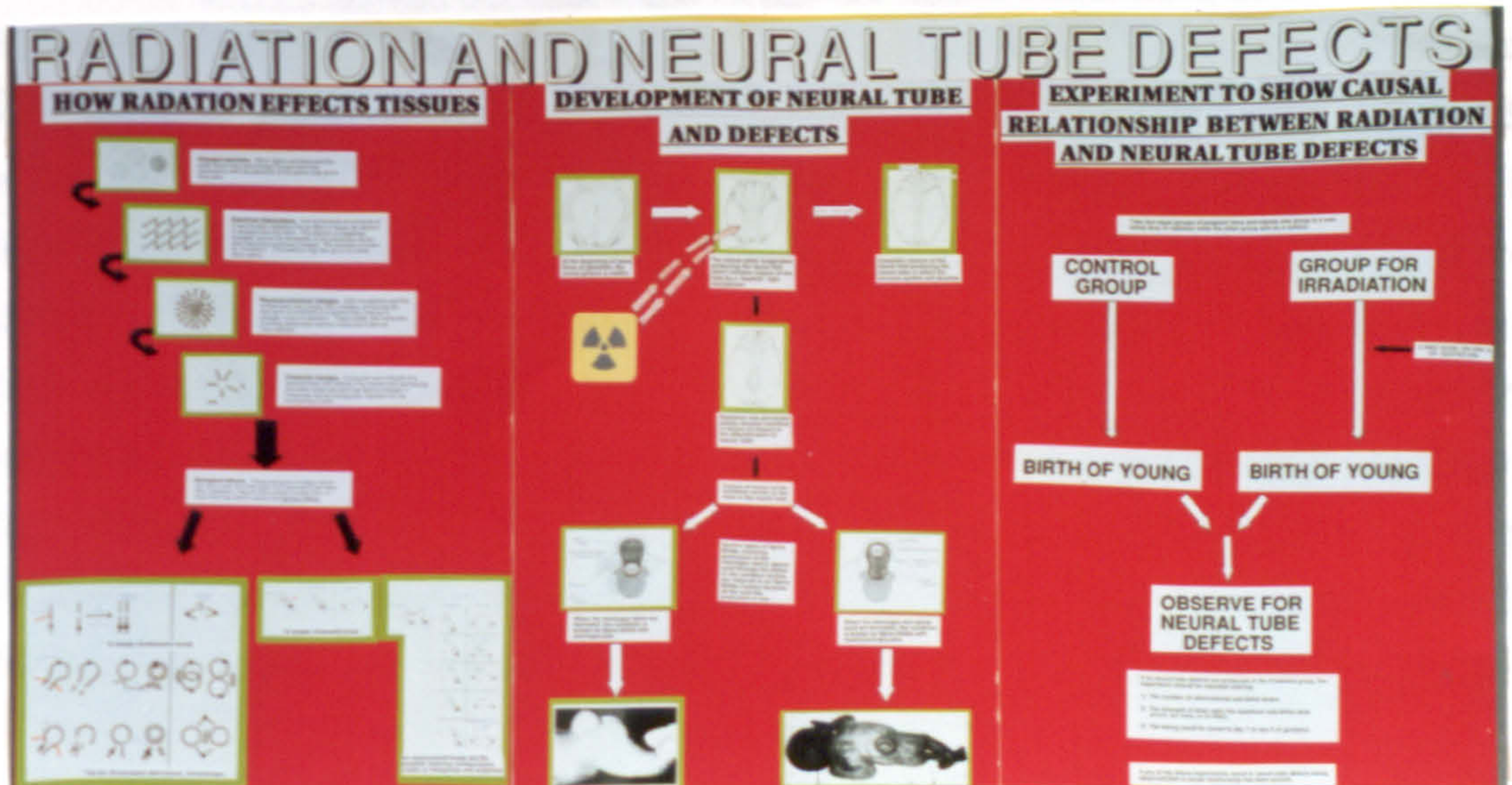
Photograph 5.1 - Human Limb Development - 1993-'94



Photograph 5.2 - Neurodegenerative Clinic - 1993-94



Photograph 5.3 - Neural Tube Defects - 1993-94



first groups commented that they hadn't been able to gauge the scientific level of their poster from just a cursory viewing of the previous year's posters at the beginning of the year, and that they would probably have changed the way in which they pitched the scientific content in their poster, having seen the rest of the class's work.

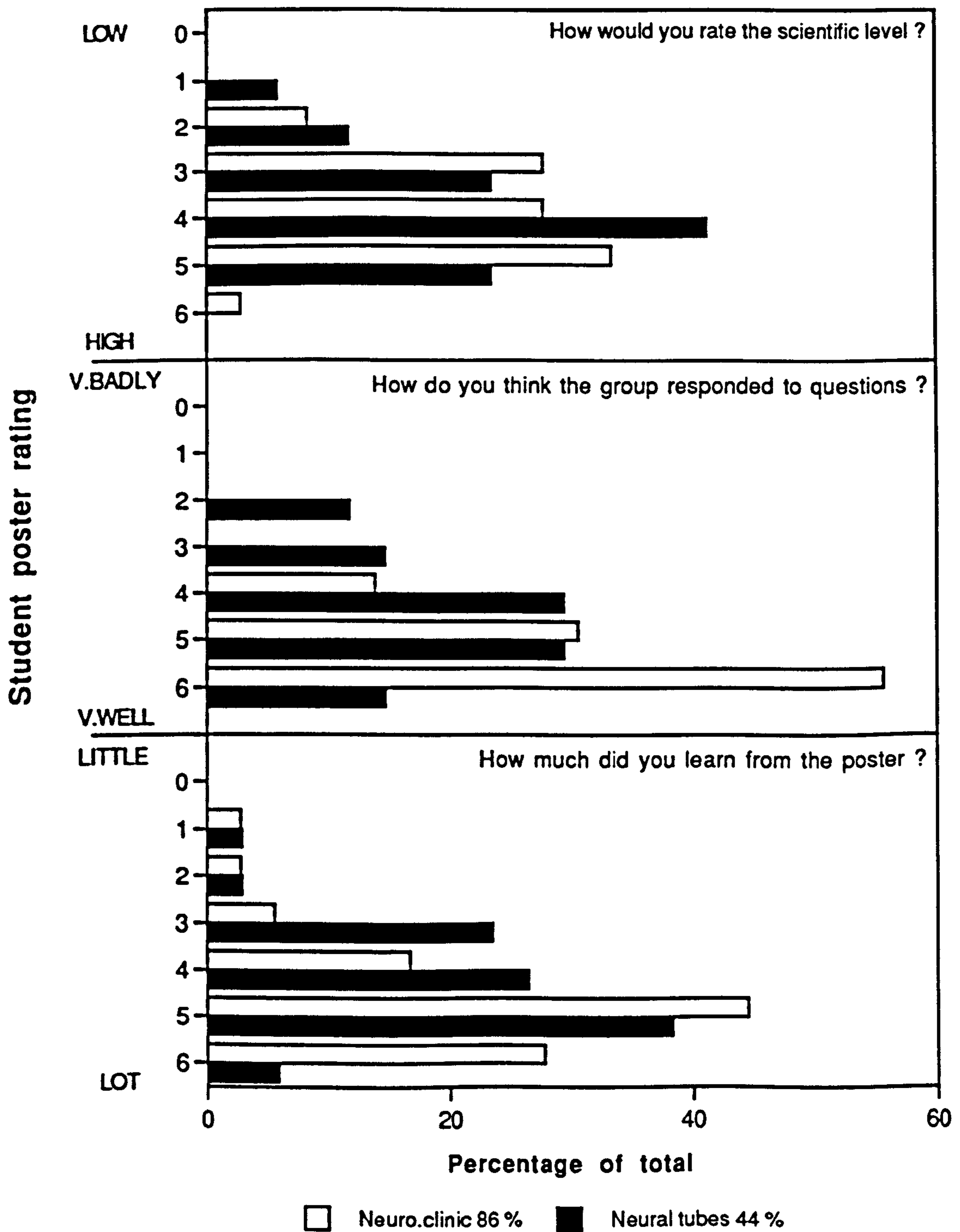
With the aims and assessment criteria established prior to the exercise, everyone seemed much clearer as to the requirements of the exercise, which resulted in a much closer agreement between the staff and student marking immediately after the poster presentations. For example, if a comparison is made between student marking in the Checklist C5 (Appendix 2), for the top and bottom posters for this year, the Neurodegenerative Diseases Clinic (Group 9) and the Neural Tube (Group 6) posters, a difference emerges between the perceived scientific level, how the group responded to questions and more importantly how much the students felt that they had learned from the posters (Figure 5.1). This corresponded closely with the views of the staff and was the first year that students had recognised a difference between the scientific levels of the posters marked as top and bottom by the staff or had indicated also through the checklists that they had gained anything substantial from the other groups work. Although the group awarded the lowest mark by staff (Group 6), were angry about this assessment, most of the rest of the class considered this group's work to be of a low scientific level in their checklist marking. However, apart from and probably because of, the students' increased involvement in the exercise during 1993-4, almost all the students had attended all the poster presentation sessions, throughout the year.

5.3.6 End of year ratings by students and staff

In addition to the similarity between the student and staff assessments of the posters throughout the year, the end of year ratings following the final exhibition were also much closer than had been found in any of the previous years (Table 5.1 see Table 4.4 for comparison). The student ratings in Table 5.1 are taken from the responses to the end of year Checklist C3 which asks students to indicate which poster they rate most highly in a number of categories, for example, which one of posters they considered to have the best design from out of all the posters on display (Appendix 2). The votes for each of the posters were totalled and put into rank order, '1' had obtained the highest number of votes and '9' the smallest number. Table 5.1 shows the student ratings for the highest scientific level

Figure 5.1

A comparison between the student ratings given in Checklist C5 for the posters obtaining the highest and lowest marks from staff during 1993 -'94



'Sci. level' and the ratings for the 'best' poster which combines all criteria. The staff ratings for the 'best' poster are taken from the final marks awarded to the students and are also a combination of all marking criteria.

Table 5.1
A comparison between the staff and student end of year poster ratings given in Checklists C5 and C6 during 1993 - '94
(1 is top ranking and 9 is bottom ranking)

Group	Poster Title	Staff		Students	
		Sci.level	best	Sci.level	best
1	Extraterrestrial Metabolism	3	3	2	3
2	Dragon Metabolism	5	6	5	7
3	Homeostasis - Mermaid	6	7	4	9
4	Calcification - Wigetus	8	8	8	5
5	Limb Development	2	2	3	1
6	Neural Tube Defects	9	9	8	7
7	Loch Ness Monster	3	5	5	4
8	Bones - Dinosaur 747	6	4	5	5
9	Neurodegenerative Diseases	1	1	1	2

Ranking in Table 5.1:

Sci. level indicates the overall ranking for scientific level,
best indicates ranking for the award for best overall poster

5.3.7 Group work and group roles

Despite the reservations which students had at the beginning of the year about working with people they didn't know (see Section 5.3.1), all the groups seemed to get on well while working in the Resource Centre and this observation was further supported by students' responses in Questionnaire G3 (Appendix 2) with all groups, except one, being very enthusiastic and positive about the way in which they had worked together. Almost half the class included comments about positive group experiences such as : *"its fun to work with others"*, *"we made new friends"* and *"group work is good"* Eighty seven percent of the class said that they felt now felt positive about working on a group task without specific lecturer direction (Question 4c) making comments like *"I feel more comfortable about it"* and *"I'd do it again"*. However, almost half of these comments suggested that it was their

particular group composition that had determined the success.

After their poster presentation session, students indicated that they had undertaken a wider range of roles within their groups than they had anticipated before the exercise. A comparison between the responses given to the beginning of the year Questionnaire G2 and those given to the same question in the post exercise Questionnaire G3 (Table 5.2) showed an increase in the number of students feeling that they had acted as 'organisers', 'helpers' and 'clarifiers' while preparing the poster. In addition, the responses from this question had further confirmed that the exercise had encouraged the students to develop a wide range of group skills during the presentation.

Table 5.2
Responses given to 'What role (s) do you anticipate taking /did you take within your group ?' in Questionnaires G2 and G3 respectively
 (Shown as percent/class)

pre - exercise %	Group Role	post exercise %
12	organiser	39
63	supporter	83
56	initiator	69
23	helper	69
56	sharer	88
5	loner	0
0	blocker	3
28	clarifier	39
2	other	8

pre-exercise question - "What kind of role(s) do you anticipate undertaking ."

post-exercise question - "What now best describes your role(s) ."

5.3.9 Case study

a) *Group 6 - Neural tube defects - Photograph 5.3*

Group 6 who worked on the Poster about Neural tube defects obtained the lowest mark of all the posters during the four years. The students had tackled their subject at a very superficial or as already described (see Section 2.10.5) at a very Dualistic level, although their poster itself was very well designed.

During the question/answer part of their presentation session, the group, who were very nervous about being in front of the class, became very

defensive in their responses. The member of staff involved in facilitating the discussion, provided as much help as he could by rephrasing questions and giving the group several opportunities to rethink their responses. However, the students continued to repeat the same answers becoming almost antagonistic in their attitudes.

This 'confrontation', as it seemed to the rest of the class, resulted in many of the other groups becoming overly worried about this part of the exercise and preparing much more for the questions in advance, commenting that Group 6 had had a 'real grilling' during the discussion. The excellent presentation by the other group, Group 5, who had worked on 'Human Limb Development' (Photograph 5.1) also emphasised the difference in approach between the two groups. Group 5 obtained 85 % for their presentation whereas Group 6 obtained 44 %.

Although the staff had explained in great detail to Group 6 why they had received such a low mark the students were very unhappy about it, complaining that the challenge had not been as stimulating as the other one, and that the questioning had been unfair. Even although other group's posters, from previous years, were shown to members of Group 6 as a way of explaining the difference between other's work, which was well integrated and their disjointed approach, the group did not seem to understand the differences.

5.4 Perry Approaches to the poster exercise in 1993 -'94

5.4.1 Introduction

Each of the students completed the three part Perry questionnaire P2 at the beginning of the year (see Appendix 3 and Chapter 3 for description). An individual's score was calculated using the procedure described in Chapter 3.

5.4.2 Relationship between Perry group scores and poster marks

If the average percentage A (Dualist), B (Multiplist) and C (Relativist) type responses was calculated for all of the groups, in the same way as in the previous year, there was no overall relationship shown between these percentages and the staff marks awarded to each of the groups. However, there was very strong evidence of a negative correlation ($r = - 0.757$) between the average % C type and % A type scores from the 19 poster groups from the years 1992 -'93 and 1993 -'94. This was significantly different from zero at the

Figure 5.2
The relationship between the mean percentage for A and C type positive responses for the poster groups from 1992 to 1994 (n = 19)

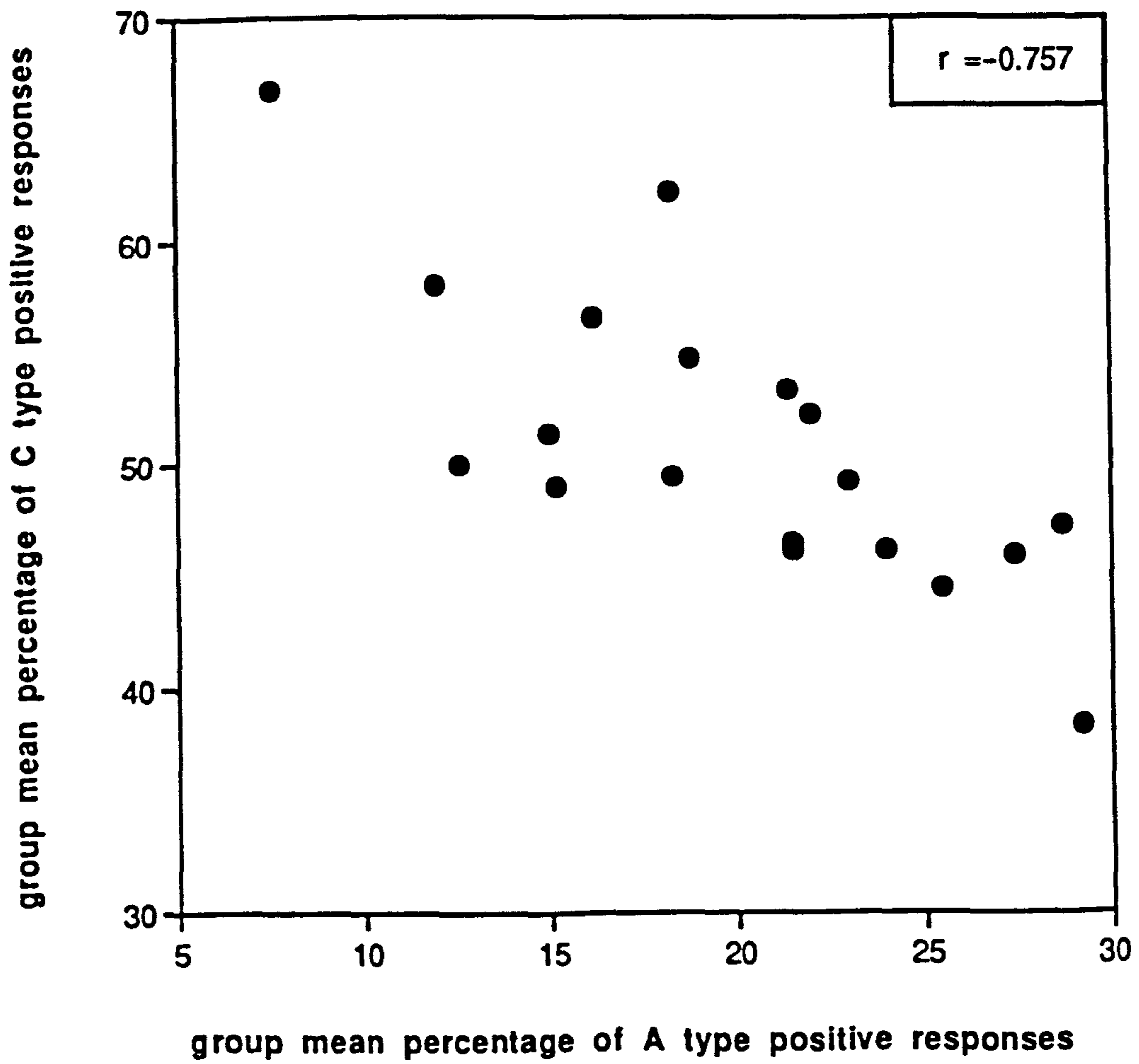
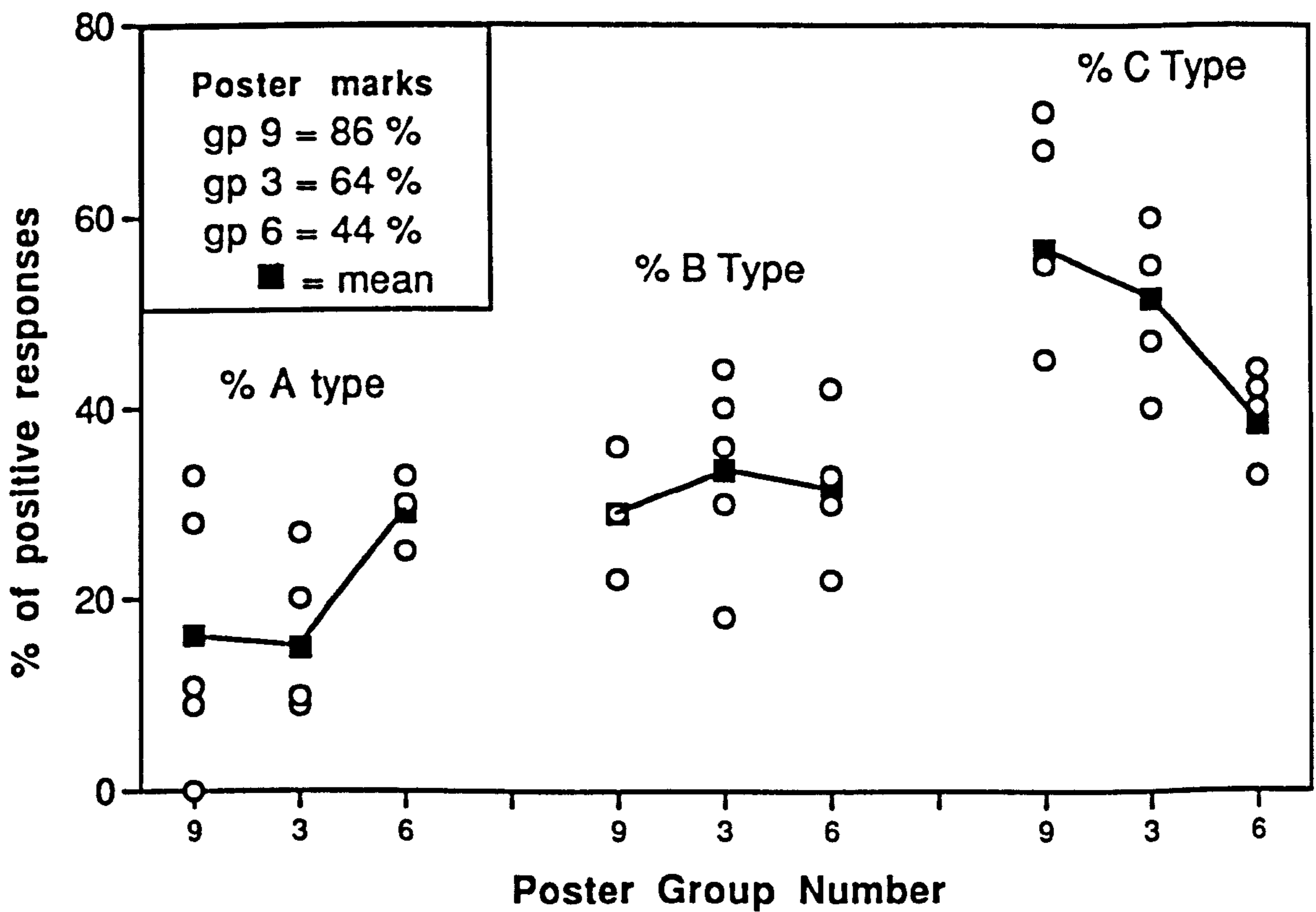


Figure 5.3

A comparison between group poster performance and type of positive responses given to the Perry Questionnaire P2 in October 1993 by individuals in the groups rated by staff as being top, middle and bottom of the class



0.1 % level.

However, if the groups marked top, middle and bottom of the class during 1993-'94 are taken in isolation, Groups 9, 3 and 6 awarded 86, 64 and 44 percent respectively, (Figure 5.2) these marks appear to relate to their Perry scores and in a way in which would have been predicted by the Perry model (Chapter 3): the mean A type is lower and the C type higher for the top group (Group 9) and the opposite is true for the group marked as lowest (Group 6). Group 6 has an unusual grouping of individual Perry responses, having a cluster of high A and low C type responses. This was the group which had shown such dissatisfaction with their final mark (see Section 5.3.9) and had experienced difficulty both in answering questions and recognising what constituted good and bad levels of integration of scientific material as shown in other posters.

5.4.3 The group dynamics related to the Perry scores

During 1993-'94, after their poster presentation, each student in the group was asked in Questionnaire G4 (Appendix 2) to identify the two students from their group, whom they thought : 1) had most influenced opinion 2) had least influenced opinion and 3) they had most regularly checked their work with. Some of the students voiced concern over making these selections, as they felt that selecting out only two students, particularly as the influencers, in some ways devalued the contribution of other members in their group. However, when it was explained that the responses were 'only' for research purposes and not for use in the marking scheme, almost all of the students completed this questionnaire section.

The feedback responses obtained from Questionnaire G3 were in line with my own observations of the groups at work in the Resource Centre in all but one group. This group, Group 6 (Neural tube defects poster) had appeared to be influenced by two of the more verbal members. However, all the group indicated that one of the quieter students, a male student, had been one of the most influential, and had been the one that they had checked their work with. Twelve out of the 16 male students in the class were described as having an influential role within their groups. The four male students remaining, were in groups influenced by other male students not female students.

5.4.4 Anticipated vs. actual roles adopted by students

The influencing and non-influencing roles within the groups could

not be predicted by the responses given by students to the Questionnaire G2 (Appendix 2) prior to the exercise, in other words, the 24 students described as influencers in their group had not anticipated taking on an organisational or influential role. Seventeen of the class indicated in the post exercise Questionnaire G3 (Appendix 2) that they had undertaken the role of being an organiser with their group however, only 12 of them were perceived as influencers by the rest of their group members.

5.4.5 The Perry scores of the Influencing/Non-influencing group members

If the individual Perry scores are plotted in poster rank order and the individual scores for the students who were the most and least influential for each of the groups identified, in most cases the Influencing members of each group were the students who had low A type and high C type approaches (Figure 5.4). There is no distinctive trend with the B type responses, with each of the groups having students with a mixture of different levels. Group 6, who had scored 44 %, had two Influencers who had the highest out of their 5 student's A type scores.

It might be predicted that students who are more relativistic are more likely to adopt a more influential role within an exercise encouraging such an approach and that there might be some characteristic attitudes which would discriminate a group Influencer from a group Non-influencer.

5.4.6 Differences between students adopting Influential / Non-influential roles in groups

a) *Part 1 of the Perry Questionnaire P2*

If a comparison is made between the A/C, the B/C and the B/A type (Figure 5.5) responses then three interesting trends emerge. The Influencers tend to have high C/A, high C/B and low A/B, whereas the Non-influencers seem to show the opposite trend. The two groups of students can be seen to have distinctive types of approaches as identified by the Perry questionnaire which have, in some way, determined the type of role which they have adopted within the poster exercise. If the average percentage of A, B and C type positive scores are compared for the two groups collectively, the Influencers have lower A and B type responses and higher C type responses than the Non-influencers (Figure 5.6). Using a z test for the equality of two proportions, the Non-Influencing students were shown to have a significantly higher level of agreement to three of the A type statements than that of the Influencing students (Figure 5.7). In addition,

Figure 5.4

A comparison between the type of positive responses given by individuals reported to be Influencers and Non-influencers in groups during 1993 -'94

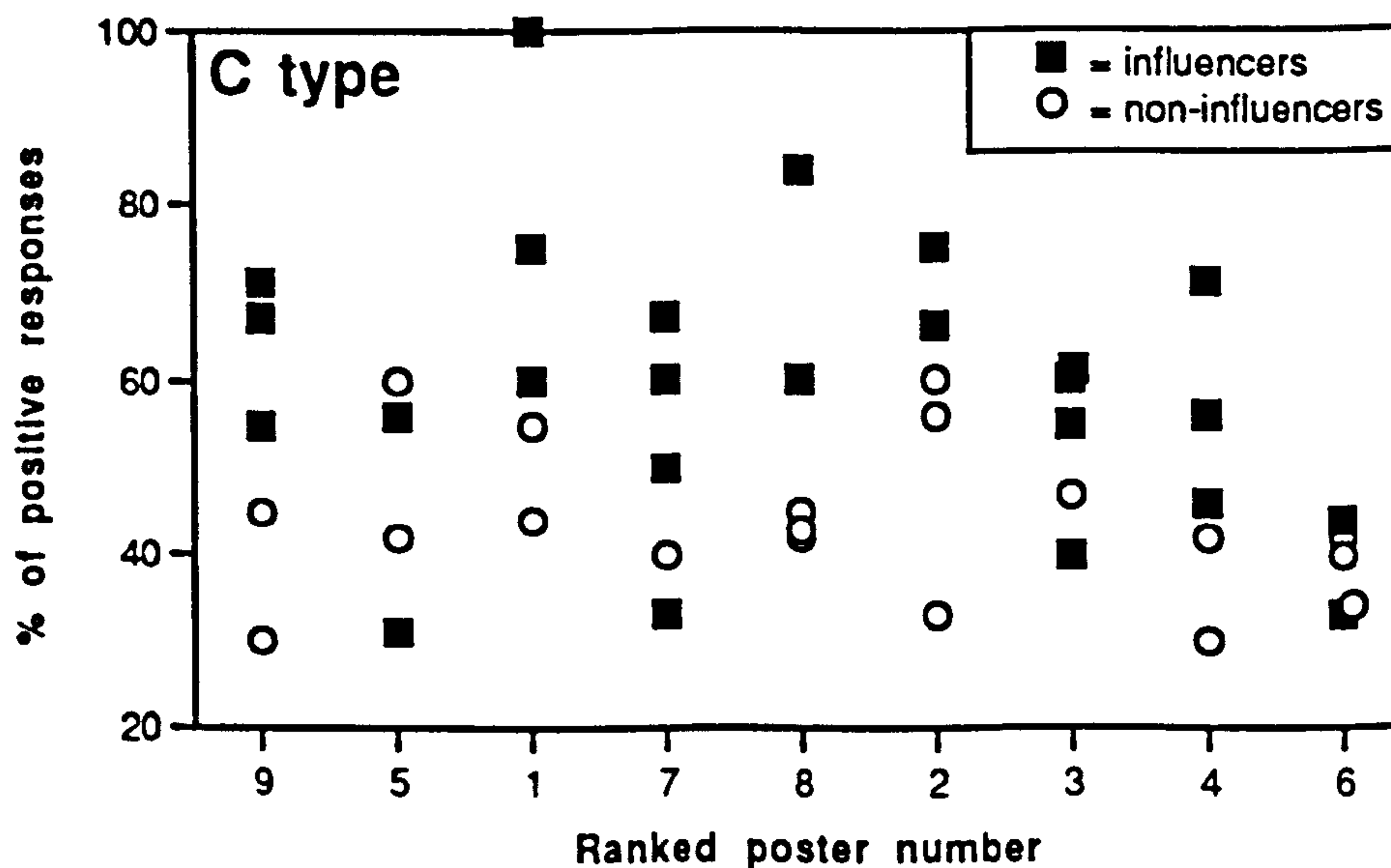
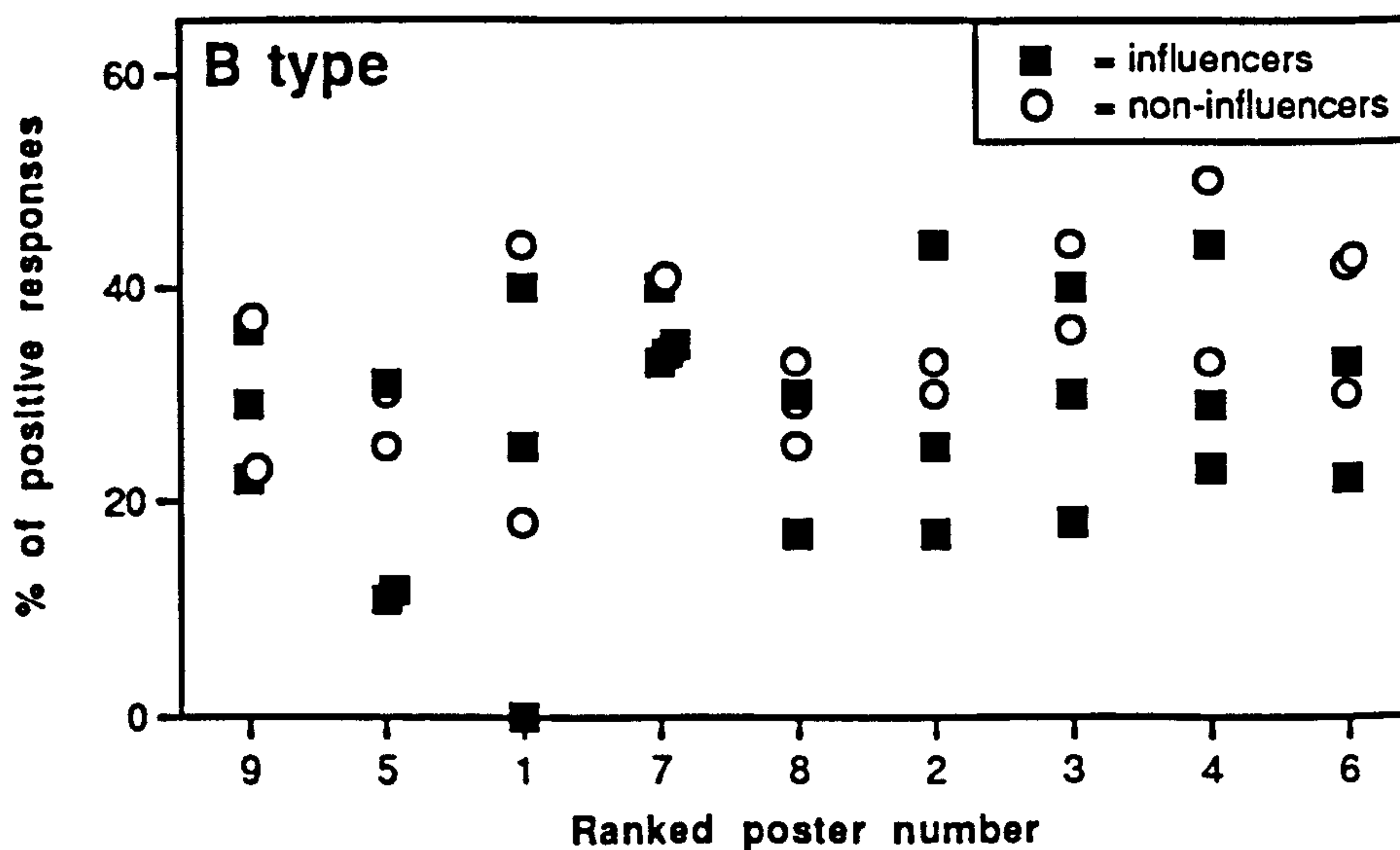
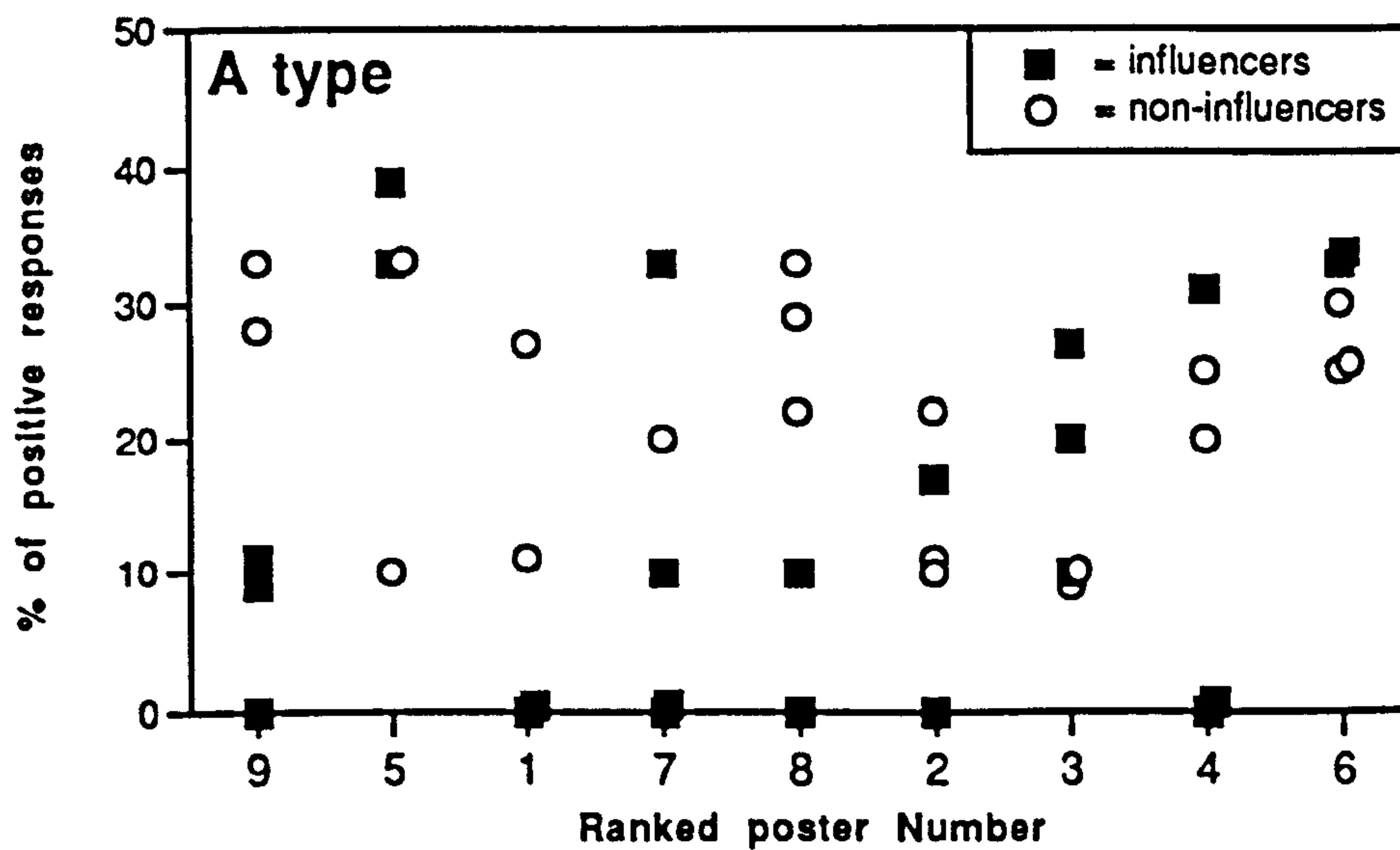


Figure 5.5
 A comparison between the percentage of A, B and C type positive responses given by those students reported as being the most and least influential within the poster exercise in October 1993

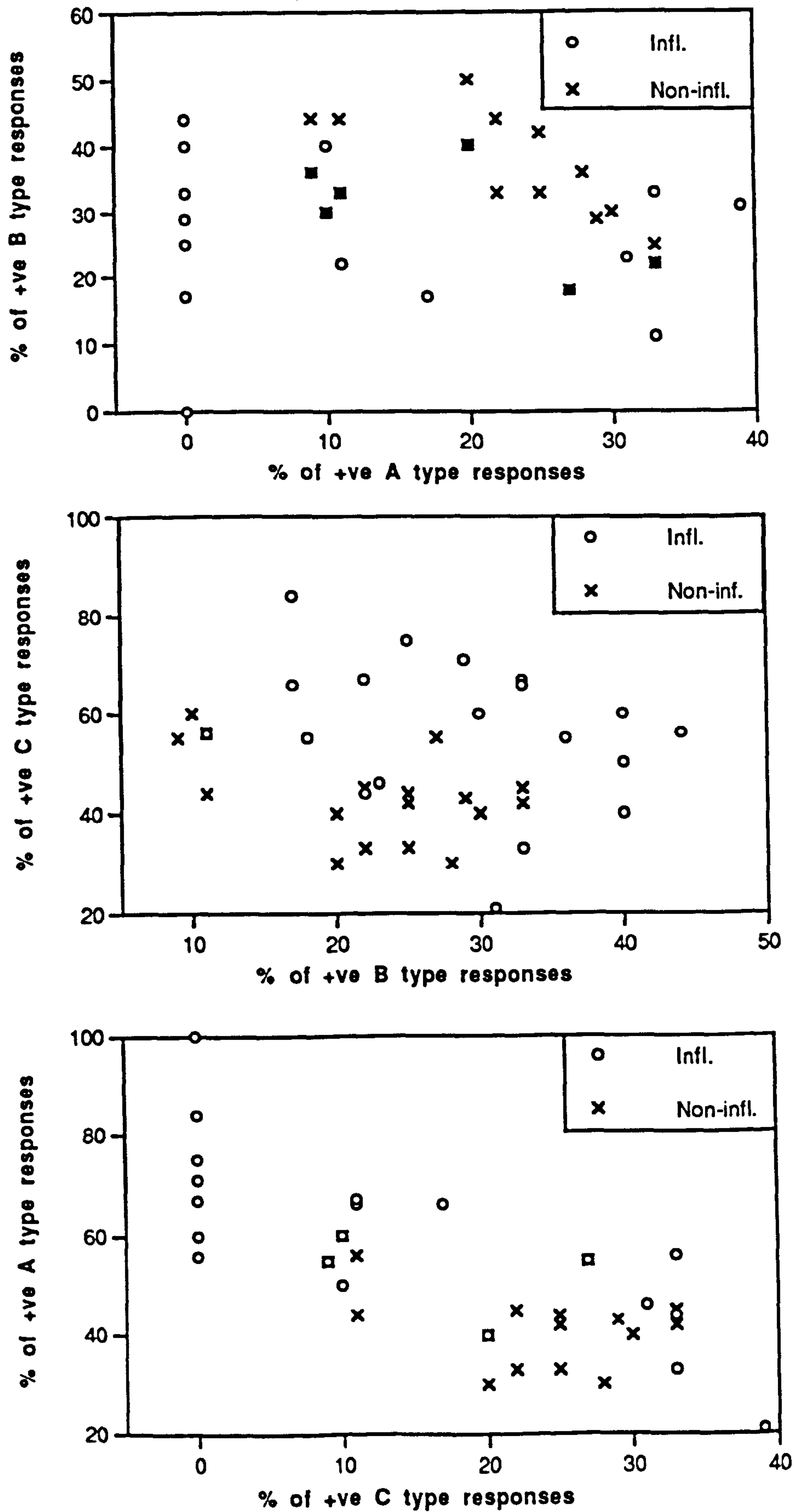


Figure 5.6

A comparison between the percentage A, B and C type positive responses given in Perry Questionnaire P2 by those students reported as being the most and least influential within the group poster work during 1993-'94

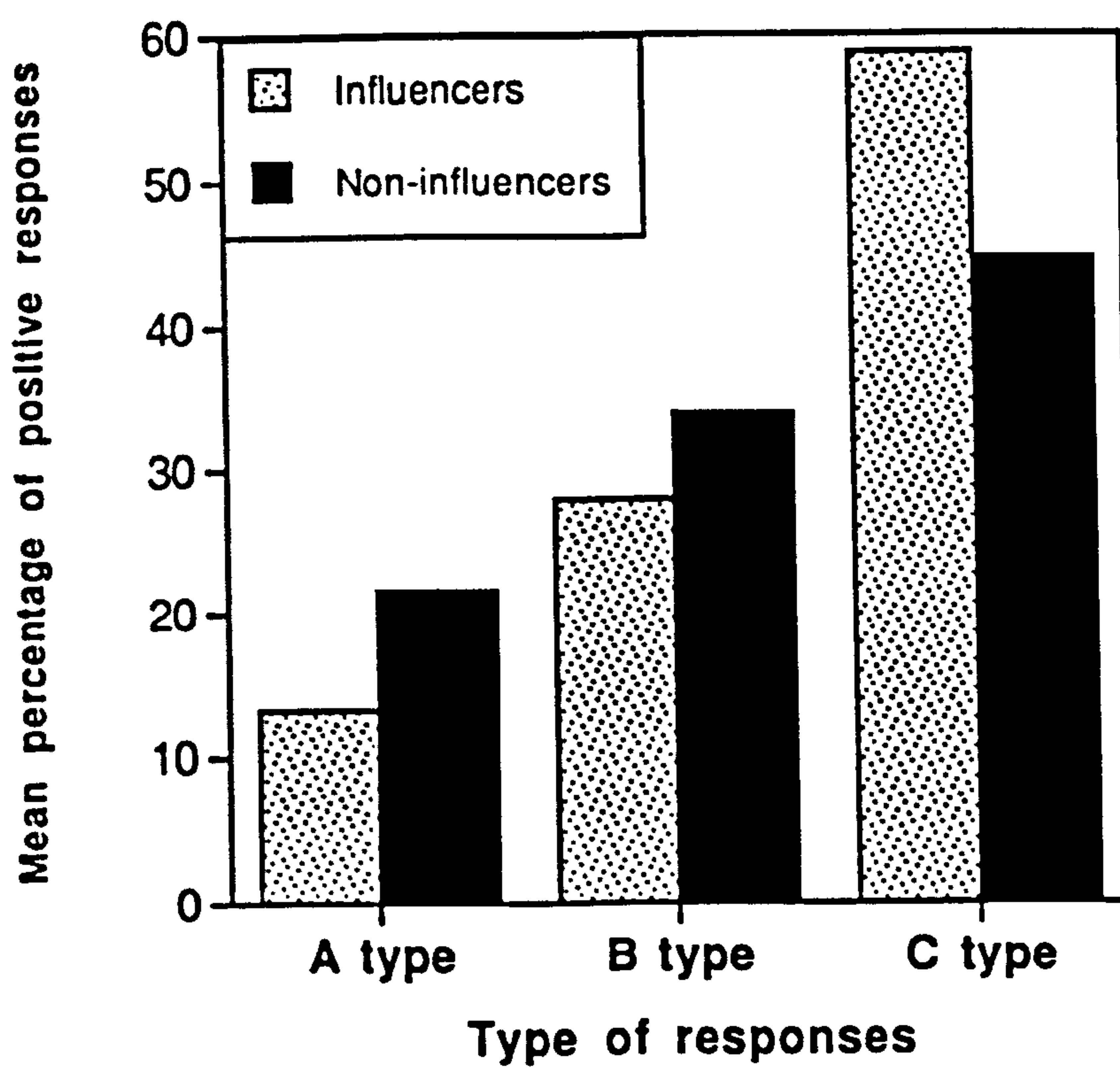
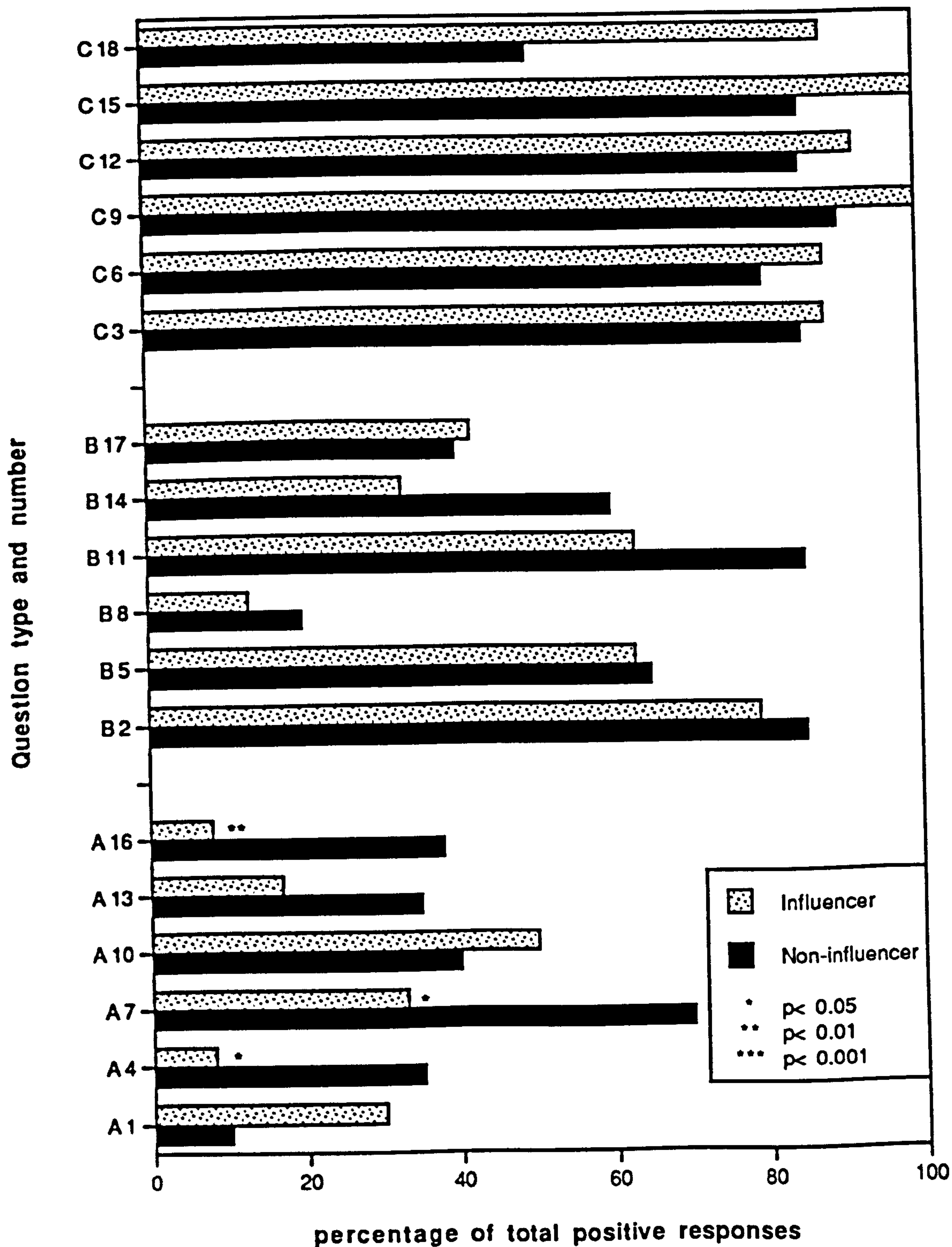


Figure 5.7

A comparison between the responses given to specific statements in Part 1 of the Perry Questionnaire P2 by students reported as being the most and the least influential within the poster exercise during 1993-'94



(The percentages given by the two groups were compared using a z test for the equality of two proportions)

there was evidence from the scores from the Perry Questionnaire P2 Part 1 that it was possible to predict at a 0.7 level of accuracy given a student's score to which group the student would belong. This was significant at the 0.05 level.

b) Responses to the Part 2 of the Perry questionnaire P2

In Part 2 of Questionnaire P2, where the students were asked to justify their decisions about six selected statements, there was no difference between the number of students from the two groups responding to the open ended questions, with some of the Influencers leaving the questions blank and some of the Non-influencers not doing so. However, a significantly higher number of the Non-influencing students than the Influencing students agreed with Statement 3 : *"Sometimes there seems to be so many ways of looking at science subjects, I feel confused about what is right or wrong"* (Figure 5.8). Whereas the same statement in Part One of Questionnaire P2 (Question 11) had not shown a difference. This would suggest that the 'immediate responses' given to Part 1 of the questionnaire may not be a true representation of how students really feel and that it is only when they are asked to justify their decisions that they put more thought into their replies. The responses for Part 2 - Statement 3 fell into four categories which can be summarised as being of the following types:

Disagree No, I'm not confused, most things we have been taught have had a right or wrong answer

Agree Yes, I'm confused, concerned, upset etc., I'm having difficulty in working out what / who to believe - what is right or wrong ?

