Royal Society of Chemistry Chemical Education Research Group

"Trends in Recruitment of Secondary Chemistry Teachers onto 1-year PGCE Courses"

November 2000 FINAL REPORT on SURVEYS CARRIED OUT in JUNE 1998 and JULY 1999

Anne Doherty (University College Worcester), Alan Goodwin (Manchester Metropolitan University) and Ann Benson (University of Bristol).*

Abstract

The results of the survey indicate a fall off in the number of chemistry students completing initial training on 1-year PGCE courses. Numbers completing 1-year PGCE physics courses are in an even worse state and there are signs that even the previously stable biology numbers are now beginning to slip. The percentage non completion of all these courses is getting worse in all three subject areas, although some care must be taken in the interpretation of the figures since the numbers concerned are already worryingly low. Concerns were expressed on recruitment for 1998/1999 and for 1999/2000, with most institutions recording recruitment difficulties and some showing uneasiness about the declining quality of their recruits. Early indications are that recent financial inducements for teachers in shortage areas have improved matters a little. The report concludes that the increasing proportion of secondary science teaching by colleagues formally qualified in biological sciences has to be accepted. Certainly the implications for teacher education in both initial training and subsequently on Continuing Professional Development need to be examined. The changing teacher backgrounds may also need to impact on school science programmes in order to recognise the new strengths and needs.

Introduction:

At the start of the survey, it was clear from GTTR statistics[1] that numbers of students accepting places on PGCE physical science courses had been steadily falling, while those on combined sciences (and biology) had apparently been rising. By 1998, however, all the figures were down. See Figure 1 (For purposes of comparison this also includes data for Mathematics) and Table 1. As can be seen, there was a slight improvement for 1999, although despite the new financial inducements the overall movement was not quite back to the 1997 figures.

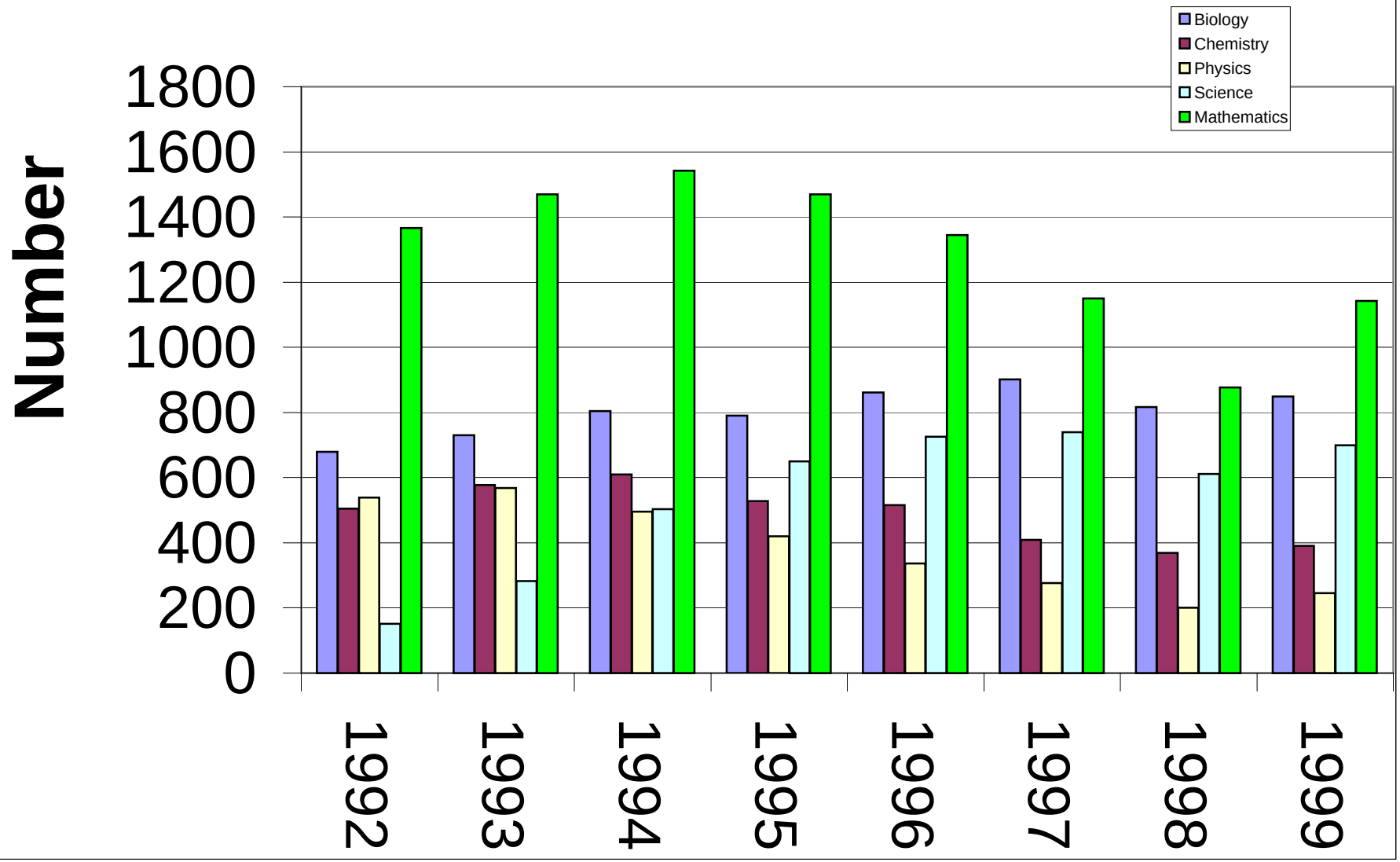
Table 1: Numbers of students accepting PGCE science places

	Chemistry	Physics	Biology	Combined/ General Science	Totals
1994 entry	610	495	805	504	2414
1995 entry	528	420	791	650	2389

1996 entry	515	337	861	726	2439
1997 entry	409	277	901	740	2327
1998 entry	369	201	816	611	1997
1999 entry	390	245	849	699	2183

([1]Source: GTTR Annual Statistical Reports - Autumn 1996-2000.
Note that these figures include a small number of students on subject conversion courses - 1 chemist and 5 physicists in 1996, 2 physicists in 1997. In 1998 and 1999 a non specified number of CS subject conversion students are included in the overall CS figures.)