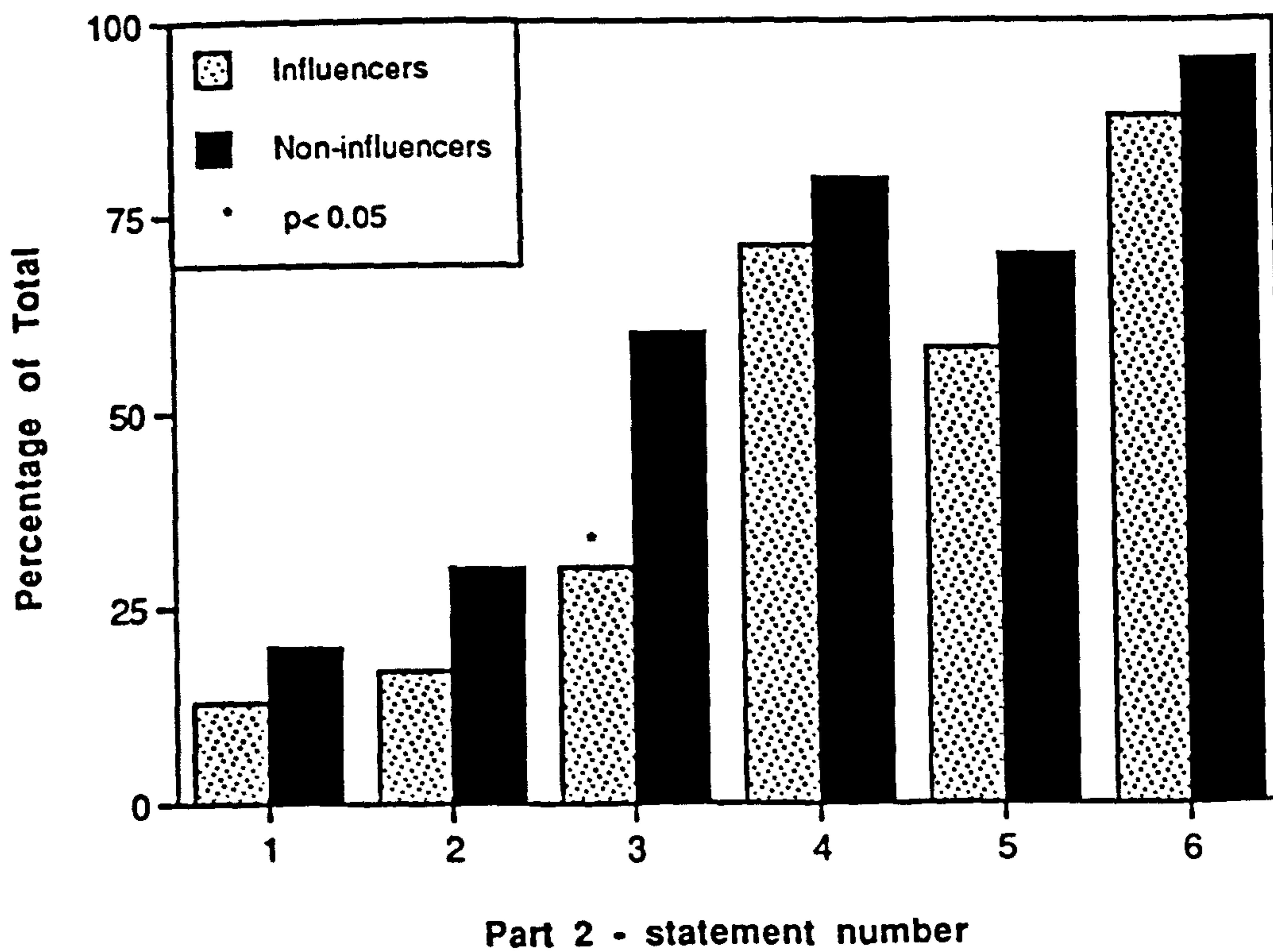
Agree Yes, the subject is confusing, has grey areas etc. - but that is what makes it interesting / more fun

Disagree Although there are many different ways of looking at the subjects it is not confusing, it is up to you to decide what is appropriate for a topic

These four different interpretations suggested that Statement 3 was being taken in two parts namely 'is the subject confusing?' and 'are there different ways of looking at the subject ?' However, the justifications given by the students seemed to give a clear indication as to how they felt, with many of the Non-influencing group voicing feelings of panic and frustration whereas the Influencing group wrote more positively suggesting that they enjoyed the different perspectives which the subjects offered. This is further

Figure 5.8

A comparison between the responses given to Part 2 of Perry Questionnaire P2 by those students reported as being the most and least influential within the poster exercise work during 1993-'94



(The average class percentages were compared using a z test for the equality of two proportions)

Table 5.3 :
Reasons behind the preferences given to Part 3 of the Perry Questionnaire by students considered to be Influencers and Non-influencers within groups

Non - influencers
<p><i>Teaching methods</i></p> <ul style="list-style-type: none"> - Tutorials can often deviate from the issue, lectures guarantee some information - A larger number of students usually needs to be given directions, without a lecturer topics become side-tracked - Everyone has a different view and the lecturers give you theirs - this is confusing when there are three or four - There are many opinions and it is confusing to know which to believe - Because I am being taught second hand I don't do anything myself, at my level my knowledge is very limited - Some say one thing is correct when someone else says it isn't <p><i>Assessment methods</i></p> <ul style="list-style-type: none"> - Multiple choice questions tend to confuse you - Questions without clearcut answers cause frustration and confusion - Multiple choice questions are better because the right answer is there - Short answer questions are easier to answer, less confusing - Problem solving questions with no definite answer tend to confuse and cause panic as no answer has been reached, you don't know if you are right or wrong - Clearcut answers are unsettling if you don't get the right answer - Problem solving questions are hard enough without having to wonder if your answer was suitable - Most things we have had, had a right or wrong answer
Influencers
<p><i>Teaching methods</i></p> <ul style="list-style-type: none"> - A student must be able to work independently of the lecturer - Group work allows you to develop initiative - Group and individual work without supervision gives you a freer hand, supervision can restrict you - Participation from others is beneficial, as I believe that interaction stimulates the mind and the retention of the fact /information is certainly longer - Participation with students is the best way to learn, a lecturer present all the time leads to laziness - There is the need for students to have their own space outwith the classroom - It is easier to discuss yours and others opinions in a small group - Small groups - better to get feedback without being bombarded with too much information <p><i>Assessment methods</i></p> <ul style="list-style-type: none"> - It is important to be able to put forward your opinion - multiple choice is guess work - In these ways I can best put across my views and knowledge on a topic - Multiple choice test recall, to be able to solve a problem looking at possible answers shows that you have grasped and applied concepts while keeping an open mind - I prefer to use the information I have learned - I believe opinions are important and these allow students to express theirs - Problem solving is valuable to students, my opinion should be made - Individual opinion is a good way, as long as it is fairly marked - Essays allow you to put forward your opinion, short answer type ones don't - Approaching a question with no answer is a good way of testing knowledge - I approach from different ways then decide which one works best for me - If you read around the subject you can make up your mind

exemplified by the reasons for their Course Preference selections given by the students in Part 3 of Questionnaire P3. Examples of responses considered to be reflective of the two groups are shown in Table 5.4.

c) **Part 3 of the Perry Questionnaire P2**

In the final section of the Perry Questionnaire P2 (Appendix 2) students are asked to indicate their most and least preferred teaching and assessment methods in addition to their preferred method of preparing for their selected assessment methods. A number of differences were found between the Influencing and Non-Influencing groups (Figures 5.9 and 5.10). A z-test was used to compare the equality of the mean responses for the two groups. Those showing a significant difference in all parts of the Perry Questionnaire are listed in Table 5.4 below :

Table 5.4
Comparison between responses to Perry Questionnaire P 2 given by third year Influencing and Non-influencing poster group students in October 1993

Influencing students		
Part 1 - Agreement with C type statement - No.18 I enjoy undertaking assignments where the lecturer doesn't specify exactly what has to be done and it is up to me to decide		
Part 3 - Significant differences from Non influencing students (p < 0.05)		
Teaching	<i>most preferred</i>	Tutorial - lecturer directs class
Assessment	<i>most preferred</i> <i>least preferred</i>	Problems - no clearcut answer Multiple choice questions
Studying	<i>most preferred</i>	summarising notes, prioritising points
Non - influencing students		
Part 1 Agreement with A type statements Nos		
4 The only fair problem exercises are those which are exactly like those we have already done in class (p< 0.05)		
7 I would be surprised, if the lecturer could not answer any questions relating to their course which I might ask (p <0.05)		
16 It is a waste of time working on problems which have no possibility of resulting in a clear cut answer (p <0.01)		
Part 2 Agreement + justification No		
3 Sometimes there seems to be so many ways of looking at scientific subjects, I feel confused about what is right and wrong (p <0.05)		
Part 3 Significant differences from Influencing students (p < 0.05)		
Assessment	<i>less preferred</i> <i>more preferred</i>	Problems - no answer Multiple choice questions
Study skills	<i>most preferred</i>	Rewriting notes

Figure 5.9

A comparison between the teaching, assessment and study methods listed as being the most preferred by the students reported as being the most and least influential within the poster group during 1993 -'94

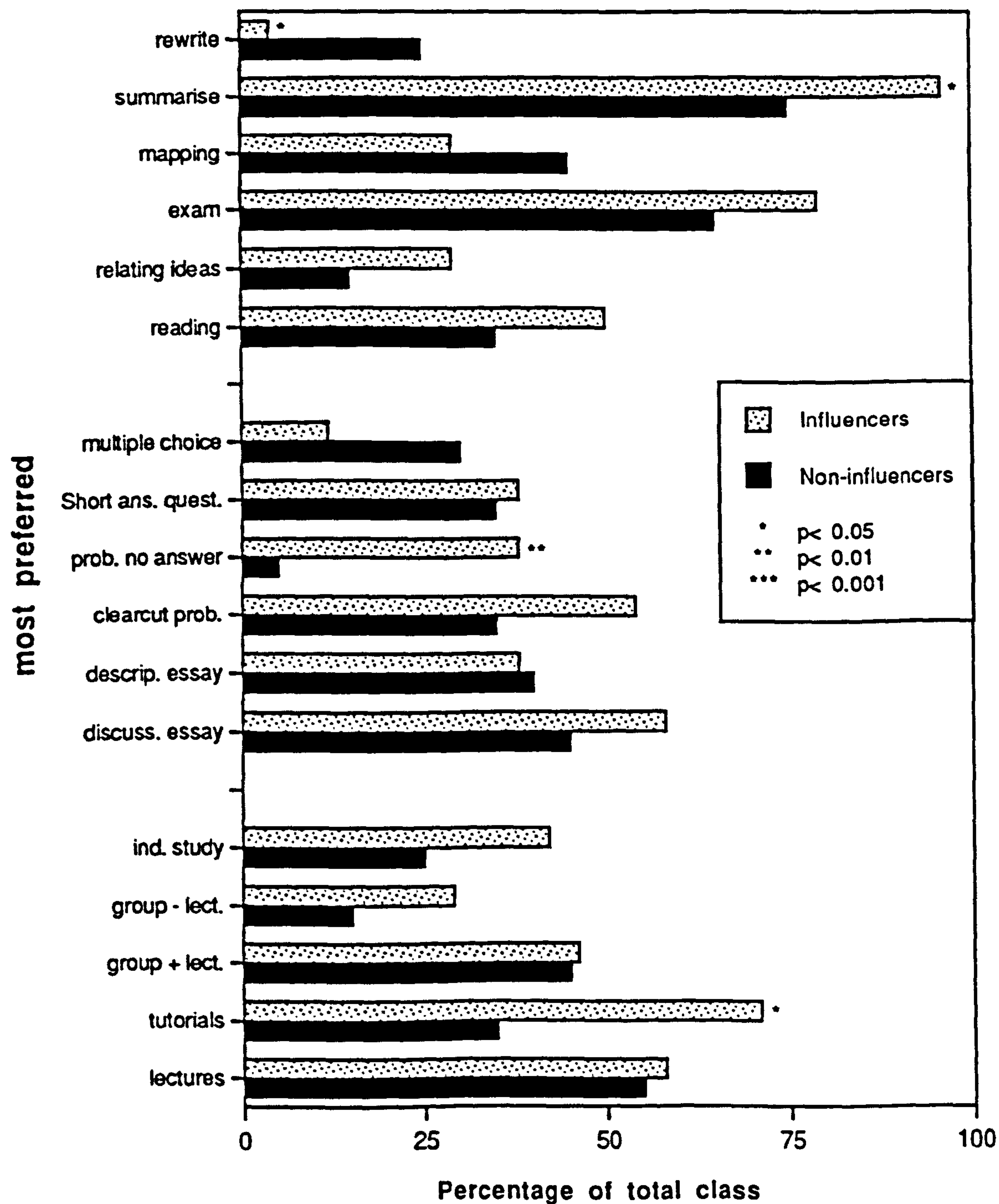
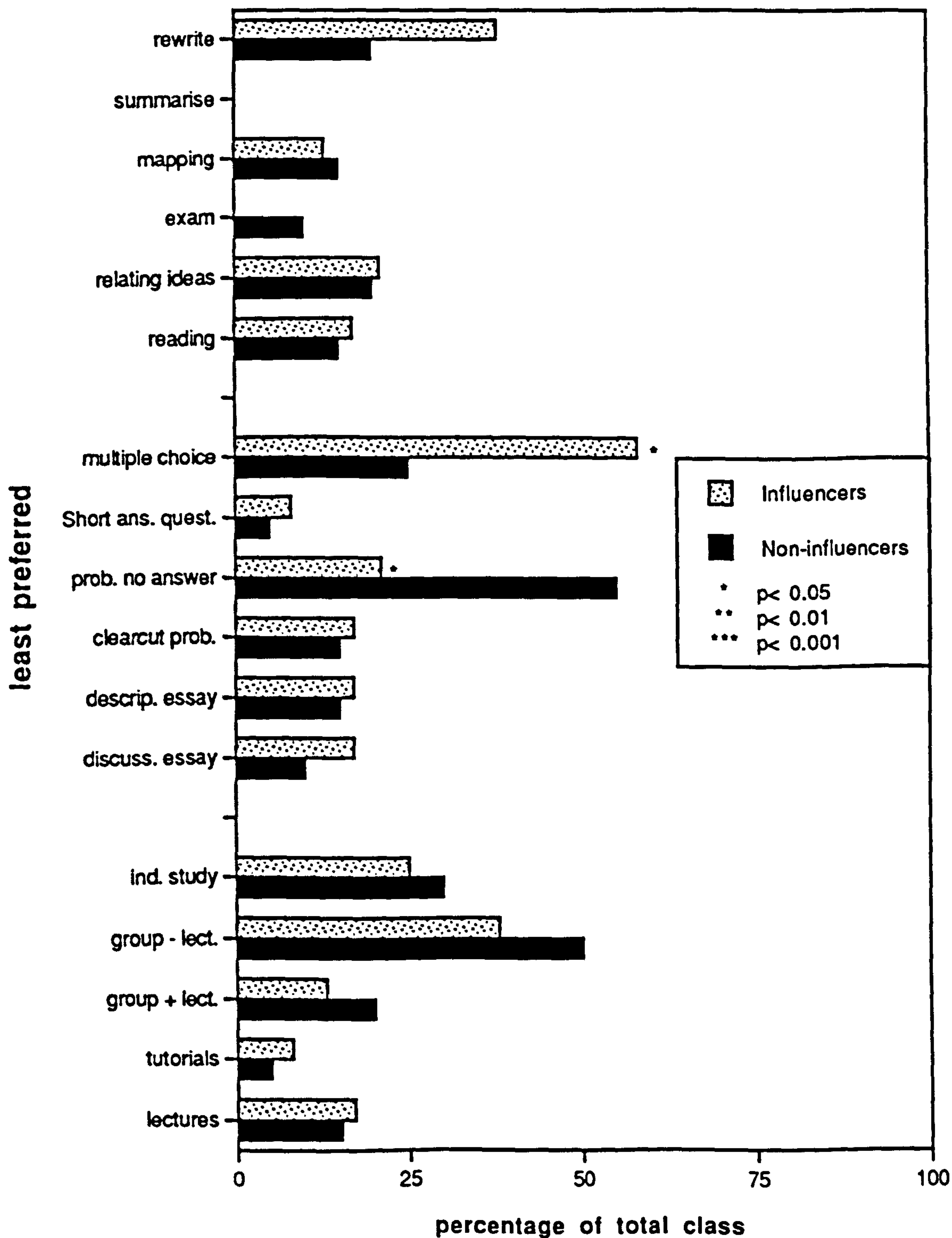


Figure 5.10

A comparison between the teaching, assessment and study methods listed as being the least preferred by the students reported as being the most and least influential within the poster group during 1993 -'94



(The percentages given by the two groups were compared using a z test for the equality of two proportions)

d) Responses to Part 3 of Questionnaire P2

As shown by the responses in Table 5.3, when giving a reason for their choices to Part 3 of the questionnaire the Non-influencing students almost all talked about learning in a more depersonalised way, indicating an almost linear, directional approach to science which was in some way guided/directed by the lecturer, and that they felt confused/unsettled/panicked when there was any deviation or alternative paths to select from. The Influencers however, talked about learning in a more personalised way in terms of what method had worked for them, which they preferred and most of the students mentioned the importance of voicing their opinions/views /ideas and that of other students through discussion and participation.

e) Gender differences between Influencing and Non-influencing students

Half the Influencing group were male. This proportion constituted 75% of the male students of the class but only 43% of the female students. Non-influencing male students were only found in groups with Influencing males. There was no difference between the male and female Influencers' preferences in Part 3 of the Perry Questionnaire P2 although male students did show more of a preference for group work than the female students (Data not shown). The small number of male students within the Non-influencing students' group does not really allow for any statistical comparisons to be made between the male students from each group. However, there was a statistically significant difference between the Influencing male and female students and Non-influencing female students responses to the A and B type but not the C statements of the Perry Questionnaire P2 (Figure 5.11). This, in combination to the differing responses in other parts of the questionnaire, suggests that the Influencing and Non-influencing roles adopted by the students were determined more by their stage of intellectual development than by the students gender.

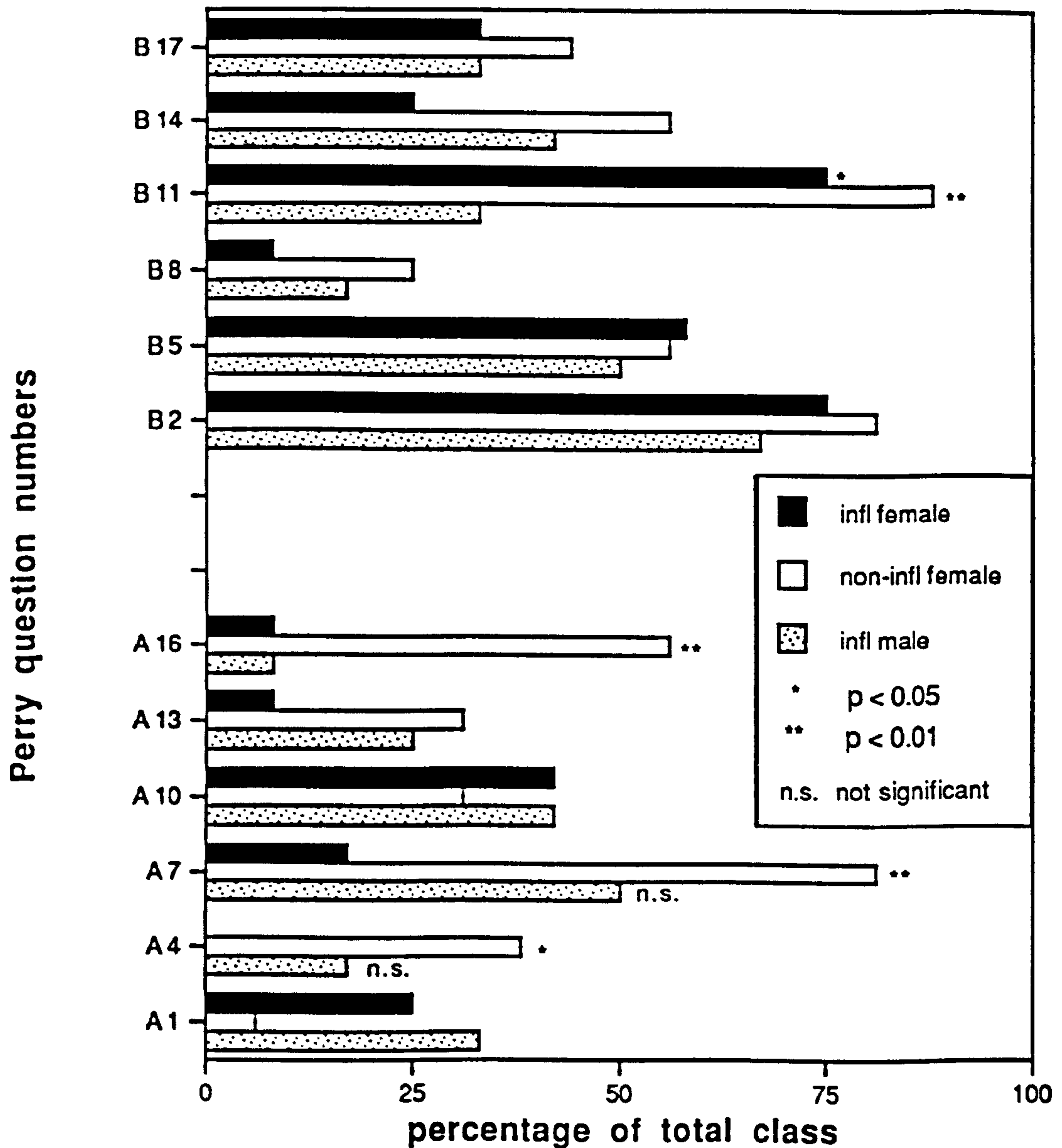
5.5 Students' influencing behaviour compared to relativist thinking

5.5.1 Introduction

Although the poster exercise seemed to be encouraging the more relativistic thinkers from each of the groups to become the influencing

Figure 5.11

A comparison between the responses given to the Perry Questionnaire P2 by the male and female students reported as being the most and least influential in the poster exercise 1993-'94



(The percentages given by the groups were compared using a z test for the equality of two proportions)

students within their groups, their level of C/A type thinking was higher comparative to the rest of their group and not to the rest of the class. It could be speculated that the Influencers, for example, from a group comprising students all with low C/A thinking, like Group 6 in 1993 -'94, would probably have less relativistic thinking than the Non-influencing students from, for example, a group all of whom had high C/A like Group 9 in 1993 -'94 (Figure 5.3). If the group poster exercise was selecting out the most relativistic thinkers from each group, it would therefore be predicted that if the same third year class was separated into High (C/A) and Low (C/A) Perry groups, by only using their Perry scores (Chapter 3) there would be a more pronounced difference in aspects, such as their course preferences, shown to discriminate between the Influencing and Non-influencing groups.

5.5.2 High and Low Perry scoring students taken from the third year class

a) *Selection of groups*

High and Low Perry groups were selected according to their relative percentage of A and C type responses in Part 1 of Perry Questionnaire P2. The High Perry group contained 17 students with A type positive responses ranging from 0 to 11 % and C type responses from 55 - 100 %. The Low Perry group, of 17 students, ranges were from A type - 20 to 39 % and the C type 30 to 45 %. The 11 students in the middle section of the class, with scores between these ranges were not included in this study. The average A, B and C percentage scores for the two groups are shown in Figure 5.12. The teaching and assessment preferences indicated by the two groups are shown in Figure 5.13.

The High Perry group showed several similar course preferences to that of the Influencing group and the Low Perry group to that of the Non-influencing group (see Figures 5.9 and 5.10 for comparison). However, there were differences between the groups selected by their Perry scores and those selected by their group work which suggested that the group roles adopted in the poster exercise were indicative of student's particular course preferences as well as their stage of intellectual development.

b) *High Perry group*

The High Perry group showed a significantly higher preference for discussion essays and significantly lower dislike for problems without clearcut answers and lectures than the Low Perry group (Figure 5.14). The

Figure 5.12
A comparison between the average A, B and C type responses given by the third year groups of High and Low Perry students to Perry Questionnaire Part 1 in October 1993 -'94

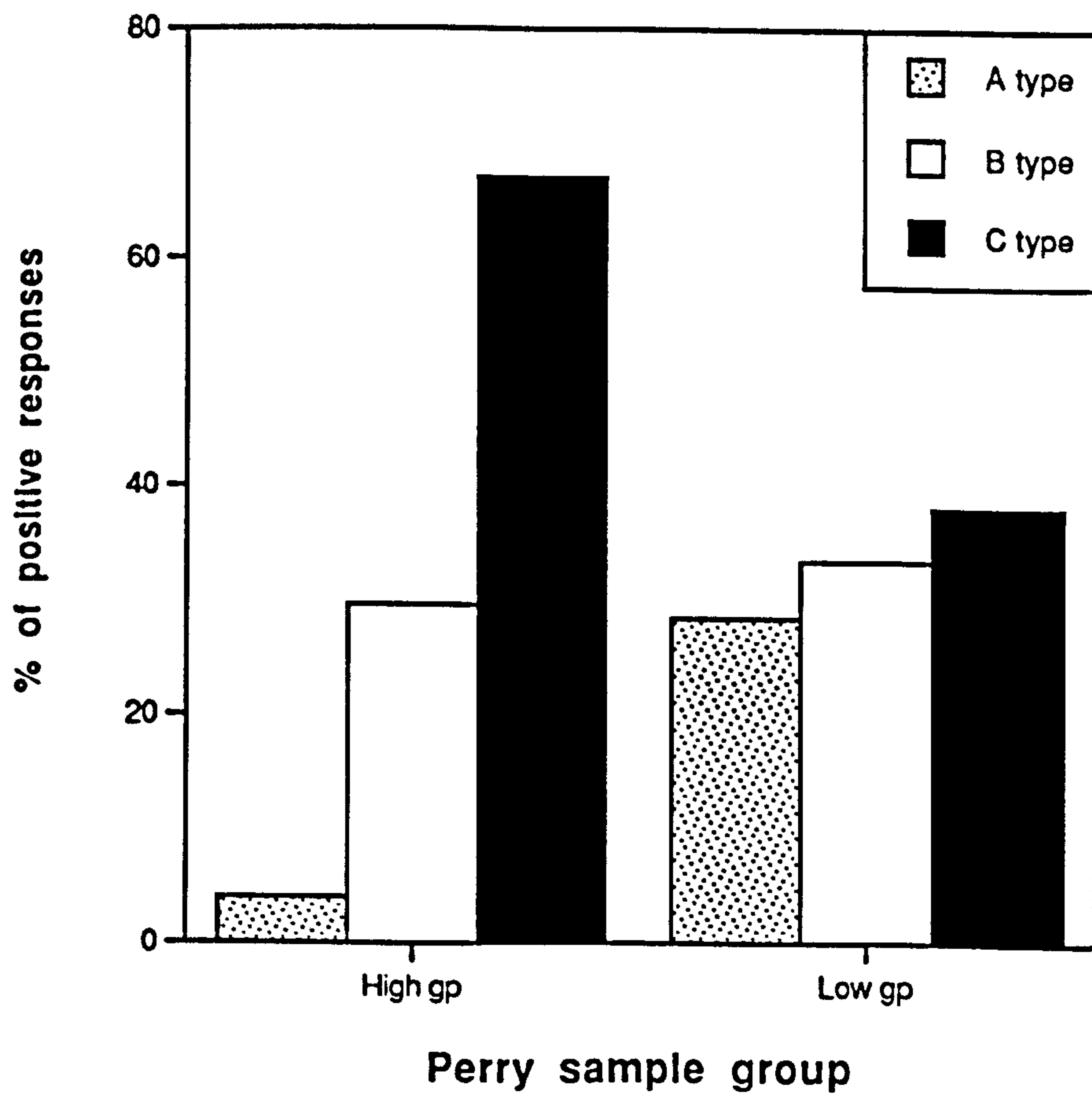
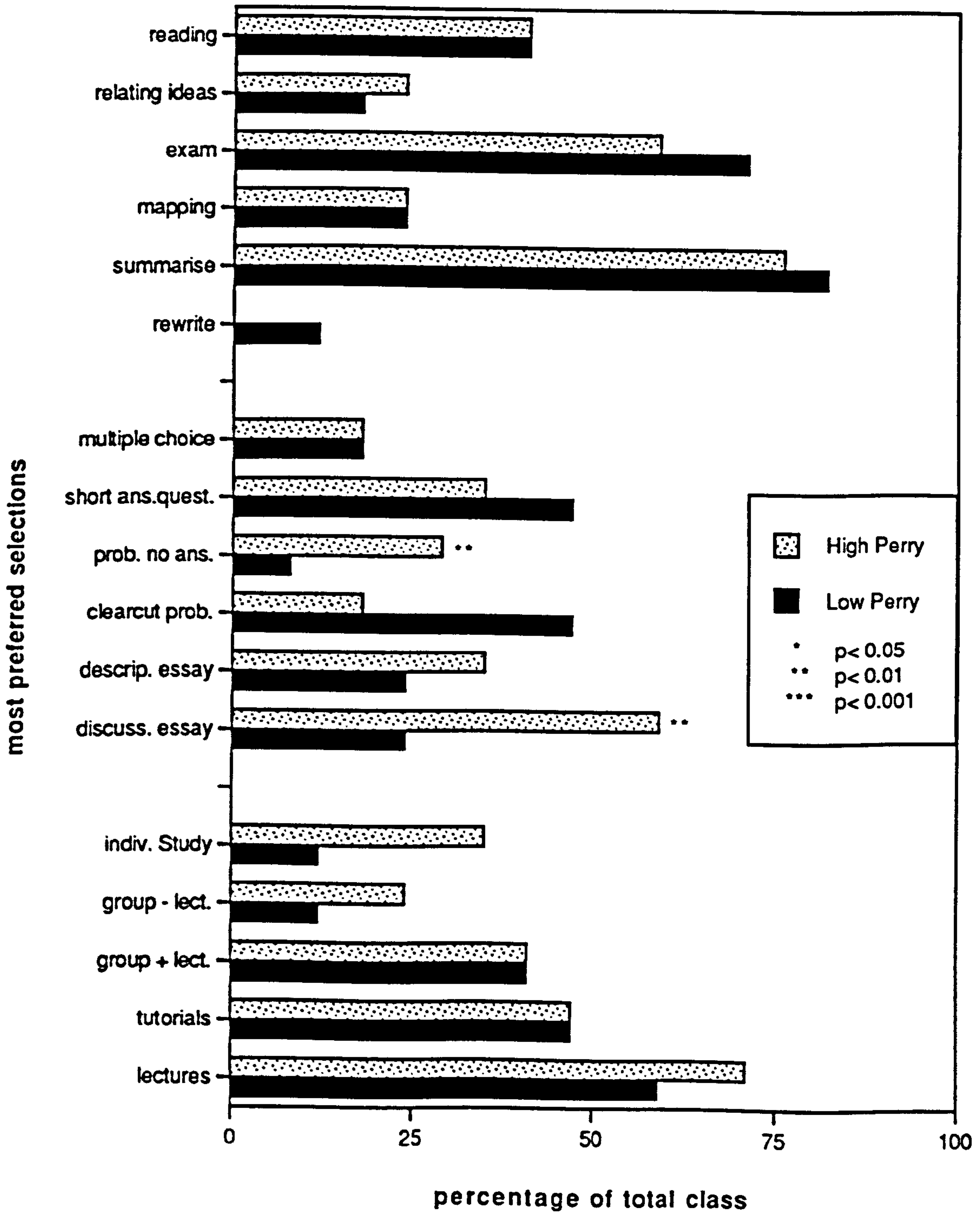
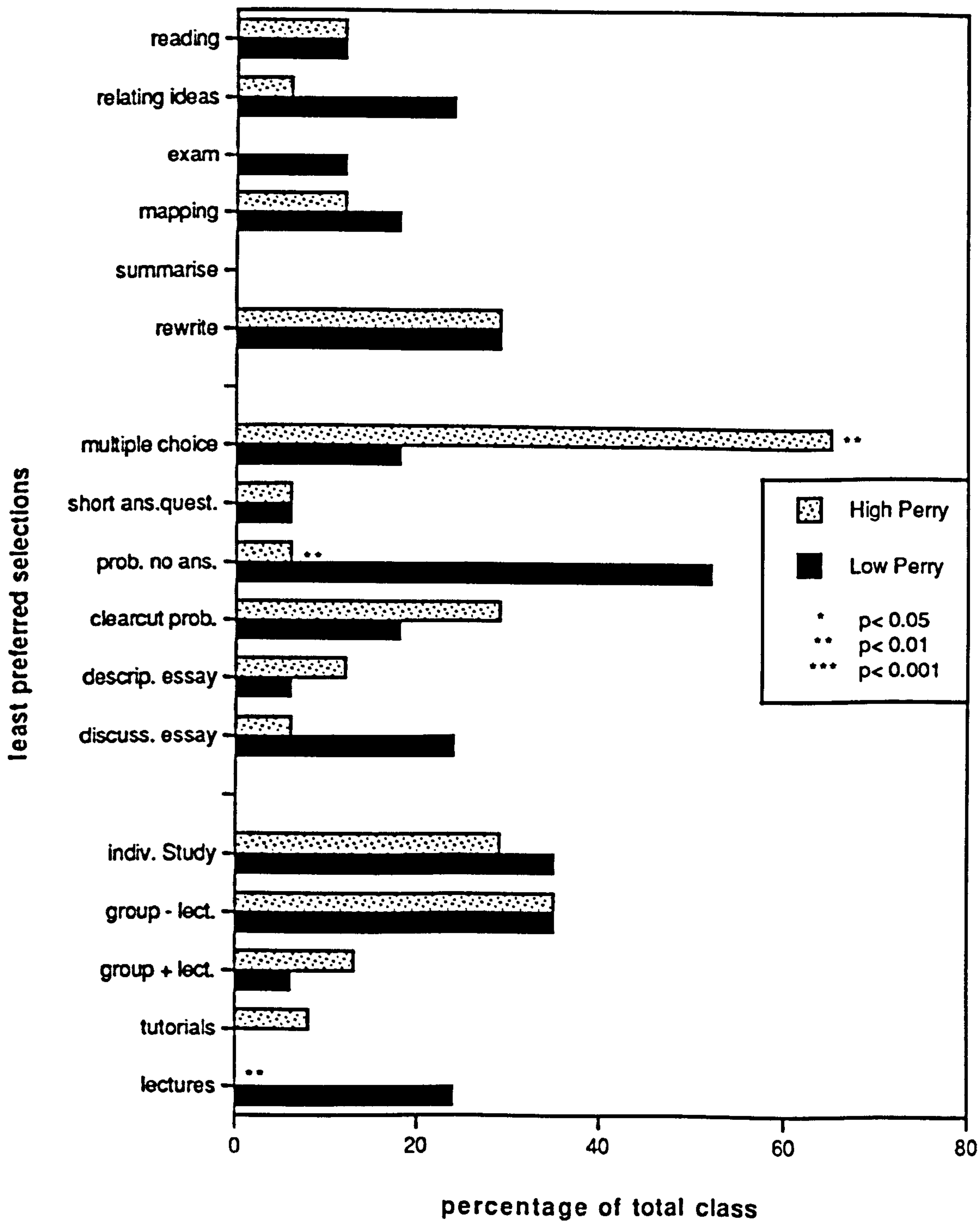


Figure 5.13
 A comparison between the most preferred instructional methods selections made in Perry Questionnaire P2 by the High and Low Perry scoring third year groups in October 1993



(The average class percentages were compared using a z test for the equality of two proportions)

Figure 5.14
 A comparison between the least preferred instructional methods selections made in Perry Questionnaire P2 by the High and Low Perry scoring third year groups in October 1993



mean responses from the two groups were compared using the z-test for equality of two proportions. The High Perry students showed more of a liking for lectures and individual study and less of a preference for tutorials than had the Influencing group (Figures 5.9 and 5.10). The discussion essay followed by the descriptive essay were the High Perry group's most highly rated assessment methods, while problem type questions with an answer were less popular than those without (Figures 5.13). In contrast, the Influencers had shown a greater general preference for both types of problem solving questions, in particular, clearcut problems. The difference in the number selecting Multiple choice type questions as their least preferred method of assessment was far more pronounced between these two groups (47%) than between that of the two Influencing groups (18 %).

c) Low Perry Group

The Low Perry group rated lectures and individual study less favourably than the High Perry group in their list of most preferred teaching methods (Figure 5.13) and significantly more in their least preferred selections. In addition, the Low Perry group indicated a greater liking for short answer type questions and problems with clearcut answers but a stronger dislike for problem type questions without an answer. This was a very similar attitude to that of the Non-Influencing group, but very different from that of the High Perry and Influencing groups which both had the strongest dislike for Multiple Choice questions (Figures 5.9 and 5.10). Clearcut problems featured as second least preferred for the High Perry group with discussion essays being the second least preferred for the low group under the same category.

The study methods used by the High and Low Perry groups were similar, (data not shown) although more of the Low Perry group were rewriting their notes as a means of learning material and more of this same group indicated a lack of preference for going through past exam papers and relating ideas when compared to the High Perry group.

5.6 Discussion of the poster exercise 1993-'94

5.6.1 General Comments

The introduction of the formal programme for the presentation session and the new assessment methods had rectified many of the problems encountered during the first three years of the poster exercise. For

example, the level of students' participation within the poster presentation sessions had increased, and with this the student attendance had remained high throughout the year. Staff had also reported that the general quality of the poster presentations had improved with two groups obtaining the highest marks awarded throughout the four years.

The feedback from this project, the modifications to the poster exercise over the years, had also resulted in the exercise aims, objectives and assessment criteria becoming more clearly defined from both the staff and students' perspectives. This is supported by the strong agreement between the student and staff final poster rankings and their checklist assessments (Table 5.1). A number of researchers (Laurillard, 1979; Thomas and Bain, 1984; Boud, 1990) have described the importance of well defined assessment criteria and task requirements in determining student approaches to a task. The discrepancy between the staff and student ranking of poster in previous years (see Table 4.4 for examples) suggests that in previous years that there was a mismatch between the staff and students' perceived aims of the poster presentation exercise.

5.6.2 Organisation of the poster exercise

a) *Student questioning*

In previous years students had asked groups very few questions about the scientific content of their posters, concentrating rather on the design or poster production aspects of their work. The introduction of a poster presentation programme (Appendix 1) which included a formalised scientific questioning session meant that all groups were required to ask the poster presenting groups scientific questions about their work. With both the provision of guidelines for asking good questions and the incentive of gaining bonus marks for their groups, for the first time, some of the students were also quite critical of their classmates' work and the groups did not hold back on the level of questioning during the poster presentation discussion periods. King (1990) has described how students need to be taught how to ask good questions, and perhaps in previous years, it might be speculated that students did not have the confidence, particularly in the presence of staff, or know how to ask the presenting groups questions.

The addition of a question and answer session resulted in the students learning, not only during the production of their own poster, but also from other groups' work even from the poster ranked lowest by the class (Figure 5.1). Encouraging students to question both their own and

other's work has been described as a useful process of encouraging individuals to develop a deeper understanding of information (Fordyce, 1987; Entwistle and Entwistle, 1991). The increased class involvement in the poster exercise also meant that the students prepared more thoroughly for their presentation session with the idea of facing the rest of the class seeming to be a more daunting prospect than the informal question and answer session of the three previous years 1990 - '93.

b) The timing of the poster groups

In previous years, students apparently had not learned or seemed to have benefited from viewing the earlier poster (Tables 2.4 and 4.2) with many groups carrying out bad practice in terms of poster design and content and in a similar way to that which had been marked down previously. This year's (1993 -'94) groups appeared to be more strategic in their planning for their poster presentation sessions and an element of competition seemed to enter into the sessions for the first time. The final group, Group 9, for example, when planning their poster in the Resource Centre, talked about previous good and bad poster designs and what had and hadn't worked in the way that students had responded to class questions. This group probably had more pressure on them both within and outwith the group to produce the 'best' poster of the year. There were high expectations from the class and staff because the group contained three academically very able students. Internally, one of the group was very competitive and was determined to produce a high quality poster and as a result acted as the driving force within the group. It would have been interesting to see if such a highly motivated and able group would have produced the same level of work had they been given an unstructured challenge.

c) Poster challenges

1993 -'94 was the first year that all the challenges were of the same type or all with a structured task for the group to work on (see Section 2.2.2 for description). The staff on the teaching team were very supportive of the 'last' member of staff to decide to change his topic title from an unstructured type to one which was of a similar kind to the others. The group working on this new 'structured' challenge about the Brontosaurus 747 worked at a high level and for the first time a group working on this subject area obtained a mark above that of the class poster mean mark. Encouraged by this group's performance, the member of staff concerned has now become

involved in organising a similar group poster presentation exercise for a modified degree course to be run next year.

Providing a group with a structured challenge, however, does not necessarily guarantee that a group will perform at a higher level, as has been shown during the four years. But the comparison between the mean marks for the structured and unstructured challenges (Figure 5.14) suggests that students working on an undefined type of challenge are more likely to obtain a lower mark.

In addition, the subject matter of the challenge, might be affecting some of the students' levels of creativity towards the exercise. Challenges for Topics 1 and 2 and half those of Topic 4 relate to mythical creatures such as dragons, mermaids and monsters for which there is no literature to access. These challenges are designed in such a way that the students have to use their background knowledge or what they are learning in parallel areas from the teaching component as a basis for their poster content. The subject matter for the Development topic, for example, is associated with more 'real life' topics and perhaps some groups of students do not feel the same control over their level of creativity or feel so imaginatively stimulated by the subject matter. Several of the groups working on the Development topic had obtained relatively low marks for their poster presentations. However, the performance of some groups for example, the Tissue Repair Group (1991-'92), Photograph 4.1, and the Limb Development Group (1993-'94) Photograph 5.1, show that some groups, at least, have been stimulated to produce high quality and creative work. It is unlikely that all topics will capture the imagination of all groups, in the same way as different parts of the course will be of interest to some students and not to others and the complaints about the lack of stimulation of different challenges each year from students would seem to support this.

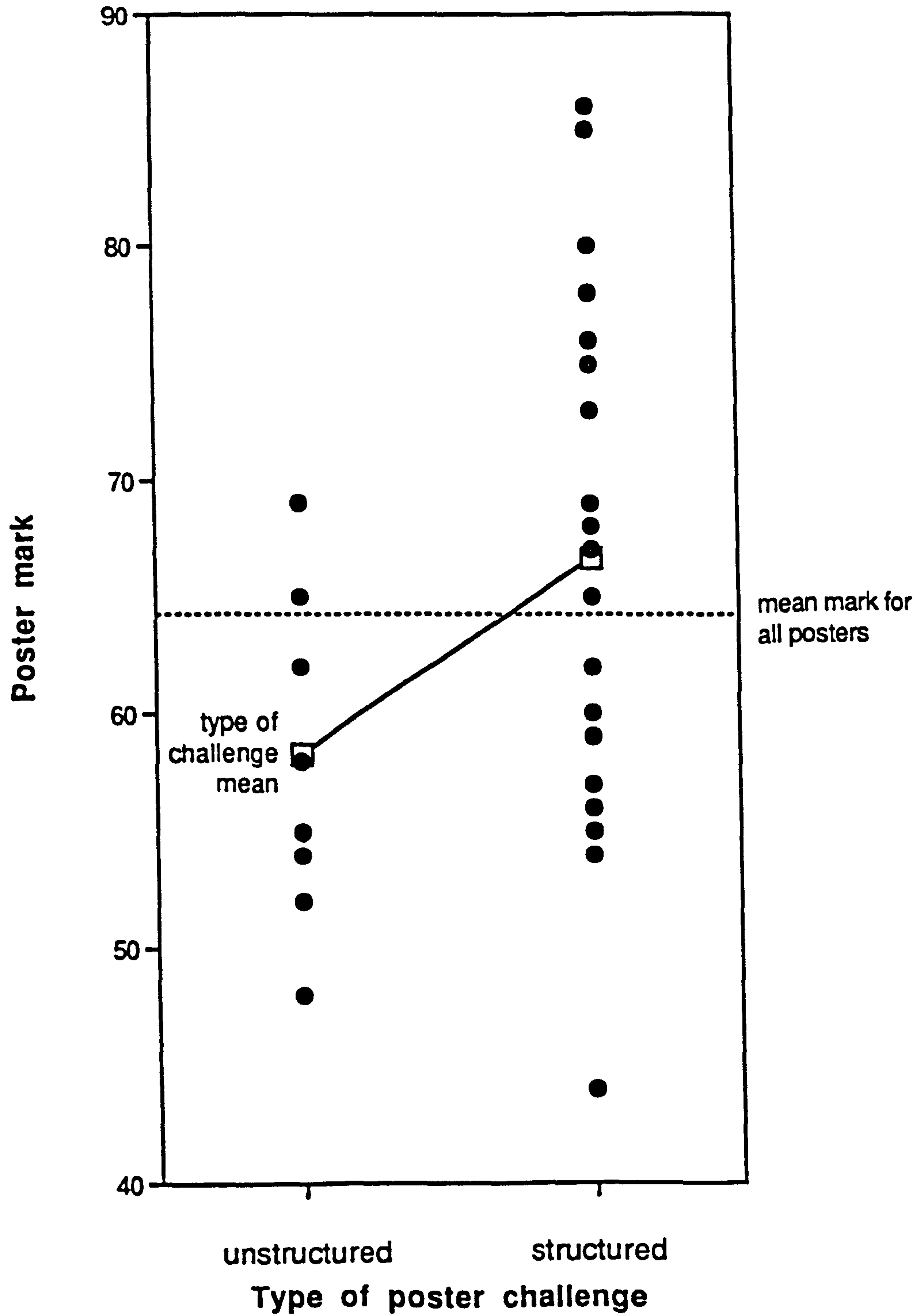
d) Scientific level of the posters

Perhaps the reorganisation of the poster sessions had meant that in some way this exercise was viewed as being separate from the teaching component and even although a topic had been taught in a way which might not have encouraged a more relativistic approach (see Examination question types in Appendix 1 and Section 4.7.2) the students would work at that level because the trend had been set by the previous posters.

During the class discussion at the end of the year, one of the first poster groups mentioned that they had felt unsure about the level at which

Figure 5.14

A comparison between the poster marks obtained for structured and unstructured challenges during 1991 - 1994 (n = 34)



they should pitch their poster and felt, retrospectively, that they would have worked at a higher scientific level had they seen some of the following students' work. Being the first groups to work on an exercise is likely to be difficult, especially if the challenge given to a group is not clearly defined. This is a factor which staff members report to have taken into account when marking the posters, and is one of the reasons that the posters are marked at the end of the year, when the posters can be assessed relatively. Perhaps, in the future, students undertaking the first poster of the year could be provided with some additional guidance on gauging scientific level by, for example, allowing them to access to a poster from a previous year on the same subject area but for a different challenge.

The complaints from some students about the unfairness of some challenges continued into 1993-'94, although all the challenges were of the same type. This perception that other challenges or tasks are easier or more interesting remained a persistent excuse for poorer performances. Some students seem to uphold the idea, that the lecturer or task setter is in some way responsible for the level at which they work, rather than taking responsibility for their own learning. This kind of behaviour might again be explained by the Perry Scheme of Intellectual Development (see Section 1.4). where students going through the Multiplist stage seem to look to the lecturer for direction as if they control the level at which the students work (Knefelkamp and Slepitza, 1976; Touchton *et al.*, 1977; Finster, 1989).

5.7 Group Work

5.7.1 Group selection

The random selection of groups in 1993 -'94 worked better than had the alphabetic selection of previous years, in terms of both process and product. All groups got on well together except one, with all except six students reporting back positively in the questionnaires (see Section 5.3.7). Despite the reservations which the class had shown at the beginning of the year, the groups which did not know each other prior to the beginning of the year (Section 5.3.1) had almost all worked productively together. Random selection of groups had been criticised, particularly for problem solving tasks (Liden *et al.*, 1985 -'86) because group members are starting without a common frame of reference. However, the format of the group poster exercise could have resulted in the 'forming' stages (Tuckman and Jensen, 1977) prior to their actual poster preparation work and for the group 'norms' to have been established prior to commencement of work on the poster

itself.

The introduction of the sessions during the poster presentation day when groups work together to compile questions to put to the poster groups meant that the students, except for those working on Topic 1, had the benefit of getting to know each other prior to commencing their poster work. This is likely to have developed a form of group identity and probably was an important stage in establishing a group structure even before the exercise. The incentive of a group reward, such as bonus marks for the best questions compiled for the groups, might have also encouraged group cohesiveness (Deutsch, 1968; Cartwright and Zander, 1968; Slavin, 1978).

5.7.2 Group Assessment

In addition, the award of individual marks for levels of participation has been shown to encourage students to spend more time on a particular task (Slavin, 1977). The way in which the students had completed the group assessment forms meant that no individual students had gained more or less than the rest of their groups for the poster exercise, even within the group which had not worked so well together. During the class discussion, the students had indicated that they preferred a form of assessment which gave them a degree of flexibility, so that they had the option of selecting the level and the type of work which they carried out during the exercise.

The staff allocation of marks however, did take into account those groups which had experienced problems by awarding the whole group a lower mark collectively, based on the way in which the students responded during the presentation and on my observations of the way in which they worked in the Resource Centre. In reality, this reduced staff 'group mark' worked out as making only a negligible difference between the final poster marks with eight of the groups working so well together.

5.7.3 Group roles and group skills

The students had tended to delegate particular responsibilities during this year to specific tasks involved during the exercise. Although some mention of this method of group working had been made during the introductory session at the beginning of the year, perhaps the format of the poster presentation sessions had some bearing on this (Appendix 1).

With the potential reward of bonus marks, students within group discussions during the presentation sessions, are more likely to pay

attention to those individuals who are better at compiling questions. With the exercise and the type of questions being designed in such way that they encourage more of a Relativist approach (Appendix 1) it is likely that this form of interaction is also going to encourage the more relativistic thinkers to have a more influential role within the discussion and also later in the exercise, as was found when the students started work on their own posters (Section 5.4.5). This might explain the discrepancy between the intended organisers (Table 5.2) identified by the beginning of the year Questionnaire G2 (Appendix 2) and the actual Influencers recognised after the exercise was completed.

The inclusion of a section in the initial Questionnaire G3 (Appendix 2) about the skills which students felt they were bringing to the group work, the recording of group roles both pre and post exercise, in addition to the new method of peer group assessment (Sheet GA 2 - Appendix 2), might have contributed to the way that the groups worked together during the poster exercise. The increased range of roles which the students cited as having undertaken during the exercise (Table 5.2) seem to indicate that the poster production had allowed them to develop and to use a number of group skills. This part of the questionnaire however, should perhaps be amended if it is to be used in future years as a number of the roles overlap and perhaps a list of different types of group skills could replace it, on which the students could record their various group activities, perhaps as the work itself is ongoing rather than using the current retrospective analysis.

It might be argued that providing students with a list of skills encourages them to tick skills that they might not have used, and that the increase in the number of perceived skills is a misleading change (see first year students different responses to a list and open ended question when recording their study methods in Table 6.5). However, providing individual students with an open ended question asking about their group work also might provide an inaccurate picture as students are likely to prioritise or omit skills perhaps not deemed, by them, as appropriate. For example, the ability of drawing ideas together and summarising them for the group, or constructing new ideas or different perspectives on subjects can be useful contributions to a group's activities, but are unlikely to be skills which would immediately be considered by a student. Therefore, providing a list, from which to work, in itself, might be a useful way of encouraging students to recognise and to value their contributions and if the same list is used both pre and post exercise should reflect a change in roles.

5.8 The relationship between Perry scores and group work

5.8.1 Perry scores and group work

As might be expected, the average group score whether for A, B or C type responses to the Perry Questionnaire could not be used as a predictor for performance in the poster exercise. A group, for example which had a higher level of C type responses would not always work at a higher level than a lower C scoring group, even in exercises which demanded a higher level of relativistic thinking. Most of the groups had students with a range of A, B and C type responses and an average of all of their marks is not going to adequately describe the activity of a group which has a range of personalities, viewpoints and attitudes. However, the responses given by Group 6 during 1993-'94, the Neural Tubes Poster, who had members all with High A and Low C Perry scores had produced work at a low scientific level and had difficulties in understanding what constituted a high level scientific approach.

The information from group scores (Figure 5.2) has also identified a correlation ($r = -0.757$) between the average levels of C and A type responses, with the level of A type positive responses decreasing with increasing C type responses. In addition, the Perry scores from the individual students considered to be the most and least influential within the poster exercise has provided evidence that it is possible to predict with a 0.70 degree of accuracy what role a student is likely to adopt in the poster exercise simply from their responses to Part 1 of the Perry Questionnaire P2. Although, further studies would have to be completed to establish whether this finding could be duplicated in subsequent years and/or with different classes.

5.8.2 Students' conceptions of scientific levels of information

During 1993-'94, Group 6's (Neural tubes poster) work and their responses to their staff assessment suggested that these students did not fully understand what was meant by 'integrated' material, although the difference between integrated and non-integrated scientific information had been explained to students at the beginning of the year by showing examples of previous year's posters. Group 6's responses to the Perry questionnaire showed that this group all had a low C to A ratio indicating a non-relativistic view of scientific knowledge. If students do not have a conception of the difference between integrated and non-integrated information, then explaining after the poster is completed is probably not

going to have much effect, as happened during 1993-'94 with Group 6. Groups might become defensive of what is now considered collectively as their own work and be more likely to blame other factors rather than take responsibility for their inadequacy or lack of understanding. Kitchener and King (1990) and others (Churchman, 1971; Fischer, 1980; Wood, 1983; Good, 1993) have described how students generally are unable to reason at a level more than one stage above their current position.

A homogeneous group of students thinking at Dualist or Multiplist levels are unlikely to be encouraged to take a more relativistic approach if they don't know what that is. Expecting students to adopt a way of thinking far above their particular intellectual stage might be more likely to confuse however interesting they find a poster challenge to be. Finster, (1990) and others (Widick and Simpson, 1978; Parker and Lawson, 1978) have recommended that if students are to be encouraged to develop towards a more relativistic way of thinking then they should be taught at a level above their current stage. Therefore an heterogeneous mix of students at different stages might be more likely to stimulate the lower level student to take a higher approach through example, if they gain intra group support and encouragement, particularly in exercises encouraging that type of relativistic behaviour as has been shown in other heterogeneous groups with mixes of academic ability (Bennet and Cass, 1988; Webb, 1989).

It would be interesting, in the future, for heterogeneous groups to be randomly selected from a pool of top middle and lower level students, as established by completing the Perry Questionnaire P2. If an exercise such as the poster exercise which encourages and rewards higher level thinking but at the same time allows students a degree of flexibility in their selection of scientific level is used, it would be hoped that the lower students would be challenged to work at a higher level by other higher level thinkers within their group. Once a student understands what the difference between an integrated and non-integrated approach then perhaps this understanding can be transferred to their work in other areas of the course, where this type of thinking is a required aim. Multiplist thinkers working in homogeneous groups, it might be speculated would only serve to reinforce a particular level of behaviour, as seen by the students becoming overly upset about the unfairness of the marking. It would also be interesting to study the work of homogeneous groups of High Perry or what might be classified as Relativist thinkers to investigate their level of approach within an exercise such as the poster exercise.

However, if the aim of an exercise is to encourage as many students in a class as possible to think at a higher level, then heterogeneous groups providing support for individuals at different stages of intellectual development would seem to be the most effective method. A knowledge of where the 'class is' in terms of their stage of intellectual development, as measured by the 'Perry questionnaire' could then be useful for deciding the most appropriate support and ways in which the students might be challenged to become more Relativistic thinkers and in a way in which the most appropriate instructional methods might be matched up with the students.

5.8.3 Group dynamics related to Perry scores

The present study suggests that a student with a higher level of C type and lower A type than other group members would seem to be more likely to become an influencer within an exercise such as a poster group exercise which encourages the use and development of Relativistic thinking within a group centred task.

During 1993-'94, as the poster groups had not worked with each other before, it could be hypothesised that they would be more likely to adopt an approach with which they were more comfortable or in which they felt less threatened when first put into a group situation. This would mean that during work on the poster exercise, a relativist thinker would start as relativist thinker and adopt a more influential role and a multiplist thinker would start with a multiplist approach and adopt a non-influential role. This would be unlike the way the groups in previous years who had started the exercise by being in roles, which they felt were expected of them and in which they had been accustomed to working in for the previous 3 years (see Section 4.4.5). A dualistic thinker might, for example, be in an influential role within a group and direct the group's work accordingly.

The clusters of results shown in Figure 5.5, which compares the relationship between the A, B and C type responses for individual students also supports the idea that students with particular attitudes or behaviours are becoming group influencers. By comparing the behaviour of the Influencing and the Non-influencing groups there seems to be some kind of attitude which differentiates them from each other. This might be, as already discussed (Section 5.8.3) because the questions and answer session is actively selecting out the relativist thinkers, through the examples of questioning used and the incentive of bonus marks for more C type questioning.

However, as the first two groups also showed the same trend in their selection with students having higher C/A type responses becoming the Influencers, without having worked together as a group compiling questions, this would suggest that perhaps some additional factors were affecting the establishment of this group structure.

5.8.4 Characterising Influencers' and Non-influencers' attitudes

Separating the third year class into High and Low Perry groups according to their responses to the Perry questionnaire enabled a comparison to be made between these two groups and the Influencing and Non-Influencing groups of the poster exercise in terms of their Course preferences. If the Influencers' teaching and assessment preferences were indicative of a higher level thinkers then the selection of exclusively High and Low Perry students from the same class should have shown a more pronounced difference between these preferences for these two new sample groups. There was a more pronounced difference between the High and Low groups with respect to disliking multiple choice questions and their lack of dislike of problem type questions without clearcut answers than there was between the two Influencing groups. However, High Perry thinkers showed more of a preference for lectures and individual study and less for tutorials than had the influencing groups. They also had a much higher agreement with the C type statements, as might have been expected by the way in which they were selected (Section 5.4.6).

Although there were similarities in the trends shown in the course preferences, some of the differences between the High Perry and Influencing groups suggest that the students are taking a more influential role because they have a stronger liking for problem type questions without answers, small group work, student interaction/participation and going into more depth into subjects with others such as might be found in a tutorial setting.

This selection of student Influencers therefore is more though a strategic approach towards success in this exercise rather than indicative of a selection of generally more Relativist thinkers and perhaps assessing the Influencing students for their general level of Strategic approach (Section 1.2.5) using a questionnaire designed to measure student approaches to learning and studying in students, for example might be useful (Entwistle and Tait, 1990). However, the characterisation of the Influencer's relativist attitudes, supports the idea that in its current format, the poster exercise encourages the use and development of higher level cognitive skills such as

might be described as more of a relativist approach.

5.8.5 Determinants of group roles

At the beginning of the academic year 1993-'94, the students within the groups had not worked with each other before and therefore, would not be aware of other's strengths and weaknesses, apart from by reputation, that is to say whether someone consistently had got high or low marks in assessments. As the students cited as being the most influential within the poster presentation exercise tended to have the highest C type and lowest A type behaviour as identified by Perry Questionnaire P2 (Figure 5.4) there must be some process whereby these students select themselves or are selected to take up particular roles within their groups. Although an individual, under normal circumstances, might be naturally pre-disposed to take up an organising role, the poster exercise, now with its question and answer sessions is likely to favour the more Relativist of the thinkers within each group. Saidla (1970) has used the Perry scheme of intellectual development as a basis for which to speculate about the potential roles which students at different stages of development would adopt within a group situation. However, her work does not take into account that the roles adopted by individuals will be relative to the stages of others within the group and how they are responding. The differences between the Influencing and Non-influencing students within the poster exercise suggested that their adopted roles were as a result of their particular intellectual stages. For example, the uncertainty and search for lecturer direction would predispose a less participatory role than that of the Influencing students who look to express their opinion and to work independently of the lecturer.

The discrepancy found between the number of student thinking that they had taken an organisational role and the rest of their group's opinion might be explained by a difference in the responsibilities involved. An individual might arrange group meetings, for example, and delegate work, but another student might be the one that a group member would check their work with or value the scientific opinion of. One example of this was found in Group 6's behaviour (Section 5.4.4) where two of the more vocal students seemed to be the organising influences within the group in the Resource Centre: they answered the questions on the presentation day and were the ones to complain about their marks. However, one of the other students in the group was the one that the rest of the group had put down as

having the most influence and the one which students would check their work with.

The students listed as being the two who had the most influence over the group opinion, were usually the same two students who were listed as being the ones with whom students would check their work. It might have been expected that students would select out the less intimidating of their group to check their work with before taking their scientific material to the most influential or putting it up for group discussion. Checking directly with the most influential person in the group might be a reflection of amicable intragroup relationships or a time saving procedure or if the person checking was a multiplist thinker, the likelihood would be that they would check with whoever was the most akin to the director of the group activities or the 'lecturer substitutes'.

5.8.6 Recommendations for future work

The results from the 1993-'94 poster exercise suggest that many of the modifications made to the exercise have resulted in more students attaining what might be considered to be more of a Relativistic approach to the exercise. Repeating the same format during a subsequent year would have been useful to establish how much of an influence the motivation of this particular class had on the success of the exercise.

The random selection of the groups during 1993-'94 suggested that this form was more successful than that of alphabetic selection. However, a method which took into account student's intellectual stage of development might be worth considering, using perhaps a mix of high, medium and low Perry scoring students. Some instruction as to how to work more productively in a group might be useful at the beginning of the year and perhaps a mid exercise report back session, when students were required to report to the staff on their group's progress. This might help to identify any group problems and would hopefully be at a stage when perhaps some solution might be reached. A method of each group negotiating 'their group's' criteria for the peer group assessment prior to the exercise might be useful in encouraging students to value each other contributions and not just on a cognitive level.

Chapter 6
The piloting of a measure of student intellectual development
(1992-1994)

6.1 Introduction

6.1.1 Use of the Perry Questionnaire P1 during 1992 -'93

Classes of biology students were tested using the Perry Questionnaire P1 (Appendix 3) in October 1992 during the first week of their academic year. Eleven classes were tested in total : five part time classes (from the Life Sciences Degree Course) and six full time classes (from the BSc Degree and Higher National Diploma Courses). A total of 379 students were tested. The average class size during 1992-'93 was 35 students.

The Perry Questionnaire P1 asks students to give their relative agreement/disagreement to 6 Dualist (A) type, 6 Multiplist (B) type and 6 Relativist (C) type statements (see Chapter 3 for a fuller description of the Questionnaire). Each student's individual score (their percentage A, B and C type positive responses) was calculated using the method outlined in Section 3.3.1. The average A, B and C type positive responses were then calculated for each of the classes.

A follow-up testing of the first, second and third year classes of the full time degree course was also carried out in February 1993, four months later, using the same questionnaire, Perry Questionnaire P1.

6.1.2 Use of the Perry Questionnaire P2 during 1993 -'94

Students from all full and part time courses were tested during October 1993 using Perry Questionnaire P2 (Appendix 3). In total, 415 students were tested in this year. The Perry Questionnaire P2 comprised three parts : Part 1 containing the 18 'Perry statements', Part 2 where students were asked to give their opinion on six statements and to justify their decisions and a Part 3 which asked students to indicate their teaching, assessment and study method preferences (see Section 3.4 for a fuller description of these parts). The first year full time degree students were tested during the second week of their academic year 1993 -'94 and the rest of classes were tested during their first week.

A follow-up testing of the first year full time degree students was also carried out four months later in February 1994 using Perry Questionnaire P3 (Appendix 3). This included a Part 1 with eighteen statements and a Part 2 which asked students their feelings about the teaching, assessment methods utilised on their course and also about their perception of 'Science' as a general subject area.

6.2 Results from using the Perry Questionnaire Q1 during 1992 -'93

6.2.1 Student responses to Perry Questionnaire P1 (October 1992)

As was found in the pilot study on the second and fifth year part time degree students (see Section 3.2.2) generally, each of the students tested showed a higher agreement with the Relativistic (C) than with the Dualistic (A) type statements. There was a wide variation in the averages for each of the class mean percentage A, B and C type responses (Figure 6.1). The average C type responses were higher than the average A type responses for all classes apart from the part time BSc Life Sciences Level 2 students.

All three courses tested showed a similar trend in the class average profiles (Figure 6.1): the first year students had a significantly higher mean C type and lower A type than the students in the final years of the courses, with the middle years of each of the courses showing lower C and higher average A type responses. This trend is seen more clearly if the average C to A type responses are compared for each course (Figure 6.2) : each of the courses appears to have a high C to A ratio in the first and final years and a trough in C to A responses in the middle years. The first year A type responses of each course tested were shown to be significantly different ($p < 0.05$) from those of the rest of the classes on their course tested using a Mann-Whitney test.

6.2.2 Student follow-up responses in Perry Questionnaire P1 (February '93)

As each of the courses tested had shown similar C to A type profiles in October 1992, a second testing using Perry Questionnaire P1 was carried out on the first, second and third year full time degree students in February 1993 to try and establish whether these drops in C to A type scores were differences between the class compositions or were as a result of some general change which was happening within each of the courses during students' first and second years of study, perhaps through use of particular teaching or assessment methods or course content.

The results from the second testing in February 1993 of the three full time degree classes are shown in comparison to the original responses in October 1992 in Figure 6.3. The February class means of A, B and C type positive responses suggested that the students, in particular, the first year students, had changed in their approach during the 4 months between October 1992 and February 1993. By February, the first year mean C to A ratio for the first year full time degree course students had dropped to below

Figure 6.1

A comparison between the class mean percentage of A, B and C type positive responses given by students to the Perry Questionnaire P1 in October 1992

(A type responses given by the first year classes were shown to be significantly different to those given by the all other classes tested on their course using a Mann-Whitney test, $p < 0.05$)

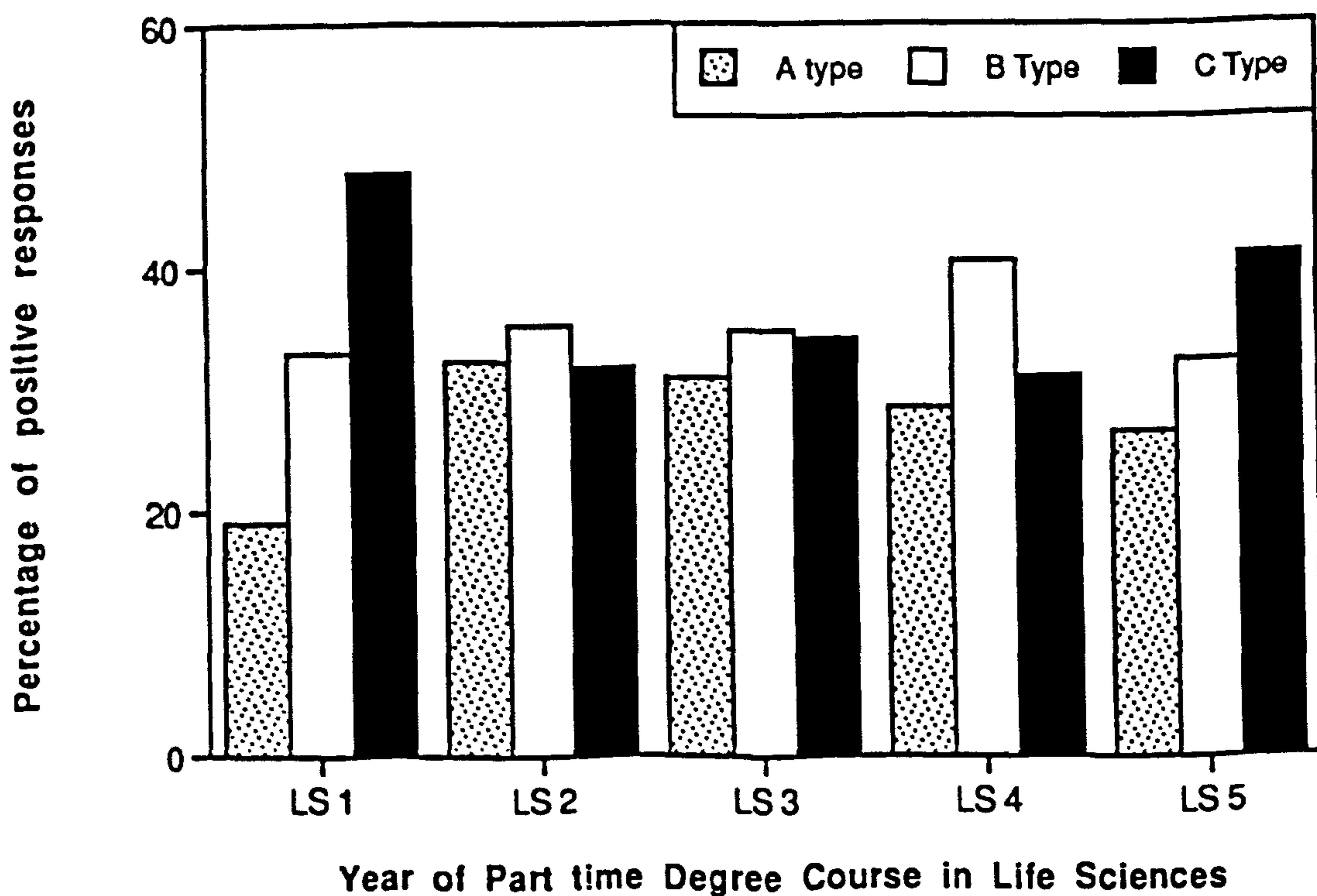
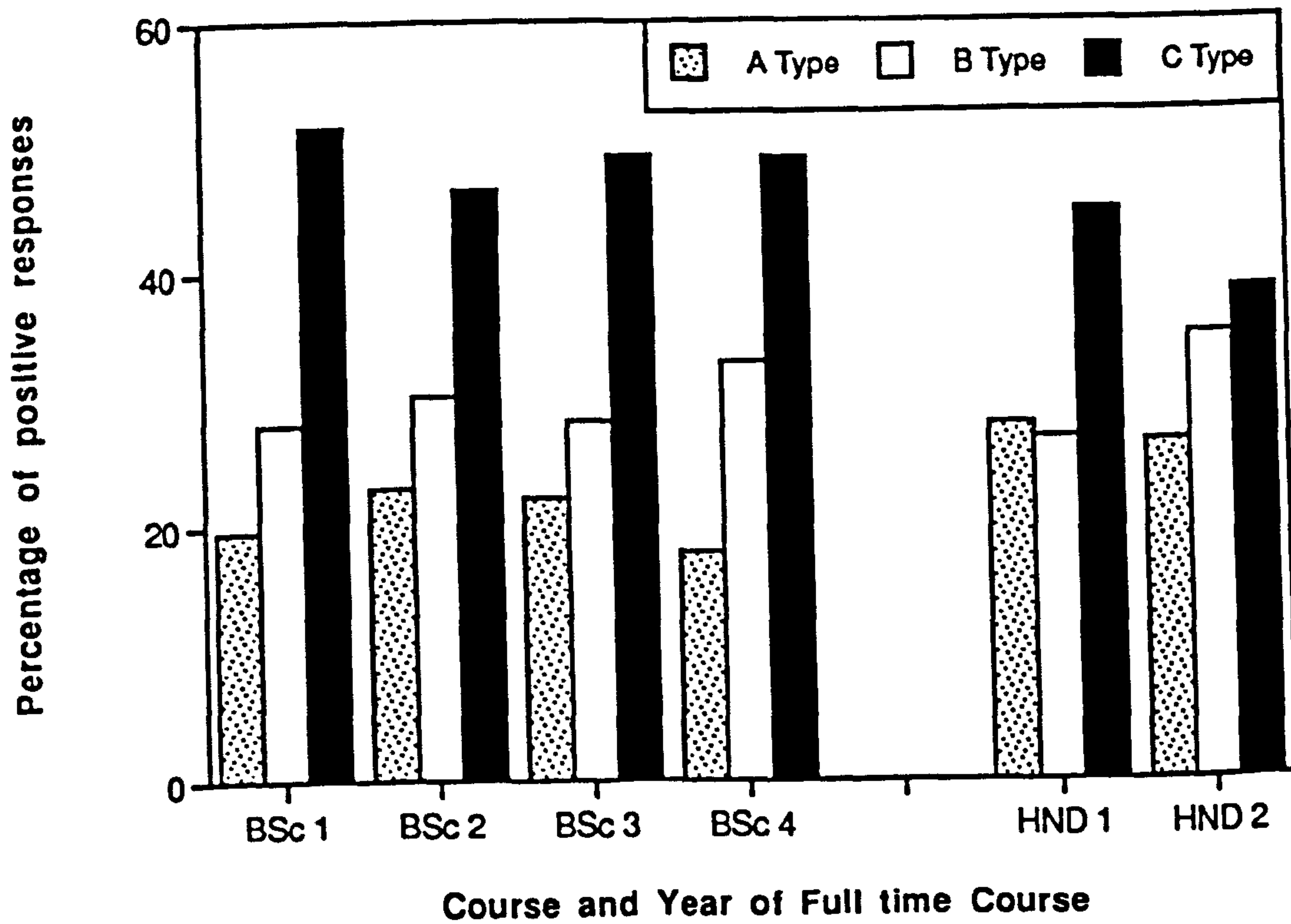


Figure 6.2
 A comparison between the trends of C to A type average positive responses given to the Perry Questionnaire P1 by different classes attending the full and part time courses in October 1992

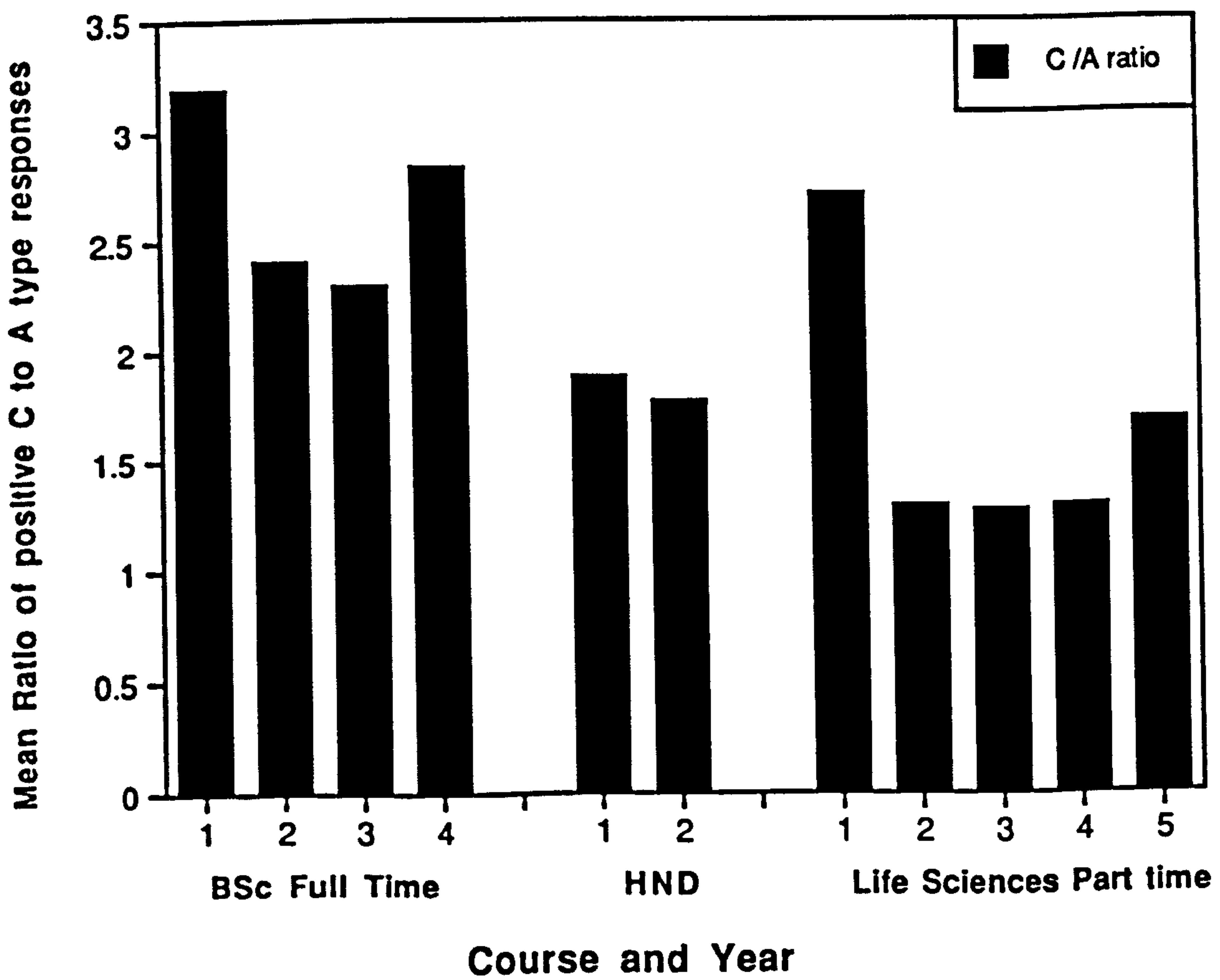
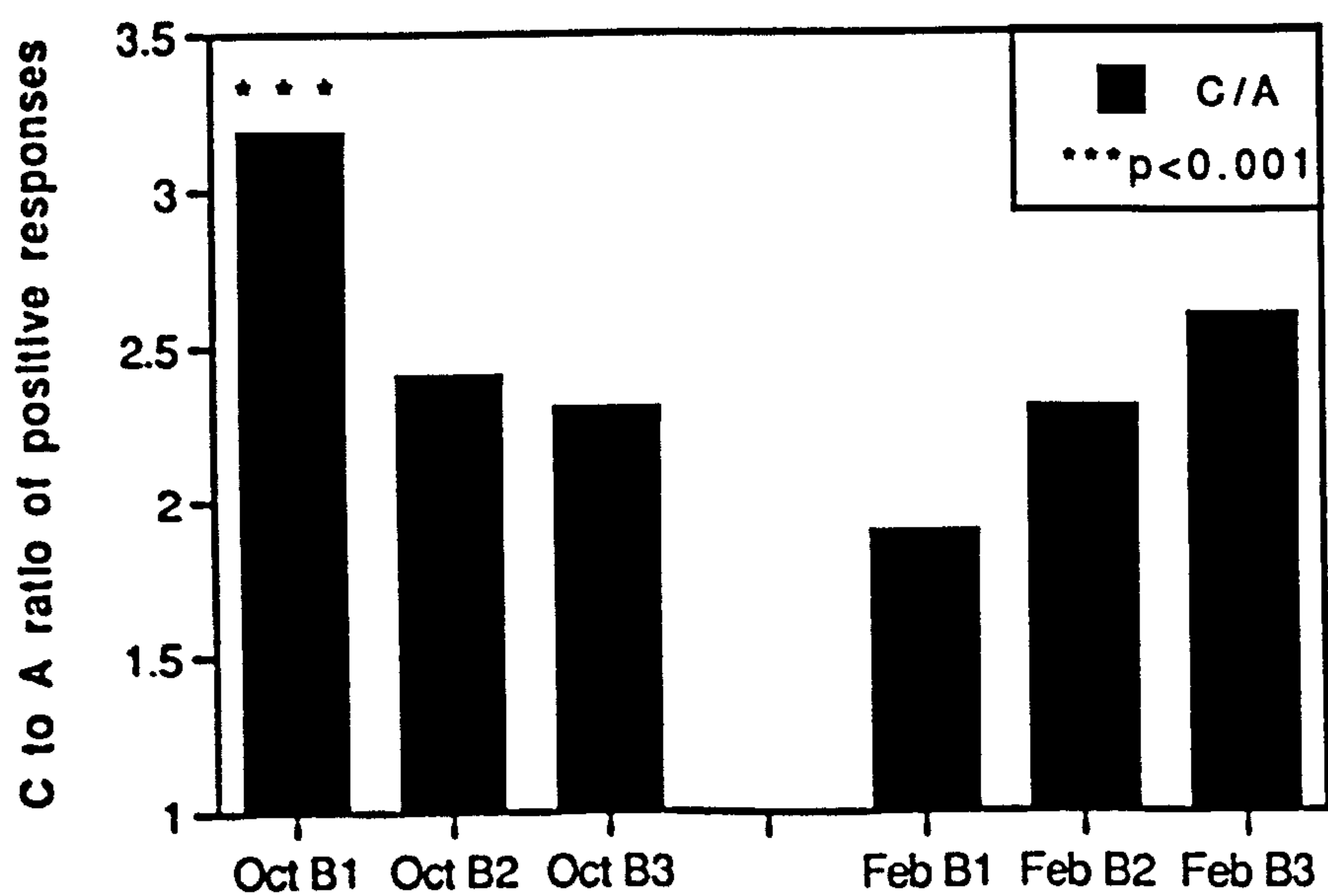
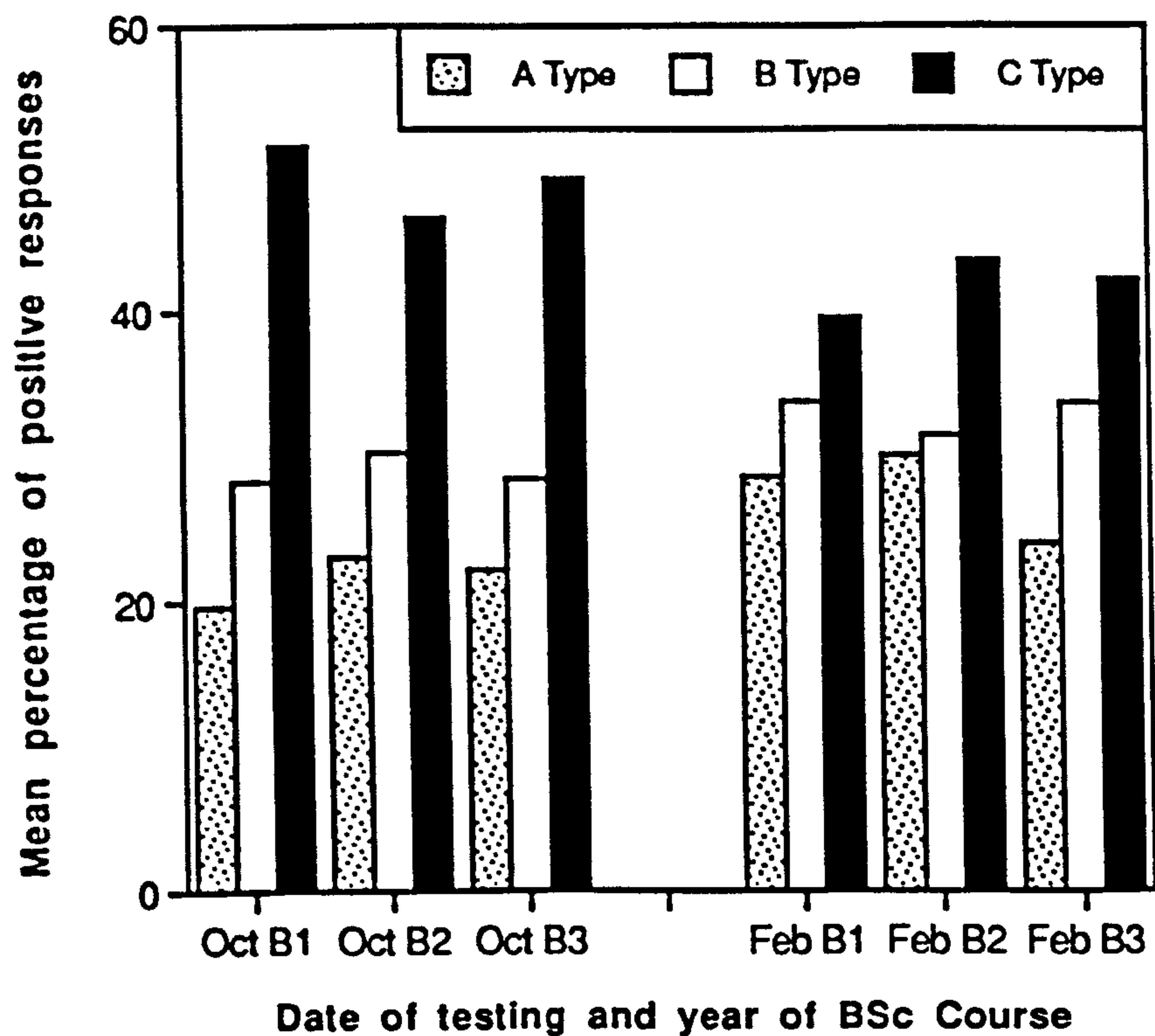


Figure 6.3

A comparison between the average C and A ratios and the A, B and C type responses given to Perry Questionnaire P1 by the first, second and third year BSc classes in October 1992 and February 1993



(the number of C and A positive responses given by 1st year students were shown to be significantly different in February 1993 to those given in October 1992 using the Mann-Whitney test)

that of the second years (Figure 6.4). The mean number of A and C type positive responses given by the first year students in February was shown to be significantly different to that of those given by the class in October 1992. The trend shown in Figure 6.3 shows what might have been predicted by the Perry scheme (see Section 3.2.1) with the class average C to A responses being increasingly higher in the third year than that found in the first.

6.2.3 Individual changes in response to Perry Questionnaire P1 from October 1992 to February 1993 given by the first year degree students

Although, averaging out each class's individual scores can give an impression of a general course trends, it does not give an indication of how individual responses are changing, half the class for example, could be changing towards an C type approach but this might be negated by the other half showing an equal but opposite movement. As the first year degree students seemed to have shown such a pronounced general change in attitude towards having a more A Type behaviour, a comparison was made between individual students Perry scores from Perry Questionnaire P1 in October 1992 and those from the same students in February 1993 responding to the same questionnaire.

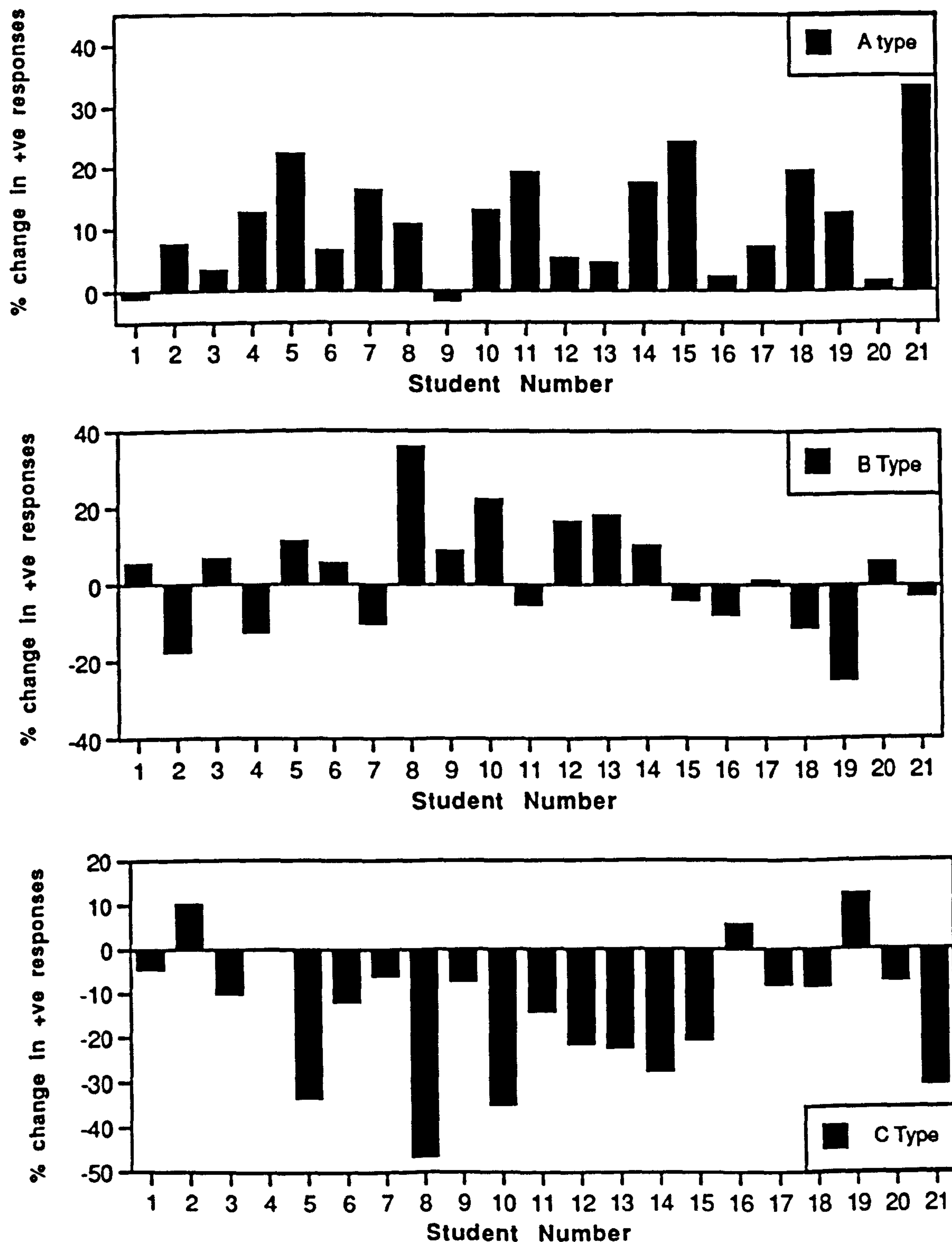
Giving all the students the option as to whether they included their name on the top of the questionnaire did however, result in this study being able to follow through only 21 students in the first year as some students had omitted their names on one or both questionnaires. A comparison between the first year students October and February responses is shown in Figure 6.4. Nineteen students out of the twenty one students followed through, showed an increased agreement with the A type responses and seventeen had a decreased agreement with the C type responses. The change in B type responses had not shown any particular trend. Although the sample followed through was small, the uniformity of the type of change shown by these students would seem to suggest that their responses are likely to reflect what was a universal change across the class towards a more dualistic way of thinking. The students responses to the A and C type statements were shown to be very highly significantly different ($p < 0.001$) in February 1992 from those in October 1993 when compared using a Wilcoxon Rank Paired Test.

6.2.4 Responses to Perry Questionnaire P2 during academic year 1993 -'94

In the following year of testing (October 1993) using Perry

Figure 6.4

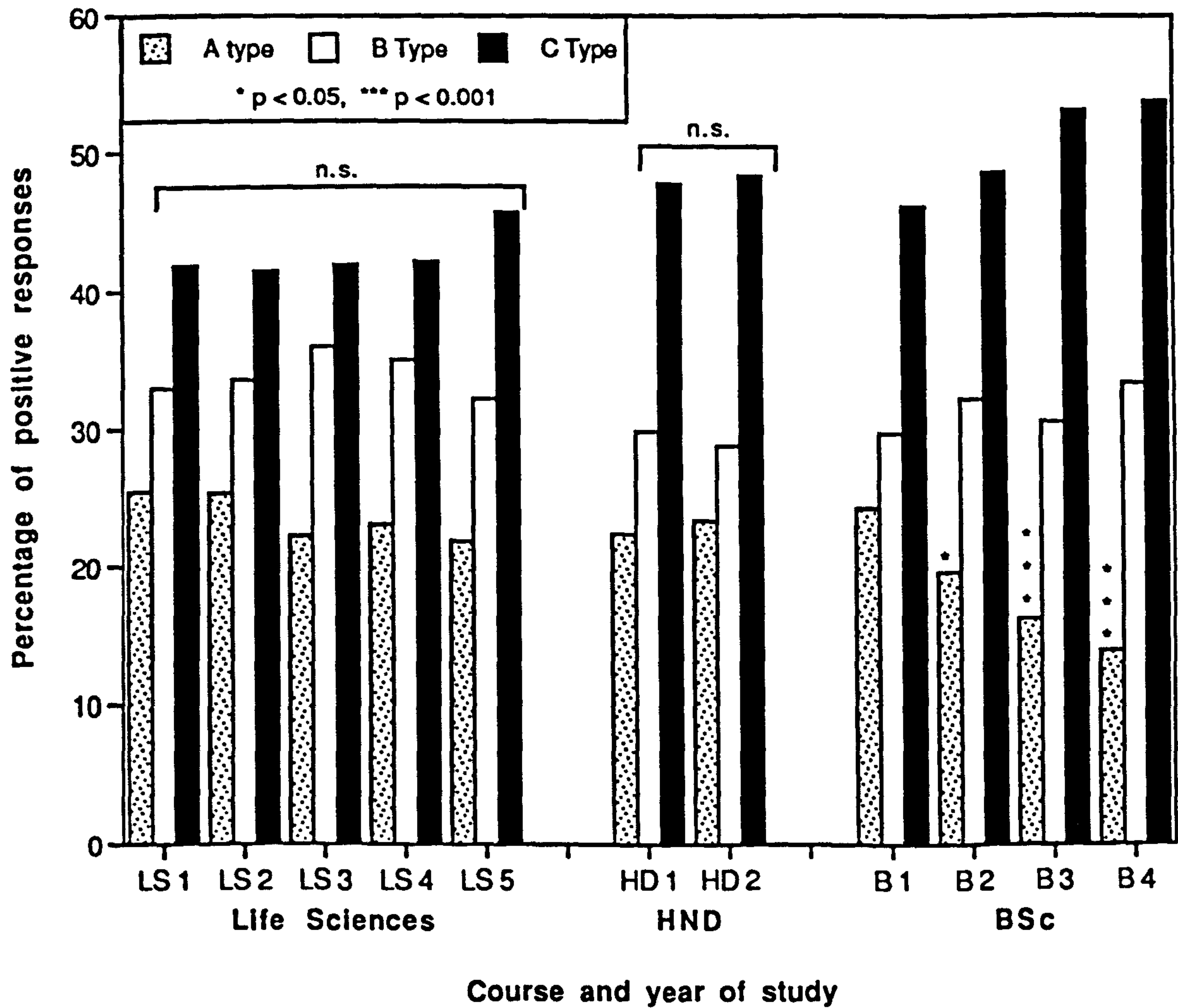
A comparison between the percentage of A, B and C type positive responses given by first year BSc full time students in Perry Questionnaire P1 completed in October 1992 and February 1993



(The Wilcoxon matched pairs test indicated that the number of A and C type positive responses given in February 1993 were very highly significantly different ($p < 0.001$) to those given by the same students in October 1992)

Figure 6.5

A comparison between the class mean percentage of A, B and C type responses given by students to the Perry Questionnaire P2 in October 1993



(The number of A, B and C type responses given by each class were compared using the Mann - Whitney test. The number of A type responses given the first year BSc class was shown to be significantly different from that of the other three years)

Questionnaire P2, the average class A, B and C type responses did not show the same trough of C to A responses in the middle years in the three courses tested (Figure 6.5) as had been observed on the same courses tested in the October of the previous year (Figure 6.1). Instead, the final year class had higher C and lower A average responses in the later years of the courses. A comparison between the October 1992 and October 1993 average A and C type positive responses for the one part time and two full time courses is shown in Figure 6.6. There was no particular trend in the students' responses to the B type statements shown across the courses.

Unlike the results from the cross sectional study of classes in October 1992, it was possible in October 1993 to make a comparison between the responses to the Perry Questionnaire set of eighteen statements given by classes of students in two subsequent years. For example, the first year full time degree class in October 1992 which had shown a trend towards agreement with A type statements in February 1993, had recovered to almost their original high C to A level by the beginning of their second year in October 1993. The average class percentage C to A ratios for all classes for both years are shown in Figure 6.7.

6.2.5 Follow-up testing of first year students using Perry questionnaire P1 in February 1994

As there had been such a pronounced change towards agreement with A type statements shown by the first year full time degree students from October 1992 to February 1993, a follow-up testing of the 1993-'94 first year full time degree students of the subsequent year was also carried out in February 1994.

Figure 6.8 shows that there was a slight decrease in the average C type positive responses and an increase in the average A type responses from October 1993 to February 1994 by the first year class but that this was not nearly as pronounced as had been observed with the first year full time class during 1992-1993.

Similarly to the previous year, a comparison was made between the individual responses in the Perry Questionnaire Part 1 to the A, B or C type statements in October 1993 and February 1994 (Figure 6.9). As was found in 1992 -'93 because students had omitted their names in one or both of the questionnaires, it was only possible to follow through under half the class (32 students). There was a variety of changes in responses, with some students showing increased agreement with A type statements and some

Figure 6.6
 A comparison between the October 1992 and October 1993 class mean percentages of A and C type positive responses given in the Perry Questionnaire by full and part time biology students

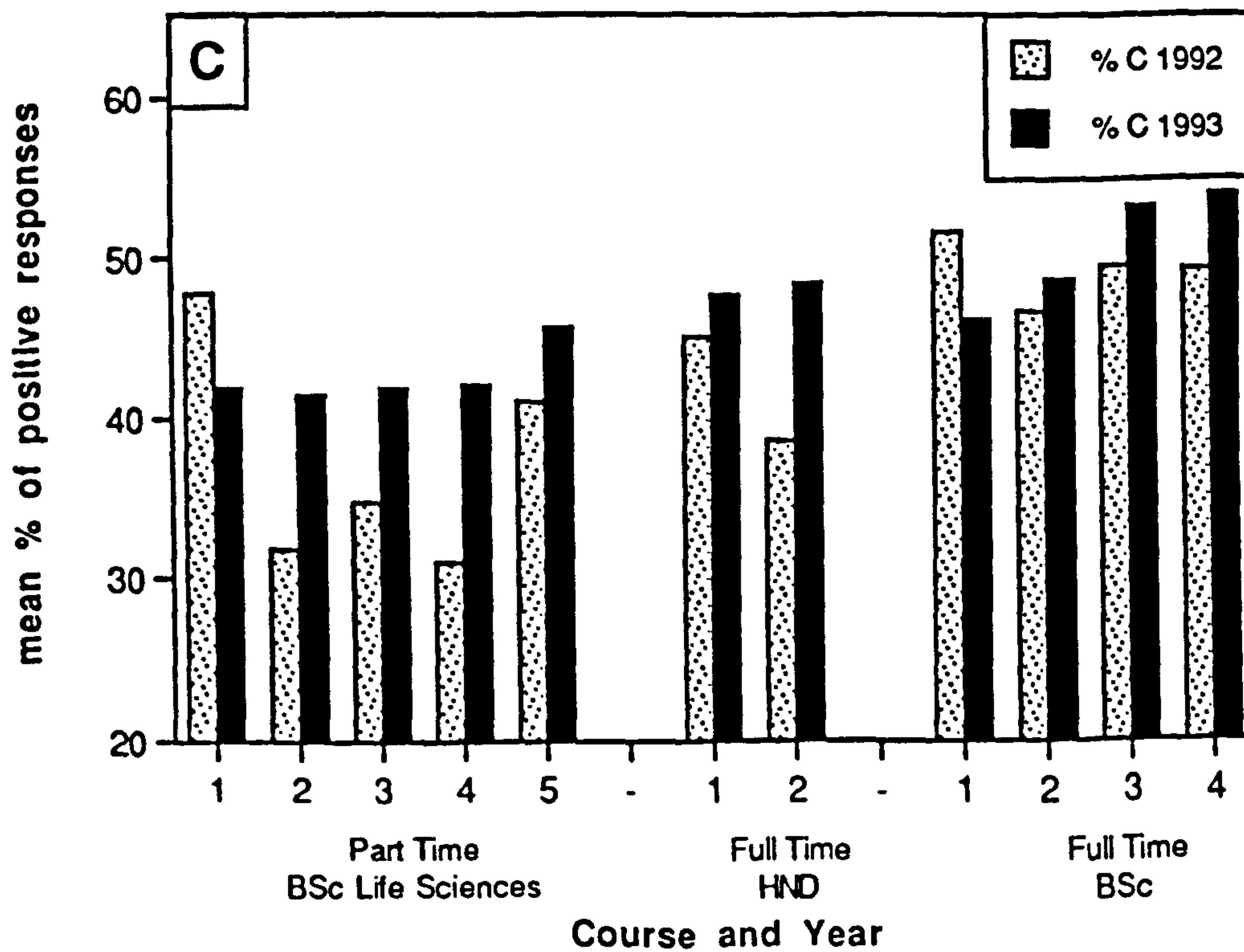
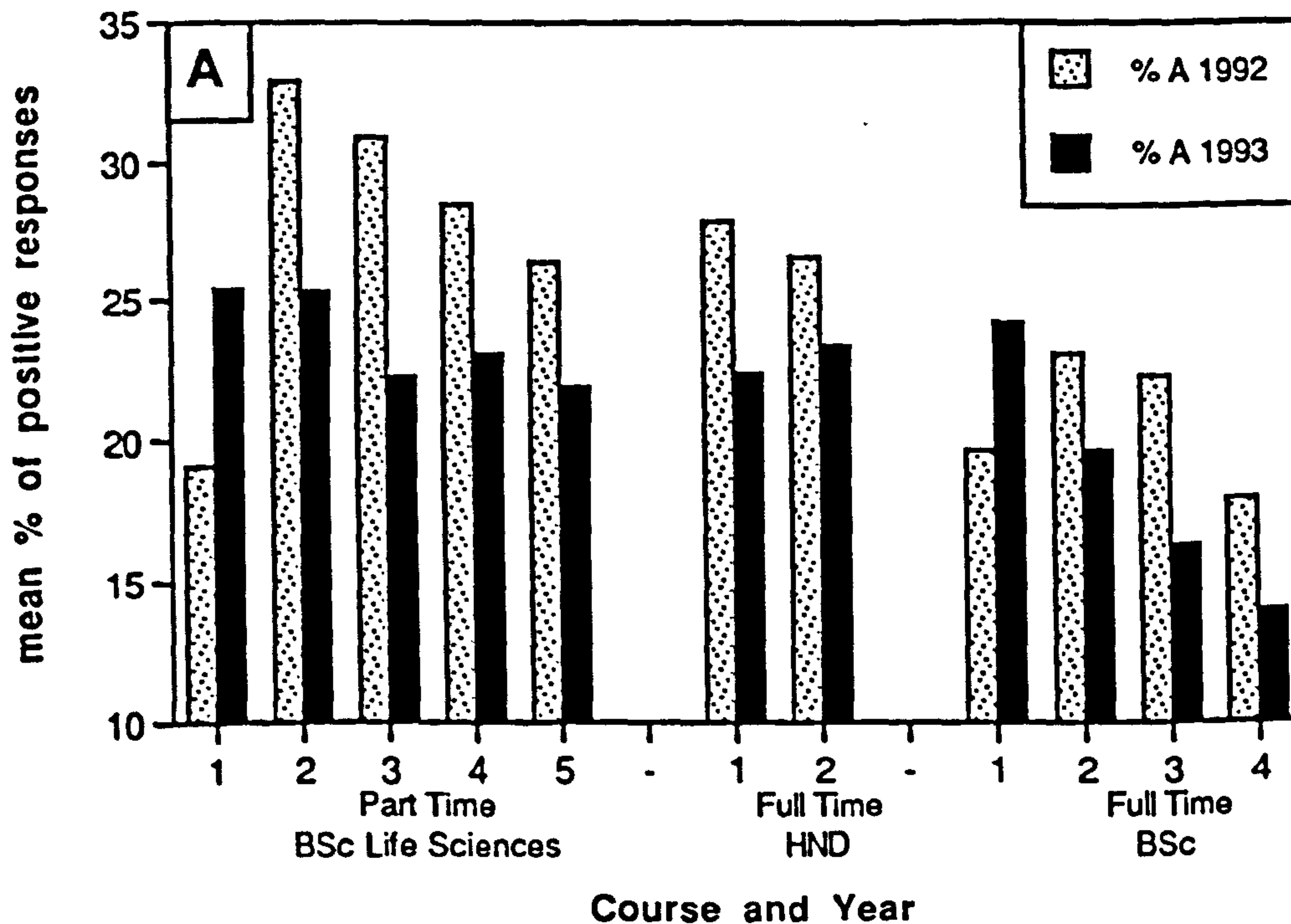


Figure 6.7

A comparison between the average class percentage C to A ratios obtained in October 1993 and October 1992 from Part 1 of the Perry Questionnaire

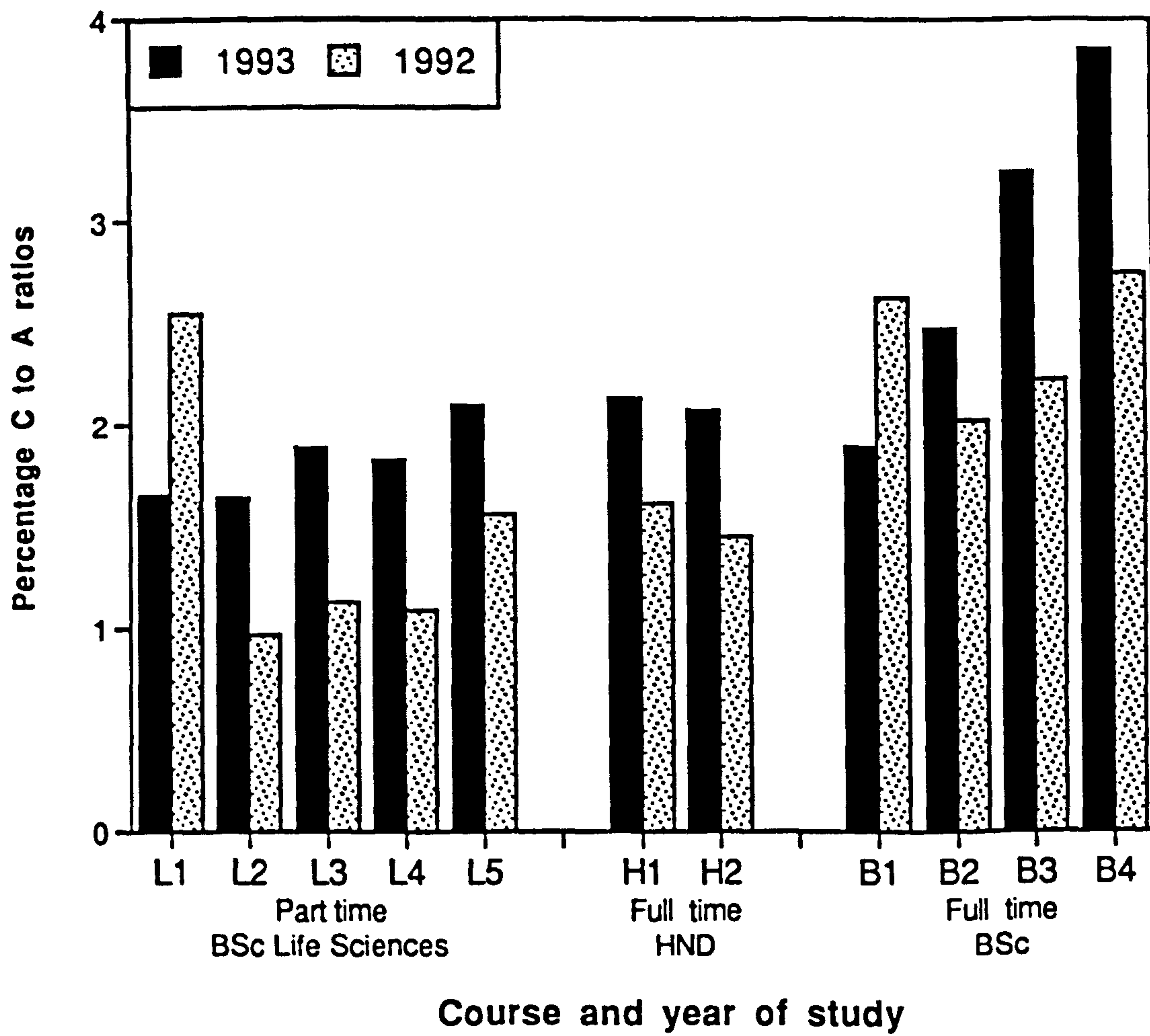


Figure 6.8

A comparison between the type of positive responses given by the 1992-'93 and 1993-'94 first year full time degree classes to Perry Questionnaire P1 in October and February of those years

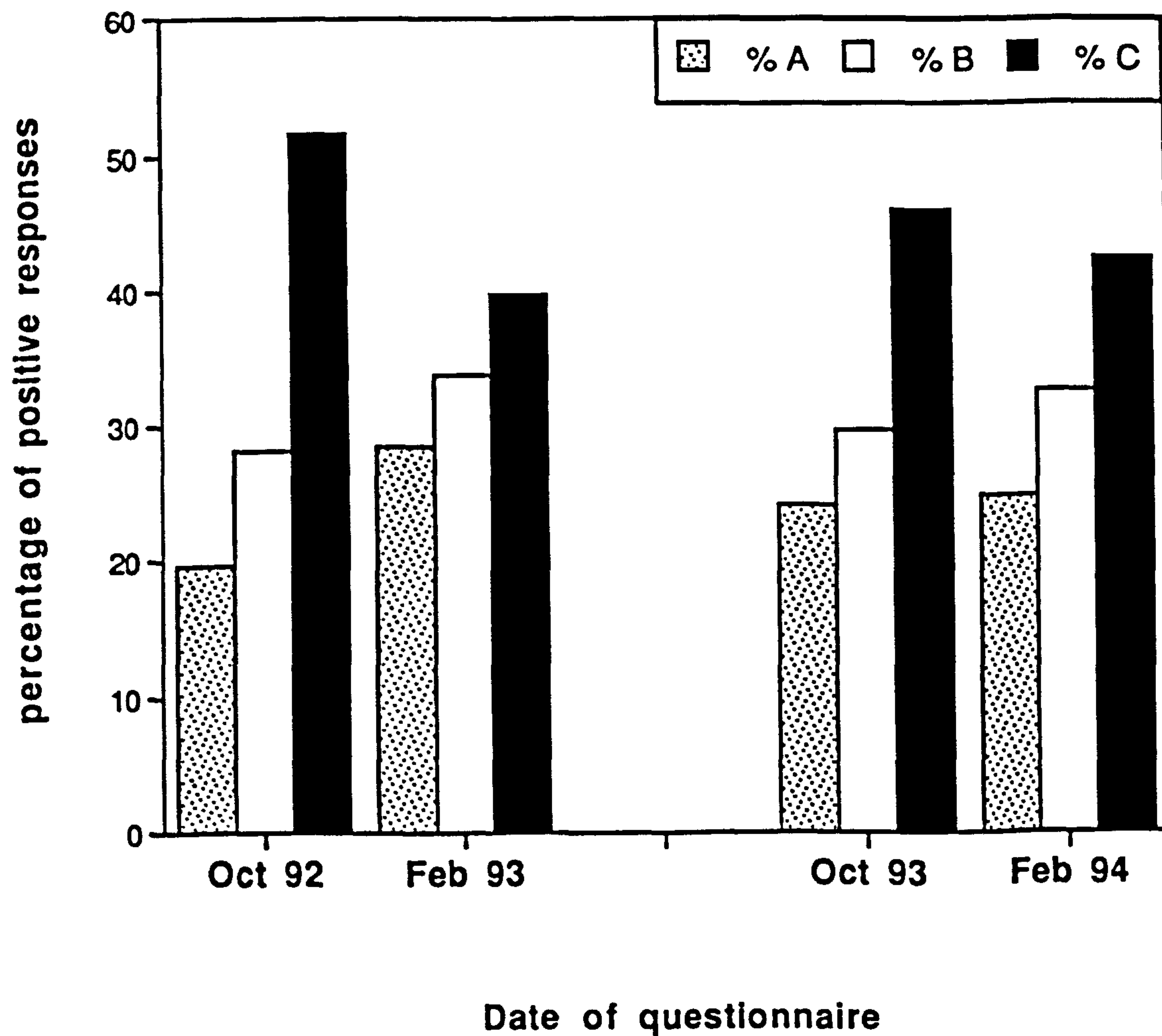
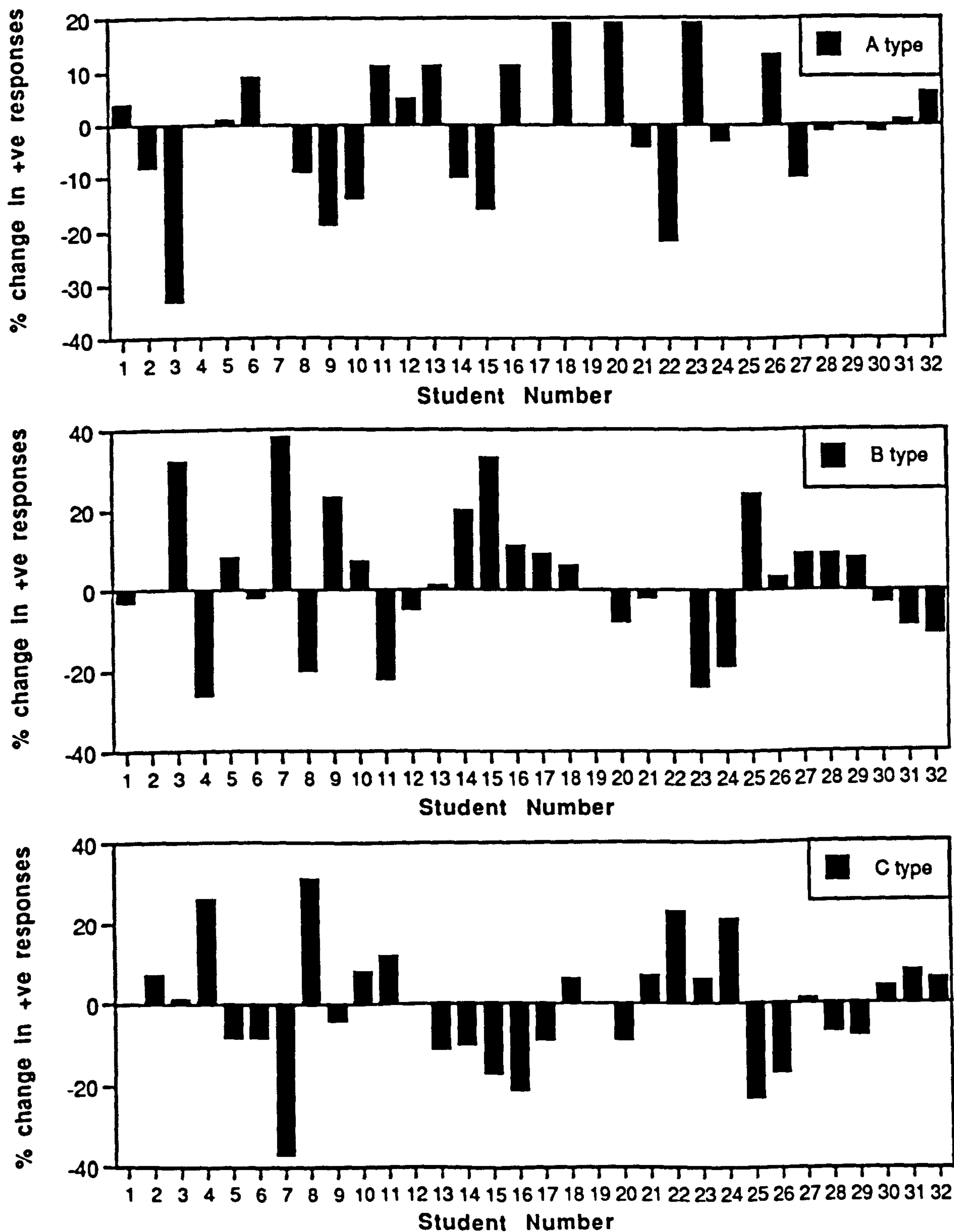


Figure 6.9

A comparison between the percentage of A, B and C type positive responses given by first year BSc full time students to Part 1 of the Perry Questionnaire P2 completed in October 1993 and February 1994



showing increased agreement with C type statements. The student responses in February 1994 were not significantly different from those found in October 1993, using the Wilcoxon rank paired test.

6.2.6 Class responses to Part 2 of the Perry Questionnaire P2 - October 1993

During the 1992-'93 study, in Part 2 of the Perry Questionnaire P2, students were asked to justify their responses (agree /disagree) to six statements using two or three sentences (Appendix 3). On completion or during completion of Part 2, many of the students were seen to turn back to the front page of the questionnaire and to score out their name, just leaving the details about their course and year of study.

If the number of students not justifying their responses (by not writing anything in the space provided in Part 2 of the questionnaire and/or not giving a decision on a particular statement) is compared for each of the courses studied in October 1993, a trend of responses emerges (Figure 6.10). The average percentage of each class of students not giving justifications to their decisions decreases as the year of the course increases.

The statement most frequently not eliciting a justification was Statement 4. *'A scientific fact cannot have meaning if considered in isolation : meaning is only gained by context''*. Several of the students made comments about not knowing what the statement meant or wrote a question mark in the justification section beside the statement. Other students however, had no apparent problem in understanding Statement 4 and gave a clear response for their decision. A breakdown of the full time degree class responses in October 1993 to each of the statements is given in Figure 6.11. The statement eliciting the highest number of justifications was Statement 2 : *'Scientists will eventually be able to solve every medical problem : it is only a question of time'* Each of the six statements used had shown an increased number of justifications by the full time students with the increasing year of the course.

Although students had expressed the same opinion to the six statements in Part 2 of the Perry Questionnaire P2 the individual reasons given for their decisions, in many instances, were very different : see Table 6.1 overleaf. Although subjective, a selection was made from all the statements given by students in order to give an indication of the range of opinions expressed in the questionnaire.

Figure 6.10

A comparison between the average number of students from different course years not justifying their decisions to statements in Part 2 of the Perry Questionnaire P2 in October 1993
(results expressed as average class percentages for all statements)

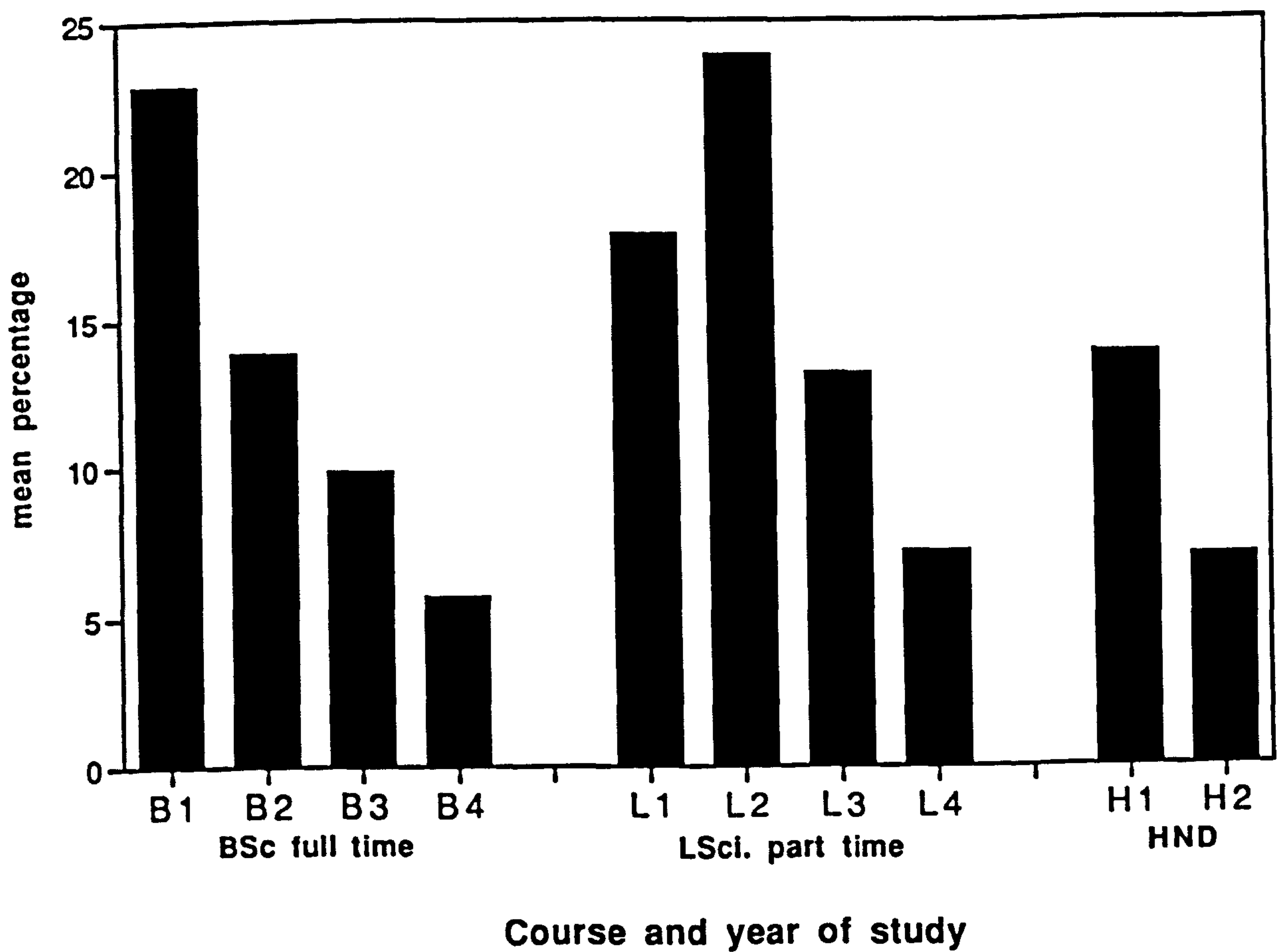
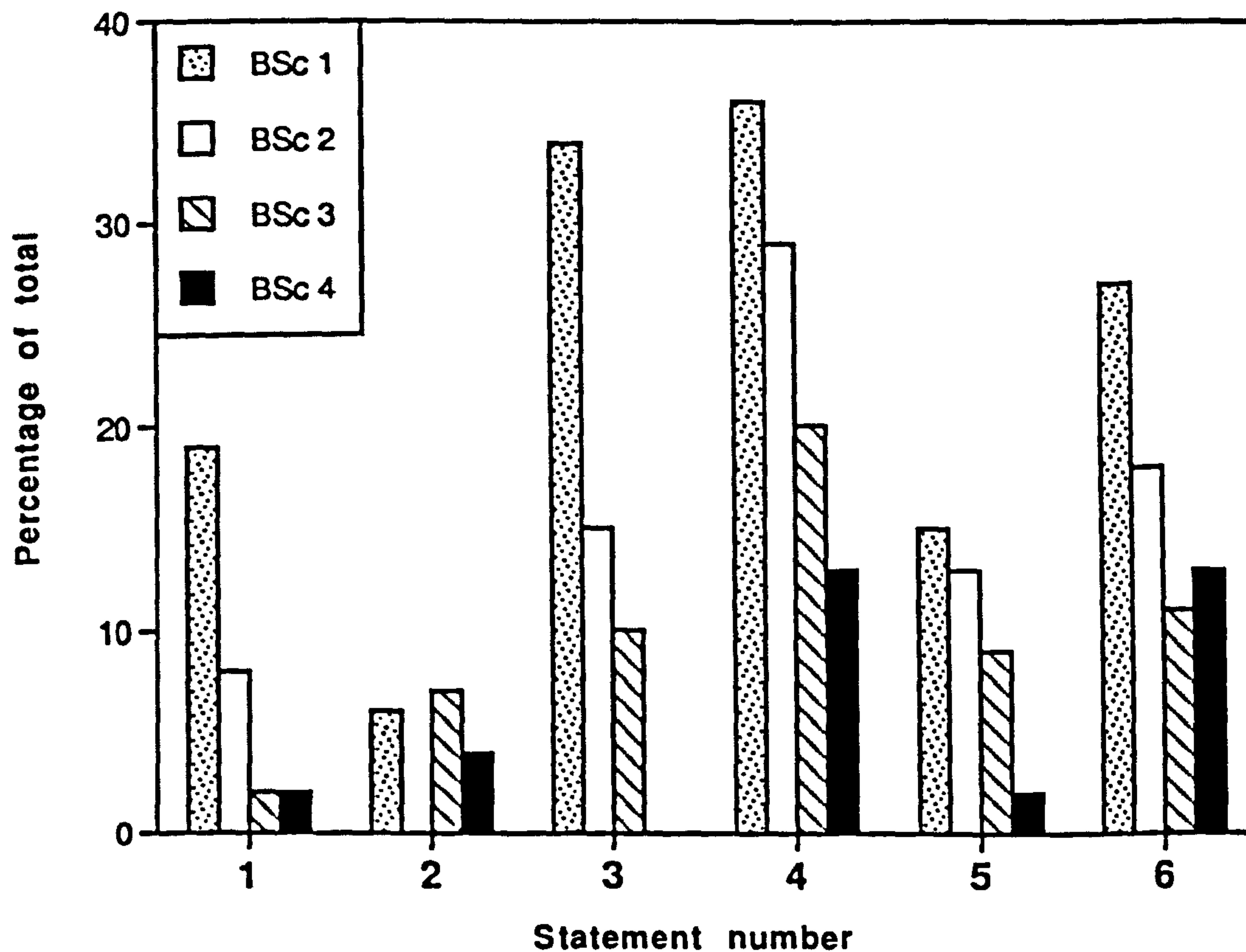


Figure 6.11

A comparison between the percentage of students from the full time BSc degree classes not justifying their decisions in Part 2 of the Perry Questionnaire P2 in October 1993



Statements

1. A good thing about science is the fact that everything is so clear cut - either right or wrong
2. Scientists will eventually be able to solve every medical problem : it is just a question of time
3. There sometimes seems to be so many ways of looking at scientific subjects, I feel confused about what is right and wrong
4. A scientific fact cannot have meaning if considered in isolation ; meaning is only gained by context
5. You can never be completely sure of any scientific fact : uncertainty will always exist
6. I usually think about how any new scientific information relates to other subjects and topics on the course

Table 6.1
A selection of student comments from Part 2 of the Perry Questionnaire P2
in October 1993

Statement 1 :

A good thing about learning science is the fact that everything is so clearcut : either right or wrong

- The result of a science test is either positive or negative, there is no opinion
 - I'm a definite sort of a person, I like to know if it is correct : no in between
 - When you hand in a report you will be judged fairly : it is either right or wrong
 - If it wasn't clearcut books would all say different things and you wouldn't know which was right and wrong.
 - Many factors contribute and there is a great variation, practical work is often inconclusive
 - A lot of scientific research/data is subject to interpretation and perspective because of the natural diversity of the subject area, science can therefore only deal with probability
-

Statement 2 :

Scientists will eventually be able to solve every medical problem it s only a question of time

- I think that there is an answer to every problem, we just need to find it
 - If they had an infinite amount of money, they would do it
 - Genes /viruses will always evolve so there will always be new problems, we really know so little
 - It would be difficult for scientists to predict illnesses, they are always one step behind
 - It seems to be a question of saving the environment or improving the quality of life over 70 years old
 - It is too big a field with too many unknown quantities
-

Statement 3 :

There sometimes seems to be so many ways of looking at scientific subjects I feel confused about what is right and wrong

- I only go by what we are told to do so there is never any confusion
- Sometimes you can do an experiment the wrong way theoretically, but get the right results
- I think our education presents subjects in a manner where it is obvious what is right and wrong
- The lecturer tells us the right way of looking at the subject
- There are so many people who think they are right
- I don't know which way to go
- One person approaches a subject one way and someone else might say the same thing but in a different way - Who do we listen to ? Do we go by a book or by what the lecturer says ?
- It is difficult to work out what is right and wrong, at the same time it is also difficult to know if there is a right and a wrong - who is to say that something is completely right or wrong ?
- You get confused because you have to learn up the lecturer's opinion and you have another
- Confusion arises not because of the subject but because of an ambiguity which the lecturer introduces
- It is good that I am confused and see that different personalities are involved in formulating scientific theories
- You have to go with the logical choice

Table 6.1 (cont.)

Statement 4 :

A scientific fact cannot have meaning if considered in isolation : meaning is only gained by context

- A fact is a fact
 - Maths is a science many mathematical formulae exist in isolation
 - It is not necessary to explore every direction of a scientific fact
 - A scientific fact can have meaning in isolation it allows people to understand it before being put into context
 - Most facts are interrelated so if you take one on its own it is pointless
 - Scientific facts depend on the culture the scientist comes from
 - Context can be compared to taking the same words and manipulating them as in a comedy sketch
 - Measuring the level of say a woman's reproductive hormones, only one would be meaningless, you have to take many samples for it to have meaning
-

Statement 5 :

You can never be completely sure of any scientific fact : uncertainty will always exist

- What you learn are actual proven facts
 - If sufficient work has been done on it then it is proven
 - Scientists have proved them either by writing a book or doing a TV production - They work for years to find the solution
 - Humans have to see something with their own eyes before they believe it
 - The more you read, the less you know, by eliminating the dross by trial and error, the truth will eventually be known
 - It is rare to be able to have complete faith in scientific facts as over time they can change through either incorrect or improved research methods
 - Scientists are not infallible
 - Often a fact is proven by eliminating other facts so you can never be sure of its foundation
 - Certain facts can be taken as clear, water can become a solid or gas according to temperature
-

Statement 6 :

I usually think about how any new scientific information relates to other subjects / topics on a course

- Everything must relate or it wouldn't be in the course
 - TV programmes relate to topics on the course
 - Overlapping ideas can be confusing
 - I don't relate because that leads to confusion and misunderstandings
 - To gain an overall perspective on several topics you need to draw them together to date we haven't had any new information to relate (4th year student)
 - I feel that you have to have many facts to piece together the jigsaw
 - Each topic has an impact on another, e.g. a piece of chemical information can make a biological subject easier
 - Because getting the wider picture makes things easier to remember to consider isolated facts are just memories, once related to something else it becomes knowledge with meaning
-

6.2.7 A comparison between the student responses given to the statements in Part 1 and Part 2 of the Perry Questionnaire P2 (October 1993)

In October 1993, a comparison was made between the students' responses to the three statements which were included in both Parts 1 and 2 of Perry Questionnaire P2, in order to investigate whether or not students had changed their opinion when they were asked to justify their decisions. There was a general slight decrease in the number of students agreeing with the statements when they were asked to justify their decisions (Figure 6.12). The second year HND class was the only class to show a significant reduction ($p < 0.05$, using the z test for the equality of two proportions) in their level of agreement when asked to justify their decisions on the B Type statement *'There sometimes seems to be so many ways of looking at the course subjects, I feel confused about what is right and wrong'*. None of this classes' responses to other statements or any of the other classes tested had shown a significantly different level of agreement between the two parts of the Questionnaire. The classes' mean responses were compared using a z test for the equality of two proportions.

The C type statement *'I usually think about how any new information relates to other subjects and topics on the course'* elicited an average of 75 percent agreement by all the classes tested. There was generally a small decrease in the level of agreement when students were asked to justify their decision to this statement but this was not significant. The reasons given for the students' agreement in Part 2, however, (see Table 6.1 for examples) appeared to differ between students.

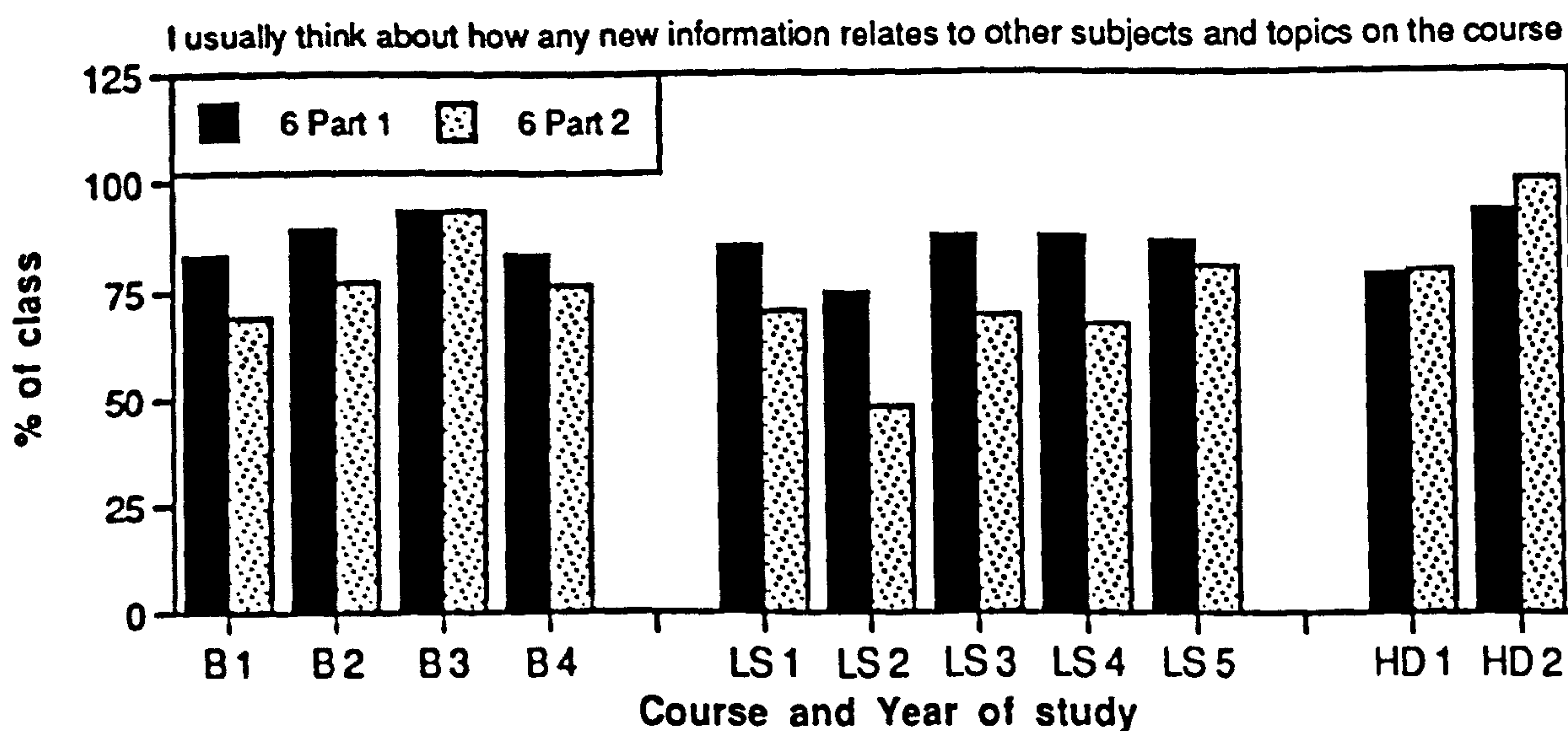
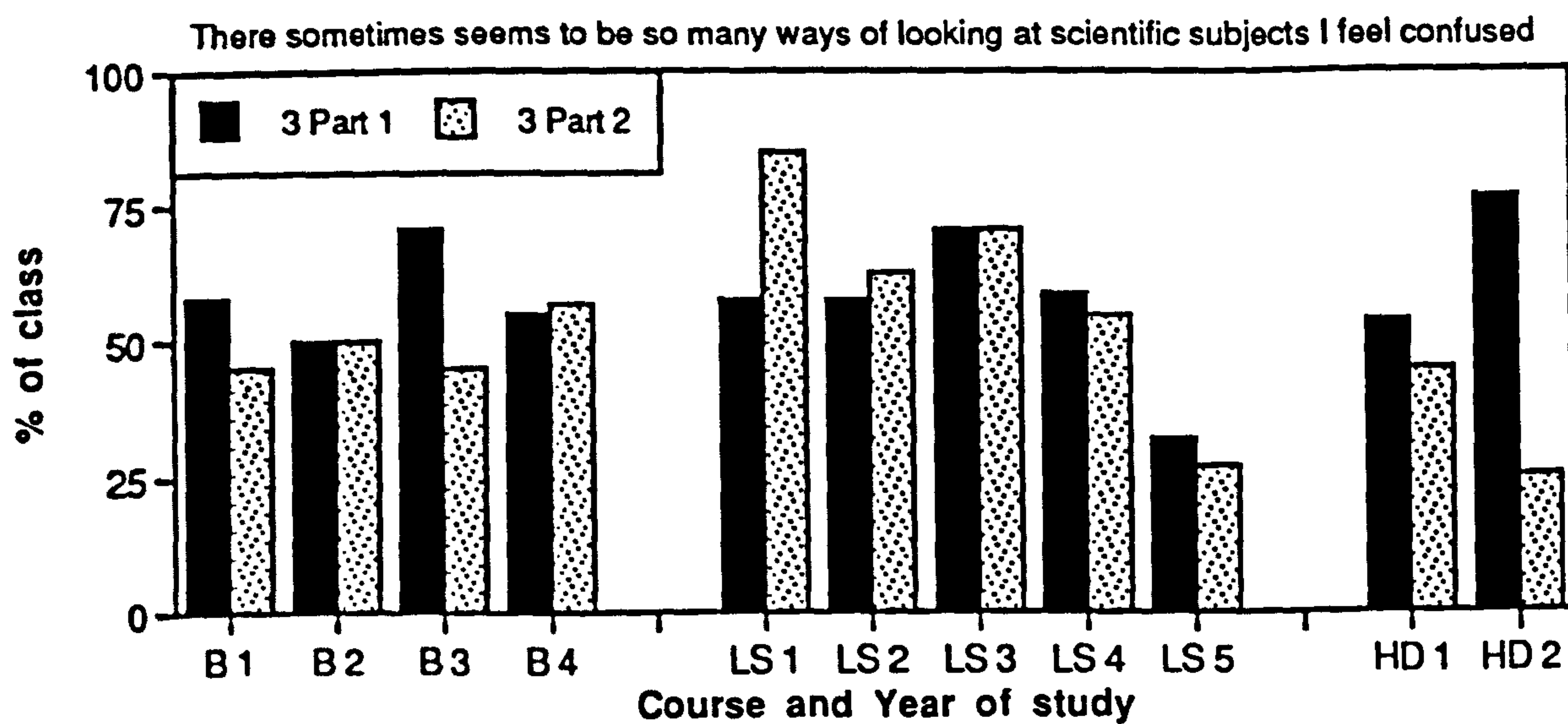
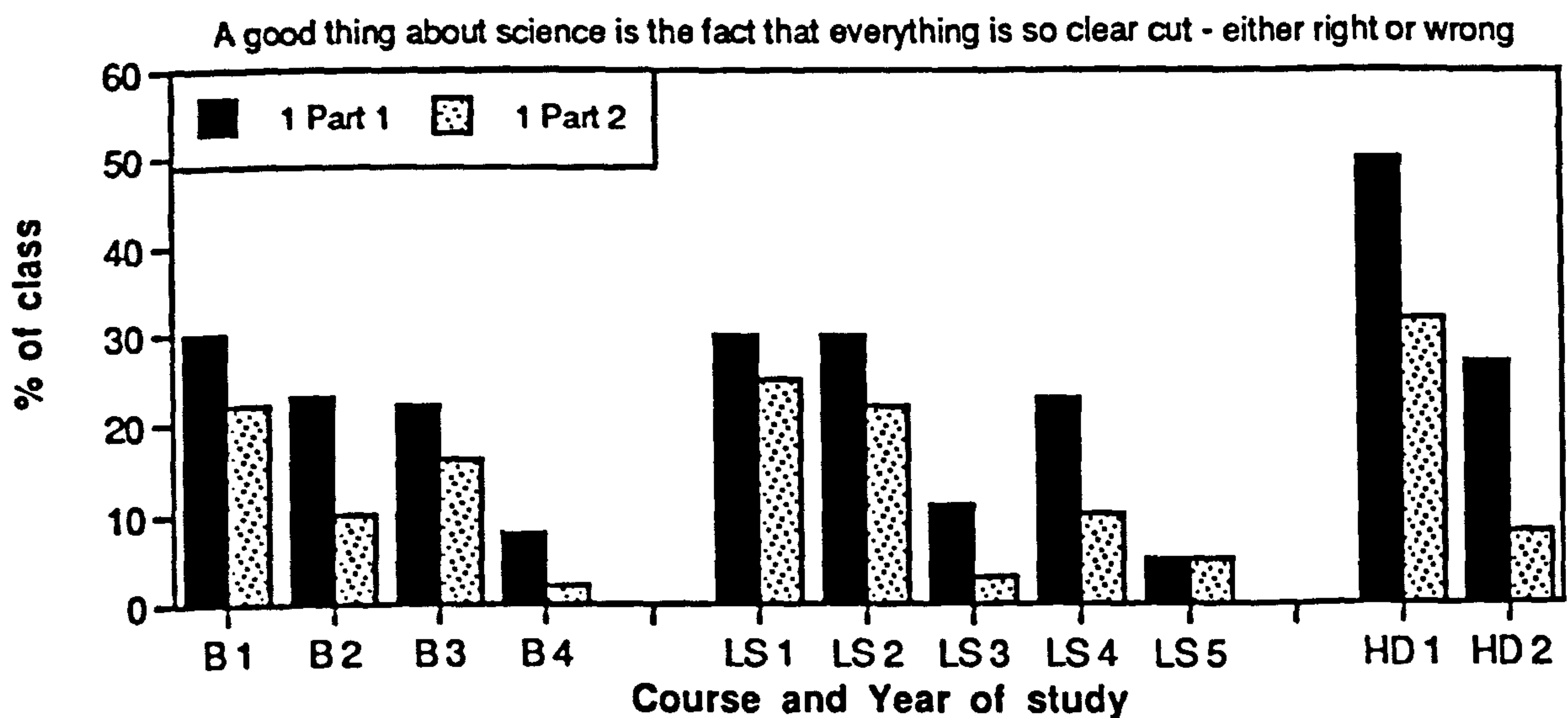
The majority of the students who had expressed a response of 'probably agree' or category '4' in Part 1 of the Perry Questionnaire P2 went on to 'agree' with the same statement in Part 2 of the questionnaire and many also went on to strongly defend their opinion. This supported the use of all the 'agree' categories (*strongly agree, agree and probably agree* or 6, 5 and 4) as being positive responses when calculating the 'Perry scores' for students.

6.2.8 Student responses to Part 3 of the Perry Questionnaire P2 (October '93)

In Part 3 of the Perry Questionnaire P2, students were asked to indicate their preferences for teaching and assessment methods and their preferred method of studying for their choice of assessment(s). As a result of the students' comments about Selection 5 in the Teaching Preferences : Individual study (1) working by yourself on a task in the classroom with the

Figure 6.12

A comparison between the number of students agreeing with statements 1, 11, and 9 in Part 1 of the Perry Questionnaire P2 and agreeing with the same statements (1,3 and 6) in Part 2 in October 1993



lecturer present, this selection was discounted from the study because of the ambiguity of the situation described. Some of the students had interpreted this selection as being taught on a one to one basis, with only the lecturer and student present in the classroom. The description was originally intended to mean that students would be working individually along with the rest of the class, on an exercise with the lecturer present. The average class Course preferences for all courses tested which show a course trend are included in Appendix 3.

6.2.9 First and fourth year full time students' responses to Part 3

In October 1993, the responses to Part 3 of the Perry Questionnaire P2 identified significant differences between the preferences indicated by different classes tested (Appendix 3). A comparison between the average most and least preferred responses given by the first and fourth year Full Time BSc students, demonstrates what might be considered to be the general course trends. A z-test was used to compare the equality of the mean responses for the two groups. The preferences showing significant differences the first and fourth year full time students are in Table 6.2 .

Table 6.2

A comparison between the responses given in Part 3 of the Perry Questionnaire P2 by the full time first year class which were significantly different from the fourth degree classes' response given in October '93 (A z test for the equality of 2 proportions was used to compare class average percentages)

Most preferred selections				
	Fourth year		First Year	
Teaching	Lectures	**	Small group + lecturer	***
	Individual study	*		
Assessment	Descriptive essays	***	Short answer questions	***
			Multiple Choice questions	***
Study Methods	Mapping overlying principles	***		
Least preferred selections				
	Fourth year		First Year	
Teaching			Lectures	**
			Individual Study	***
Assessment	Multiple Choice Questions	**	Descriptive essay	**
			Discussion essay	**

(* p< 0.05, ** p<0.01, *** p<0.001)

a) Teaching method preferences

In all three courses tested, the first year students had significantly less of a preference ($p < 0.01$) and a more of a dislike ($p < 0.01$) for *lectures* than did the final year students (see Figures 6.12, 6.13 and in Appendix 3). In addition, significantly more of the first year students selected *small group format with the lecturer present* as their most preferred ($p < 0.001$) and *individual study without the lecturer present* as their least preferred ($p < 0.05$) teaching method when compared to the fourth year students. *Group work* either with or without the lecturer present generally was less popular in the later years of all courses whereas *tutorials* were generally more popular in the later years of the courses tested, with the classes in the middle years of the full and part time showing the highest level of preference (Appendix 3).

b) Assessment method preferences

Significantly more ($p < 0.001$) fourth year than the first year students selected descriptive essays as their most preferred assessment. Conversely, multiple choice and short answer type questions were preferred by significantly more ($p < 0.05$ and $p < 0.001$ respectively) of the first year students than the fourth year students. Similar trends were shown on all courses tested in October 1993 (Appendix 3).

In addition, all courses showed the opposite trends with respect to the least preferred selections of assessment methods, as reflected by the fourth and first year students' results shown in Figure 6.12. The fourth year students indicated a significantly higher dislike ($p < 0.01$) of multiple choice type questions and significantly less of a dislike ($p < 0.01$) than the first year students of both essay types. Problem type questions without answers were the most frequently indicated as being the least preferred by all classes tested (Appendix 3). Both the first and fourth year classes indicated that this form of assessment was the least preferred of all assessment methods (Figures 6.13 and 6.14).

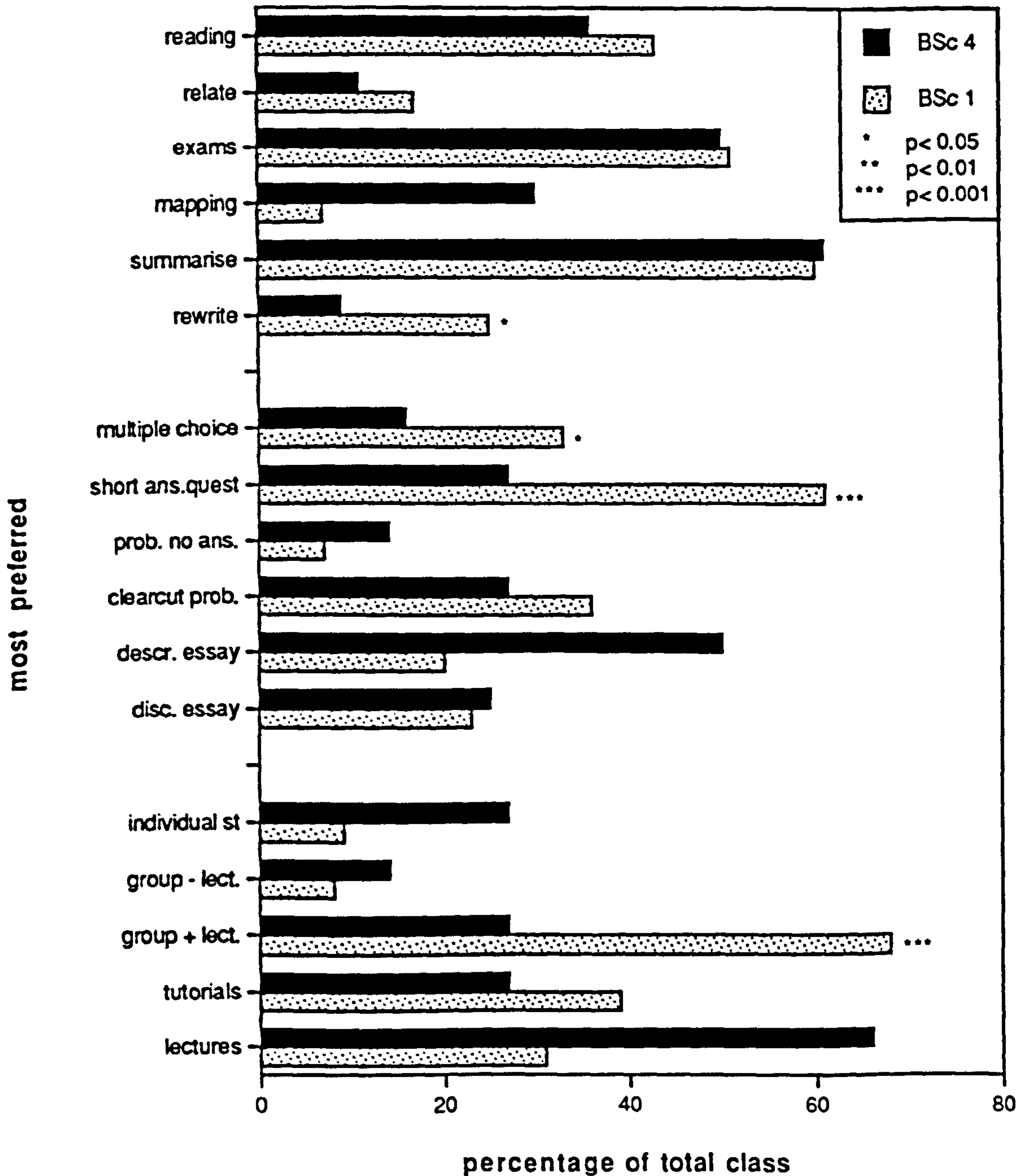
c) Study Methods

The most preferred study method selected by students from all courses tested was to summarise their lecture notes (Appendix 3) followed by going through past examination papers. The first and fourth year students also listed these methods as their most preferred in the Perry Questionnaire P2. However, significantly more ($p < 0.05$) of the first year students indicated that they rewrote their lecture notes and significantly

Figure 6.13

A comparison the most preferred selections for teaching, assessment and study methods made by the BSc first and second year classes in the Perry Questionnaire P2 in October 1993

(The percentages of both classes were compared using a z test for the equality of 2 proportions)

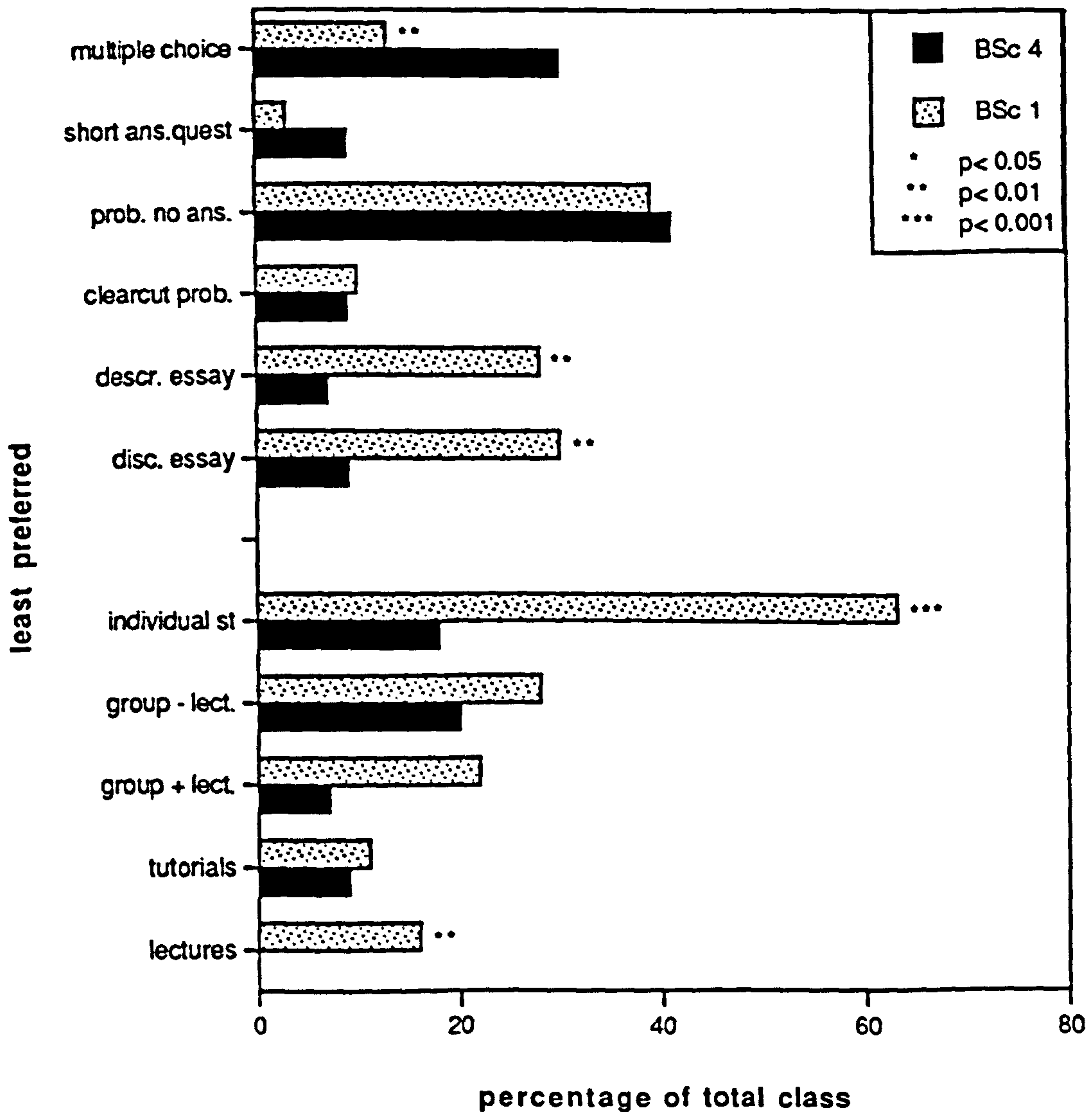


(The class average percentages were compared using a z test for the equality of two proportions)

Figure 6.14

A comparison the least preferred selections for teaching, assessment and study methods made by the BSc first and second year classes in the Perry Questionnaire P2 in October 1993

(The percentages of both classes were compared using a z test for the equality of 2 proportions)



(The average class percentages were compared using a z test for the equality of two proportions)

significantly more ($p < 0.05$) of the first year students indicated that they rewrote their lecture notes and significantly more ($p < 0.001$) of the fourth year students indicated that they concentrated in mapping out the overlying principles of subjects as a method of preparing for assessments. The same trends were shown on all the other courses tested (Appendix 3).

6.3 A comparison between the questionnaire responses given by students obtaining the highest and lowest Perry scores in Oct'93

6.3.1 Introduction

The original Perry scheme describes students as entering higher education at the Dualist stage and then if challenged, although not always, developing through other stages towards a level of commitment in Relativist stage of development (Perry, 1970). During 1993-'94, by using the Perry Questionnaire P2, significant differences had been shown between the first and final year full time degree students' responses to the Perry Questionnaire P2 (see Section 6.2.9). In addition, students adopting Influencing and Non-influencing roles in the group poster exercise (see Section 5.4.8) and the third year low and high Perry scoring groups (see Section 5.4.11) had shown significant differences between their responses to the questionnaire.

However the questionnaire responses over the two academic sessions 1992-'93 and 1993-'94 had also suggested that there were students in first year who had low levels of responses to A type or dualist type thinking and high levels of agreement with C type or relativistic thinking responses and even the average C/A ratios for the first year students in October 1992 had been higher than that of the fourth year students tested at the same time. Conversely, some fourth year students had shown the opposite trend : high A type responses and low C type responses. In addition, the change in responses towards dualist, A type thinking found by the first year degree students in 1992-'93 (Section 6.2.2) and the wide range of Perry scores in each of the years tested raised a number of questions as to what the questionnaire was measuring. Was a high C scoring student in the first year the same as a high C scoring student in the fourth year and had the first year full time degree students' experience of the first four months at Napier caused the students to regress intellectually ?

If Part 1 of the Perry questionnaire P2 containing the eighteen statements was measuring behaviours characteristic of the Perry scheme

then a sample of the highest and lowest Perry scoring students from all courses and years would be expected to show significantly different preferences in Parts 3 and 4 of the questionnaire which would be independent of their course and year of study. In addition, it would be expected that these differences would be more pronounced than those found in the full time third year degree student High and Low Perry groups (Section 5.5.2)

6.3.2 Selection of High and Low Perry groups from all courses

The High and Low Perry groups for the comparative study were selected from the 415 students tested in October 1993 using the Perry Questionnaire P2. The October 1993 testing was selected in order to establish whether or not there was a link or parallel trend between the students' responses in Part 1 of the Questionnaire with their responses to Parts 2 and 3, where they were asked to justify their opinions and to indicate their teaching, assessment and study preferences.

A selection of the 45 highest and the 45 lowest scoring students from Part 1 of the Perry Questionnaire P2 was made on the basis of the C type positive responses given by the students. The High group had a minimum of 65 % C type responses and the Low group had a maximum of 35% C type responses. A summary of the scores for these two groups is shown in Figure 6.14. Students were selected from all three courses and from all years on each course. The High group had 29 female and 16 male students and the Low group had 33 female and 12 male students. These numbers reflected the gender proportions of students on the courses. The z-test was used to compare the equality of the mean responses for the two groups in all comparisons made.

6.3.3 High and Low Perry Groups responses to Part 2 of Perry Questionnaire P2

The number of positive responses (agreements) with the six statements included in Part 2 of Perry Questionnaire P2 are shown in Figure 6.15a. The responses to statements 1, 2 and 3 had a significantly higher levels of agreement by the Low Perry group. Statement 6 had a significantly higher level of agreement by the High Perry group than the Low group. Statements 4 and 5 showed no significant difference between the groups with respect to the number of positive responses, however, the number of students not giving justifications for statements 3, 4 and 6 was significantly

Figure 6.15

A comparison between the mean percentage of A, B and C type positive responses given in Part 1 of the Perry Questionnaire P2 by the sample of High and Low Perry scoring students selected from all classes in October 1993

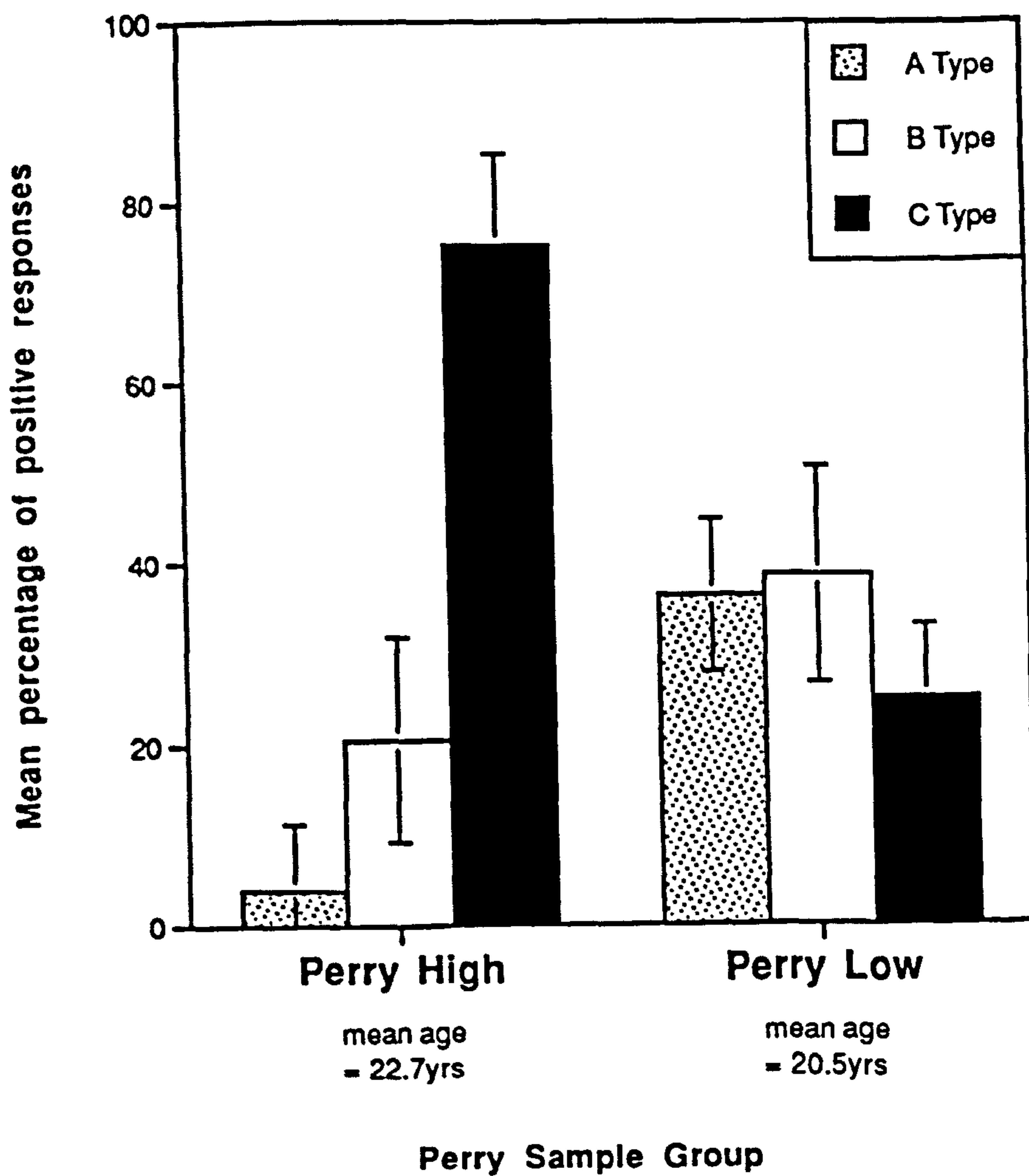
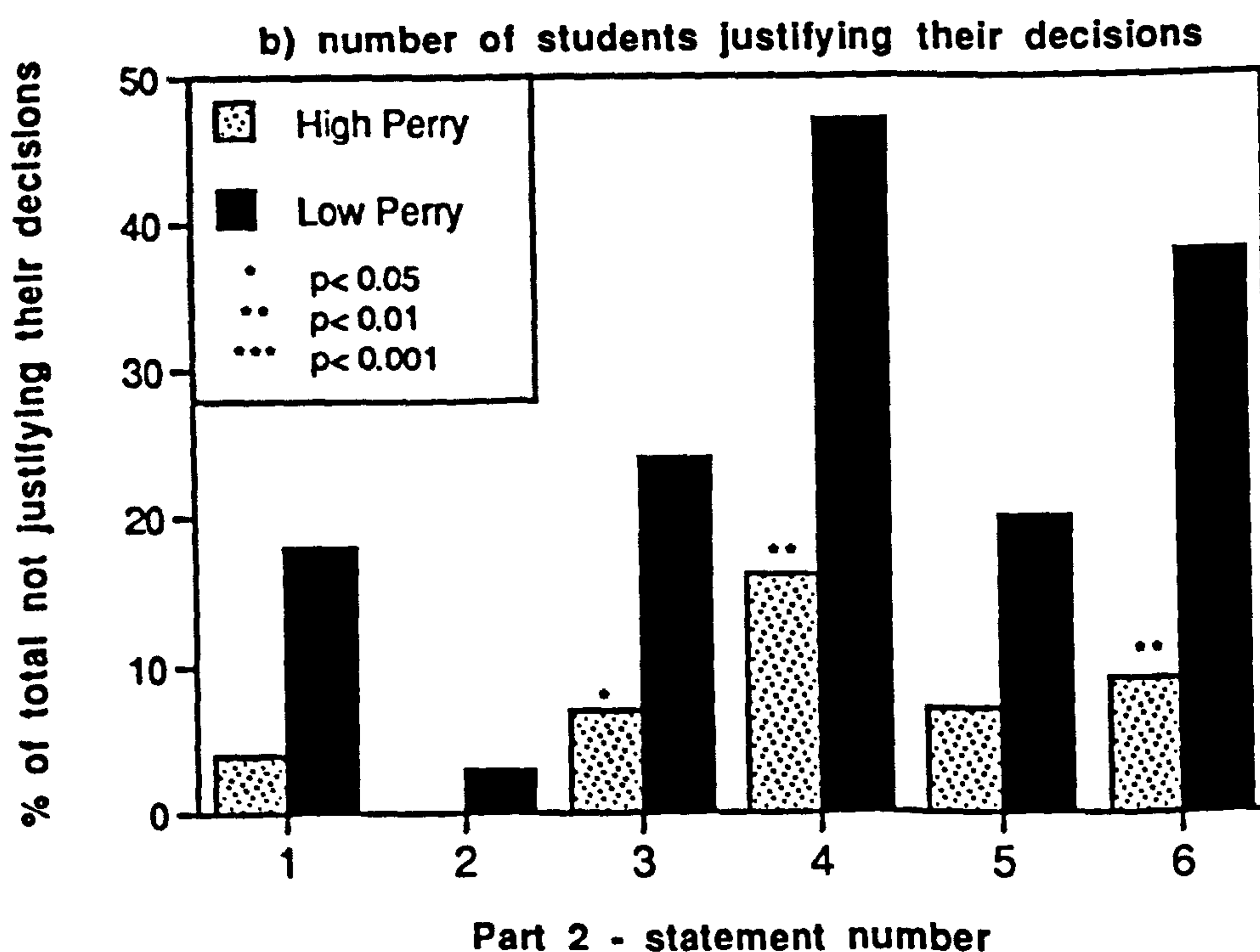
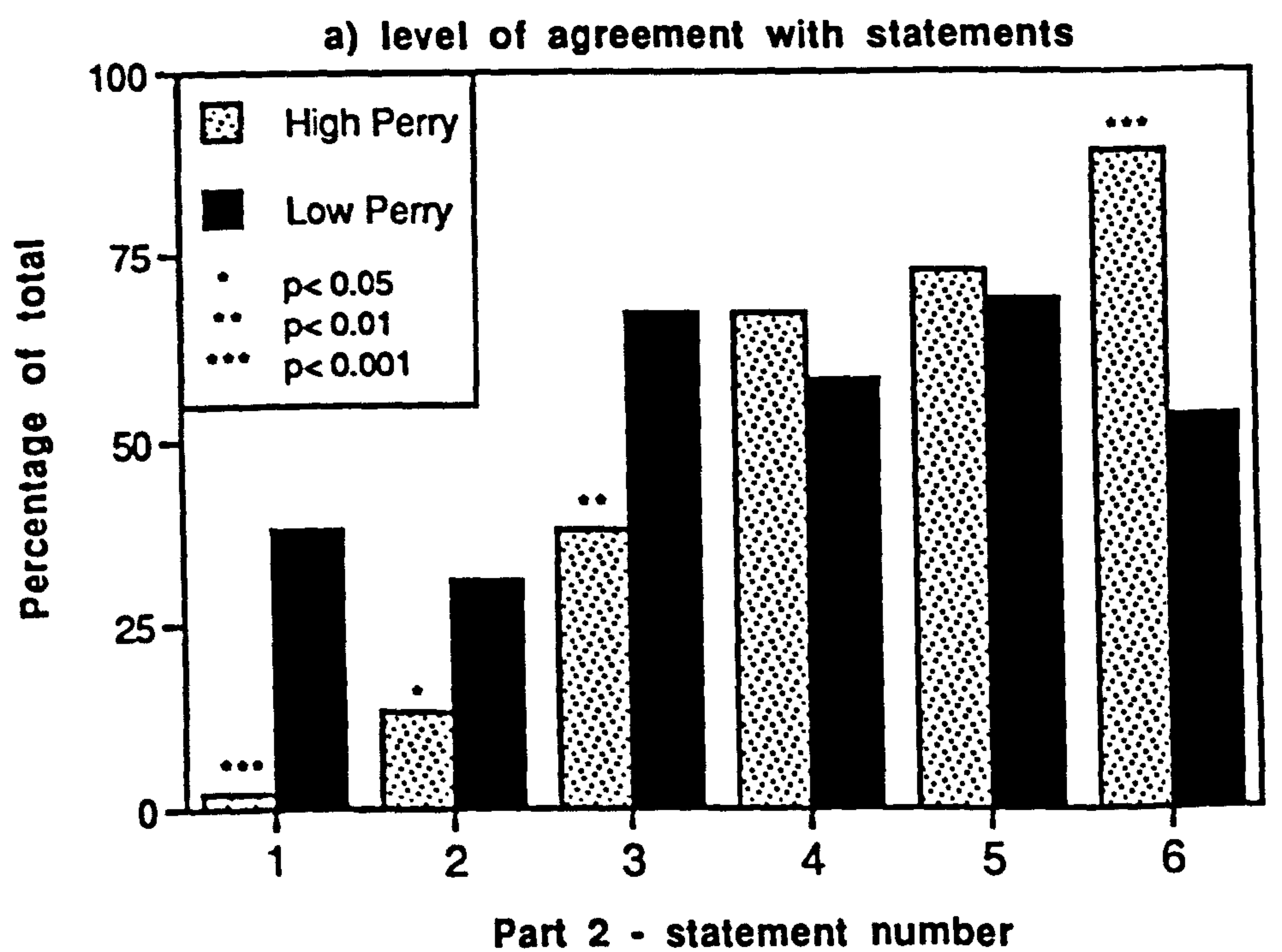


Figure 6.16

A comparison between the responses given to Part 2 of the Perry Questionnaire P2 by the High and Low Perry scoring students in Part 1 of the Perry Questionnaire P2 in October 1993



(The percentages given by the two groups were compared using a z test for the equality of two proportions)

higher for the Low Perry group than for the High Perry group (Figure 6.14b). The number of Low Perry group members not justifying their answers was higher than that of the High group for all the statements in this part of the questionnaire.

6.3.4 High and Low Perry group responses to Part 3 Perry Questionnaire P2

The High Perry group generally had a greater preference for a wider range of teaching methods, scoring higher in all the most preferred categories, than that of the Low Perry group (Figure 6.15). The Low Perry group had indicated higher levels of dislike for more teaching methods than did the High Group (Figure 6.16). The preferences indicated by the High Perry group which were significantly different from that of the Low Perry group using a z test for the equality of two proportions are shown below in Table 6.3.

Table 6.3

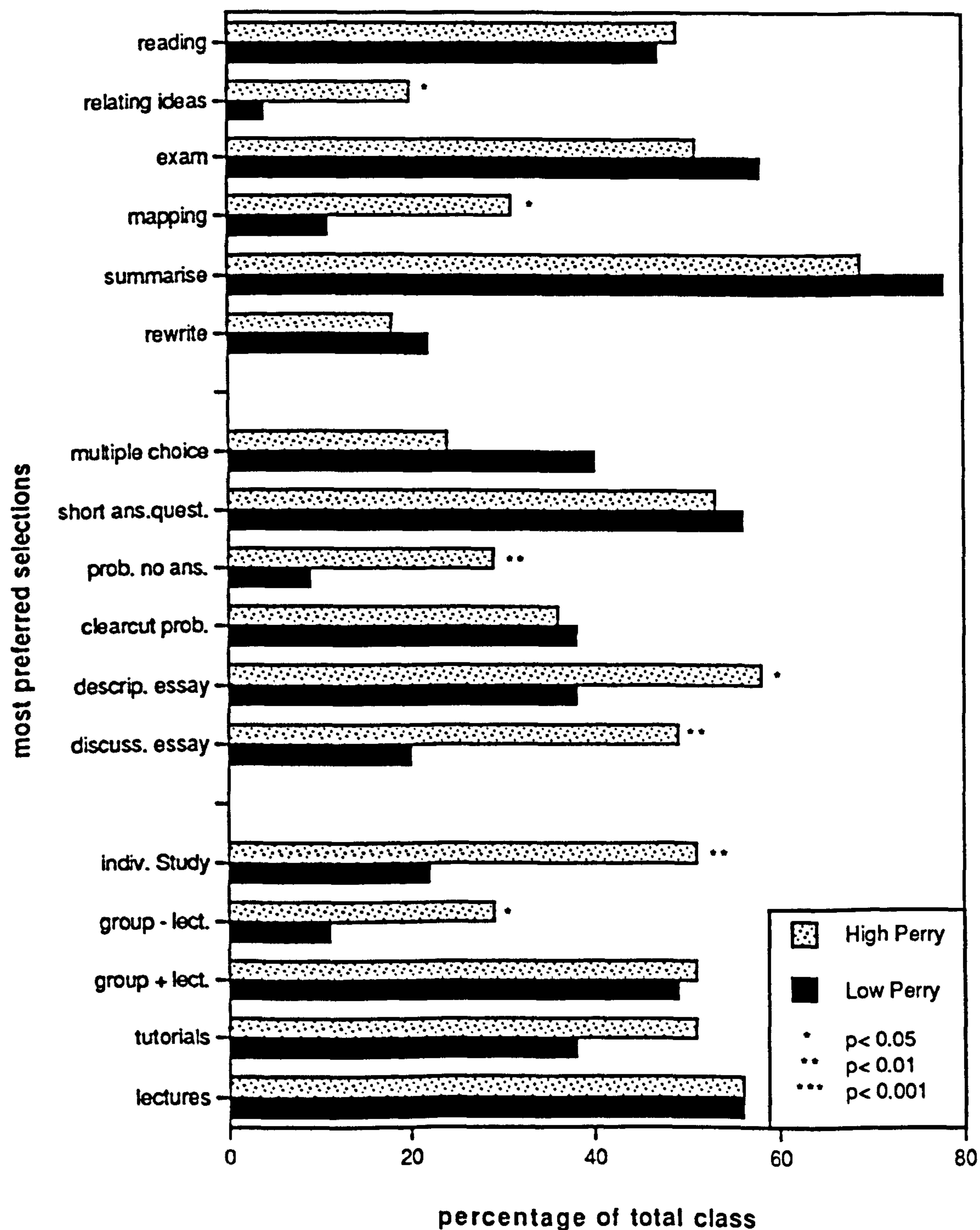
The preferences indicated in Part 3 of the Perry Questionnaire P2 showing a significant difference between the High and Low Perry scoring groups from Part 1 of the questionnaire (*p < 0.05, **p < 0.01, ***p < 0.001)

High Perry Group			
Teaching methods	<i>most preferred</i>	Individual study	**
		Groups no Lecturer	*
Assessment methods	<i>most preferred</i>	Discussion Essay	**
		Descriptive Essay	*
		Problems no answers	**
Study Methods	<i>least preferred</i>	Multiple Choice	***
		<i>most preferred</i>	Relating ideas
			Mapping out principles
Low Perry Group			
Teaching Methods	<i>least preferred</i>	Individual Study	*
Assessment Methods	<i>least preferred</i>	Discussion essay	***
		Problem - answer	**

(Statistical comparisons were made used the z-test for equality of 2 proportions)

Figure 6.17

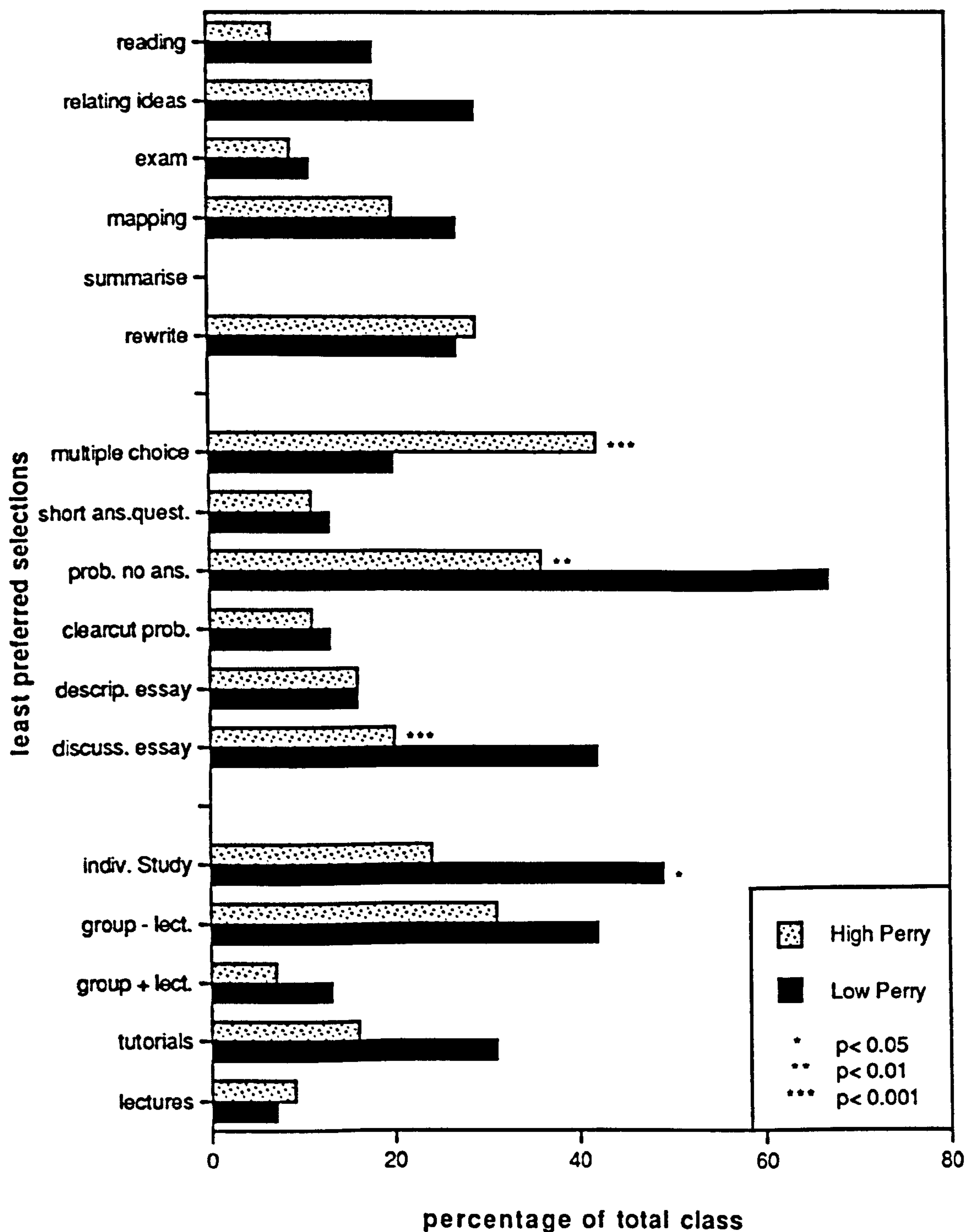
A comparison between the most preferred teaching, assessment and study methods selection in Part 3 of Perry Questionnaire P2 given by the High and Low Perry scoring samples in Part 1 taken from all classes tested in Oct ' 1993



(The class average percentages were compared using a z test for the equality of two proportions)

Figure 6.18

A comparison between the least preferred teaching, assessment and study methods selection in Part 3 of Perry Questionnaire P2 given by the High and Low Perry scoring samples in Part 1 taken from all classes tested in Oct ' 1993



(The class average percentages were compared using a z test for the equality of two proportions)

Both the High and Low Perry groups had indicated that lectures was their most preferred teaching method. If a comparison is made between the most and least preferred selections by both groups in almost every instance a preference for one instructional method by one group is balanced by a dislike for that method by the other group. For example, significantly more of the High Perry group than the Low Perry group indicated a preference for discussion essays ($p < 0.01$), whereas, significantly more of the Low Perry group than the High Perry group indicated a dislike for discussion essays ($p < 0.001$).

6.3.5 Follow-up study of first year full time degree students (February 1994)

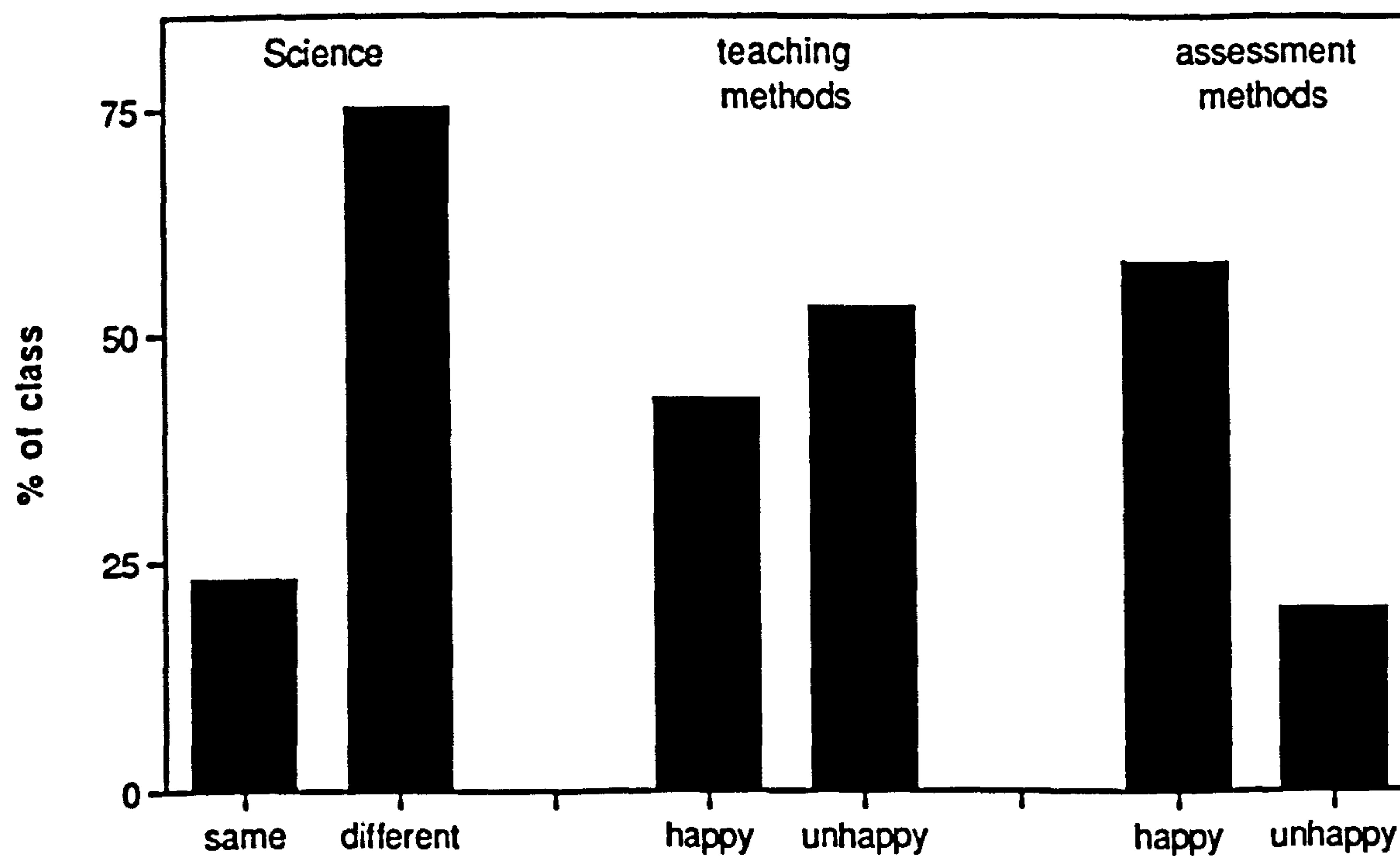
In February 1994, the first year degree students were asked to complete Perry Questionnaire P3 which comprised Part 1 with 18 statements, in addition to a section where the class was asked about their attitudes and feelings towards various aspects of the first year course (Appendix 3). The inclusion of this section aimed to link the students' attitudes with the changes, if any, which they might have had in their levels of agreement with A, B or C statements. For example, would an individual student showing an increase in A type responses indicate some problem or change in attitude towards the assessment or teaching methods that might suggest a reason for their change in approach as reflected by their Perry score. A summary of the students' responses is shown in Figure 6.17 (more information about changes in the first year students' responses to individual statements in Part 1 of the Questionnaire is given in Appendix 3).

a) *Perception of 'Science'*

Out of the total first year full time degree class, only 23 % responded that they thought of the subject 'Science' in the same way as they when they first came to Napier University. The remainder of the class felt that the subject was different in either a positive or negative way. Students' comments ranged from science being, '*less complex*', '*more fun*', '*easier*' and '*more interconnected*' to negative comments that science was '*more difficult*', '*more ambiguous*', and even '*tedious*' and '*confusing*'. The most frequently written comment was that Science was '*more interesting*' given by 28% percent of the class, while 18 % of the students replied that Science was '*more complex*'. There was no apparent link between the first year students' number of A type responses or changes in A type responses from October 1993 to February 1994 given in Part 1 of the questionnaire if and the

Figure 6.19

A summary of the opinions expressed in Part 2 of the Perry Questionnaire P3 by first year full time BSc students towards 'Science' and the teaching and assessment methods used on the first four months of their course



General opinion expressed in questionnaire

their comments about their perception of science given to Question 1 in Part 2. For example, positive responses such as Science is 'fun', 'easier', 'less complex', 'more interesting' were not given by students with either high or low A type scores or by students who had shown a change to a higher or lower A % type level of positive responses (Data not shown). A change in Perry scores therefore did not appear to be related to a change in perception if measured in this way.

b) *Teaching methods*

Out of the all first year full time degree class tested, only 43 % indicated that they were happy with the teaching methods used on their course. There were a range of comments as to how the teaching methods might be improved with opposing opinions as whether the number of lectures, tutorials, amount of laboratory work and individual study should be increased or decreased. Many of the students (33 %), however, did comment in the questionnaire about problems such as overcrowding, student groups that were too large in laboratories, a feeling that they (the students) were not having enough individual attention from the lecturer and that there was not a strong enough relationship between the lecturer and individual students in the class.

c) *Assessment Methods*

Seventy seven percent of the class commented that they were happy about the assessment methods used during the first year course so far, indicating that a mixture of assessment methods was good and that the methods used gave more people a better chance of passing and were, therefore, 'fair'. Some students did however, make comments about not knowing what was expected from them in the assessments and how they were marked like '*I don't know how I am assessed*', or '*I don't what the lecturer wants me to do*'. There were mixed opinions from the students as to how much of each type of assessment there should be and as to the weighting coursework and final exams should have in the final marks awarded to students for each subject.

d) *Study methods*

Most of the students indicated that they used either their notes or the course textbook as a basis for their preparatory work for the exams. The results are summarised in Table 6.3 :

Table 6.4

A summary of the study methods used in preparing for assessments as listed by first year students in the Perry Questionnaire P3 in February 1994

	%
rewrite notes	62
summarise notes	9
learn up notes	37
read through notes	22
read/learn from textbook	42
tried similar problems	8
asked myself questions	8
looked at past papers	9

There was no apparent link between the students Perry scores from Part 1 of the Perry Questionnaire P3 and the methods used for studying, for example, the students using more active learning methods such as asking themselves questions about their notes or trying problems did not have lower A type scores or higher C type scores. The responses given in February 1994, to the question on study methods, however, were different to the anticipated study methods indicated by the same class in response to the Perry Questionnaire P2 Part 3 which they had completed four months earlier in October 1993. In the October, 51 % of the class had indicated that they would be practising exam questions and only 25 percent of the class had responded that they would be rewriting their notes.

6.4 Discussion about Questionnaire responses during 1992- 1994

6.4.1 Course trends observed from the October 1992 and 1993 testing of students using Perry questionnaire P1

The original Perry Scheme of Intellectual Development describes potential changes which students undergo in response to the learning environment which higher education provides (Section 1.4). This research project developed and used a questionnaire as a means of trying to identify and monitor changes in intellectual development as first described by Perry (1970). Classes of students from three biology courses, two full time and one part time were tested in October 1992 and October 1993 using the Perry Questionnaire 18 statements (Appendix 3).

In October 1993, the average class responses to the different types of statements showed trends which supported the Perry model, with the fourth year students showing a higher level of relativistic thinking than the preceding years. It might be argued that a comparison between class averages of different course years is not comparing like with like, however, other investigators, (including Meyer, 1977; Blake 1976; Moore, 1982; Baxter-Margolda and Porterfield, 1985) have shown trends of responses from first to final year students carrying out similar cross sectional studies. In addition, other research relating to ethical and intellectual change has shown similar trends of changes during student academic life, for example in students' reflective judgement ability (Kitchener and King, 1977), moral judgement (Kohlberg, 1976), attitudinal development (Heath, 1964) and the utilisation of knowledge (Wentz *et al.*, 1986). The agreement with these studies and Perry's original findings would seem to suggest that the trends shown using the Perry Questionnaire developed for this project were identifying changes in student development occurring during their time at university.

However, during in October 1992, each of the course profiles of class averages showed a trough in intellectual development during the middle years of each course tested (Figure 6.2). Although the course profiles in 1993 - '94 did not show the same troughs (Figure 6.7), when compared to the class responses in October 1992, there was a reduction in the level of agreement to C type statements by all the classes in the middle years of their courses (Appendix 3). Several investigators (Chickering, 1969; Heffernan, 1975; Lemans and Richmond, 1987) have described a phenomenon when students in the middle years of their course have started using less of a deep approach to their learning and in some cases students have gone through a stage of uncertainty and experienced feelings of a lack of direction.

6.4.2 Course trends observed in the February 1993 and 1994 testing of students using the Perry Questionnaire P1

When the 1992 - '93 first year degree students were tested using Perry Questionnaire P1 in February 1993, four months after their first testing, their responses suggested that the class had generally changed towards having a more dualistic type approach to their learning (Figure 6.3). The importance of the learning environment has been shown as being important in stimulating developmental change (Heath, 1964; Kurfiss, 1977; Widick, 1977; Kitchener and King, 1990) and also in determining a student's approach to

their learning (Ramsden *et al.*, 1986; Parsons and Meyer, 1990) and the way a course is taught influences the way in which the students approach a particular discipline (Ramsden, 1979; Sheppard and Gilbert, 1991). Many science courses are perceived by students as being heavily content bound and having a high workload (Ramsden and Entwistle, 1981), with an emphasis on the accumulation of knowledge (Entwistle and Hounsell, 1975; Tobin and Gallagher, 1987) through assessments being based on the recall of factual material (Ramsden and Entwistle, 1981; Gibbs *et al.*, 1982; Hounsell, 1984; Laurillard, 1984).

The trend in the changes of type of responses to the Perry statements towards a more dualist approach observed by the first year degree students in 1992-'93, seemed to be related to assessment methods and the students perceptions of the role of the lecturer, with the students starting to look to the lecturer for direction in their studies (Appendix 3). In the subsequent year (1992 - '93), similar changes were observed in relation to the first year classes' attitude towards the lecturer although there was not the same reduction in the total number of positive responses to the C type statements. This difference in type of response meant that there did not appear to be the same universal trend towards A type responses as had been shown in the previous year (1992 - '93). The comments in the questionnaire supported the idea that students did not feel, at that stage, that they had the confidence to know what to study outwith their formal classes and felt they needed direction from the lecturer as to course and assessment content.

The format of many first year classes particularly large classes of over one hundred students might be considered as encouraging students to adopt a dualist approach to their learning. A student's first impression of a new environment is perhaps likely to influence the way in which they subsequently respond to the experience of a higher education and Heffernan (1975) and Geiger and Pinto (1991) have described how individuals can go through a reorientation with each new learning environment encountered. If, following the challenge of, for example, a particular school environment, students are entering higher education with a relativistic approach to their learning then it might be speculated that a new learning environment which encourages a more dualistic approach would encourage students to adopt this type of approach. Perry (1970) and Finster (1990) have described a phenomenon of decalage when students can adopt differing levels of approach depending on their perception of the learning environment, for example, an individual might operate at a relativistic level in a Humanities

based subject and dualistically in a Science based subject.

The questionnaire feedback from the first year degree class from 1992 - '93 would suggest that students had more of a relativistic type of approach when they entered university in October 1992 than they had when they were tested in February 1993, four months into their course (Figure 6.4). By the following October (1993) by the time they were about to enter their second year, the same class of students had returned to almost the same high level of relativistic thinking as that of their original testing, in the previous October. If, as Perry (1970) describes, students adopt the level of approach which is considered appropriate to a particular course then, during 1992 -'93, the first year students might have just been adjusting to their perception of the level of thinking required for that particular course.

In the subsequent year, 1993-'94, the first year class did not show the same general change in responses (Figure 6.9). It might be speculated that there was no general change in responses because the average original level of intellectual development for the first year class upon entry to university for was not so high and that the first year course was pitched at the level which those students were at or just above. As a result, the students did not feel the requirement to change. The positive comments about the first year course's instructional methods given by the students in the follow-up Questionnaire P3 in February 1994 (see Section 6.2.5) would seem to support the idea that the students were not being overly challenged.

If the first year students' responses to the Perry Questionnaire P1 during 1992-'94 are taken as indicators that students tend to adopt the level of intellectual approach which they feel is required by a particular course, this might have implications as to the level at which first year classes are taught. For example, it could be speculated that the instructional methods used in the first year degree course were appropriate to the 1993-'94 first year students but were at an intellectual level below that of the majority first year students of 1992-'93. As the responses from only two first year classes are available, it is not possible to know which, if either, of the classes represents the norm. However, a knowledge of the intellectual stage of the first year students of 1992 -'93, it might be speculated, could have allowed the use of instructional methods more appropriate to their intellectual requirements in the first year course in order that they might have been encouraged to develop more rapidly towards or to continue within a stage of relativism. Matching instructional methods to students' needs however, would necessitate a level of flexibility to be built into courses.

6.4.3 Timing the Perry Questionnaire

The timing and the frequency of use of the questionnaire might also be of relevance to the way in which the students responded to the 18 statements in Perry Questionnaire P1. The original Perry work and other interview type research is not likely to have been carried out during the first week of the academic first year for, if nothing else, practical reasons. This could suggest that either the relativist first year degree students approach in October 1993 was simply due to the anticipation of attending University or as a result of their prior educational experiences. As Perry's original work was carried out during the 1950's and 60's, perhaps many of his students had not been challenged within their school environment to reach a level of Relativism and as he describes, entered university at a Dualist stage. Given the range of entry qualifications which the first year students have upon entering Napier University, particularly as this project had tested students from a range of courses, it seems unlikely that all the students had educational experiences which had put the majority of them into a more relativistic frame of mind. Rather, the high scores which the first year students had are more likely to be as a result of a certain openness of mind or anticipation of what is to come, an openness or receptivity which might be in part characteristic of a relativistic way of thinking. If this openness is short lived for whatever reason, this might mean that questionnaires or interviews carried out later on in the academic year might miss this particular attitude or approach to learning. However, a comparison between the responses given by the first and fourth year students who had obtained a high Perry score in Part 1 of the Perry Questionnaire P2 in October 1993 (Section 6.3) suggests that a high Perry score indicates more than just an openness but rather a different intellectual approach to that of students with low Perry scores. This differing level of approach might have been identified had the 1992-'93 first year students completed a Perry Questionnaire P2 comprising three parts including a section about their course preferences (Appendix 3).

6.4.3 Course trends in response to particular statements in Perry Questionnaire P1 during 1992 -94

It could be argued that questionnaire familiarity might influence the results obtained from students responding to a questionnaire if completed more than once. However, repeated usage of Perry Questionnaire P1 over two years did show similar trends of students' responses across different

stages of courses and studying individual student's questionnaires revealed almost a 'fingerprinting' of responses.

In both 1992-'93 and 1993-'94 similar trends in responses were shown to particular statements in the Perry Questionnaire P1. In the same way as Perry (1970) had described, the questionnaire identified students changes in perception of the subject, and also changing perceptions of the lecturers' role within the learning environment (Table 1.1) That these changes are being stimulated by the learning environment, might be suggested in the course trends to statements observed over the two years. For example, in the middle years of the courses, students responded that they preferred courses with only one lecturer on them as they preferred 'not getting any conflicting opinions' and that they felt confused about the courses subjects during these years because 'there were so many ways of looking at the course subjects'.

Each of the courses tested showed a higher level of agreement by students to the B type Statement *'I sometimes pick a topic or way of answering an exam question which I know the lecturer likes, in order to get higher marks'* in their later years (Appendix 3). This change in perception towards looking to the lecturer for direction might be viewed as being the initial stages of Multiplism, and the findings from trends of response given by students on the first year of the degree course during 1992-'94 suggest that this change of perception is occurring during the first few months of a course. Whether this change is a result of lecturers' attitudes towards the first year classes, the restrictions on the level of participation encouraged within a large class or whether this is a necessary step on the students' way through towards Multiplism, is debatable. It is possible that students are likely to become more lecturer directed as courses progress by positive reinforcement as the lecturer is the assessor of their work. It would be interesting to compare the student responses to externally and internally assessed courses, in order to discover whether as many externally assessed students develop a strategic approach in their study.

6.4.5 Course trends to Part 2 of Perry Questionnaire P2

The findings from Part 2 of the Perry Questionnaire P2 complimented the Perry findings from Part 1 of the same questionnaire. Firstly, asking the students to justify their decisions provided some supporting evidence (Figure 6.12) that the opinions voiced in Part 1 were genuine : with the students' level of agreement with the 3 statements in Part 1 not being significantly different to those given to the same statements in Part 2 for all

classes tested except one, the second year HND class (comprising only fifteen students). The majority of classes however, had shown a decrease in agreement when asked to justify their decision about a statement in Part 2. It might be speculated that given an option, multiplist students would tend to agree with statements because they would see everyone as having a right to their opinion, however, justifying this 'agreement' might be problematic when asked to do so in Part 2 of the questionnaire.

In addition, the number of students going on to justify their decisions would appear to support the Perry scheme of development as more students justified their decisions in later years of their course, following Perry's descriptions of individuals going on to make decisions and to take responsibility for their decisions and actions (Perry, 1970). Erwin (1983) has described a link between student's stage of intellectual development and their uptake of responsibility within clubs and organisations external to university. This increase in being able to responsibility is also perhaps reflected by the number of students indicating a preference in Part 3 of the Perry Questionnaire P2 for discussion essays, with more students in the later years indicating a preference for this type of assessment than classes from earlier years. It might be argued that perhaps students, in the early Perry's stages of intellectual development, do not have the confidence in voicing their opinion, particularly in this type of subject area covered in the questionnaire. Students would, for example, score out their names at the top of the first page of the questionnaire when they saw that a justification was required, even although they might not have stated their opinion in Part 2 of the questionnaire.

The way in which students justified their decisions in Part 2 of the questionnaire could also be considered to be indicative of the different stages described by Perry (1970). Some of the students would, instead of justifying their decision would simply switch the word order of the statement and use that by way of a response. For example, the statement '*A scientific fact cannot have meaning if considered in isolation ; meaning is only gained by context*' would become '*Yes I agree, a fact has to be put into context before it has meaning you can't just take it in isolation*' This might suggest an approach characteristic of a multiplist thinker where perhaps they can't make up their mind about the statement and just feeds back the lecturer's viewpoint. Those students who missed out a justification might also be considered to be Multiplist who perhaps could not decide whether they agreed or disagreed. However, the course trends observed with increasing

number of justifications in the later years of all courses suggested that those omitting a response were probably more transitional dualist / multiplist thinkers. Dualist type responses seemed to be indicated by uncompromised stances and students who would make comments like *'A fact is a fact'* or *'my tick is my justification'*. Some of students who might be considered to be more relativist thinkers would give specific examples in response to the statements, for example, a response given to Statement 4 *'Taking a one off reading of for example a hormone level is meaningless unless the conditions are known and the level is considered in comparison with other readings'*.

Some researchers (for example Chickering, 1969; and Loevinger *et al.*, 1970) have questioned how much of an influence intellectual development at University would affect student's feeling of personal identity. It might be speculated that the way in which students responded to Part 2 of the Perry Questionnaire P2 might give an indicator as to how they would respond outwith the university environment. The majority of students had disagreed with Statement 2 : *'Scientists will eventually be able to solve every medical problem : it is only a question of time '* (between 58 - 90% of each class, see Figure 6.10), with the most frequently used argument that as each new disease is cured then a new one arises. AIDs was most commonly used by means of an example. Although, this statement (no. 2) had the highest level of justifications given by the students (a mean of 6% for the classes) 27 % of, for example the HND first years had not given a justification although 29 % of this class had agreed with the statement. This lack of justification might suggest either a lack of strength of opinion or the attitude of making unfounded decisions or having opinions without supporting evidence. This kind of approach might be considered to be indicative of a more closed type of attitude, which if unchallenged, for example, through higher education, might remain and be reflected in a general attitude which the individual expresses in everyday life.

6.4.6 Course trend response indicated in Part 3 of Perry questionnaire P2

Part 3 of the Perry Questionnaire P2 was useful in further discriminating between students who had obtained similar scores in Part 1 of the questionnaire by providing a clearer description of students' overall attitude to different instructional methods. Students' preferences to particular assessments and teaching methods appeared to show particular trends at different stages of development (see Section 6.3) with students in

later years indicating more of a preference towards for example, description essays and the first year students preferring short answer type assessments.

It could, however, be argued that students in first year, entering university for the first time, might not be so familiar with certain teaching and assessment methods and that this was influencing their selections. Lectures for example, appeared to become more popular in later years of all courses, and this popularity appeared to be unrelated to the student's other course preferences or to their Perry scores.

a) Teaching Methods

In October 1993, 57 % of first year part time students and 68% of the full time students indicated that their most preferred teaching method was small groups with the lecturer present, with 29 % of the part time first year students indicating that they did not like lectures. This liking for group work, had diminished by the later years of the courses tested when many of the students indicated a strong dislike for working in groups (see also Section 5.3.1 about the poster groups). It is possible that in first year, students might like the security of being within a group when they do not feel so confident about the academic environment. This feeling of 'security' is perhaps not so necessary in later years when students have more able to work by themselves.

Alternatively, through their previous experiences at school or at work, students could be entering university with a positive attitude towards group work which changes as they progress through their course through perhaps negative experiences. A change in approach towards group work might be determined by the assessment methods used during the students' first year at university. The negative attitudes expressed towards group work, for example, in Group Questionnaire G2 which was completed by the third year students in October 1993 prior to their working on the group poster exercise, suggested that the students were negative towards group work because of the unequal participation usually experienced when working on a group project (Section 5.3.1). A group reward system which assesses a group collectively has been noted as sometimes resulting in negative attitudes between group members or an inequality of levels of participation (Slavin, 1978).

This preference for small group work indicated by all the first year classes could appear to contradict Perry's (1970) description of the behaviour of students who were at a dualist stage of intellectual development. It might

have been expected that students entering university, for example, would prefer a teaching method which would support what they might consider to be a passive role within the learning environment. A small group situation would suppose the necessity for some level of interaction within the group of students and also make the assumption that the interaction with students and not the lecturer was beneficial.

The popularity of lectures increased in later years of all courses and in the final year of the Full Time course, 66 % of the students responded that lectures were their preferred teaching method (Figure 6.12) with all the first year students indicating a preference for small group work over lecture type format. As students in later years were indicating a preference for lecture format this would suggest that liking lectures was in some way a 'learned' preference through experience at university. A first year follow-up questionnaire about students' course preferences in October 1995 would be useful to investigate whether the 1993-'94 first year student preferences had changed from liking group work towards a lecture type format by the time they have reached the beginning of their second year.

A 'traditional' lecture format when one lecturer talks to a large group of students, it might be argued, would appear to almost encourage students to adopt a passive role and asking questions in front of a class is likely to be a daunting task even for the most confident of relativist thinking students. The comments from students at different stages of their course, suggest that information presented in a lecture format is used by students in different and personalised ways (see Table 5.4 for some examples). The way in which students take notes and prepare for assessments using lecture derived material has been shown to differ between students who are adopting a reproductive approach as opposed to a transformational approach and can therefore affect the quality of their learning (Bucat and Williams, 1989; Entwistle and Tait, 1990). The way in which students make use of information from lectures also seems to be dependent on a student's stage of intellectual development. For example, the multiplist students, of the later years commented that they liked lectures because they were 'lecturer controlled' and did not deviate from the subject in the same way as was found in, for example, tutorials. The relativists saw lectures as an efficient means of gaining a foundation of knowledge which could be used as a basis for other types of work.

The high level of dislike for individual study in all first years tested (Figure 6.13 and Appendix 3) might have been expected as students are

unlikely to feel confident enough to undertake individual work and at whatever stage of intellectual development a students will probably feel that they require guidance with the course content, in order that they can prepare for the course assessments. This feeling of a need of lecturer direction felt by some students in their first year is important, in particular, when considering how to provide students with the appropriate support or instructions when they are about to undertake any flexible learning packages or to carry out directed learning for classes.

b) Assessment methods

The description essay had become the most preferred instructional method by the fourth year of the full time degree course (see Figure 6.12) whereas in first year, short answer type questions were the most preferred assessment method. The way in which third year full time students answered descriptive type questions in the end of year exams (see Section 4.7) however, suggested that instead of using this type of essay as a way of developing complex ideas or dealing with subjects at greater depth, this type of assessment in many instances was being used as a method of writing out quantities of factual material. In the same way as students seemed to have developed different ways of using information from lectures, a descriptive type essay could be used (and be assessed) in different ways depending on student's stage of development. For example, Dualists could learn up quantities of material about a selected subject, the multiplist could write about a subject in greater length, producing large quantities of material and a relativist could go into a subject in greater depth. The way in which students selected their questions in third year exams (Section 4.7) suggested that students generally preferred to answer questions which were of a type which required a more straightforward presentation of factual material, although students did not necessarily obtain higher marks for this type of approach. This would suggest that students felt more comfortable working at this intellectual level, whether or not they were capable and had experience of working at a higher cognitive level. Hakistan (1971) and Biggs (1973) have described how students can often adopt a surface approach when preparing for essay type questions and short answer type questions although Ramsden (1979) has described how small chunks of information can also be learned in a way which is meaningful to an individual and not in the passive way as described in a surface approach (Marton and Saljo, 1976).

Deciding to undertake a discussion type essay whether as part of

coursework or in an exam question does mean that an individual has to open themselves up to more potential criticism of their work rather than if factual 'unprocessed' information was used for an assessment. The level of encouragement and support which students are given in the early stages of a course could probably be influential in whether students develop and use the higher level skills involved in putting forward an argument or drawing conclusions from evidence. For example, in Part 2 of the Questionnaire P2 where respondents were required to justify their decisions the low Perry scoring students of Part 1 tended to make unjustified comments or sweeping statements and in some cases they seemed to be unable to justify their decisions. Marking down similar types of student responses in assessments might result in students feeling that it was their own opinion that was being marked down rather than the way in which it was put forward or phrased. Instructions and assistance in the analysis and the evaluation of ideas might, therefore, be useful even in the early stages of a course, for example, the high Perry scoring first year students from 1992-'93 might be encouraged to discuss and analyse aspects of their laboratory work.

A number of students expressed concern about having to use the lecturer's opinion when answering questions rather than their own or being unfairly marked because their opinion was different to that of the lecturer (Section 5.4). Generally the fourth year degree students seemed to feel fairly ambivalent neither showing a great liking or dislike towards discussion essays (Figure 6.12 and 6.13) whereas the High Perry students had shown a preference for discussion type essays (Figure 6.16). During the initial stages of Dualism and Multiplism, students are likely to be sensitive about expressing their opinion particularly in a subject area in which they do not feel confident or are not sure what they believe. One student had commented that *'my opinion does not matter, it is only at the research level that opinion matters'*. This does have implications on the course with respect to the type of assessments used and the feedback which students obtain. The high level of agreement by all classes tested to statement C 15 *'If I was given the choice between written feedback and a specific mark at the end of an assessment, I would select the feedback'* (Appendix 3) would suggest that feedback is important to all students, not only as a means of feedback but also as a means of encouragement and support.

c) *Students study methods*

In October 1993, the students indicated in Part 3 of Perry

Questionnaire P2, how they studied for their preferred method of assessment. The first year students were asked in February 1994 in the follow-up Questionnaire P3, how they had been preparing for the assessments over the previous four months. The majority of students (Table 6.5) were using only their notes as a basis for their studying, either by rewriting or summarising the main points. Few were practising exam questions, although their responses in the previous October might have suggested that this was what they had intended to do. There is also the possibility that providing students with a list of possible ways of studying as was found in Perry Questionnaire P2 led students to just tick off selections, as discussed earlier in Section 5.6. Alternatively, this change in responses from October 1993 might be due to students having had good intentions at the beginning of the year, but in reality not having either the time or the desire to carry them out in the subsequent four months.

6.4.9 Students' transitions between Perry's stages of development

The transitions between Perry's stages of development have been highlighted by a number of researchers (Nelson, 1989; Finster, 1990; Thoma, 1993) and various teaching intervention programmes have been designed to encourage student to develop towards a more relativistic way of thinking (Stevenson and Hunt, 1977; Widdick and Simpson, 1978; Parker and Lawson, 1978; among others) However, in order to make transitions from Dualism to Multiplism and to Relativism students appear to need to reassess 'where they are' within the educational system and to establish within their own minds a directional aim. A transition from Dualism to Relativism seems according to Finster (1989) and others (Chickering, 1969; Heffernan, 1975; Lemans and Richmond, 1987) to necessitate students to go through a trough of uncertainty as shown by Finster's schematic representation of the Perry model (Figure 1.1).

Several of the third year students had shown large swings of opinion (data not shown) moving from a C/A response of 7.0 to one of 1.5 or vice versa in the four months between the October 1992 and February 1993 testing. In addition, comments made to statements in Part 2 and as reasons for selecting particular course preferences in Part 3 of the Perry Questionnaire P2 (see Tables 5.4 and 6.1) described feelings of confusion and not knowing 'which way to go' or 'who to believe'. From Perry's descriptions, (Section 1.4) these feelings expressed within the middle of the course tested suggest that these students were at a stage of Multiplism and

were, it might be speculated, making the transition towards Relativism. These swings in scores and feelings described support an impression that a transition into Multiplism is an emotional stage for the students and that Perry's descriptions of students retreating or temporising might seem to be understandable as an individual reorientate themselves intellectually within the learning environment.

The majority of students attending full time courses are within the 17 to 23 age range when perhaps they are going to be re-evaluating their value systems and developing an idea of 'self'. Widick *et al.* (1975) have described how students' intellectual and identity development can occur in parallel at university and that the university environment provides a forum or suitable challenges which facilitate this process.

An openness or receptivity for change seems to be a determining factor in whether or not students reach a stage of Relativism (Widick, 1977; Parker and Lawson, 1978; Perry, 1981) with an additional willingness to learn and to develop at a personal level rather than just obtain a qualification. A lack of either necessity or desire to make the transition to Relativism, therefore, might in part explain why not all final year students tested in this project had reached a stage of relativism, although they had been tested only at the beginning of their final academic year. Other research projects, however, (Finster, 1989; Kitchener and King, 1990) including Perry's (1970) have also found that a group of students do not appear to make a transition to Relativism, preferring to remain at the earlier stages of intellectual development. This is supported by this project's findings of general differences between the average Perry scores and responses to Part 2 and 3 of the Perry questionnaire P2 given by final year students and the High Perry Groups. Although students in their final year generally had a higher C to A score in the Perry questionnaire to that of first year students, their course preferences seemed to indicate that they did not like for example discussion type essays or problems without clearcut answers, whereas the High Perry group of students taken from all stages of courses indicated a preference for these types of assessment.

If a comparison is made between students Perry scores and their level of attainment at University ie examination marks or grading at Honours level (data not shown) there are students with high Perry scores who do not obtain high marks and conversely some students with low Perry scores who are attaining first class marks. Depending on the individual student's attitude, if a student can work the system strategically and do well e.g. by

'actively cue seeking' then perhaps for most students there is not the necessity or encouragement to develop a Relativist approach which might not always be institutionally rewarded in, for example, a science department where the recall of factual information is emphasised in the course assessments (Entwistle and Percy, 1974; Watkins and Hattie, 1985; Biggs, 1987) and see also Section 4.7. This would suggest that perhaps students do not pass the stage of Multiplism described by Miller and Partlett (1974) and by strategically selecting to undertake modules which reward more factually based recall of material, they can remain at a stage where they actively 'cue seek' from lecturers and direct their learning towards a high level of achievement but at a lower intellectual stage.

6.5 Summary of Findings

The findings from the two year Napier University study have shown that students are undergoing changes in their perception and approach to study while at University. There appear to be differences between the changes experienced from going from first to fourth year University where a student becomes a more strategic learner and that experienced by students making the transitions between Dualism, Multiplism and Relativism as described in the Perry model.

The Perry questionnaire testing and analysis has identified a number of approaches which can be characterised as Dualist, Multiplist and Relativist and also attitudinal changes between these stages which can and are occurring in many students while at University. The changes which have been shown in the preceding chapter are summarised below.

Although many students enter University on whatever course with the impression that Science is clearcut and factual, this generally changes as they progress through the course; although some students maintain this opinion until they leave. The students' perception of lecturers also generally changes from being Authority figures who know everything about their subject to people who might not know all the answers. The students also start to take more responsibility for their own learning as they progress through University rather than expecting the lecturer to provide all the information. This includes wanting to undertake more individual study and to work with other students.

Students generally become more strategic in their assessment choice

as a course progresses and, with the recognition that there is a diversity of opinions, some become confused about quantifiable issues. This period of uncertainty is most evident within the middle years of the course, but generally students will strategically and actively try to establish and use the lecturer's point of view. With the realisation that a diversity of opinion exists, students will initially prefer to have only one lecturer teaching on a course but this opinion generally changes as the course progresses and there is a preference for more than one viewpoint. As students become more responsible for their own learning so they have a greater preference for undertaking assignments where the lecturer does not specify exactly what has to be done but they can decide. Students at this stage also become more active in attempting to relate any new information into topics or subjects on their course.

With these changing perceptions of the subject areas and the role of themselves, the lecturer and their peer group within the learning environment so students' preferences for teaching, assessment and study methods change both through institutional familiarity of use and intellectual developmental stages.

The Dualistic concept of science as factually based, is reflected in early preferences for assessments which will assess this type of approach e.g. multiple choice and short answer questions and methods of teaching which are lecturer directed. There is a dislike of Individual study outwith the classroom.

The uncertainty of Multiplism brings with it the preference towards problem based questions with clearcut answers and away from the options of Multiple choice. Discussion essays and problem type questions without answers are disliked because of feelings of uncertainty and the existence of a diversity of opinions and not working towards a specific outcome is unsettling. Teaching methods should be lecturer directed or have the lecturer present in the role of expert to answer questions. Classes should be directed towards outcomes and should not deviate from the process needed to attain this outcome. The idea of outcomes and working hard or to prove things becomes an issue.

As Relativism develops the students are happier with individual study and non lecturer directed work. They like the development of ideas in tutorials and in refining their opinions in discussion essays. They dislike dealing with information on a purely factual basis and will actively look for interconnections and overlying principles behind ideas.

Chapter 7

Discussion of project findings

7.0 Introduction

7.1.1 General comments

This research project aimed to investigate ways to encourage the development of higher level cognitive skills in undergraduate biology students. This was carried out by monitoring and evaluating a third year group poster presentation exercise which aimed to encourage students to integrate and relate two subject areas by working in a group on a problem or challenge. Initially focusing on one particular instructional method over a period of four years had several advantages : any modifications could be evaluated on an annual basis, feedback from the same staff and different student classes could be obtained and a certain level of control could be exerted over a range of different aspects of the one exercise, for example, assessment methods and levels of staff support.

Although the poster exercise had the aims and the potential of encouraging students to develop higher level cognitive skills through its instructional nature (see Section 1.2), during the first two years of its implementation, a number of students did not seem to fulfil the aims of the exercise and/or failed to comprehend what was expected of them. Therefore, in the second phase of this project a questionnaire based on the Perry Scheme of intellectual development (Section 1.4) was devised in order to investigate the relationship between student's stage of intellectual development and their performance in the poster exercise. Subsequently this information was used as a basis for providing more appropriate student instructional support in order that more of the class might attain the exercise's objectives.

Given the range of variables affecting student approaches and the quality of their learning, the project also benefited from frequent staff discussions at all stages of the poster exercise implementation process. Consequently, a number of changes were made to improve the instructional method. These were primarily related to clarifying the students' perception of the staff aims of the exercise, introducing more appropriate methods of support and assessment, in addition to increasing the students' interaction within the exercise. The maintenance of what appeared to be a supportive relationship between the staff and students also meant that after the presentation sessions, students felt able to discuss any problems they had encountered and with a group of staff who were prepared to listen to any constructive comments. This student feedback was useful in that it allowed

a number of issues to be brought up which otherwise might not have been raised, for example, the influence which differing challenge types had on student motivation. Adopting a holistic type of approach to the planning and implementation of the exercise was also considered to have worked well from the staff's perspective and resulted in a gradual increase in the number of students fulfilling the staff aims of the exercise with each year that the exercise was run.

7.2 Group poster presentation exercise

7.2.1 Clarification of the staff aims and objectives of the exercise

Well - defined assessment criteria and the clarification of task requirements have been shown to be influential in determining student approaches to a learning task (Thomas and Bain, 1984; Laurillard, 1979; Boud, 1990) and the importance of supporting and making students aware of appropriate learning strategies for specific learning tasks has been highlighted by McKeachie, (1974), Ramsden (1979) and Parker and Lawson, (1977). Sometimes, there can be a mismatch between student and staff perceptions of the purpose and aims of instructional methods (Laurillard, 1979; Collier 1985). In the first three years of the poster exercise, the students seemed to be assessing the group posters in a different way to that of the staff and presumably working towards a different set of assessment criteria. The introduction of a new method of presenting group project work, like the poster, was problematic in that both staff and students seemed to have preconceived ideas as to how it (the poster) was to be assessed. The assessment criteria seemed to appear, from the students' perspective, to be primarily based on aesthetic quality, and from the staffs' perspective, more intuitively defined. A gradual process by staff of redefining the assessment method over a period of three years resulted in the group poster mark becoming split into four weighted categories relating to the scientific content, artistic quality, group work and responses to questioning from students during the poster presentation. This method of marking seemed to provide the students with much clearer guidelines as to the purpose of the exercise as well as giving them more feedback as to their level of presentation. The last two years of the exercise also benefited from the use of students' work from previous years in order to provide current students with examples of good and bad practice in terms of poster design and content, and to reinforce the descriptions given by staff as to the level of

scientific thinking desired and how this was to be marked. In the final year of the exercise (1993 - '94), for the first time, the staff and students gave very similar rankings to the student posters for scientific design and overall quality, which suggested that the students and staff had a clearer perception of the aims and objectives of the exercise than they had had in previous years (Table 5.4).

7.2.2 Development of higher level cognitive skills

Even in the first year of the poster exercise (1990 -'91), as was exemplified by the success of one of the groups (ET Metabolism poster - Section 2.4.1), the poster exercise could encourage, and the staff reward students using the higher level cognitive skills of application, synthesis and analysis (Bloom, 1956). There has been considerable interest in encouraging students to take a transformational approach to their learning in that they should intend to understand and to relate any new material into their existing knowledge (Biggs, 1973; Marton and Saljo, 1976; Svensson, 1977; Ramsden, 1979; Thomas and Bain, 1984).

Working on the poster exercise required students even at the most basic level to summarise and to prioritise information in order that the material could be used in a poster. For example, in the first year of the exercise one highly motivated group, (Group 5 - Section 2.4.1) had selected out what they considered to be important aspects of their subject (Motor Neuron Disease) and had transformed the material into a poster format and were able to answer questions about their poster content. This type of approach would appear to be one which could be classified as being 'transformational' (see Section 1.2). However, the staff involved in the organisation of the poster exercise seemed to desire students to adopt a level of thinking which might be characterised as being on a higher cognitive level. This higher level required students to attempt to integrate two subject areas together using their group's collective background knowledge and not simply using summarised textual material from a book. Working at this higher cognitive level required students not only to be highly motivated but also that they should have the intellectual ability and the prerequisite cognitive skills (Glaser, 1984; Labudde *et al.*, 1988, Fischer and Aufschnaitre, 1993).

As the poster exercise was carried out in parallel to the taught component of their topic, students were adding to their developing and existing knowledge of their topic area as well as going into one specific

subject area in greater depth, which seemed in many cases, from the student feedback to increase the exercise's relevance and interest. In addition, many of the groups appeared highly motivated, spending large amounts of time on their posters, even at the expense of missing other classes. This motivation was, in part, instigated by the competition with other groups although in the later years of the exercise the students appeared very positive about the concept of the exercise in their feedback forms. Working in groups comprising individuals with different abilities and learning styles also gave students the opportunity to learn more about other student's learning strategies for solving problems rather than by being formally taught techniques or by working by themselves (Ruddock, 1978; Beard *et al.*, 1978; Abercrombie, 1979).

The support of a small group environment can also assist students who are uncertain, lack confidence or have difficulty in using appropriate problem solving strategies (Beach, 1974; Pask, 1976; Webb, 1982) or who perhaps were lacking in some aspects of the background knowledge or had difficulty in working at a higher cognitive level (Labudde *et al.*, 1988; Klauer, 1988; Chinn and Brewer, 1993). Displaying student's group work as in a poster format also seemed to be perceived as being a positive aspect of the exercise and both staff and students were enthusiastic in showing off the student's work, with some of the students bringing in their families to look at their poster.

7.2.3. Student peer group questioning

The introduction of question compiling and discussion sessions in the final year (1993 -'94) resulted in more of the students commenting that they had gained from poster presentations other than their own. The students' questionnaire responses indicated that not only were the presenting groups of students studying some aspects of the module topics in depth, but that the other students in the class were also benefiting from their work by having to think up possible questions to ask groups about their posters.

Questioning your own and other's work and explaining something to a fellow student has been shown to be a useful process in creating a deeper understanding of a subject, and as a way of producing more meaningful learning (Entwistle and Entwistle, 1991). However, King, (1990) has described how students need to be taught the importance of asking and the way to ask 'good' questions. During the first three years of the exercise,

students were expected to ask the poster presenting groups questions relating to their poster contents during an informal discussion session. However, giving students the option as to whether they asked questions, and the type of question they asked, seemed to result in students either not asking questions or asking the groups about their poster design and not about the scientific content. At this stage, from the students' perspective, there was probably little to be gained from asking a scientific question in front of the teaching team and the presence of staff, however supportive, is likely to have been considered intimidating.

Formalising the discussion sessions, however, by asking non-presenting groups to write down two questions to be posed to the presenting groups, resulted in a higher quality of questions being asked and the non-presenting groups learning more from other groups posters. In addition, students who perhaps would not have felt confident enough to ask groups a question in front of the class could be encouraged to put forward a written question with the security of having discussed it previously within their group. The questioning and discussion sessions also seemed to assist students in gauging the scientific level of other students work, as illustrated by the end of year ranking of posters.

Preparing for the question sessions could also be considered to assist in improving the level of learning undertaken by the poster presenting students. Generally, groups of students would spend time preparing for the peer group questions by standing round the poster groups and reflecting on their work. This preparation for questions seemed as a result to encourage students to consider interrelationships between the scientific material, identifying any problem areas and obtaining a more holistic view of their work. All of these activities have been shown as encouraging the development of higher level cognitive skills (Newble and Jaeger, 1986; Ramsden, 1987; Eylon and Linn, 1988; Boud, 1990). The official recognition of the importance of questioning, by rewarding good questions and answers in the staff marking system also seemed not only to improve the quality of the students questions but also the quality of their responses, with most of the groups obtaining good marks from staff during the final year.

In all years, the way in which poster groups responded to questions appeared to be related to the way in which the groups constructed their posters, with groups who had obtained high marks for the integration of scientific material in their posters, obtaining higher marks for their responses to questions. Marton *et al.* (1984) have described how responding

to questions requires the use of an 'outcome space', which indicates an individual's level of understanding by how they express and emphasise the information in their answers. The form and the structure of a question can affect this 'outcome space' and the more open a question the more difficulty students have in responding. The selection, by staff, of the two best questions submitted by students as triggers for the group discussion might have resulted in the groups being provided with questions in the most suitable format. In addition, staff were also able to adopt a supporting role to the groups being asked questions, in case the students were unsure of any subject areas or they did not understand or could not answer any questions asked in the ensuing discussion with the rest of the class.

However, the type and content of questions posed to poster presenting groups did provoke comments and criticisms of unfairness by some of the students in the follow-up questionnaires. One group during the final year of the exercise had problems with both answering peer group questions as well as gauging the level of the scientific content of their work and they as a result became defensive and antagonistic in their approaches during the discussion exercise. Chinn and Brewer (1993) have described how entrenched some students can become in their conceptions of 'Science' and how this can result in a dogmatic and closed approach to some subject areas. Other students answering questions in what might be considered fairly abstract and futuristic subjects about dragons and mermaids responded in a way which was considered by staff to be evasive and non-scientific. As a result, these kind of topics were considered by some students to be easier than those covering 'real topics'. Students in the rest of the class did not seem to recognise that this type of response did not gain the groups higher marks. Some guidance in ways of responding to questions might, in the future assist students both in the way in which they answer and also the way in which they assess question responses.

7.3 Group work

7.3.1 Use of group work

If properly managed, group work is a useful way of encouraging students to have a more active involvement in their learning than can most lecture type formats (Tobin and Gallagher, 1987). Learning in small groups has been shown to be one of the most preferred methods of learning at secondary school level onwards (Pipburn and Baker, 1993) and this research

project identified that in 1993-'94 the three first year student classes tested with the Perry questionnaire considered small group work with a lecturer present to be their most preferred teaching method. The use of group work in parallel to a lecture based course has been shown as useful for learning how to apply knowledge and to encourage students independence (Kember, 1991). However it seems that use of exclusively group work would not always be popular with students and most students tested using Perry Questionnaire P2 indicated a preference for a range of teaching methods. This is supported by Goodwin *et al.* (1991) who found that a biology first year course comprising predominantly group projects resulted in students worrying that they had not 'learned enough' scientific material, although this was not found to be the case by their performance in subsequent examinations.

By the second year of the three courses tested at Napier during 1993-'94, small group work was ranked as being lower down the list of most preferred teaching methods with a lecture type format being more popular in students' lists of most preferred teaching methods indicated in the Perry questionnaire. Although, the project was comparing different samples, the similarity between the first and second year preferences indicated on all three courses tested in this year suggests that perhaps the student's experiences of first year group work are in some way changing their perception about how they feel about working with other students. It might be speculated that a mismanagement of group activities might be the cause of this negativity or that the reward system operating for students' level of participation was inappropriate for the type of group work exercise used (Jalajas and Sutton, 1984) resulting in low group cohesion or a reduction in positive attitudes between members (Johnston and Johnston, 1974; Slavin, 1978; Webb, 1989).

The importance of considering students' perceptions of University course requirements and making sure that students know the reasons behind carrying out particular learning tasks has been highlighted by Laurillard (1979). In the same way as the clarification of the staff aims of the poster exercise to students resulted in a higher level of attainment, if students are given an indication of a group exercise's aims, whether it be learning support for each other, or encouraging the development of group skills, then perhaps more students can use an instructional method to its full advantage.

7.3.2 Selection of Groups

The groups for the poster exercise were selected alphabetically from the class during the first three years of the poster exercise and randomly selected in the final year. Liden *et al.*, (1985-6) have criticised the use of randomly selected groups because individuals going into a group sometimes have difficulty, during the group's formative stages, in establishing a cohesive unit as they lack a frame of reference (Bales and Stodtbeck, 1968; Tuckman and Jensen, 1977; Collier, 1983). However, in the final year of this project, when poster groups were selected randomly, there were fewer reported group conflicts than had been found in the previous two years when the students were working in groups with students they already knew. Apart from the new group selection process, as there were a number of changes introduced to the format of the group work during this year, including a new peer group assessment method, it is perhaps difficult to draw conclusions as to which one or which combination of the variables might have helped to improve the groups' dynamics.

Nevertheless, there were far more positive comments about group work during the final year of the exercise than there had been for the previous three years, with students commenting about how group work was 'fun', that they would like to work with the same group again and that the poster exercise had enabled them to make new friends. However, the positive references which some of the students made regarding their group suggested that perhaps some of the students felt that the good group dynamics were more to do with their particular group's composition rather than anything to do with the way in which they had interacted and worked together. Perhaps some retrospective method of encouraging students to reflect on the positive aspects of their group co-ordination would benefit students and affect their future approaches to group work.

7.3.3 Group composition

Performance in the group poster exercise could not be related to the student's performance in other assessments, nor to their group dynamics, the individuals' scores in the Perry questionnaire and who was influencing the group's activities. Given the range of activities involved and the nature of the group exercise this is perhaps to be expected. Researchers investigating predictors of group performance have not found a link with intellectual abilities or knowledge of individuals (Davis, 1969), the presence of problem solvers (Olsen and Davis, 1964) extroversion and dominance of individuals

(McGrath and Altman, 1966) or group cohesiveness (Cartwright and Zander, 1968). However, several studies (Webb, 1980, 1983; Bennet and Cass, 1989; King, 1990) have found that the quality of the group interactions during the group process are important in determining the overall performance and that the structure of the groups can aid or hinder this communication process (Shaw, 1964; Kempa and Ayob, 1991).

Webb (1989) found that in mixed groups of students, both female and male students would tend to direct their explanations to questions to the male students within the groups. This was supported, in part, by the findings during the final year of the poster exercise when students were asked to record the students who had undertaken different roles within their groups. If there were males in a poster group, they were generally the students listed as being the influencers within their group. The four males, listed as being non-influencers were in groups which had males in the influencing roles. This finding might have been coincidental during this year, as there were predominantly more female students in the class. In addition, the female students shown to be influential in other group and class activities were in all female groups.

Heterogeneous problem solving groups, comprising students with mixed academic abilities, usually have been found to have more peer group interactions with more explanations being sought and given than in groups of a homogeneous composition, although the interactions might not always be appropriate or beneficial to the work (Webb, 1980, 1983; Bennet and Cass, 1989; Kempa and Ayob, 1991). Giving students instructions as how to ask 'good' questions of other students and including a formal question compilation session in the exercise might also have assisted in setting the levels of scientific interaction during the poster work (King, 1990; Brophy, 1983).

Taking the performance of individual students in other assessments as a guide of students academic ability, the groups of students in the poster exercise were heterogeneous in all years in terms of academic ability, but the average marks for each of the groups were not significantly different from each other. However, when the students were tested using the Perry questionnaire there appeared to in some cases to be a difference in 'group profiles'. In the final year, one group (Group 6 - the Neural Tube Defects poster, Section 5.3.9) all had very similar Perry scores, low C type and high A type. This group had shown an approach to their poster considered by staff to be of a low scientific level and had difficulty in answering questions about

their poster contents. This perhaps reinforces the idea of using the Perry model as a means of explaining some students' behaviours in instructional situations. Although, in reverse, a homogeneous high C to A group might not be predicted to respond in a relativistic way, a homogeneous low C to A is unlikely to be able to work in a relativistic way because, as was exemplified by the low scoring poster group, the students do not understand what is meant by a relativistic type of approach.

7.3.4 Group assessment methods

The rewards or instructions given to groups can also be influential in determining the group process with more interpersonal conflicts occurring within a group if the lecturer's marking system is not perceived as appropriate (Jalajas and Sutton, 1984). Different forms of group assessment were used for each of the years of the exercise which enabled a comparison to be made between the efficacy of a variety of methods. In the first year, students were given a group mark, in the second year, each group was asked collectively about levels of participation, in the third year groups were asked to split fifty marks between the group members and in the final year students awarded each of the members marks out of ten for four different group work categories.

Slavin, (1977) has described how team rewards can increase the time spent on a task but not the level of academic achievement and Johnston and Johnston, (1974) have reported that if groups are made accountable for their individual contributions then they will generally spend more time on the task. In the final year of the poster exercise both methods were used as part of the assessment procedure : the individual level of participation within the group poster exercise comprised a peer group assessment of individual levels of participation and the question compilation exercise prior to the discussion comprised a group reward. As these questions might subsequently gain the group marks or a group reward, this might have helped to encourage group cohesiveness and positive attitudes towards the group task (Deutsch, 1968; Cartwright and Zander, 1976; Slavin, 1978).

Liden *et al.*, (1985 - 6) have found that students with high grade marks are often less amenable to group work than those with average or low grade marks. High achieving students generally consider that the level of work will be brought down by working with students who are lower achievers. Several groups during the first three years of the exercise had experienced group conflicts. Some students, usually the higher achievers (as identified

by their performance in other assessments) excluded other students from the group work. The assessment scheme during these years was perceived, by students, as not rewarding groups who resolved group conflicts and shared out the work co-operatively, which was felt to encourage the high grade students to exclude the less able students from the group. In the final year, when students obtained separate marks for their different contributions to the group exercise, all groups worked well together, sharing out the work and the responsibility.

7.3.5 Group performance in the poster exercise

The formative stages of the group process when groups 'set the groundrules' have been shown to be important determinants of future achievement (Bradford, 1978; Liden *et al.*, 1985, Johnston and Johnston, 1982). At this stage, students worry about their status within the group (Brandstater *et al.*, 1978) and the students who go on to have the most influence on group opinion are generally those who individual's perceive as having the highest relative level of expertise although this might not be at an absolute level. Webb and Kenderski (1984) have found that the higher ability students will often adopt a lecturer role towards students perceived as having less ability.

During the final year of the poster exercise, when the students were asked to record their roles within the group exercise, the students who were noted as having the highest influences within the groups were students shown as having higher Perry scores or being more relativistic thinkers as well as being those who enjoyed working on problem type questions without answers. This suggests that this type of thinking was recognised by the students as being important for success in the exercise and that perhaps the collective compilation of questions, had perhaps resulted in these students becoming the more influential within the groups during the formative processes.

One of the potential problems of group work as a method of developing higher level cognitive skills is that perhaps the non-influencing or non-participatory members are not deriving the same benefit from working with other students as those who are more actively involved. However, in the same way as students might approach any form of instructional exercise, it could be argued that students obtain as much as they want to from working within a group. Watching and listening to other group members might result in learning from other student's interactions,

depending on how the individual approaches the experience and whether there is a genuine intent to learn or to simply let the rest do the work. The benefit derived from a group experience might also be dependent on a student's level of intellectual development and a student who was at a Dualist or Multiplist level might not consider their peer group to be a source of academic knowledge and might not therefore pay much attention to other student's contributions.

7.4 Perry responses and group roles

7.4.1 Influencing and Non-influencing roles in groups

The relationship between the students' group roles in the poster exercise and their responses to the Perry questionnaire suggested that there might be a link between a student's stage of intellectual development and their participation within their groups. The students considered to be the influencers and the non-influencers within the groups showed very different profiles with respect to their relative agreement with Relativist and Dualist type statements, their reasons for their decisions about statements, their justifications and their course preferences as given in the Perry questionnaire. The influencing students, for example, were generally the more relativistic thinkers who also had a significantly higher preference for tutorials, problem based exercises and discussion essays than had the non-influential students of the group.

7.4.2 Relationship between stage of intellectual development and adopted group roles

The adoption of different roles and changing perceptions of locus of control within the learning environment has been one aspect of the Perry scheme which has appeared to differentiate between stages of intellectual development (Knefelkamp and Slepitzka, 1976; Stephenson and Hunt, 1977). The Dualist thinker, for example, is described as seeing their role within the learning environment as being a passive recipient of factual material, the Multiplist looks to the lecturer for direction and the Relativist takes on a more autonomous role in their learning, recognising the value of members of their peer group as sources of learning and diversity (Parker and Lawson, 1978; Finster, 1989). The poster exercise, which required students to work in a group on an open ended problem without lecturer direction might, therefore, cause some confusion within groups of students at differing stages

of development. A group of Multiplist students would be expected to have difficulty in working without either a student's direction within their group or without specific direction from the lecturer. Some of the groups of students working on unstructured challenges (see Section 2.2.2 for a description) during the poster exercise seemed to be reacting in what might be expected from homogeneous groups of Multiplist thinkers by not being able to gauge the level of their work, by having difficulty working without guidance towards 'the right answer' and complaining about the 'fairness' of their poster challenge.

Saidla, (1990) has speculated about the responses which students at different stages of development would adopt within stages of the group process. Saidla describes a Dualist feeling threatened by the student leadership of a group and a Multiplist student, because of their feelings of uncertainty either opposing or adhering to the leader's authority. A Relativist, however, she speculates, would be looking for meaning from the group experience. The findings from the poster exercise in its final year, however, suggest that the Multiplist students were adopting the non-influential roles in the poster exercise. The feelings of uncertainty which these students appeared to have were apparent in their justification responses to the Perry Questionnaire and it would appear unlikely that students at this stage would be oppositional to the leaders of their group as they 'don't know which way to go'.

It is debatable how the more relativistic thinkers became influencers or the more multiplistic thinkers became the non-influencers within their group in the final year of the poster exercise and whether there would be a similar finding in a subsequent year. The format of the exercise with the question compiling sessions throughout the year, it might be speculated, could encourage the more adept at question compiling to become the influencing members as the 'good' questions were to be rewarded by bonus marks for the groups. However, the first groups to work on the exercise at the beginning of the year also showed the same pattern in their influencing roles.

Perry has described how his developmental stages are not exclusively education orientated and others have shown that developmental changes can relate to career decisions (Knefelkamp and Slepitz, 1976; Widdick, 1977; Touchton *et al.*, 1977) relationships with friends and family (Stephenson and Hunt, 1977), and personal identity (Knefelkamp and Widdick, 1974; Erwin, 1983). However, the relevance of the scheme as a potential determinant of

group roles is also worth considering. If, as suggested by the group poster exercise, Multiplist students tend to take on non-influential roles within groups, this might have implications to group work activities at other stages of a course. Would, for example Multiplist students regress their opinions in favour of the Dualist stance on a subject? In a study by Erwin (1983), who compared student's stage of intellectual development with participation and roles within clubs and organisations, Dualists and Relativists were found generally not to participate very actively and to tend to simply belong to a club rather than hold office. Students scoring highest in Commitment generally had held some office in an organisation or had adopted a more active role. Erwin combines students classified as Multiplist thinkers in his project as part of his Dualistic group. However, it might be assumed that these Multiplists would therefore respond in the same way as his Dualists and would also be unlikely to take responsibility within a group. This is also supported by Knefelkamp and Slepitza (1976) who describe Dualists as not taking control and Multiplists as being students who cannot act independently of others.

Although a formal position within a social group is more of a commitment than being an influencer within a group work in University, the adoption of such a role might be considered to be the beginning of a stage where students are beginning to be take on responsibility and to be able to make a commitment. However, by a definition of terms, there is also the possibility that being in an influencing role within a group does not necessarily mean that an individual has taken up the responsibility of being a group leader or that roles have been determined by the nature of the exercise (Johnston and Johnston, 1974; Webb, 1980; Baron *et al.*, 1992). For example, someone who was good at co-ordinating and organising groups might become group leader, whereas, another student perceived as an expert in the task itself, might be the person with whom one would check one's work.

In the first three years of the poster exercise, students were working in groups which had been established from the first year of their course. Bales (1950) has described how students' group's roles will change with time, whereas Webb (1984) has found that students will maintain their group roles. If, perhaps a student had become established as the group co-ordinator /leader in first year and had subsequently remained with a Dualist way of thinking, they might try to maintain this leadership role within the group poster exercise and to organise the group work accordingly. Given that the

poster exercise aims to develop a more relativistic way of thinking then perhaps a Dualist's attempt to maintain control could result in conflict with other group members who had developed intellectually in the preceding years and recognised the need for a different way of thinking than that proposed by the 'Dualist leader'. This in part might have contributed towards the group conflicts experienced in the present study.

7.5 Perry scheme of intellectual development

7.5.1 Use of a measure of intellectual development

A knowledge of the Perry scheme of intellectual development was not only useful in explaining the behaviours of students within the poster exercise but also in suggesting ideas for ways of encouraging and supporting students to develop more Relativistic ways of thinking. Finster (1990) suggests that assumptions can perhaps be made, based on the research of others, as to the relative 'Perry positions' of the average student of each year and classes can be taught accordingly. However, a knowledge of 'where individual students are' or 'where the majority of a class of students are' could be considered preferable particularly if the effects of different instructional methods are to be monitored. Most researchers have attempted to place students within one of the nine Perry positions (see Section 1.4). Although an awareness of a student's position might be considered important when individuals require counselling, or when developmental studies are being carried out for research purposes, in some instances there is perhaps not the same necessity for finding out the exact positions of all students. Rather, when planning the format of a laboratory practical, it might be sufficient to know that, for example, most of a science class held predominantly Dualist perceptions or were in the midst of the uncertainty of Multiplism and expecting that the lecturer would give them directions. A challenge for the Dualists, as Finster (1990) suggests, could be group projects or laboratories carried out in students teams followed by a discussion of the different interpretations of the results. Whereas the Multiplists could be challenged by undertaking group designed projects which were carried out independently in the laboratories before discussing together collectively. Providing a learning environment which challenges and supports students has been suggested to encourage and promote progression through the Perry scheme (Perry, 1970; Finster, 1990) and has been used as a basis for designing teaching programmes (Sanford, 1966;

Knefelkamp 1974; Widdick, 1975; Stephenson and Hunt, 1977; Widdick and Simpson, 1978; Parker and Lawson, 1978)

Identifying an individual's Perry position can be problematic not only in the act of measuring but also because individuals can exhibit behaviours characteristic of different stages, perhaps responding dualistically within one learning context and relativistically in another (Finster, 1991) and not all students exhibit the same behaviours within one particular stage of development, a phenomenon of vertical and horizontal decalage, first described by Piaget (1977). The most commonly used method for identifying students developmental stages, therefore, has been that of the interview which provides more information than, for example, a questionnaire. However, interviews have the drawback of being subjective and time consuming to conduct. This research project aimed to develop a questionnaire which could be used as a precursor to interviews. Baxter-Margolda and Porterfield (1985) have highlighted the importance of developing measures which can separate aspects of development and which are less subjective than interviews but at the same time allow students to justify their responses. The findings from this project's surveys on students at different stages of biology courses in combination with the group poster exercise feedback suggest that the Perry questionnaires developed for this project are providing information pertaining to a student's stage of intellectual development. The format of the questionnaire and its resultant short time of completion means that it can be used to monitor changes in attitude in large numbers of students and also subsequently be used as a method of identifying particular types of students for interviews. For example, students who perhaps have undergone sudden rapid changes in attitude or have remained at one stage for a long period of time and who might require additional support or encouragement could be followed up (Widdick, 1977; Parker and Lawson, 1978; Moore, 1990).

In addition, the Perry statements from Part 1 of the Perry Questionnaire could be put into a computer format and students could find their own Perry profiles and see how their score relates to that of the rest of their class. Depending on their scores, students could perhaps gain some additional guidance or support through being referred to appropriate support materials. In a computer format, a lecturer could also look at particular class profiles and use this information to decide on the instructional methods for a course or module.

7.5.2 Findings from the Perry Questionnaire analysis

Students from all years and all biology courses at Napier University were tested using the questionnaire developed for this project. The responses to the eighteen statements in Part 1 of the questionnaire indicated that all individuals tested, agreed with a range of statements of all three types, Dualist, Multiplist and Relativist. These findings would follow the descriptions of decalage described by Perry (1970), when students have been described as exhibiting behaviours from different positions and /or students do not exhibit all the behaviours characterised as being from one position of the Perry Scheme (Finster, 1991). Only a few students showed a high agreement with only B or only C type statements and no students had a high agreement with only A type statements. Loevinger (1975) has commented on how difficult it is to pin down students behaviours to one particular Perry position, but that various patterns and trends can be recognised as students progress through the scheme and Perry (1970) himself described how his scheme was a descriptor of developmental patterns rather than of specific behaviours.

Developmental schemes have been criticised because of their lack of context, with students being perceived as adopting different strategies according to particular learning contexts (Entwistle and Marton, 1978). Furthermore, some studies have not supported the changes observed by Perry (Kurfiss, 1977; Laurillard, 1978). However, as the original Perry model describes such a wide range of behaviours it is possible that by selecting out only a number of aspects of developmental change, others which are undergoing changes could have been omitted. The existence of horizontal decalage suggests that students will develop only certain behaviours characteristic of a particular stage and at different rates (King, 1978; Finster, 1990). If developmental changes are occurring in response to the academic environment, it could be argued that in a particular course or environment, students are changing in particular ways. For example, both Laurillard (1978) and Meyer (1975) found that students' theories of knowledge showed no change as courses progress, but this does not eliminate the possibility that the students were changing in other ways, such as in their perception of roles within the learning environment. This would be supported by this research project's findings that some of the student responses to particular statements in the Perry questionnaire showed a similar percentage of student agreement for each class, while other statements had elicited significant changes as courses progressed. Witkin *et al.* (1969) have described

how there is a stability of cognitive style from childhood to adulthood and it would, for example, be expected that some degree of stability within a student's cognitive state would be required for an individual to maintain a level of personal identity (Fischer and Aufschaitre, 1993).

7.5.3 Course trends in students' responses

In October 1993, a cross sectional analysis of the average full time class positive responses had revealed a profile which would also have been predicted by the Perry model, with the first year students showing a significantly higher average level of A type responses and lower level of C type responses to that of the fourth year students (Table 7.1)

Table 7.1

A comparison between the type of class average positive responses given to Perry Questionnaire P2 by full time degree students in October 1993

year of course	class average percentage of positive statements		
	A type	B type	C type
Oct. 92			
1	19.6	28.1	51.6
2	23.0 *	30.4	46.6
3	22.2 *	28.4	49.4
4	17.9	32.9	49.2
Oct. 93			
1	24.2	29.7	46.1
2	19.6 *	32.2	48.6
3	16.3 **	30.5	53.3
4	14.0 ***	30.0	53.9 *
(***) $p < 0.001$, ** $p < 0.01$, * $p < 0.05$)			
shown significantly different from their 1st year responses using a Mann-Whitney test			

However, in the previous year the first year classes in all courses had shown a significantly higher average C type and lower A type of responses than the rest of classes on the courses tested (Table 6.1). These two profiles from different years reinforces the idea of treating each class as a separate entity and monitoring the changes which are occurring to this class generally and/or to individuals within the class as they progress through university. However, although the first year classes from both years tested showed

different average levels of A and C type responses relative to the rest of the classes, the profiles for the rest of the course were similar in both years : the second year students had a lower average C to A ratio than that of the third and fourth years (Table 7.1).

The learning environment has been shown as being important to in stimulating developmental change and also in determining a student's approach to their learning as described in Section 1.2. As shown by the changes in level of agreement to particular statements in Part 1 of the Perry questionnaire (Appendix 3) the lecturer/student relationship and assessment methods also have a strong influence on students' development. Almost universally during 1992 - '93, the first year students showed a trend in type of responses in the Perry questionnaire towards a more Dualist approach from October 1992 to February 1993 which seemed to be related to their perception of the assessment methods and the role of the lecturer (See Table 7.2).

Table 7.2

A comparison between the type of class average positive responses given by first, second and third year full time degree students to the Perry Questionnaire P2 Part 1 in October 1992 and February 1993

year of course	class average percentage of positive statements		
	A type	B type	C type
October 1992			
1	19.6	28.1	51.6
2	23.0	30.4	46.6
3	22.2	28.4	49.4
February 1993			
1	28.4 ***	33.7	39.7 *
2	24.9	31.3	43.7
3	23.9	33.6	42.4
October 1993			
2	19.6	32.2	48.6
(***) $p < 0.001$ * $p < 0.05$)			
first year responses shown as significantly different using a Mann-Whitney test			

7.5.4 The influence of the lecturer's role on students' development

In the subsequent year (1992 - '93), similar changes were observed in

relation to the first year class's attitude towards the lecturer (see Appendix 3). The comments in Part 3 of the Perry questionnaire P2 in October 1993 supported the idea that the first year students did not feel, at that stage, that they had the confidence to know what to study outwith their formal classes and that they needed direction from the lecturer as to course and assessment contents. In the follow-up Perry Questionnaire P3 completed by the same class in February 1994, many of the students had made comments about how it was difficult to build up a relationship between lecturer and student within such a large class (130 students).

The format of many first year classes particularly large classes of over one hundred students might be considered as almost encouraging students to adopt a Dualist approach to their learning and perhaps the first few months of a student's university experience might be considered to set the trend for the subsequent years as a student adapts to this new learning environment. Therefore if students are entering Higher Education with a relativistic approach to their learning, as seemed to be the case of the first year students 1992-'93, then it would seem important that lecturers consider ways in which this approach might be maintained throughout the duration of their course by use of appropriate instructional methods if the aim of the course is to encourage students to develop relativistic thinking. Otherwise, if the first year change in responses in 1992-'93 is typical, by the second year of the student's study the teaching staff are going to have encourage students to recover what was their stage of development upon entry to University.

A change from a more 'traditional' lecturer role to that of facilitator in order to encourage students to maintain a more active approach could perhaps prove more intellectually demanding and problematic to some lecturers (Fransson, 1976; Collier, 1985) particularly on courses which have more content bound syllabi. The incentive for some lecturers, who might have heavy teaching and research workloads to take on a more onerous role might perhaps be small, particularly if rewards for such initiatives are limited. But, it would seem that if students are to be encouraged to become more relativistic thinkers then it is important that staff are also supported within their department to use teaching methods which will encourage this development in students. In order that this is carried out it would seem that new lecturers should be trained to teach in a way which they become more involved in their students' thinking (Dart and Clarke, 1991) as without training, they are likely to teach in the way in which they themselves were taught.

7.5.5 Peer group influences in determining developmental changes

The role of one's peer group at university might also be considered to be influential in affecting developmental change. Perry, (1970) and others (for example Heath, 1964; Wilson, 1981) have described how encounters with contemporaries from different backgrounds, specialists and with different values can lead to students feeling in some way challenged to review their own personal identity and in some case students perceive University as a place where they can establish a feeling of their own identity (Biggs, 1970; Knefelkamp and Slepitzka, 1976).

The responses to the Perry questionnaire for this project indicated that students entering University had a dislike for individual study and a liking for small group work. Final year students indicated different preferences, having more of a liking for individual work, but usually in association with other methods of instruction. Boud (1990) has suggested that many students entering University do not have the prerequisite skills to be autonomous learners. The desire to learn in the presence of other students might be as a result of students feeling isolated within a large class and seeking the anticipated security and support obtained from being within a small group. If many students do have a need for peer group support during their learning experiences this might have implications for students undertaking courses by flexible learning and would, therefore, highlight the importance of tutorial groups for students otherwise studying in isolation.

In addition, presumably the feelings associated with developmental changes would be less traumatic when shared with other students and perhaps the presence of others might speed up this progression. Encouraging students to work together as groups would appear to benefit students by exposing individuals to other differing viewpoints (Heath, 1964; Wilson, 1981). Green and Klug (1990), for example, found that involving students in debating current issues and having to produce supporting evidence encouraged them to both question Authorities and at the same time revealed other students' differing perspectives. The use of well managed group work during anticipated phases of class transitions could perhaps be considered to benefit students by providing a secure environment in which to discuss issues of ethical and moral importance.

In small classes of students, there might also be the possibility that students could adopt a feeling of a group identity and might collectively either develop or regress along the Perry scheme. A group of influencing students, therefore, might affect the rate of progression which the majority

of a class might undergo. This could, in part, explain the universal change in towards a Dualist approach shown by the first year students of 1992 - '93. A large class, for example the 1993 - '94 first year class, it might be speculated, would not perhaps feel the same level of group cohesion and as a result might not act as a collective unit.

7.5.6 Trends in the changes of students' approaches

Despite the first year full time student's general trend towards a Dualist approach during 1992 - '93, the class average had however, almost recovered to the same level by the following October as that observed in October 1992 (Table 7.2). The phenomenon of decalage when students approach subject areas in different ways according to the way in which they are taught, by for example, adopting a Dualist approach in Science and a Relativist approach in a Humanities class might, however, give the impression of a regression of behaviour. The change observed by the first year students could therefore be indicative of vertical decalage and perhaps be a reflection of the way in which the course subjects were being taught rather than being a regression of student's behaviour. Some educational theorists have dismissed the possibility of regression describing how 'there is no turning back' (Kitchener and King, 1990; Fischer and Aufschnaitre, 1993) and Tedesco (1991) suggests that what appears as a regression of approach might be in effect a series of missteps but only with respect to certain aspects of intellectual development, for example, an individual would not suddenly change their perceptions of lecturer and their peer group roles but might go back to considering a new subject from a more factual perspective.

However, it seems likely that students encountering a new subject or embarking on a new course within a new learning environment are going to require at least some form of reorientation. Even if a student is looking to adopt a relativistic approach, before a new conceptual framework can be established there would be the necessity for the most fundamental constructs to be in place, otherwise, (Labudde *et al.*, 1988) a new knowledge base would remain fragmented and an almost pathological 'globetrotting' learning strategy would result (Pask, 1976).

During the academic year 1992 - '93, each of the course profiles of class average C / A responses showed a trough in the middle years (Table 7.1). Although the same trough was not observed during 1993 - '94, there was a reduction in the level of agreement to C type statements by all the classes in their subsequent middle years. A phenomenon of change of behaviour or

'sophomore angst' has been described in America by several investigators (Chickering, 1969; Heffernan, 1975; Lemans and Richmond, 1987). This change has been characterised by students becoming less impulsive, less autonomous, using less of a deep approach to their learning and in some cases students have been described as 'floundering in uncertainty' in their middle years of college.

Although there was a reduction of C type behaviours by students there appeared to be an increase in the level of B type behaviour in the middle years, with over 50 % of students in Part 2 of the Perry questionnaire describing feelings of uncertainty and confusion in the second and third years of their courses. The staff's awareness of these student feelings is perhaps important if students are to be encouraged to make the transition through Multiplism towards Relativism, otherwise, students are likely to want to remain at a stage of Dualism or to become so lecturer directed that progression to a more advanced stage would be problematic.

The findings from this project suggests that these feelings of uncertainty and confusion are more prevalent in the second and third years of the courses tested. Perhaps during these years more instructional methods could be employed which explore the concepts of uncertainty but within a supportive environment and one where students can realise that they are not alone in their experiences. Explaining the Perry scheme of development to groups of students and describing how they might adopt more advanced ways of thinking might also be of benefit.

7.5.7 Progression through the Perry scheme

Although, researchers have described how students are generally to be found at Positions 2 - 6 of the Perry scheme (Table 1.1), not all students are going to be progressing through University at the same rate or feel the same inclination to change (Perry, 1970; Blake, 1976; Kurfiss, 1977; Meyer, 1977). In addition, as was found in this project (Sections 6.2.1 and 6.2.4) first year classes can vary considerably in their stage of development upon entry into University. Subsequently, unless students' stages of intellectual development are monitored or assessed regularly it could be difficult to know where a class is and the kind of support they might require in order to develop more relativistic thinking. Although developmental stages are sequential and involve personal constructs which are of increasing complexity, development, when it occurs does not progress at a regular rate

and movement to the next stage requires a readiness for change and the prerequisite constructs. In addition, a number of researchers have shown how it is not possible for students to reason at a stage more than one above their own current one (Churchman, 1971; Broughton, 1975; Fischer, 1980; Wood, 1983; Kitchener and King, 1990; Fischer and Aufschnaitre, 1993; Good, 1993).

If, as Perry describes, developmental change is innate and occurs in response to the stimulus and support of the learning environment, why had some of the fourth year students tested in this project not made the transition to Relativism and what were the determining factors which encouraged other students to make the transitions? Was the University learning environment less important than the students' willingness for change? Perry describes how it is the exposure to the epistemological conflicts encountered within the academic environment which brings about change however, some students do not seem to feel the same challenge to make this change. Riegel (1973) has also put forward that it is exposure to uncertainty and contradiction which drives development forwards and that as adults develop intellectually they come to accept contradiction. This differs from Piaget's descriptions of individuals' development occurring through the resolution of contradictions. The comments to the statement "*Sometimes, there seems to be so many ways of looking at the course subjects I feel confused about what is right or wrong*" in Part 2 of the Perry Questionnaire given by third year poster group students in this project (Table 5.4) suggest that students at that stage had one of two responses to the recognition that 'uncertainty' existed. Firstly there was a feeling of confusion and panic and secondly one of confusion, but acceptance. This feeling of acceptance is one which Riegel (1973) suggests adults should evolve and according to Perry would appear to be a development towards contextual Relativism.

In both years of testing, several students in the final year of their course were found to have a low C/ A or low Relativist to Dualist ratios in the Perry questionnaire and in contrast there were several first year students entering University with high C to A type scores in the questionnaire. Some of the final year students with low scores had been tested three times (October, 1992, February and October 1993) and seemed to be consistent in their responses to the questionnaire and had always achieved a low C to A response. Some other students, also tested at the same times, but having a higher initial Relativist to Dualist score seemed to show large swings in

responses moving from for example a 3 C : 1 A upwards to a 7 C : 1 A score and back again. As these changes in responses seemed to happen when the students had a higher initial C to A score, this might indicate that the questionnaire was identifying a transitional stage of the Perry scheme when students were in some way being challenged to reflect and re-evaluate a number of different aspects of the learning environment. Students, however, with consistently low scores perhaps had not been challenged in the same way or did not have the same openness for acknowledging the challenges presented.

It would have been useful if both types of students could have been interviewed, in order to establish why the same learning environment had elicited such different student responses and whether the students who had shown swings in response had a different 'state of mind' or attitude towards their learning than had those who had not shown any changes (Duckworth *et al.*, 1991; Fosnot, 1993; Fischer and Aufschaitre, 1993). Perhaps these swings of responses observed by some students are indicative of Multiplist feelings of uncertainty and reflect the disequilibrium experienced by individuals prior to a transition to a relativistic way of thinking. The follow up studies of students in this project suggest that this might be the case. However, the reasons why some students go through this stage and others do not seems to be unclear, but perhaps a student's reasons for attending University might in some way be linked to their desire to change intellectually.

Widick *et al.* (1980) have described how students' intellectual and identity development can occur in parallel at University. Chickering (1969) has commented that the Perry scheme relates to only certain aspects of identity and Loevinger (1975) describes how an individual's developing cognitive framework provides only a central control of functioning. This would suggest that, if an individual's identity was related to an academic frame of reference, then their intellectual stage of development might be more likely to be related to their out of university life, and that this might produce more of a drive towards a relativistic thinking in university. If an individual's frame of reference is not academically defined, then perhaps such a student would be less likely to strive towards self actualisation. Although, exposure to a university environment would seem to produce changes in students' intellectual development, which are unlikely to occur outwith the university setting, for example by students taking responsibility for their opinion and being able to make personal commitments.

7.5.8 Reasons behind students attending University

A link has been made between the reasons for students attending university and the approaches which they adopt to their learning and ultimately the level of intellectual development they attain. Four approaches to university have been described by Entwistle and Ramsden (1983) : achieving (related to a strategic approach, hope for success and vocational motivation) meaning (deep approach and intrinsic motivation) reproducing (surface approach and fear of failure) and non-academic (disorganised, negative attitude and social motivation). However, others (Biggs, 1971; Beaty *et al.*, 1990) have described how some students look to learning and university as a means towards self actualisation and changing as a person, and in a study carried out by Wilson, (1981) 40 % of students described the most important changes which had occurred at university related to changes undergone relating to their world view and personal philosophy. Although, many of the instructional methods utilised in the third year of the Core Biology module investigated by this project are considered, by the staff involved, as encouraging a more relativistic or deeper approach, sometimes this is not always perceived by students as being the case. Experiences with the group poster exercise and also the question selections made in the Core Biology module end of third year examinations (Section 4.7) suggest that it is not always necessary for students to undertake a higher cognitive level or more relativistic thinking, then students can often select a level which is more dependant on the recall of factual material. This is supported by Biggs (1970) for example, who has also described how reproductive strategies or a Dualist type approach can still be successful throughout all stages of a University education.

7.5.9 Relationship between Perry stages and students approaches to their University Education

By way of contrast to the continuous use of a reproductive approach to learning, some students can be considered to adopt strategic approaches. Miller and Partlett, (1974) have related the Perry Scheme of intellectual development to the level of 'cue' seeking which students undertake while at University. They suggest that Dualist students are deaf to the external 'cues' available within the learning environment, while Multiplists seek out cues from the lecturers and direct their learning accordingly. Relativists are seen as cue conscious students, but those who want to demonstrate a more personalised approach to their learning rather than being specifically

lecturer directed.

Taken in the context of a university environment, a strategic approach by students described by Ramsden (1981) suggests that students' approaches are achievement directed and that students adopt whatever approach is required at a particular time, responding dualistically in one class and relativistically in another. The lecturer direction described in the Multiplist stages of the Perry model could, in a sense, be linked to a strategic approach as described by the cue seekers outlined by Miller and Partlett (1974). However, the reasons for looking to the lecturer would seem to be different, with strategic learners looking to succeed in exams but the Multiplist students looking to the lecturers as an authority figure who knows 'the answers'. A strategic learner might not, therefore, be expected to reach a stage where they can take responsibility for their own learning or to reach a stage of Commitment in Relativism stage, if they are so lecturer directed in their learning. It might also be debatable as to whether strategic learners even reach a point of Relativism, and presumably this would be dependent on whether or not this level of approach was rewarded within the instructional environment. If strategic learners do not make this final transition, then it might be argued that they are perhaps entrenched within a Multiplist stage of development (for example, at Position 4b, see Table 1.1) and that this stage provides what might be considered to be a position of security rather than feelings of uncertainty and confusion. Here, students try to give the lecturers 'what they want' and to think 'the way they want' and any responsibility for their learning is shifted to the lecturer, who is in control. Attaining this type of thinking might be sufficient for graduates who are intrinsically motivated to move to a career which requires only the completion of a degree, but careers requiring students to be capable of more autonomous relativistic approaches to their learning would appear to need students to progress through the Perry scheme.

Several researchers have experimented with ways of encouraging students to progress through the Perry scheme (Sanford, 1966; Widdick, 1975; Stephenson and Hunt, 1977; Widdick and Simpson, 1978; Parker and Lawson, 1978) with varying success, although, research suggests that students prefer to work at their own and one above their Perry position and that if students are to progress then they have to be both challenged and supported across the transitional stages of development. Nelson's variant on the Perry scheme (1985) and Finster (1991) have supported this emphasis on the transitional phases of the Perry Scheme. Simply providing students

with a variety of different instructional methods, as suggested by the findings in this project, is perhaps not enough to encourage students to progress through the Perry scheme of development. Finster (1991) suggests that students should also be supported through the transitional stages, which can prove traumatic for them. The importance of knowing where a class is in terms of their stage of intellectual development is perhaps exemplified by the experiences found in the poster exercise. Although the students were being challenged to adopt more relativistic thinking by the way in which the poster was organised, it was only when appropriate levels of support and reward were provided that the majority of students began to produce work at the scientific level originally anticipated by the teaching staff.

7.6 Further studies

7.6.1 Current studies

The use of group poster exercises as a method of encouraging students to develop higher level cognitive skills has now been adopted as an instructional method in a number of different faculties and departments throughout Napier University. The Perry Questionnaire has been and is currently being used to monitor students attending courses in Hong Kong and India. The following studies would also be of interest in further developing some of findings from this project.

7.6.2 Group poster exercise

- Repeating the group poster exercise in it's final year form would provide an indication as to whether the lack of group conflicts and the high standard of poster presentations was due to the class composition of that particular year or was a result of the changes introduced over the 4 years
- Interviewing students during and after the poster exercise might give a clearer insight into the way in which the group worked together
- Students could perhaps be asked to give a self assessment of their work according to the criteria set out by the staff
- The Perry scheme could be explained to the students at the beginning of the year and examples of previous posters be shown by way of example
- Students could be given instructions in what constitutes a good question response

- Students could be given more responsibility in directing the poster presentation discussions, perhaps with the group members from one of the two poster presenting groups selecting the questions for the other presenting group and one of their members leading the discussion
- Students could be given a choice of poster challenges, which perhaps could include different levels of support from staff and be designed specifically for different Perry positions. Different approaches to the poster exercise could be rewarded with bonus marks according to the level of support given. Allowing students to select their type of challenges and amount of staff support might help to remove this feeling of unfairness which was voiced about the challenges each year
- Groups of students could be involved in the design of poster challenges for other groups and then be responsible for assessing them. This might increase the student's involvement in the exercise.
- The Perry questionnaires and the group dynamics questionnaires could be used with other group exercises and on different courses and years in order to establish whether it was the poster exercise format which had determined the type of student who had become the influencer within each group. Would, for example, the influencing students in the groups formed to give an oral presentation, a solely information giving exercise be Dualists who preferred lectures and descriptive essays ?
- Testing groups of students in a first year class, which might be predicted to be a mixture of Dualists and Multiplists would perhaps establish whether Multiplists generally became non-influencing students or whether this happened as a result of the format of the poster exercise or because of the presence of Relativist students in the group.
- The responses of groups of students from other faculties could also be monitored to investigate whether the findings from this project were unique to the biology department or to a science department
- Students could be allocated to groups according to their Perry questionnaire responses and homogeneous groups of Dualists, Multiplist and Relativist's performances investigated in different types of exercise.
- Heterogeneous and homogeneous Perry groups could be compared in terms of the way in which they worked together as groups.
- The influence of gender on the roles adopted by students in the poster exercise in a more equally balanced class of female and male students could be followed up, to investigate whether or not male students adopted the influencing roles within exercises like the poster exercise

7.8.3 Perry Questionnaire

- Other students from other faculties and other establishments could be tested to discover whether similar trends to those found in this project could be identified using the same questionnaire, particularly in longitudinal terms
- Interviews with students showing top, middle and bottom Perry scores and a cross validation comparison between other measures of the Perry questionnaire would be interesting
- If change is in a sense determined by interaction between student and learning environment then a comparison could be made between students attending a lecture based and for example a group project based course to establish whether there was any difference in the rate of progressions through the scheme
- Following through students undertaking courses by Flexible learning when students are being presented with the same information but studying independently with only the guidance of the lecturer. This might establish the importance of the presence of other students in affecting change
- The applicability of the Perry scheme to other non University forms of learning or the teaching of manual skills could be investigated. Would for example an individual undertaking an apprenticeship as a car mechanic feel a change in the perceptions of their role with respect to their teacher
- If another eighteen statements were produced, with six more of each type, then by a process of random selection of six of each type several questionnaires could be produced in order that students could be tested with a different questionnaire at the beginning of each year in order that a longitudinal study be carried out. This could be matched with a series of interviews with selected students from each class
- The Perry statements could be put into a computer format and students could find out their Perry position with respect to the rest of their class. Lecturers could also find out the Perry profile for a course and then plan the instructional method accordingly. Students identified as being at different intellectual stages could be directed to appropriate study skills material which could be designed to either to support or challenge.

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Appendix 1

Structured Challenge 1990 -'91
Extraterrestrial Metabolism

EXTRATERRESTRIAL METABOLISM

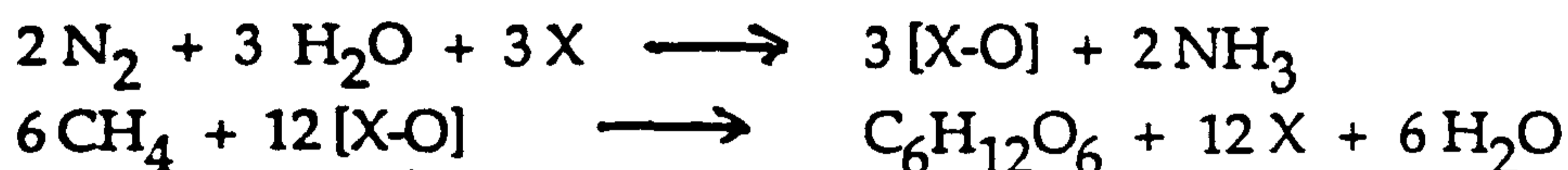
An Earth-sized planet in a distant part of the galaxy has an oxygen-free atmosphere consisting largely of nitrogen, ammonia and methane, but life has evolved on it and has generated some complex multicellular heterotrophs that can be compared to mammals. For instance, these organisms use glucose as an energy source, liberating energy by the overall reaction



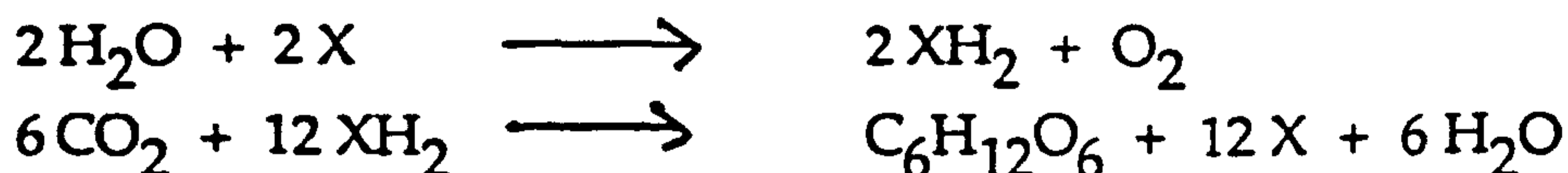
in place of the terrestrially-familiar



Autotrophs on this planet carry out a photosynthetic process involving an "active oxygen carrier", represented here as X:-



This is analogous to photosynthesis in terrestrial green plants:-



where X is NADP^+ .

HERE IS THE CHALLENGE WE'D LIKE YOU TO MEET:-

Ammonia is very soluble in water; nitrogen and methane are very insoluble. Carbon dioxide makes an important contribution to body-fluid buffering in terrestrial organisms; ammonia gives alkaline solutions. All this makes for difficulties in constructing any possible ^{alien} metabolism, let alone an efficient one. How are the multicellular heterotrophs organised (a) at the cellular and (b) at the whole-organism level so that they are metabolically efficient? In other words, what are their cell biology and physiology like?

There are numerous ways to tackle this problem and you have complete freedom of choice. You needn't focus on metabolic pathway details unless you want to; you might like to name, draw and generally describe these remarkable creatures; you might wish to focus some attention on the photosynthetic autotrophs and how they work. This is all up to you. While you're working on this poster, we'll be happy to discuss your ideas with you if you wish!

Unstructured Challenge 1991-'92

Basal Ganglia - their function in the nervous system

THE SUBJECT FOR THIS TOPIC IS "THE BASAL GANGLIA - THEIR FUNCTION IN THE NERVOUS SYSTEM"

There are several possibilities within this area - Basal ganglia are involved in several diseases, such as Parkinsons Disease, Huntingtons Chorea, Motor Neurone Disease and conditions such as Athetosis and Hemiballismus which are associated with lesions that involve the B.G.

I would suggest that you choose one disease and use one particular aspect as the basis for your poster. If you select Parkinsons Disease, for instance, you could base your poster on the underlying causes of the disease or modern treatment, or the consequences of disease progression. When you have selected your topic and approach, I will try and find some suitable background material for you. I would recommend 'TINS' - Trends in Neurological Science, which is published monthly and has reports on the latest developments in neuroscience. "TIPS" - Trends in Pharmaceutical Science is worth a look also.

POINTS TO CONSIDER

Remember, you are preparing a POSTER. This is a visual presentation and it's not the same as an essay or a lab report. Posters are a way of presenting information in an eye-catching and arresting fashion - they are not so successful for presenting complex analysis or reasoning. That can always be included in the written report!

You are basically aiming the poster at your fellow students - a well informed intelligent audience! You need to pitch your presentations at the appropriate level. It needs to be sufficiently rigorous to interest them but not so obtruse no one but yourselves understand it. Remember, you will be asked some questions about the subject, so you need to know some background beyond the poster.

Structured Challenge 1991 -'92

Wound healing and Tissue repair

In an incident a few years ago in Northern Ireland a family was attacked by paramilitary fighters. During the attack several members of the family received gunshot wounds. These were the mother (aged 26), who was 6 months pregnant at the time, her son (aged 4), and her grandmother (aged 76). All received wounds in the abdominal area, and the unborn child was also wounded. Luckily none were too seriously injured and all members of the family recovered. All the wounds healed successfully but with widely differing efficiencies. The baby was born with no visible trace of the wound, the son's wound healed rapidly with only minimal scar tissue, the mother's wound took longer to heal and showed an obvious scar, while the grandmother wounds took many months to heal at all and the scarred tissue that was produced was reopened on several occasions in the future by relatively minor accidents.

Your task is as follows:

- (a) to give an account on the mechanisms responsible for wound healing;
- (b) to explain the widely differing efficiencies seen in the recovery of the victims of the attack;
- (c) to suggest possible lines of research which could lead to improved wound healing in adults.

In all of the above you should consider physiological, cellular and molecular aspects.

Structured Challenge 1991 -'92 - Instruction sheet

Metabolism: Poster Topic

THE BIOLOGY OF *DRACO IGNISFABRICATUR*

The diet of the common dragon, *Draco ignisfabricatur*, contains a good deal of meat together with large quantities of native metal (e.g. from the armour of unsuccessful knights and the fillings in maidens' teeth). The metal is transferred to the animal's scales rendering the skin impenetrable except to magic weapons. Two other well-known characteristics of *Draco* also require explanation. First, despite a body of enormous size and strength and a pair of ridiculously small wings, it can fly. Second, it has a uniquely inflammatory kind of halitosis.

What is *Draco's* energy metabolism like, given that it is reputedly homeothermic but apparently eats infrequently (if copiously)? How does it fly? How does it coat its scales with ingested metal? By what mechanism can it set fire to its breath? What other general biological and behavioural characteristics of this animal seem to you to require a metabolic explanation, and what explanation can you offer?

We shall be happy to discuss your ideas with you, if you wish, while you are working on this poster.

Unstructured Challenge 1991 -'92 - Instruction sheet Bone Fractures

B. Title is : "BONE AND TENDON FRACTURES. WAYS OF REPAIRING AND TREATING THESE INJURIES".

This is a wide topic and I suggest you pick one aspect for the poster. Discuss amongst the group which is the best aspect from your point of view.

1. Something that lends itself to nice drawings - 'photographs'?
2. Something that is reasonably comprehensive and can be coherently displayed in the space available.
3. Should be reasonably high level but not so abstruse that you are the only ones who can understand it.
4. Should be something you can find background information on with a fair degree of ease and accuracy.

C. The title is only a general indication, we could alter it if necessary.

You might like to give a little thought to the possibilities.

Questions to ask :

1. Is it general or specific?
2. If general, how wide can it be, bearing in mind the space available on the poster.
3. If specific, can we produce a coherent, clear demonstration of the subject?
4. What is best for us? Which approach do we, as a group, think will be our best way of presenting our efforts. Remember, you need to know your topic sufficiently well to produce a good poster and answer questions at the presentation.

Unstructured Challenge 1991 -'92 - Instruction sheet (cont)

Bone Fractures

Finally, remember the dimensions in which the presentation must be contained. You know how large the poster can be, you need to plan something which will make best use of the space available. How you plan will also depend on if you incline to a general or specific approach, both have their plus and minus points. A comprehensive general presentation might be difficult to include in the space available. A specific one might give difficulties in ensuring a clear, coherent demonstration.

You will primarily be judged on the scientific content and the quality of presentation (not the artwork - that will play a minor part), so think carefully before you choose.

Examples of Structured Challenges 1991- 1994

Poster Challenge - Neurodegenerative Disease Clinic

You are to set up a diagnostic and treatment centre for people suffering from cerebral palsy and neurodegenerative diseases.

Your challenge is to consider what diagnostic procedures will be carried out and what types of treatment might be possible or might be possible in the future.

Information on the physiological basis of these procedures/treatments is expected.

We suggest that you consider the plasticity of the brain and genetic engineering in devising suitable treatments.

Poster Challenge - The Loch Ness Monster

The Loch Ness monster is readily dismissed as a myth because of the scarcity of sightings and the confused nature of reports available. Other factors reinforce this opinion ; while the loch has a large fish population, it couldn't support a breeding population of large animals and no traces of large animals, bones etc have ever been found in the vicinity of the loch.

Recent discussions in establishments surrounding Napier University have given rise to a colourable explanation of all the points raised against the possibility of the monsters existing and also possible lines for further research.

The loch supports a large population of unicellular organisms and readiness of one particular species to aggregate in very large numbers in response to a range of simple biological signals suggests that the monsters are not in fact aquatic animals but are fruiting bodies of a unicellular organism.

1993 -'94 Poster session programme

Presenters	TIME	Rest of class
Put up posters; sign in	9.00	-----
Collect sets of forms and questionnaires Lead the paperwork to see what you should be doing	9.15	Arrive & sign in Collect sets of forms and questionnaires Read the paperwork to see what you should be doing
Look at other poster Agree two questions about it with the rest of your group. Write two copies of them on the forms provided. Hand in one copy to a member of staff by 10.00		Look at both posters Assemble into your own poster group Agree on two questions to put to each of today's posters. Write two copies of them on the forms provided. Hand in one copy to a member of staff by 10.00 at the latest then go for
Recieve questions on your poster and think about them	10.00	SHORT BREAK
Two of them will be selected for class discussion	10.10	REASSEMBLE
Try to answer the questions as best you can, the staff will give you some moral support		General discussion on poster groups' answers
	10.45	
Complete questionnaires		Complete questionnaires
Pick what you consider to be the best two questions		
END	11.00	END

1993 -'94 Instruction sheet for asking the 'right questions'

A poster on unicorn metabolism detailed the metabolic processes familiar from the Assessed Tutorial exercise (28 October). Amongst the questions raised by the audience were the following.

1. *What is the main source of 3-oxohomolysine in the diet?*

A good question; simple, but challenges the presenters' general biological perspective. (In discussion, a quick-witted member of the group blamed the unicorn's commensal gut microflora for generating this mysterious nutrient from dietary glutamate and serine. Despite being unable to give metabolic details, which she said "had still not been elucidated", this quick-witted person increased the group's 'skill in handling questions' score.)

2. *What are the symptoms of 3-oxohomolysine deficiency?*

Another fairly good question, but unfortunately the group's answer to (1) defused it. As the group explained, the only deficiency cases were associated with destruction of the normal microflora, so the fact that the animals always died could not be interpreted easily.

3. *Are there any known cases of mythine over- or under-production, and what are their physiological and behavioural effects?*

Not a bad question, because it relates biochemistry to physiology and behaviour, but not a good one either because it invites a frivolous answer. There's nothing wrong with questions and answers being amusing, but it's too easy to answer this question flippantly, i.e. without any significant biological content.

4. *How does the cyclisation reaction work?*

This could be a good question for specialist biochemists, because it would have to be answered in terms of active-site reaction mechanisms. For a broad integrated course such as ours, it's a downright bad question. A decent answer (i) would lose the audience hopelessly, (ii) could not reasonably be expected of any member of the class.

5. *Why are unicorns so rare?*

A hopeless question. Irrelevant to the poster, and in any case is difficult to answer in any biologically interesting way.

1993-'94 Outline of poster assessment sheet

This sheet summarizes our approach to assessment. It might help you (i) to complete Jen's questionnaire, (ii) to think up suitable questions and (iii) to approach future poster preparation tasks satisfactorily.

Scientific content: *approximate weighting 40%*

Apparent integration of physiology and biochemistry.
Quality of response to challenge: relevance of poster to challenge;
credibility of response; depth of biological understanding shown.

Presentation: *approximate weighting 30%*

Appropriate use of text, diagrams etc..
Legibility, including ease of following the layout.
Visual impact.

Skill in handling questions *approximate weighting 20%*

Judged largely as per 'scientific content'.

NOTE; FOR ADVICE ON 'APPROPRIATE QUESTIONS', P.TO.

Group cooperation *approximate weighting 10%*

We judge this largely on the basis of the intragroup assessment questionnaires completed by the poster group members.

1993-'94 Form for poster questions

FORM FOR POSTER QUESTIONS

Copy to hand in

Your poster
group no.

TITLE: Extraterrestrial metabolism

Q.1

Q.2

Example of Core Biology module end of year exam paper

-

1. EITHER

- (a) "A detailed knowledge of metabolic pathways hinders rather than helps anyone wishing to gain an understanding of metabolism." Please discuss this view critically.

OR

- (b) The graph shows time-courses of the distribution of ^{14}C after oral dosage of a mammal with 10^5 d.p.m. of ^{14}C -glycine. (An appropriate balance of other nutrients was also supplied.)
- i. Please explain the shapes of the curves.
 - ii. On the additional copy of the graph supplied, please superimpose the time-courses you would expect for expired $^{14}\text{CO}_2$, and plasma ^{14}C -labelled free fatty acids, and explain your reasoning.

4. EITHER

- (a) Compare cartilage and bone as support materials and consider how they are adapted to the forces acting on them.

OR

- (b) "The activities of a cell are fully explained by the structures and properties of its membranes." Discuss this statement.

5. EITHER

- (a) Describe how recent advances in our knowledge of neurotransmitter release and receptors has aided our understanding of brain function.

OR

- (b) Discuss the extent to which brain damage and split brain investigations have contributed to our understanding of normal brain functioning.

Appendix 2

Poster Questionnaire Q1

Group Poster Presentation Exercise Feedback

This is the second year that students have been asked to do this kind of presentation and it would be useful if you could provide us with some feedback to enable us to improve the exercise in future years. **Note :** This questionnaire is anonymous and will be used only for information purposes and not as a means of assessing you.

Please complete the questionnaire as best you can, *remember there are no right or wrong answers.*

1. What was the title of your poster (Please tick)

..... i) Brain Function

..... j) Basal Ganglia

2. Given a free choice of all the poster titles so far :

a) Extra Terrestrial

b) Dragon metabolism

c) Water, electrolyte balance

d) Calcification disorders

e) Haemoglobin variants

f) Wound Healing

g) Bone fractures

h) Loch Ness Monster

i) Brain function

j) Basal ganglia

which would you have most preferred to have worked on and which the least : (Please write the appropriate letter only on the dotted lines below)

..... I) Most preferred

(✓)..... No strong preference

..... II) Least preferred

3. On what basis did you make the decisions In Q.2 (Please tick choice(s))

I) Most Preferred

.....the poster title was more attractive

.....the general subject matter (from the taught course) appealed to me more

.....other - *please specify*

.....

II) Least Preferred

.....the poster title was less attractive

.....the general subject matter (from the taught course) didn't appeal to me

.....other - *please specify*

.....

Poster Questionnaire Q1 (cont)

4. Before your group started work on your poster how much instruction (during this year and from other courses) do you feel that you had been given in the following areas : (Please circle appropriate number)

(4 - too much 3 - adequate 2 - too little 1 - don't remember ever having any)

(i) Working efficiently within a group	4	3	2	1
(ii) The scientific material to be used in the poster	4	3	2	1
(iii) Researching & obtaining additional material for use in a poster	4	3	2	1
(iv) Selecting the most suitable material for a poster	4	3	2	1
(v) Designing and layout of a poster	4	3	2	1
(vi) Producing text / graphics for a poster	4	3	2	1
(vii) Assessing other student's work	4	3	2	1

5. What kind of additional instruction *if any* would have been most useful to you either before or during the poster exercise ?

6. A number of the intended aims of the group poster presentation exercise are listed below (Please go through the list and indicate, by circling the appropriate number, whether or not you feel that these aims were achieved)

(1 - achieved very successfully 2 - achieved 3 - don't know 4 - not achieved)

Staff aims of exercise :

(a) to give students the experience of working in a group	1	2	3	4
(b) to make students think more about the topics in the course	1	2	3	4
(c) to give students the practical experience of producing a poster	1	2	3	4
(d) to encourage students to relate the topics of physiology and cell biology	1	2	3	4
(e) to give students the opportunity of assessing each other's work	1	2	3	4
(f) to make the subject more interesting	1	2	3	4

Poster Questionnaire Q1 (cont)

7. The following statements have been used to describe how students felt about the poster exercise. (Please go through them indicating your immediate reaction to the statement by circling the appropriate number)

(1 - strongly agree 2- probably agree 3- don't know 4- probably disagree 5- strongly disagree)

- | | | | | | |
|---|---|---|---|---|---|
| (a) There didn't seem to be much point in the exercise | 1 | 2 | 3 | 4 | 5 |
| (b) I learned a lot from working with the other students | 1 | 2 | 3 | 4 | 5 |
| (c) There were some people in my group that I didn't like much | 1 | 2 | 3 | 4 | 5 |
| (d) Deciding what should go in the poster helped me to think about the relative importance of information | 1 | 2 | 3 | 4 | 5 |
| (e) We tried to include too much information in the poster | 1 | 2 | 3 | 4 | 5 |
| (f) Anticipating questions about the poster helped me to think about how the subjects related to each other | 1 | 2 | 3 | 4 | 5 |
| (g) I felt able to answer any questions asked about our poster | 1 | 2 | 3 | 4 | 5 |
| (h) We kept the scientific content of our poster fairly simple | 1 | 2 | 3 | 4 | 5 |
| (i) I felt a sense of pride when we'd finished the poster | 1 | 2 | 3 | 4 | 5 |
| (j) We had to get a lot of help from staff while working on the poster | 1 | 2 | 3 | 4 | 5 |

8. Group work:

How would you describe your group. (Mark X on the scale eg X to indicate your opinion) For example if you felt that your group was particularly well organised then you would indicate it by :

well organised X _ _ _ _ disorganised

Description of my group :

- | | | |
|--|-----------|--|
| i) well organised | _ _ _ _ _ | disorganised |
| ii) supportive | _ _ _ _ _ | inconsiderate |
| iii) we didn't get on at all well with each other | _ _ _ _ _ | we all got on really well together |
| iv) all group members contributed equally | _ _ _ _ _ | some group members did a lot less than others |
| v) decisions were always made by one or two individuals | _ _ _ _ _ | decisions were always made collectively as a group |
| vi) we all had similar ideas when working together on the poster | _ _ _ _ _ | we all had different ideas when working together |
| vii) we wished we could have redone the poster | _ _ _ _ _ | we were all happy with the final poster |

Poster Questionnaire Q1 (cont)

9. Overall Comments (Please circle appropriate number according to your immediate reaction to the following statements)

(1 - strongly agree 2 - probably agree 3 - don't know 4 - probably disagree 5 - strongly disagree)

- | | |
|--|-------------------|
| i) I enjoyed helping to design and produce a poster | 1 2 3 4 5 |
| ii) I would have preferred to work by myself | 1 2 3 4 5 |
| iii) Some of my group deserved more marks than others | 1 2 3 4 5 |
| iv) The workload for other courses restricted the amount of time I could spend on this project | 1 2 3 4 5 |
| v) The scientific content of the other poster was difficult to follow | 1 2 3 4 5 |
| vi) I enjoyed the experience of working in a group | 1 2 3 4 5 |
| viii) Next year's 3rd year students would benefit from doing the poster presentation exercise | 1 2 3 4 5 |

10. What do you feel was the most important thing that you learned while working on the poster ?

11. If you had to give a piece of advice to students working on the same exercise next year what would it be ?

Finally, would you have answered all or some of the above questions any differently had the questionnaire not been anonymous (Please tick selection)

I would have answered

.... **all**

.... **some**

.... **none**

of the questions differently if my name had been on top of the form

Poster Questionnaire Q2

1. Last year you were involved in a group poster exercise. Did this work influence the way you tackled this years exercise ?

Yes No

2. If you answered Yes to question 1, in what way had the exercise made a difference ?

a) The way you worked together as a group - if so please specify.

b) The way you designed the poster - if so please specify.

c) The way you selected material for the poster - if so please specify.

d) The way you prepared for the questions - if so please specify.

e) Other - if so please specify.

Advice to students sheet 1991-'92

In a questionnaire, filled out after the group poster exercise last year, students were asked "If you had to give a piece of advice to students working on the same exercise next year what would it be?". Here is a list of their replies:

- 1 make sure all the group members put in the same amount of effort
- 2 don't leave till the last few days
- 3 keep the poster simple but not too basic
- 4 ask for help
- 5 start early!
- 6 don't spend as much time as we did - consider other coursework
- 7 make diagrams big, use coordinated colour
- 8 only spend necessary time on poster
- 9 think of others in your group
- 10 don't panic - enjoy the experience! you'll laugh afterwards
- 11 keep writing brief, use titles to catch attention, use large lettering & diagrams
- 12 make sure you get organised in time
- 13 use lots of colour, keep text brief, use diagrams where possible
- 14 try to avoid doing a topic you have no interest in whatsoever
- 15 don't leave it to the day before
- 16 try to use as little text as possible, be prepared!
- 17 get organised in time & try to all contribute equally, need lots of discussion
- 18 don't spend too much time on poster, but prepare for questions
- 19 start thinking about topic as soon as you get title, don't leave till last minute
- 20 get organised early, prepare for questions
- 21 work together and enjoy the presentation
- 22 start early
- 23 be organised
- 24 keep scientific language simple and brief
- 25 make sure there is no overlap between individual's work
- 26 don't just assume that everyone knows what you are talking about
- 27 discuss things within the group
- 28 try to make poster interesting
- 29 prepare for questions
- 30 use colour to attract interest, use continuity
- 31 know a bit about every poster, be prepared for questions

Categorise the above numbered suggestions under five headings of your own choice eg group work

Heading					
1	2	3	4	5	
.....

Student and staff Checklist C1

Please tick as appropriate (✓)

1. How would you rate the poster's general appearance ? eg layout, readability of text, graphics, use of headings and colour etc

excellent	very good	good	mediocre	poor	very poor
.....

2. How would you rate the the scientific level of the poster ? [High level indicates a lot of original thought, good integration of the subjects etc - Low level indicates little evidence of original thought, information just taken straight out of a book]

very high level	high level	mediocre	low level	very low level
.....

3. How much information would you say had been included in the poster ?

far too much	too much	just about the right amount	too little	far too little
.....

4. Did you find the poster interesting to read ?

very interesting	quite interesting	some parts were interesting	not very interesting	pretty boring
.....

5. How were your questions answered ?

very well	well	satisfactorily	poorly	very poorly
.....

6. How much did the group know about their subject ?

everything	a lot	some	not much	nothing
.....

7. If you had any recommendations to the group as to how they might have improved their poster what would they be ?

End of year student Checklist C2

Group

Name

Please tick your selection(s)

1. Which one of the posters do you think has the best overall design ? eg layout, readability, use of headings etc.

1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10.....

2. Which 1 of the groups, in your opinion, has dealt with their subject at the highest scientific level ie has best related the cell biology and physiology of their subject together and put in the most original thought ?

1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10.....

3. Which 1 of the groups do you think has put the least original thought into their poster ? eg taken the material straight out of a book and dealt with the subject at a very basic level

1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10.....

4. Throughout this year, which of the posters have helped you to learn more about the topics taught in the Core Biology module ? (tick one or more)

1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10.....

5. To which of the posters would you give the highest mark? (taking into account the design, originality and the level of scientific thought)

1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10.....

Why ?

6. Following your work on the poster, are you MORE or LESS likely to answer questions on that subject area in the end of year exam

more likely less likely makes no difference

7. If you had to do the same exercise again - what would you do differently ?

8. Have you any general comments about the poster exercise ? eg organisation, group work, staff support, usefulness, relevance to course etc.

End of year staff Checklist C3

Please tick your selection(s)

1. Which of the posters do you think has the best overall design ? eg layout, readability, use of headings etc.

1 2 3 4 5 6 7 8 9

2. Which of the groups, in your opinion, has dealt with their subject at the HIGHEST scientific level ie has best related the cell biology and physiology of their subject together, has put in the most original thought etc ?

1 2 3 4 5 6 7 8 9

3. Which 1 of the groups do you think has put the LEAST original thought into their poster ? eg taken the material straight out of a book and dealt with the subject at a very basic level

1 2 3 4 5 6 7 8 9

4. Which poster would you give the highest mark to ? (taking into account the originality, level of scientific thought as well as to the design)

1 2 3 4 5 6 7 8 9

Why ?

Have you any general comments about the posters ?

Staff checklist C4

Poster Title

Group Poster Presentation Staff Checklist

Please tick as appropriate (✓)

1. How would you rate the poster's general appearance ? eg layout, readability of text, graphics, use of headings and colour etc

excellent	very good	good	mediocre	poor	very poor
.....

2. How would you rate the the scientific level of the poster ? [High level indicates a lot of original thought, good integration of the subjects etc - Low level indicates little evidence of original thought, information just taken straight out of a book]

very high level	high level	mediocre	low level	very low level
.....

3. How much information would you say had been included in the poster ?

far too much	too much	just about the right amount	too little	far too little
.....

4. How were your questions answered ?

very well	well	satisfactorily	poorly	very poorly
.....

5. How much did the group know about their subject ?

very thorough knowledge	a good grasp of the main ideas	limited to poster content	many grey areas	very limited knowledge
.....

6. How did the group respond to your questions ?

equal response	only a few responded	questions directed to individuals	one person answered	generally poor response
.....

7. What improvements could the students have made to their poster ?

Student Checklist C 5

Poster Title.....Name..... Group

Group Poster Presentation Student Checklist

Please circle number as appropriate

1. How would you rate the poster's general appearance ? eg layout, readability of text, graphics, use of headings and colour etc.

excellent 6 5 4 3 2 1 0 poor

2. How would you rate the the scientific level of the poster ? [High level indicates a lot of original thought, good integration of the subjects etc. - Low level indicates little evidence of original thought, information just taken straight out of a book]

High 6 5 4 3 2 1 0 low

3. How much information would you say had been included in the poster ?

too much 6 5 4 3 2 1 0 too little

4. How do you think the group responded to the questions asked ?

very well 6 5 4 3 2 1 0 very badly

5. How much have you learned from the poster and the discussion ?

a lot 6 5 4 3 2 1 0 very little

6. If you had any recommendations to the group as to how they might have improved their poster what would they be ?

Staff Checklist C 6

Poster title Name

Staff Checklist

Please circle number as appropriate

1. How would you rate the poster's general appearance ? eg layout, readability of text, graphics, use of headings and colour etc.

excellent 6 5 4 3 2 1 0 poor

2. How would you rate the the scientific level of the poster ? [High level indicates a lot of original thought, good integration of the subjects etc. - Low level indicates little evidence of original thought, information just taken straight out of a book]

High 6 5 4 3 2 1 0 low

3. How much information would you say had been included in the poster ?

too much 6 5 4 3 2 1 0 too little

4. How do you think the group responded to the questions asked ?

very well 6 5 4 3 2 1 0 very badly

5. How would you rate the group's participation in the exercise ?

equal participation 6 5 4 3 2 1 0 left to a few individuals

6. If you had any recommendations to the group as to how they might have improved their poster presentation what would they be ?

Group Assessment sheet GA 1

Group Assessment Form

You have fifty marks to share between the rest of your group (not yourself) for their level of participation during the group poster presentation exercise. Please write down your colleague's names and your marks below :

Student's Name	Mark
1.....
2.....
3.....
4.....
5.....
6.....

Group Assessment sheet GA 2

Group

Intra - Group Assessment Marks

PART 1 - Assessment Scheme

This assessment is divided into four categories ; each category is allocated a maximum of TEN marks. To assist your judgment, a list of what might be described as desirable skills is given under each category heading below:

a) Group Work

coordinating the group's activities - giving direction and facilitating discussion - allocating responsibilities - contributing usefully to the group's discussions - regularly attending group meetings - organising group meetings - fixing deadlines - assisting groups through "difficult patches" - suggesting alternative approaches when necessary etc.

b) Scientific content

coordinating the search for research materials eg books, reprints, journals etc. - actively seeking out sources of information - creating scientific ideas - contributing a significant amount of material to be considered for inclusion in the final poster presentation

c) Poster Preparation

typing / writing of text - drawing / copying illustrations - designing layout - collating and summarising scientific material

d) Poster Presentation

preparing for and answering questions - continuing discussion arising from questions - evaluating written questions

PART 2 - Individuals' Assessments

(Do not include your own name. Marks are out of TEN for each category)

NAME	Group Work	Scientific Content	Poster Preparation	Poster Presentation	TOTAL / 40 marks
1.....
2.....
3.....
4.....
5.....

Group Questionnaire G 1 - 1992-'93

Which of the following do you think would determine whether or not a group would work efficiently together (Tick the appropriate box)

	a	neither	b	
1a) Having one person in charge, directing the work	-	-	-	b) Working together cooperatively, everyone having an equal role
2a) Sharing all the work out equally within the group	-	-	-	b) Delegating each individual with a different type of work
3a) Working with friends whom you already know	-	-	-	b) Working with people you don't know well
4a) Working with people with the same ideas	-	-	-	b) Working with people with different ideas
5a) Making all the decisions collectively within the group	-	-	-	b) Allowing individuals to make decisions about their own work
6a) Having a group of people with mixed abilities	-	-	-	b) Having a group of people with similar abilities

Please indicate your immediate reactions to the following comments:

(5- agree, 4- agree with reservations, 3- don't know, 2- disagree with reservations, 1- disagree)

I generally don't like working in groups	5	4	3	2	1
Group work is a good opportunity to get to know people better	5	4	3	2	1
Working in a group means that you don't have to do so much	5	4	3	2	1
I find that I will usually "take charge"	5	4	3	2	1
I sometimes feel excluded within a group	5	4	3	2	1
It's good when other people take over the responsibility	5	4	3	2	1
I like participating in group discussions	5	4	3	2	1
I don't like working in a group containing someone I don't like	5	4	3	2	1
I generally try to keep out of group conflicts or arguments	5	4	3	2	1
I prefer it when a group is told exactly what they have to do	5	4	3	2	1
I feel good when I win an argument	5	4	3	2	1

Group Questionnaire G 2 - 1993-'94 (cont)

Part two - Poster Presentation

1. How do you feel about undertaking a poster exercise rather than for example giving a verbal presentation ?

Enthusiastic	Generally positive	Not Bothered	Don't like idea of a poster
.....

Other (please specify)

2. What do you think are the staff aims of this particular exercise ?

3. Do you feel confident about undertaking the following aspects of the exercise ?
(Please tick as appropriate)

yes no *selecting scientific material for your poster*

yes no *producing / designing your poster*

yes no *working in a group*

yes no *researching your topic*

yes no *assessing other posters*

Please could you indicate the reasons behind any 'no' selections above

4. Are there any aspects of the exercise you feel unsure or unhappy about ?

Group Questionnaire G 3 - 1993 -'94

Group Questionnaire

Group no

Names

1..... 2.....
 3..... 4.....
 5..... 6.....

1. How would you describe your group now ?

Mutual trust

high Suspicion	3	2	1	0	1	2	3	high Trust
----------------	---	---	---	---	---	---	---	------------

Mutual support

genuine support for others	3	2	1	0	1	2	3	everyone for themselves
----------------------------	---	---	---	---	---	---	---	-------------------------

Communication

guarded, cautious	3	2	1	0	1	2	3	open, genuine
-------------------	---	---	---	---	---	---	---	---------------

Group Objectives

group committed to exercise	3	2	1	0	1	2	3	group easily distracted
-----------------------------	---	---	---	---	---	---	---	-------------------------

all happy with final poster	3	2	1	0	1	2	3	group unhappy with poster
-----------------------------	---	---	---	---	---	---	---	---------------------------

Differences in opinion

group denied /supressed /avoided all conflicts	3	2	1	0	1	2	3	group brought out conflicts and worked through them
---	---	---	---	---	---	---	---	--

Use of group skills

my ideas, abilities, knowledge were drawn out and used by the group	3	2	1	0	1	2	3	my ideas, abilities, knowledge were not drawn out and used by the group
---	---	---	---	---	---	---	---	---

2. Which of the descriptions below best indicates your role within the group ?

organiser eg directing / coordinating / managing activities, getting the work done etc

supporter eg maintaining /helping group cohesiveness, involving everyone etc

initiator eg being creative, suggesting ideas, new perspectives etc

helper eg following other individuals' directions, undertaking work directed by others etc

sharer eg sharing all tasks equally, undertaking all types of work, working cooperatively etc

loner eg working by yourself, excluding others, doing what you think is best etc

blocker eg disagreeing with ideas, avoiding work, criticising others, being disruptive etc

clarifier eg explaining ideas, drawing information together, relating ideas etc

other please specify

Appendix 3

Instructions for card selection of Perry statements

This is a pilot study to try and find out how students feel about their course and to identify their general approach to studying. A number of students have been asked to carry out this exercise with the aim, at this point, of improving the exercise so don't worry there are no right or wrong answers.

Instructions for card selection

1. Rough Selection

You have been given 33 cards, each containing a statement which relates to a different aspect of your course. Firstly, go through all the cards splitting them into three piles according to your immediate reaction to the statement : one pile for those you agree with, one for those you disagree with and one for those you aren't sure about.

2. Final Selection - Part A

Once you have completed your rough selection, take the pile of cards which contain statements you agree with and further select out the 5 statements with which you feel the most comfortable ie which sum up your attitude or you feel strongly about. Don't worry if they all relate to one aspect of your course - there are no right or wrong answers.

If you haven't started with as many as five cards in this pile - go through your 'don't know' cards and pick out the number you need to make up the total.

3. Final Selection - Part B

Once you have completed Part A above, take the pile of cards containing the statements which you disagree with. Then select the 5 cards which contain ideas you would least agree with ie reflect the opposite viewpoint to your own. Again, add in cards from your 'don't know' pile if you don't already have enough.

Once you have completed your two selections, turn over the cards and make a note of the numbers written on the reverse side, under the appropriate headings below.

AGREE

DISAGREE

Part 1 - Perry Questionnaire P 1

Name Sex..... Age..... Course and Year.....

Course Questionnaire 1

This is a questionnaire about your course and approach to studying. Go through the following statements and indicate your immediate reaction by circling the appropriate number. Remember, there are no right or wrong answers and your responses to this questionnaire will not affect any other part of your course.

(6 - strongly agree, 5 - agree, 4 - probably agree, 3 - probably disagree, 2 - disagree, 1 - strongly disagree)

1. A good thing about learning science is the fact that everything is so clear cut - either right or wrong 6 5 4 3 2 1

2. The worst thing about a vague assignment is that you don't know how much a lecturer wants done 6 5 4 3 2 1

3. I like exams which give me an opportunity to show that I have ideas of my own 6 5 4 3 2 1

4. The only fair problem exercises are those which are exactly like those we have already done in class 6 5 4 3 2 1

5. I sometimes pick a topic or a way of answering an exam question which I know the lecturer likes, in order to get higher marks 6 5 4 3 2 1

6. It's good when a number of lecturers are teaching a course because you get not just one, but a variety of opinions 6 5 4 3 2 1

7. I would be surprised, if the lecturer could not answer any questions relating to their course, I might ask 6 5 4 3 2 1

8. It is better if a course has only one person lecturing on it, so that you don't get any conflicting opinions 6 5 4 3 2 1

9. I usually find myself thinking about how new subjects or topics relate to other parts of the course 6 5 4 3 2 1

Part 1 - Perry Questionnaire P 1 (cont.)

(6 - strongly agree, 5 - agree, 4 - probably agree, 3 - probably disagree, 2 - disagree, 1 - strongly disagree)

- | | | | | | | |
|---|---|---|---|---|---|---|
| 10. I think it is the responsibility of the lecturer to give me all the information I need to pass a course | 6 | 5 | 4 | 3 | 2 | 1 |
| 11. Sometimes there seems to be so many ways of looking at the course subjects, I feel confused about what is right and wrong | 6 | 5 | 4 | 3 | 2 | 1 |
| 12. Sometimes, I find that I learn more about a subject by discussing it with other students than I do by sitting and revising at home | 6 | 5 | 4 | 3 | 2 | 1 |
| 13. There isn't any point in a course including things which will not be included in an exam | 6 | 5 | 4 | 3 | 2 | 1 |
| 14. If I read something which doesn't agree with what I have been told in lectures, I prefer to stick with the lecturer's point of view | 6 | 5 | 4 | 3 | 2 | 1 |
| 15. If I had the choice of written feedback or a specific mark at the end of a piece of coursework, I would select the feedback | 6 | 5 | 4 | 3 | 2 | 1 |
| 16. It is a waste of time to work on problems which have no possibility of resulting in a clearcut, unambiguous answer | 6 | 5 | 4 | 3 | 2 | 1 |
| 17. I feel uncomfortable when I am left to make up my own mind about a subject and I don't know how the lecturer feels | 6 | 5 | 4 | 3 | 2 | 1 |
| 18. I enjoy undertaking assignments where the lecturer doesn't specify exactly what has to be done and it is left to me to decide | 6 | 5 | 4 | 3 | 2 | 1 |

Part 2 - Perry Questionnaire P 2

Part Two

Do you **AGREE** or **DISAGREE** with the following statements ? Justify your answer in 3 or 4 sentences.

Agree Disagree

... .. A good thing about science is the fact that everything is so clear cut
- either right or wrong. Justify your decision

.....
.....
.....

.... .. Scientists will eventually be able to solve every medical problem :
it is only a question of time. Justify your decision

.....
.....
.....

.... .. There sometimes seems to be so many ways of looking at scientific
subjects, I feel confused about what is right and wrong. Justify your
decision

.....
.....
.....

.... .. A scientific fact cannot have meaning if considered in isolation ;
meaning is only gained by context Justify your decision

.....
.....
.....

.... .. You can never be completely sure of any scientific fact : uncertainty
will always exist. Justify your decision

.....
.....
.....

... .. I usually think about how any new scientific information relates to
other subjects and topics on the course. Justify your decision

.....
.....
.....

Part 3- Perry Questionnaire P 2

(Again there are no right or wrong answers for these questions)

1. Given a free choice of teaching and assessment methods listed below which do you most prefer and which do you least prefer on a science course ?

(Please indicate by a ✓ for most prefer and ✗ for least prefer)

A. Teaching methods

- Lecture format with one lecturer talking to a group of students
- Tutorial format with a lecturer directing the class's participation
- Small group format (1) working on a task in a group with a lecturer present
- Small group format (2) working on a task in a group without a lecturer present
- Individual study (1) working by yourself on a task in the classroom with the lecturer present
- Individual study (2) working on a task by yourself outwith the classroom
- Other. Please specify.

Why did you make these selections?

B. Assessment methods.

- Essay type questions discussing your opinion about a particular topic
- Essay type questions describing or outlining a topic from the course
- Problem solving type questions with clearcut answers
- Problem solving type questions without a clearcut answer
- Short answer type questions requiring a sentence or a few words
- Multiple choice questions selecting an answer from a number of options
- Other. Please specify.

Why did you make these selections?

2. How would you go about preparing for an exam including your MOST preferred type of assessment selected in Question 1B. (Please tick)

- Rewrite your notes until you feel confident you have memorised them
- Summarise your notes prioritising important points and then learn these points
- Concentrate on mapping out the overlying principles of the subjects rather than memorising details
- Go through past exam papers and practise similar types of questions, using your notes as reference
- Go through your notes relating each topic to example from your own experience
- Read up as much as you can about the subject until you are sure you understand the topic
- Other. Please specify

Part 2 - Perry Questionnaire P 3

Part Two

Do you view Science, as a subject, any differently since you have been studying at Napier? eg do you think science is *more/less* interesting, factual, complex, easy etc

Please justify your answer in 2 or 3 sentences

.....
.....
.....
.....
.....

**How do you feel about the teaching methods used to teach Science at Napier ?
eg are you quite happy about methods used or would you prefer *more or less*
lectures, laboratory work, group work, individual study etc**

Please justify your answer in 2 or 3 sentences

.....
.....
.....
.....
.....

**How do you feel about the assessment methods used on the Science Course at
Napier ? eg are you quite happy with the type of testing used or would you prefer
different types of exam or assessed coursework etc**

Please justify your answer in 2 or 3 sentences

.....
.....
.....
.....
.....

**How did you study for your first semester exams ? eg did you learn up your notes
rewrite your notes etc**

.....
.....
.....
.....

Figure A 3.1

A comparison between the type of positive responses given to Part 1 of the Perry questionnaire P1 by the first year full time BSc class of October and the first year full time BSc class of October 1992

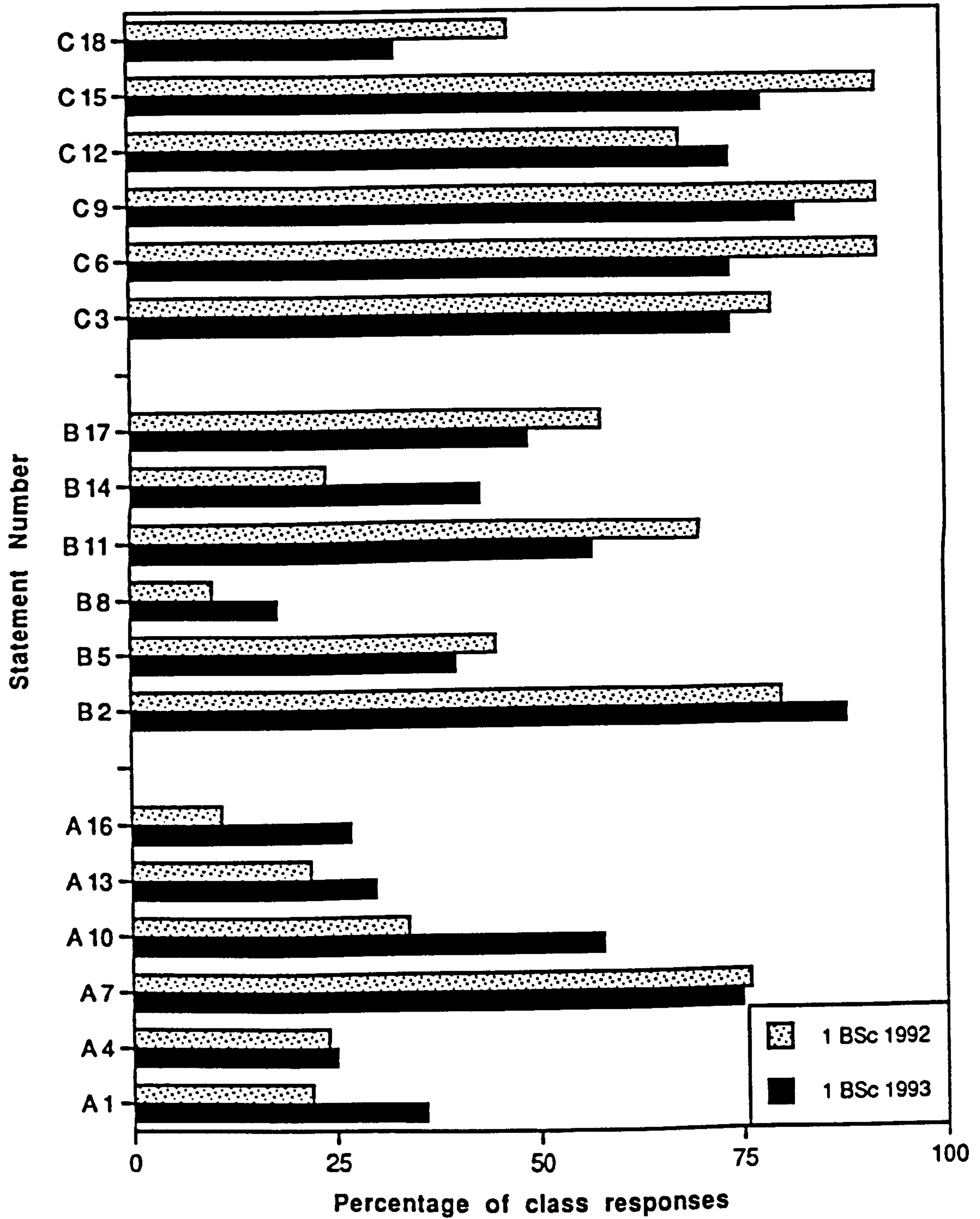


Figure A 3.2
 A comparison between the type of positive responses given to Part 1 of
 the Perry questionnaire P1 by the first year full time BSc class of October
 1992 and the first year full time BSc class of February 1993

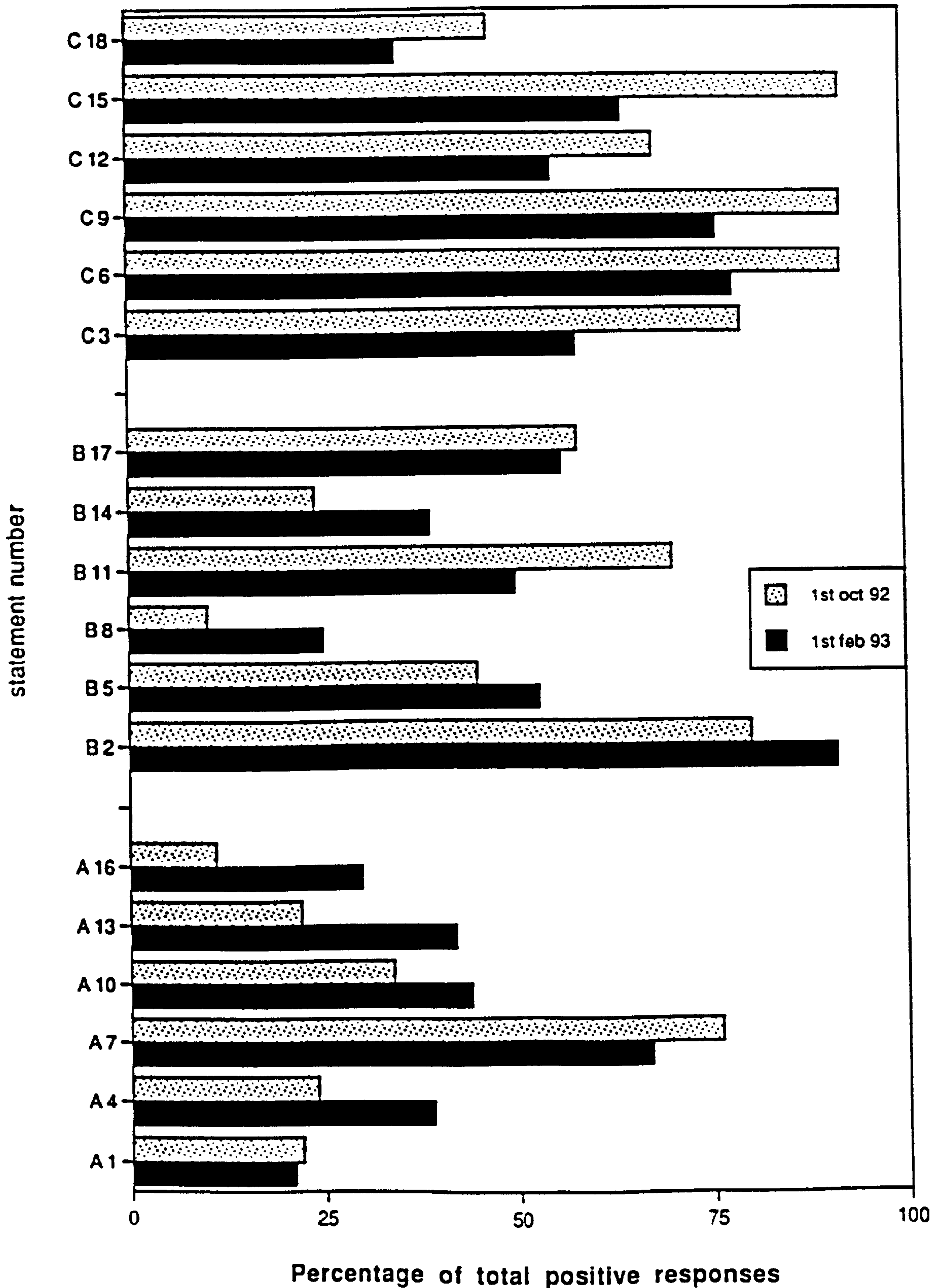


Figure A 3.3
 The changes of opinion shown by first year BSc students to specific statements in the Perry Questionnaire P1 Part 1 in February 1994 when compared to the same students responses in October 1993

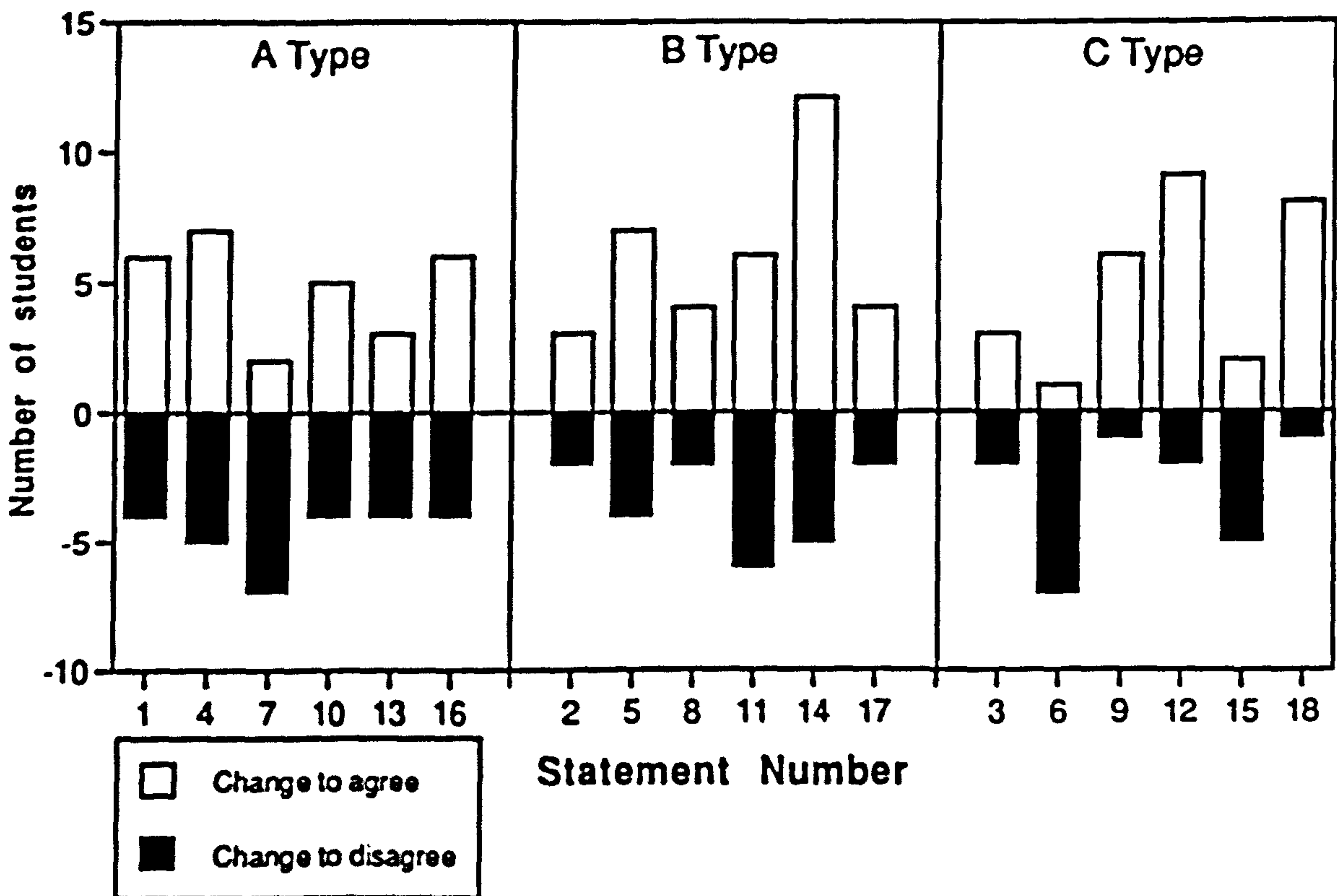


Figure A 3.4

A comparison between the mean percentage of A, B and C type positive responses given by the poster groups in 1992-'93 and 1993-'94

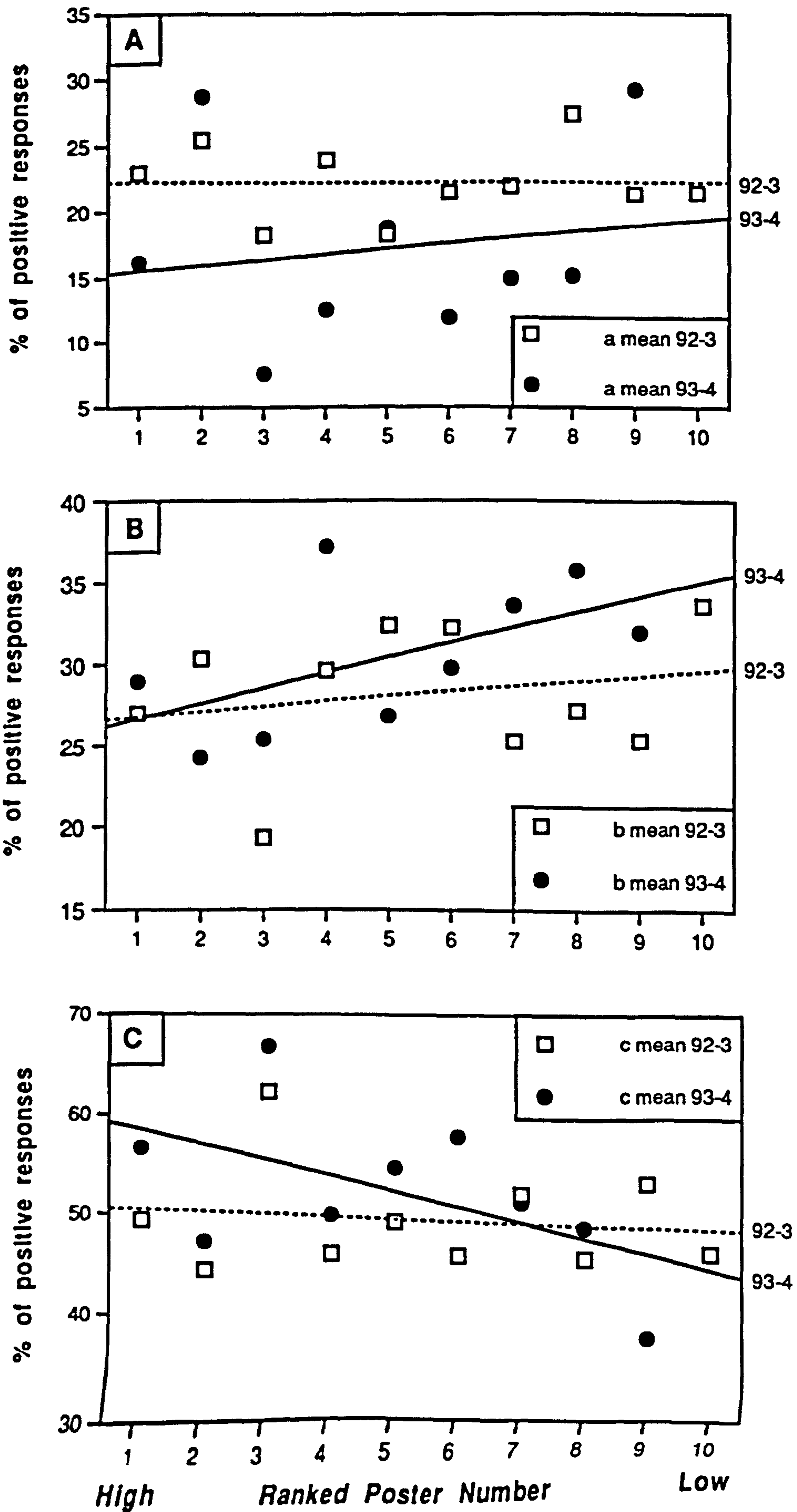


Figure A 3.5

A comparison between the mean percentage of A, B and C type responses given by the third year male and female students reported as being the most and least influential during the poster exercise in 1993-'94

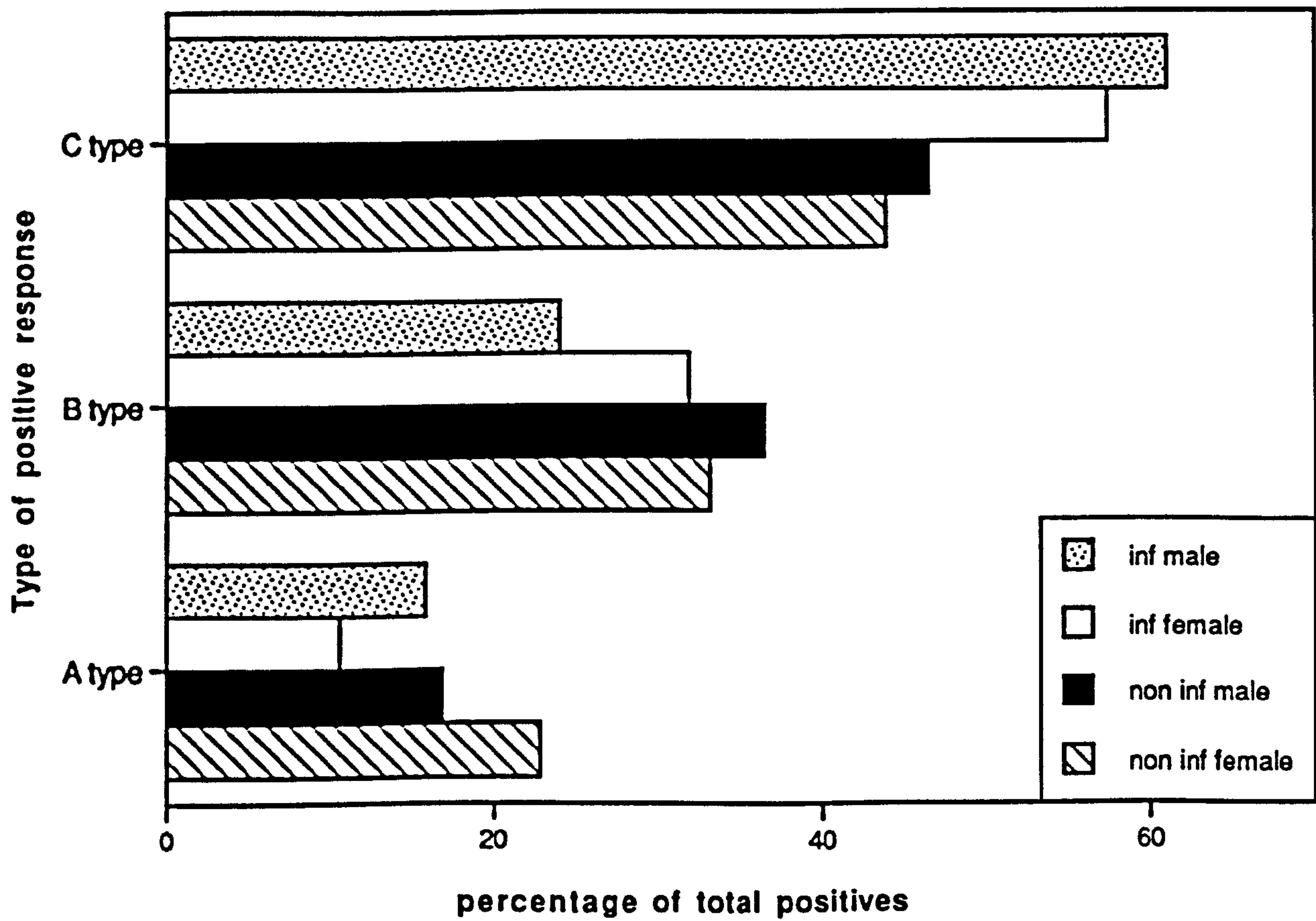
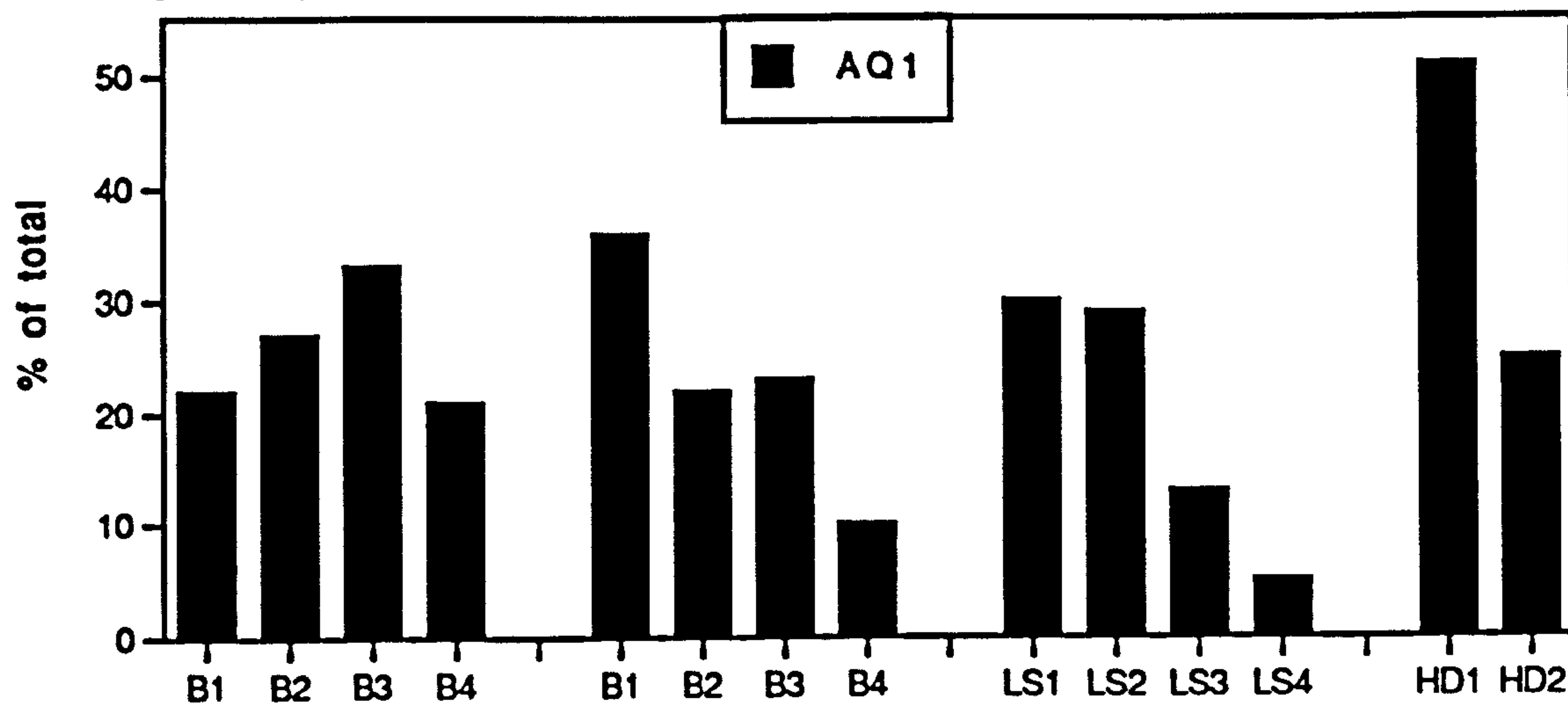


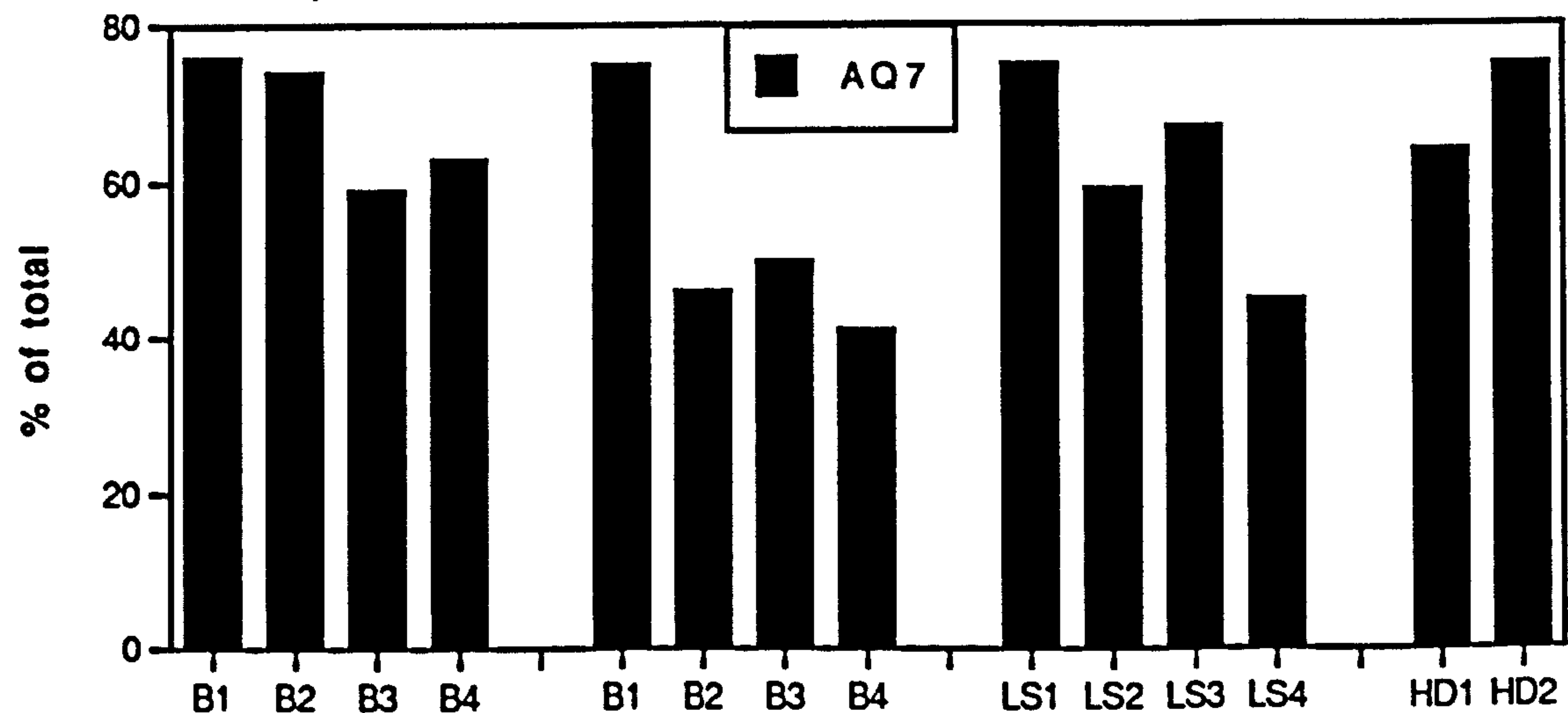
Figure A 3.6

A comparison between the average number of students from each class agreeing with A type statements in Part 1 of the Perry Questionnaire P2

A good thing about learning science is the fact that everything is so clear cut - either right or wrong



I would be surprised, if the lecturer could not answer any questions relating to their course, I might ask



I think it is the responsibility of the lecturer to give me all the information that I need to pass a course

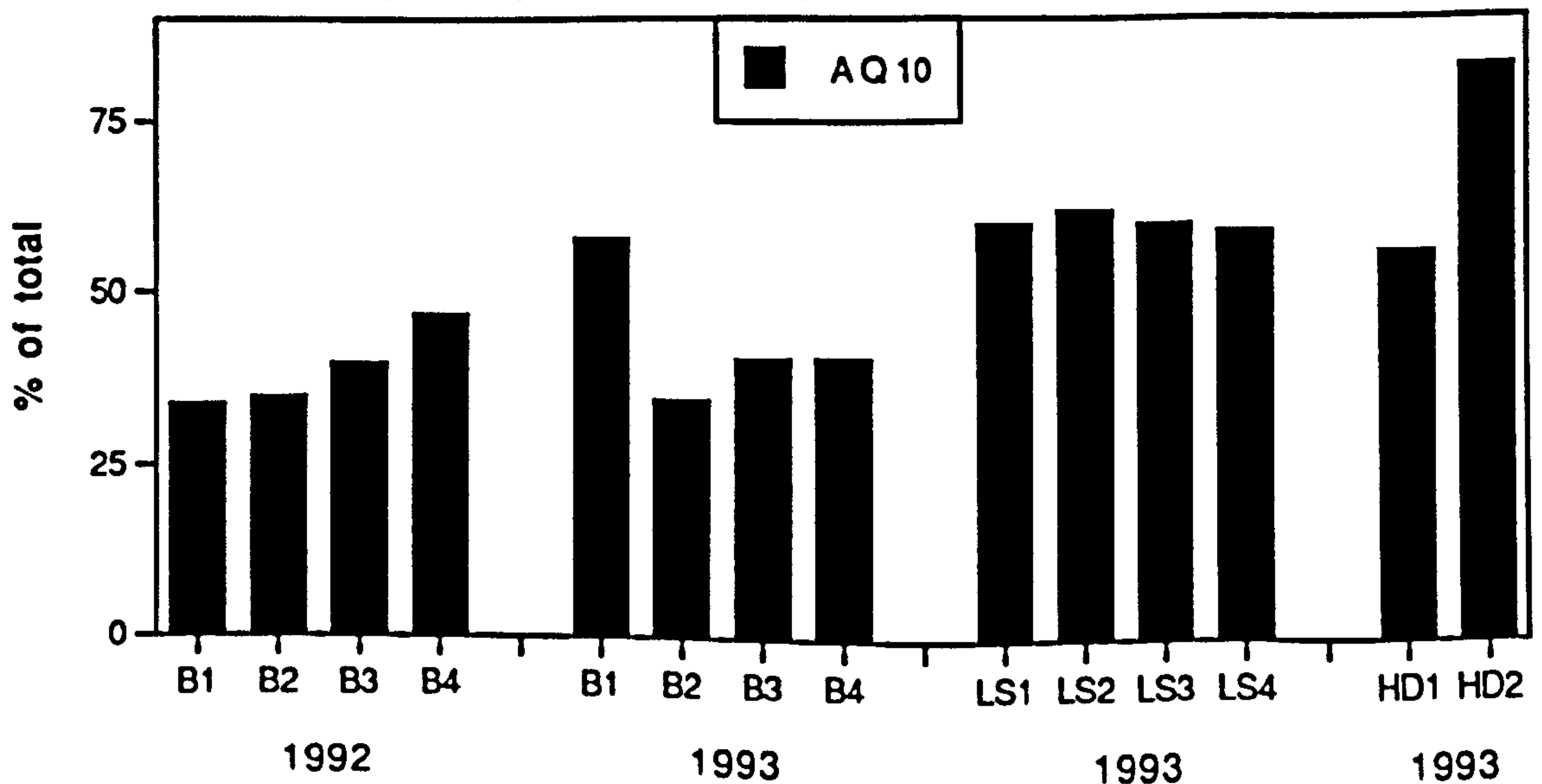
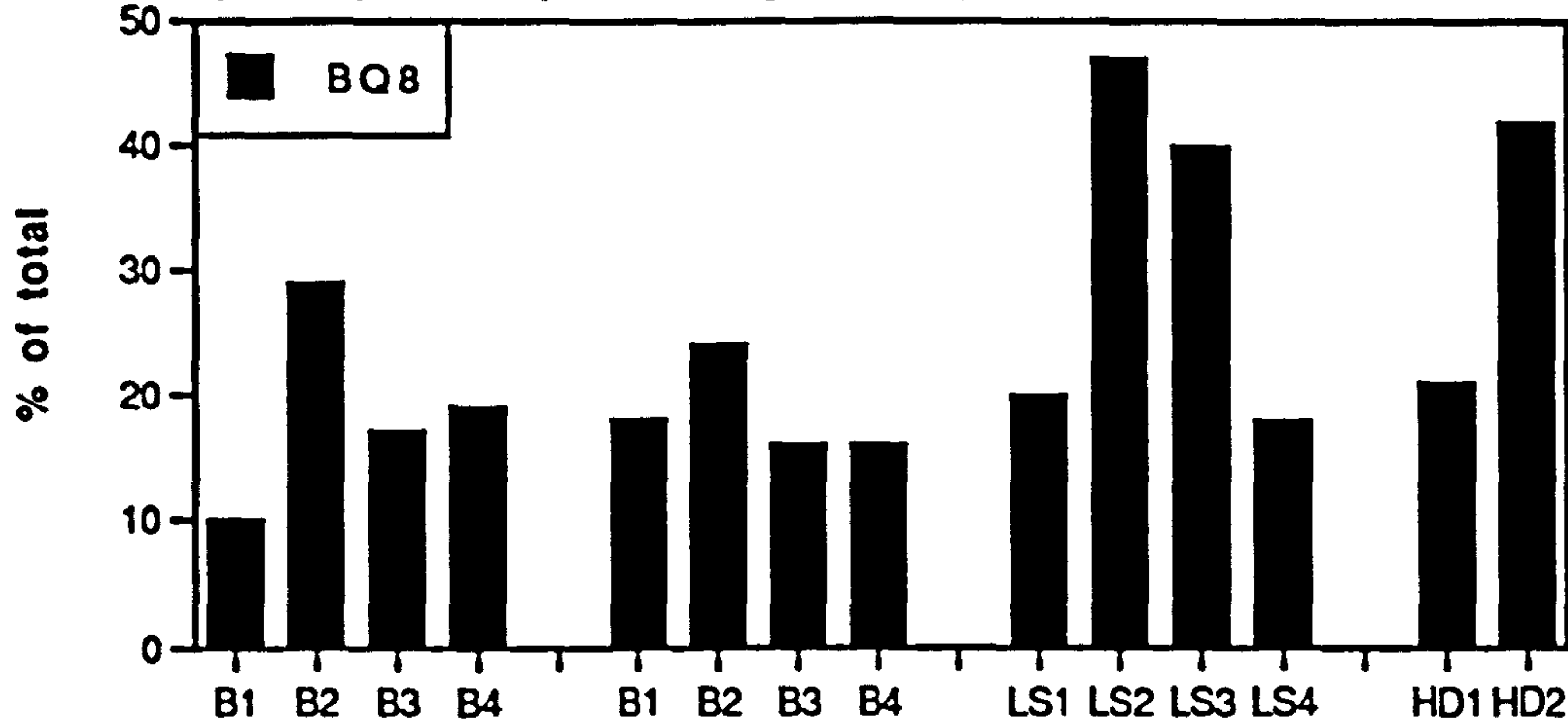


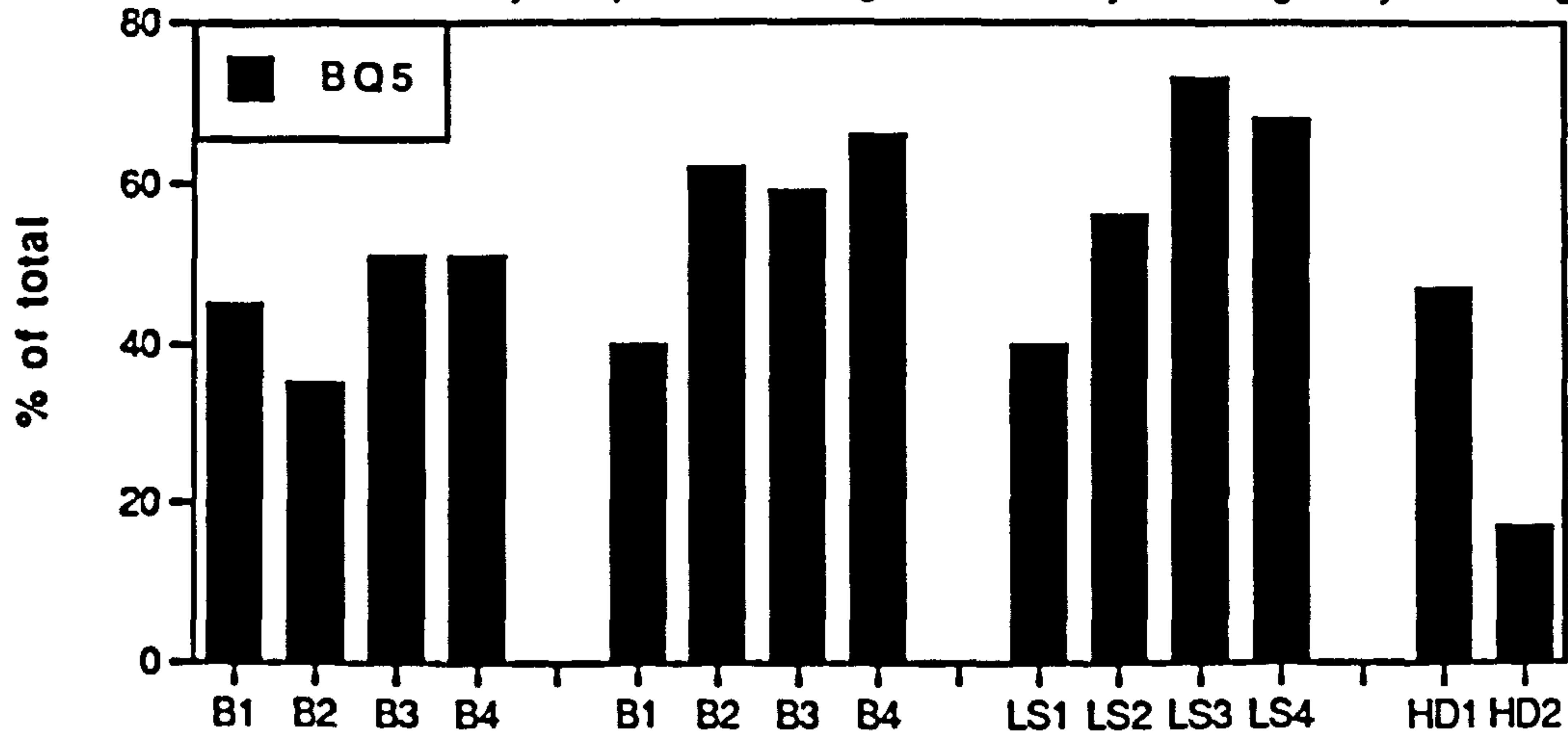
Figure A 3.7

A comparison between the average number of students from each class agreeing with B type statements in Part 1 of the Perry Questionnaire P2 in October 1993

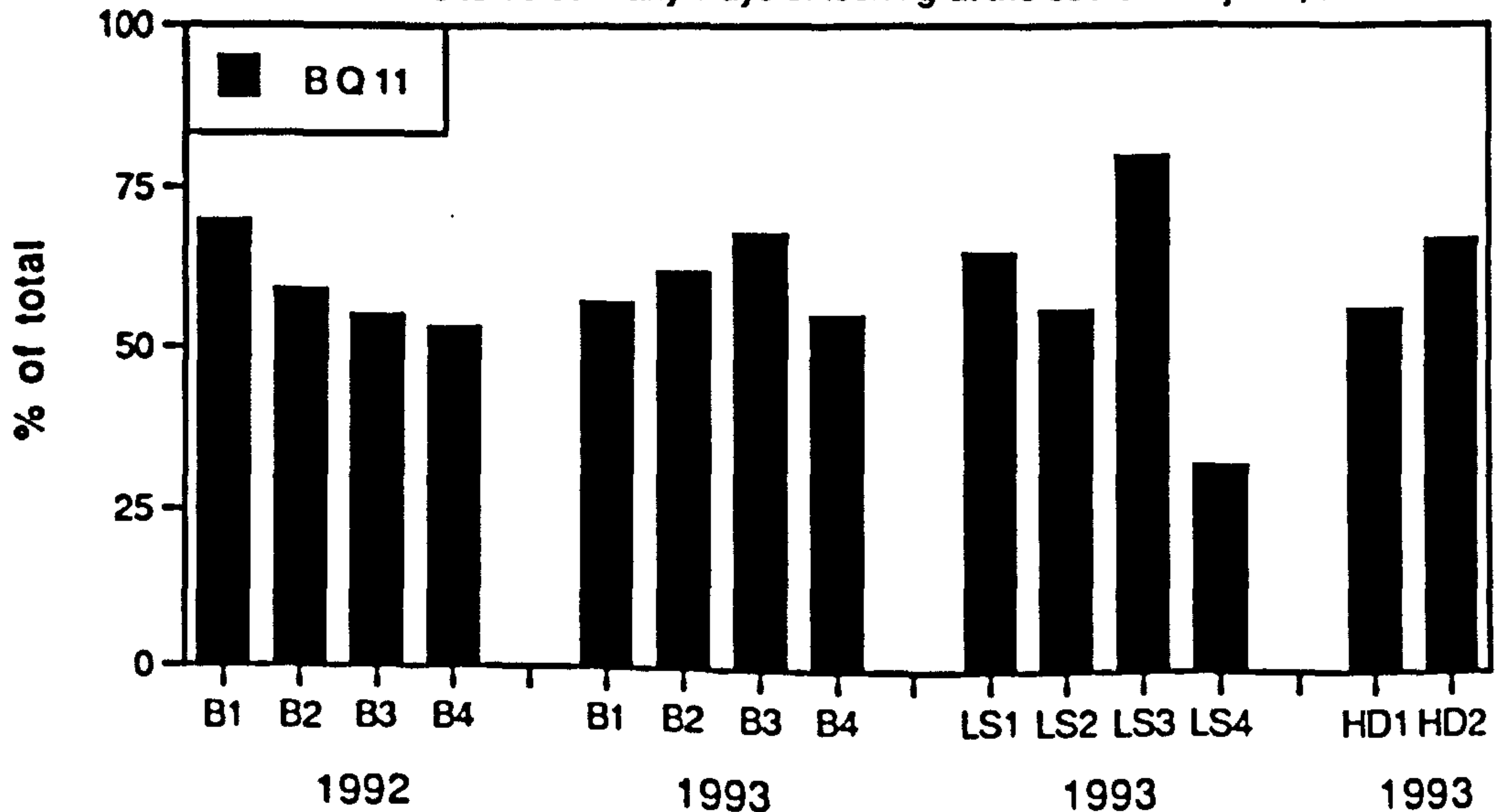
I sometimes pick a topic or a way of answering an exam question which I know the lecturer likes etc



It is better if a course has only one person lecturing on it, so that you don't get any conflicting opinions



Sometimes there seems to be so many ways of looking at the course subjects, I feel confused



1992

1993

1993

1993

Figure A 3.8

A comparison between the average number of students from each class agreeing with C type statements in Part 1 of the Perry Questionnaire P2 in October 1993

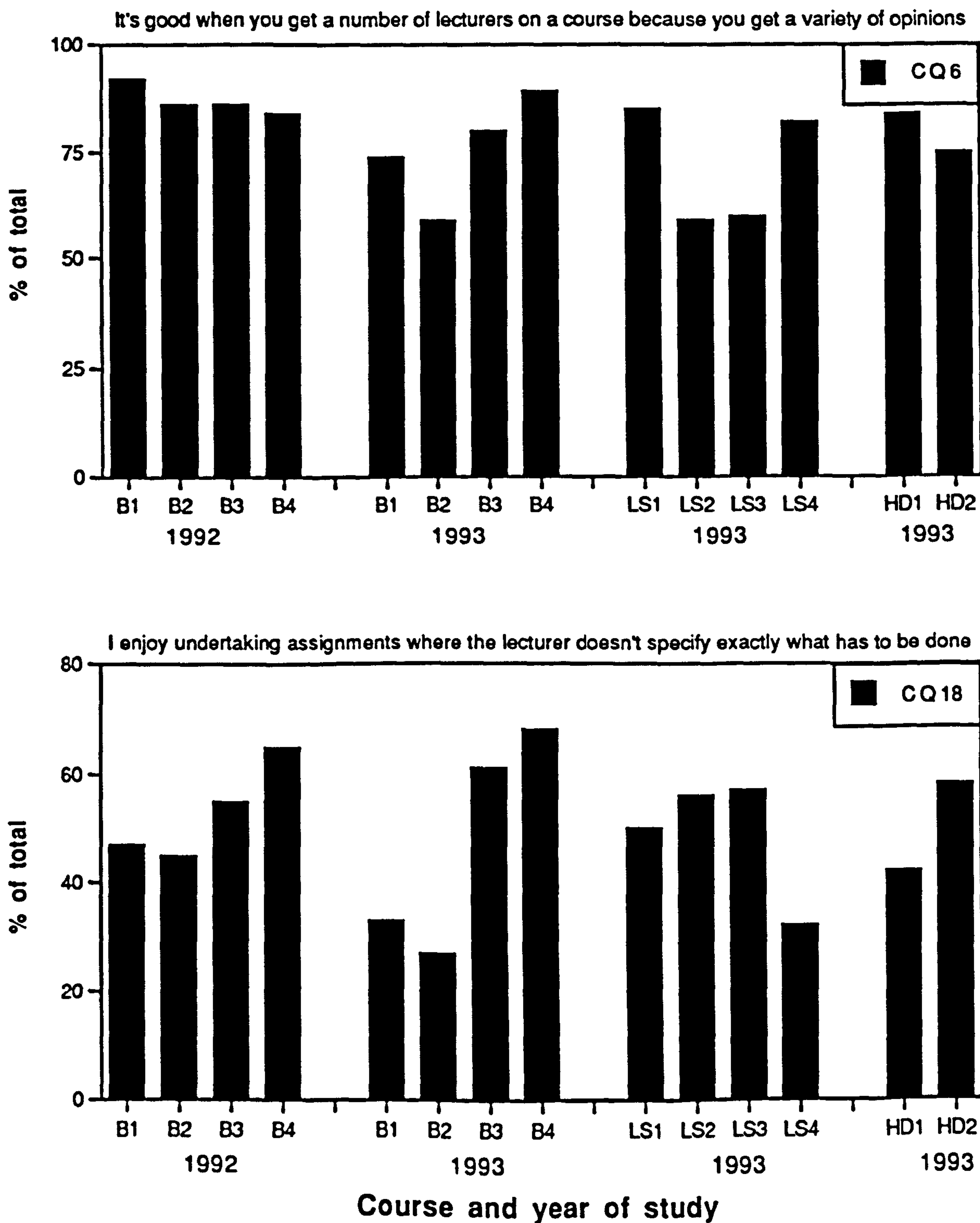


Figure A 3.9
 A comparison between the average class preferences shown for small group work with the lecturer present and individual study in Part 3 of the Perry Questionnaire P2 in October 1993

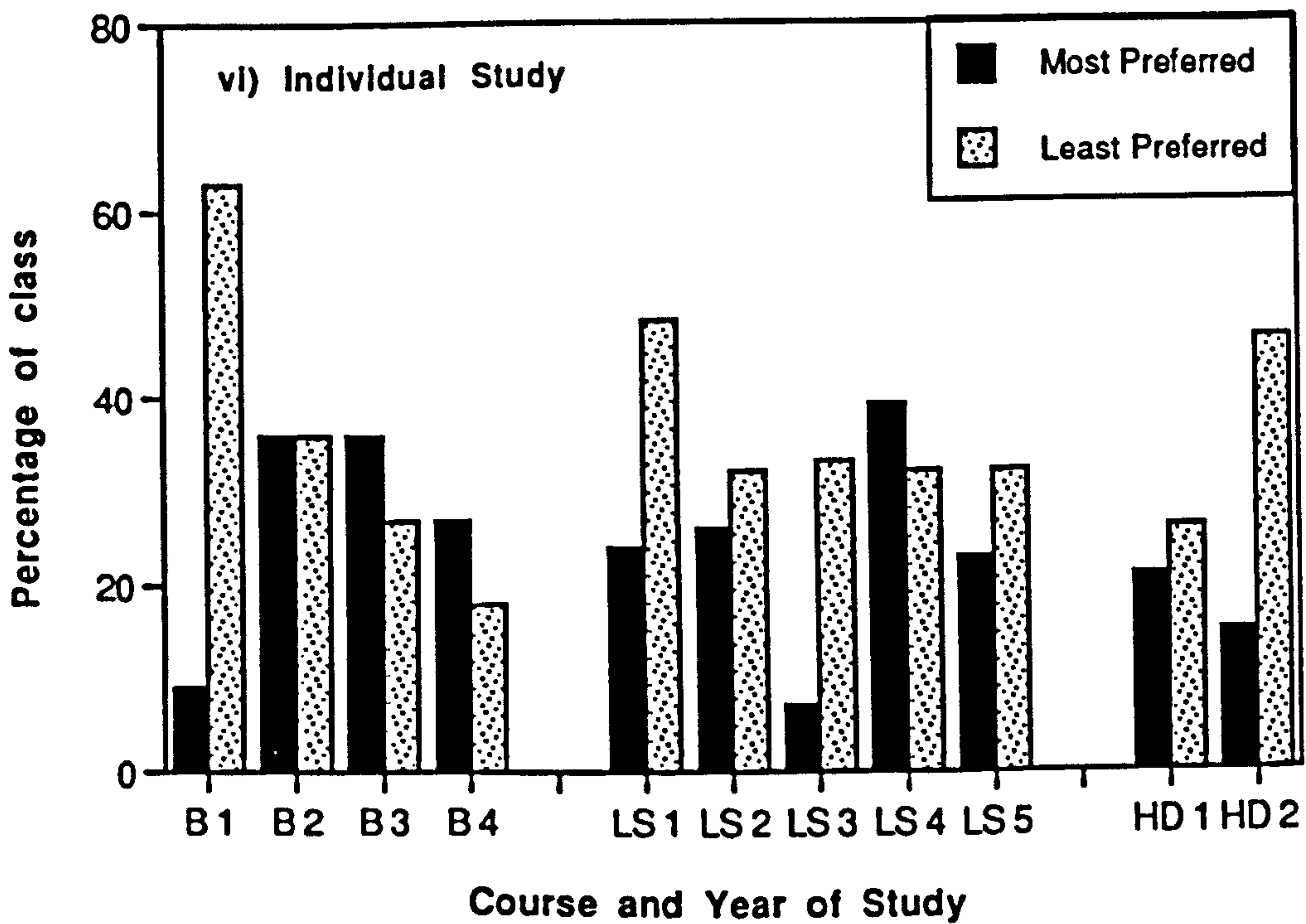
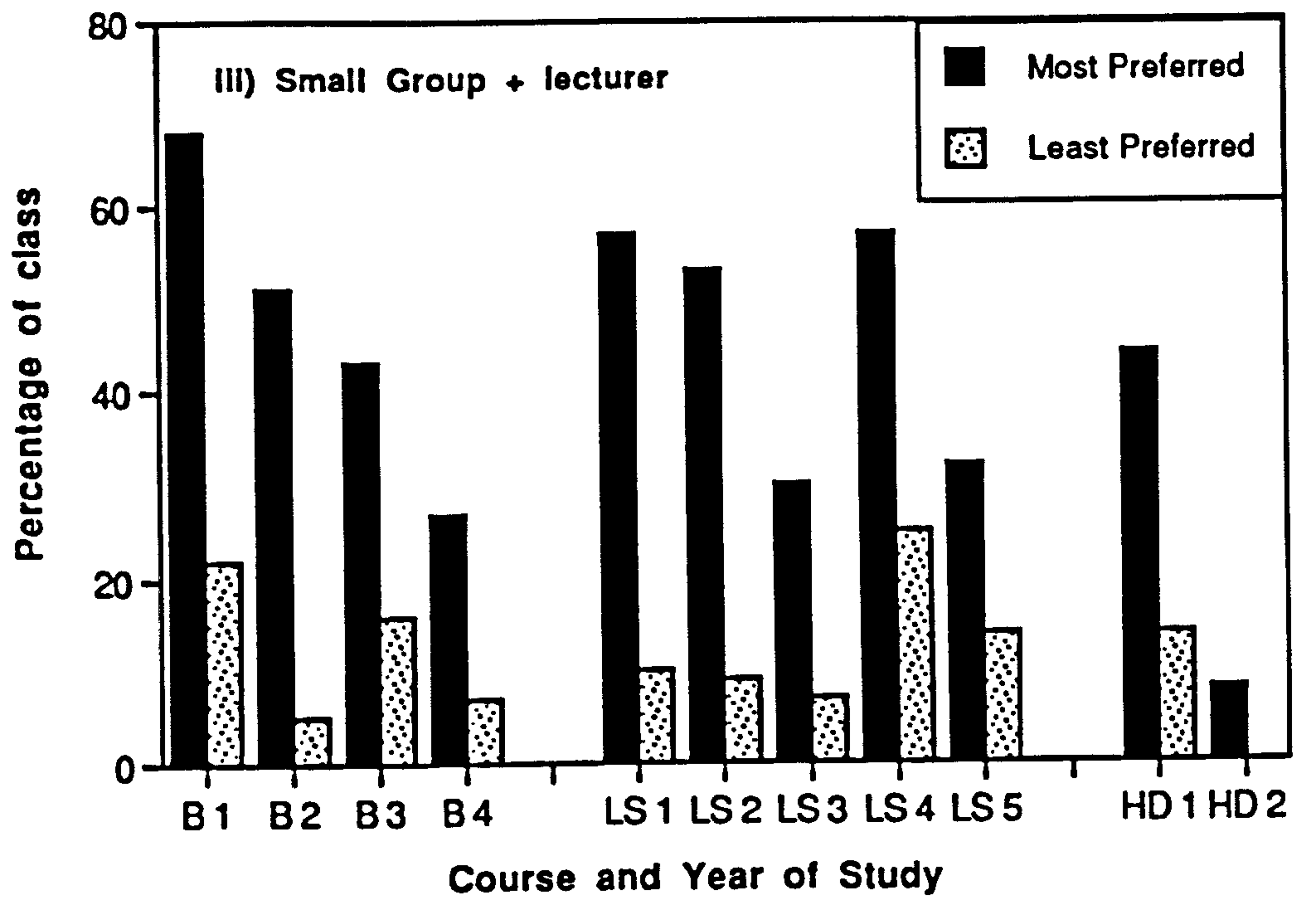


Figure A 3.10

A comparison between the average class preferences shown for discussion /descriptive essays and problem type questions without clear-cut answers as assessment methods in Part 3 of the Perry Questionnaire P2 in October 1993

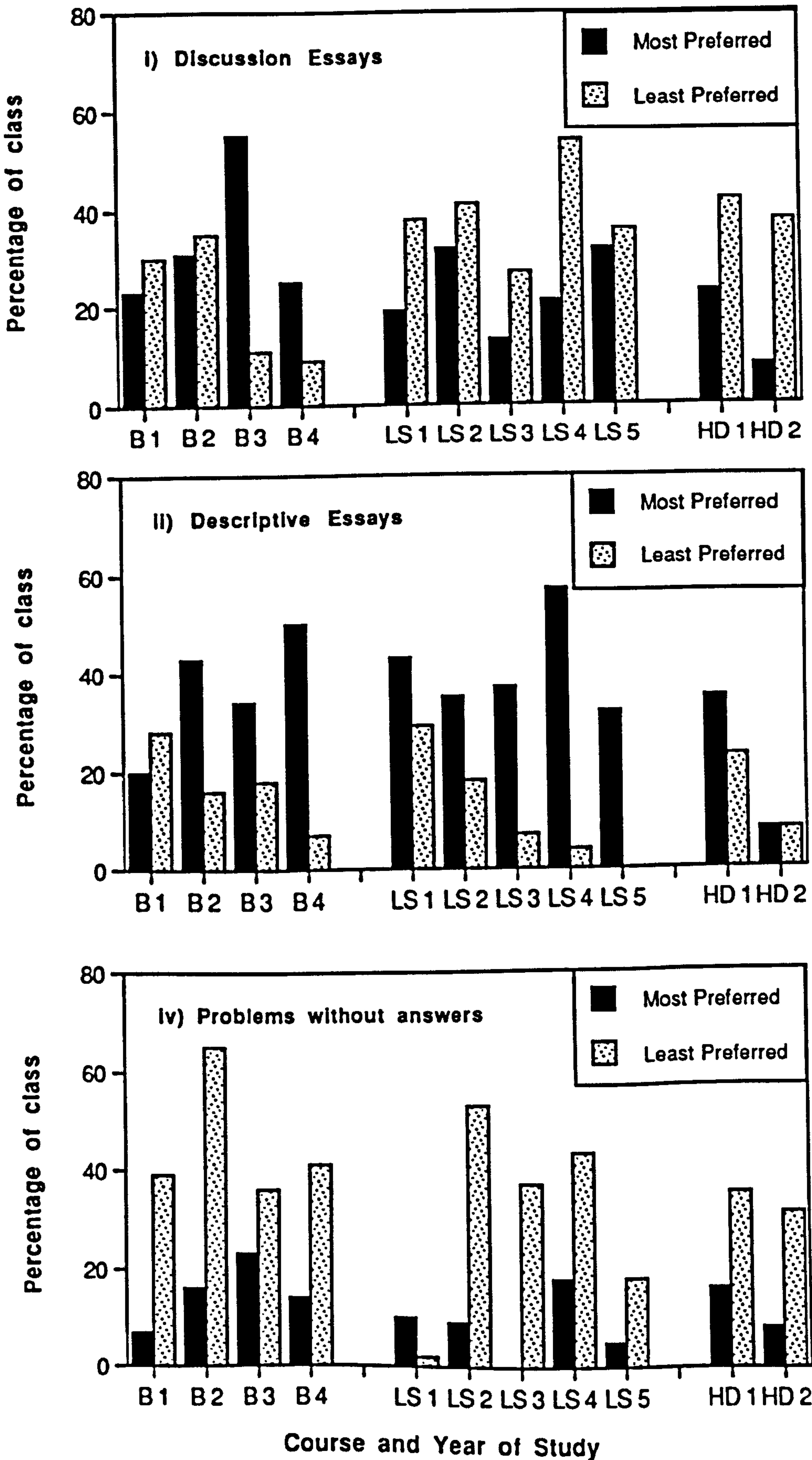


Figure A 3.11

A comparison between the average class preferences shown for multiple choice and short answer type questions as assessment methods in Part 3 of the Perry Questionnaire P2 in October 1993

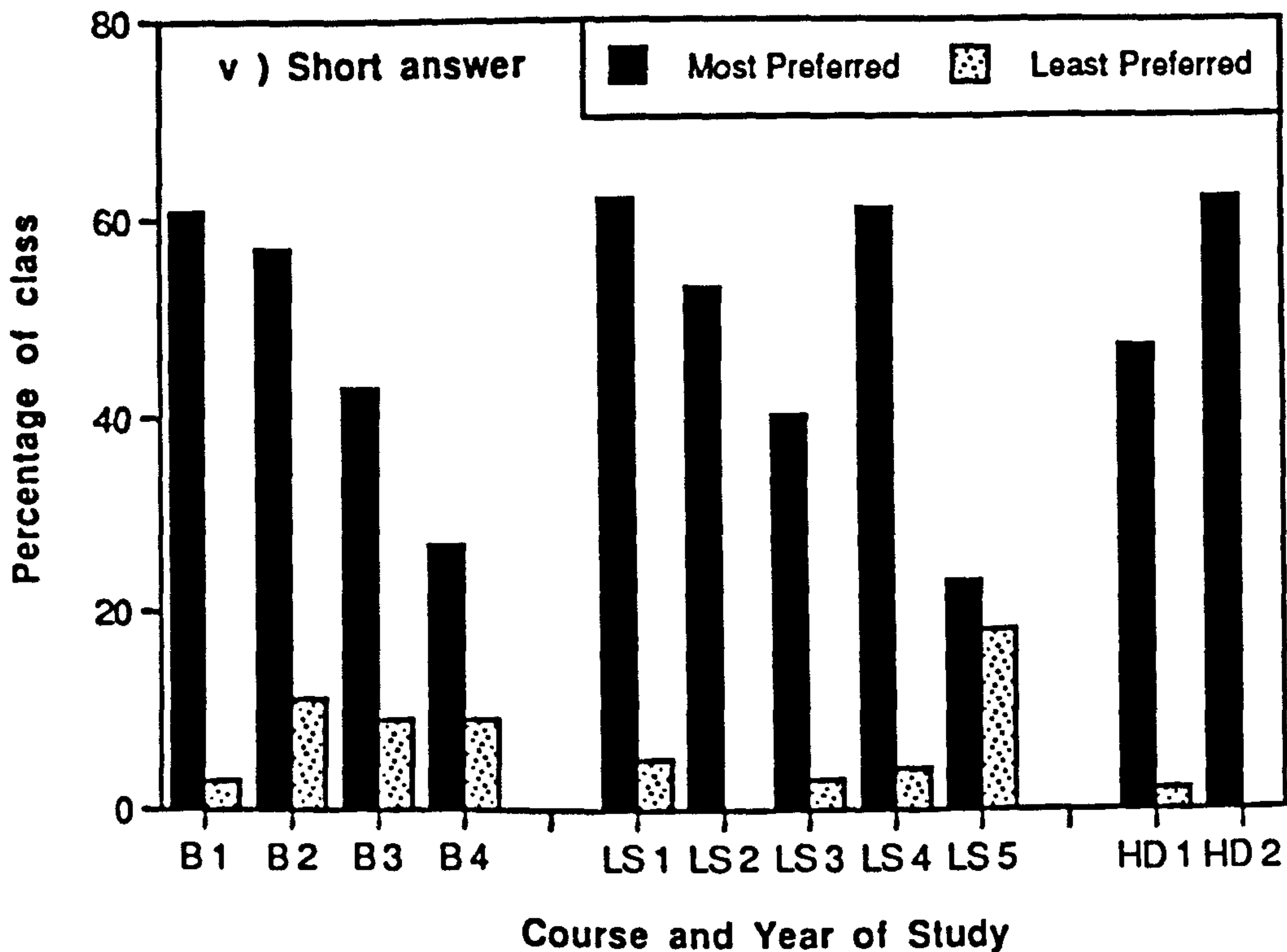
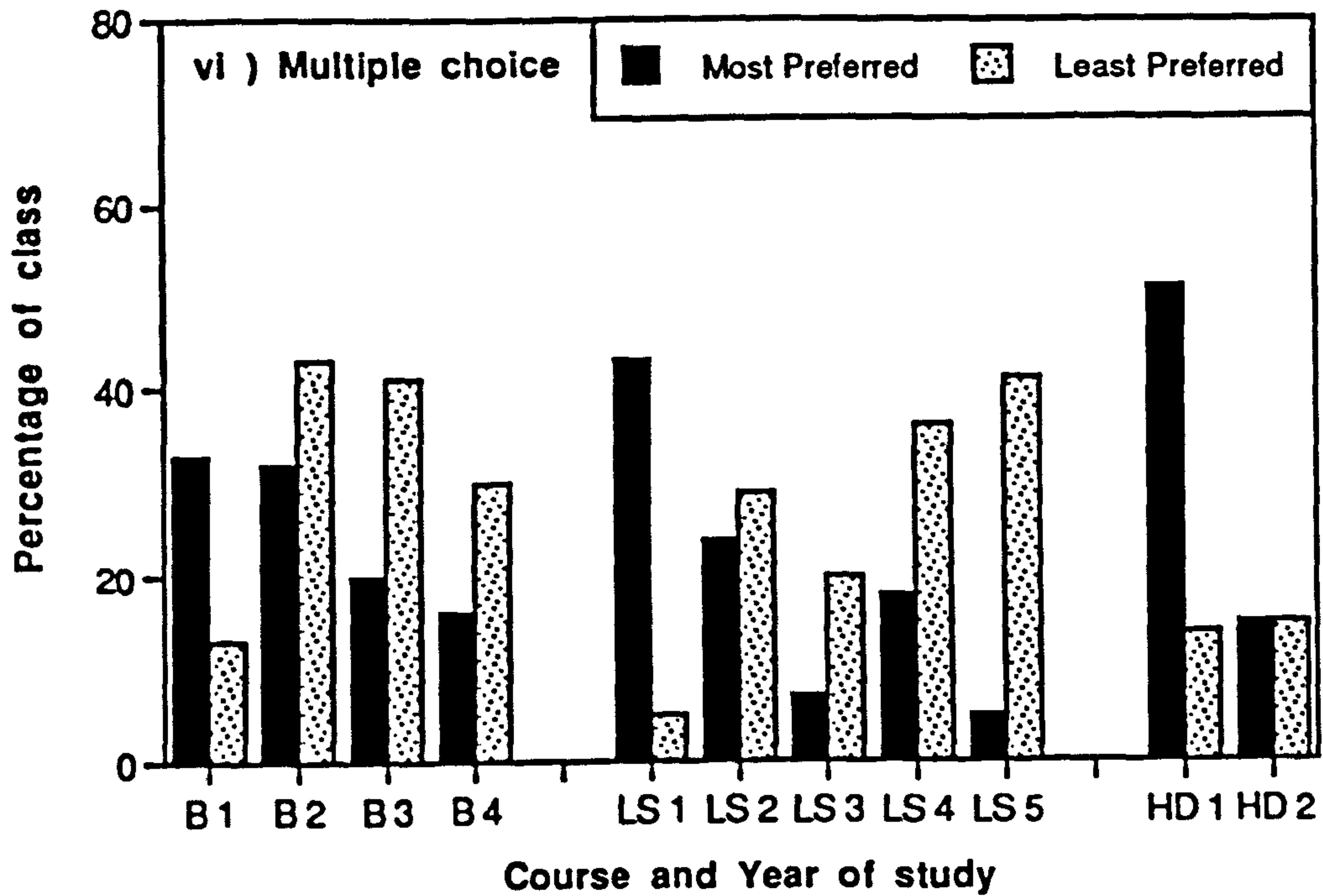


Figure A 3.12

A comparison between the class average most preferred study methods as indicated in Part 3 of the Perry Questionnaire P2 in October 1993