Figure 1: Acceptances on PGCE Courses



The initial aim, therefore, was to try to find out whether the problem was real or whether physical science numbers were in fact 'hidden' in the combined science numbers.
Where entry was for 'science' few of the responding institutions were able to separate their chemistry, physics and biology numbers from their 'science' targets. However, it seems from the limited evidence that is available, that there are *not* high numbers of chemists hidden within the science figures. (See Table 5.) This report will therefore concentrate on the completion numbers (not available from GTTR) rather than entry numbers. The final section provides illuminating comments taken from the free response sections of the survey that were made by admissions tutors who completed the questionnaires.

The survey in context:

(a) Institutions:
The number of institutions offering 'specialist' science teacher training on 1-year PGCE courses are shown in table 2.

Table 2: Nos. of institutions offering 1-year PGCE 'specialist' science

	1996 entry[1]	1997 entry[1]	1998 entry[1]
chemistry	36	35	35
physics	35	35	35
biology	39	35	36

In the 1996 entry **six** of these institutions also offered combined sciences and **two** offered subject conversion to combined science. In the 1997 entry there were **five** who also offered combined sciences and **two** who offered subject conversion to combined science. In the 1998 entry there were **eight** institutions offering combined science in addition to the specialist sciences, but this number included subject conversion.

In addition to these 'specialist' science teacher-training places, there was a substantial number of institutions that offered ***combined sciences only***. These data are summarised in table 3.

Table 3: Nos. of institutions offering 1-year PGCE Combined Science

	1996 entry[1]	1997 entry[1]	1998 entry[1]
combined science *only*	24 (+ 1 subject conversion)	31	29 (incl. subject conversion)

The number of institutions offering 'specialist' sciences, who responded to the CERG questionnaire are shown in table 4, (although the institutions responding to the second questionnaire were not always the same as those who had responded to the first questionnaire.)

Table 4: Nos. of responding institutions offering 1-year PGCE 'specialist' science

	1996/9	1997/9	1998/9

	7	8	9
chemistry	16	15	14
physics	16	15	14
biology	17	16	14

In 1996/1997 there were **eight** responding institutions 'officially' offering combined science *only*, and able to supply separate science figures for the CERG survey. There were **nine** in 1997/1998.
Six more responding institutions 'officially' offered combined science *only*, but were unable to separate the figures, and **one** institution offered combined science in addition to 'specialist' sciences.

In 1998/1999 there were **six** responding institutions 'officially' offering combined science *only*, but able to supply separate science figures for the CERG survey, **one** was unable to supply separate figures and **three** more offered combined science in addition to 'specialist' sciences.

(b) Student Numbers:

The numbers of students in chemistry, physics, biology and science courses represented by all these responding institutions are shown in Appendix 1 along with the appropriate totals for each sample. (Note that these samples are *not* directly comparable across the years.)

In Table 5 the percentage of chemists, both within specialist sciences and within combined sciences are compared. From this it is clear that the proportion of 'chemists' in the combined science group remains consistently slightly below the proportion in the 'specialist science' cohorts.

Table 5: % chemists within courses

	% of chemists within Combined Science (from those that that *can* be differentiated)	% of chemists within 'specialist' courses
1996/97	24	30
1997/98	20	25
1998/99	24	28

To provide comparable figures across **three** years it was necessary to include only those institutions that had provided data for all three years. For these institutions the numbers of students accepted onto the courses in the specialist sciences **and** the numbers completing the course successfully are shown in table 6. Inevitably there would be further loss if the numbers actually taking up teaching posts were available.

Table 6: Nos. of students starting and completing 'specialist' science courses

	*Chemistry		*Physics		*Biology	
	start	complete	start	complete	start	complete

1996/97	180	161	119	103	330	298
1997/98	144	118	86	61	355	318
1998/99	148	124	61	52	291	248

*as specialist science only (not part of 'official' combined science course)

Comparing the starting figures with the GTTR data suggests that the responses in the CERG survey represent about 35±5% of the total cohorts of science trainee teachers in the years 1996-99.

The CERG figures, however, gave numbers of students *starting* and *completing* 1-year PGCE courses and, as shown in Appendix 2, the *starting* figures are not always the same as the *acceptance* figures produced by the GTTR. In a number of cases, in fact, there are slightly fewer students starting the course than those officially accepted. The completion figures provide information related to wastage not available from the official statistics.

The survey results:

(a) Chemistry/physics/biology:
The 1997 *completion* numbers for the **16** responding institutions identified by the **survey** as offering *all three* specialist sciences were compared with the completion numbers for 1998 and 1999 and the results are shown in Figures 2 -4. (**D - AK** represent **12** institutions who offer 'specialist' science officially (GTTR) and **F* - AE*** are **4** institutions who are officially listed as offering combined science *only*.)

Figure 2: Completion numbers for Chemistry 1997-1999

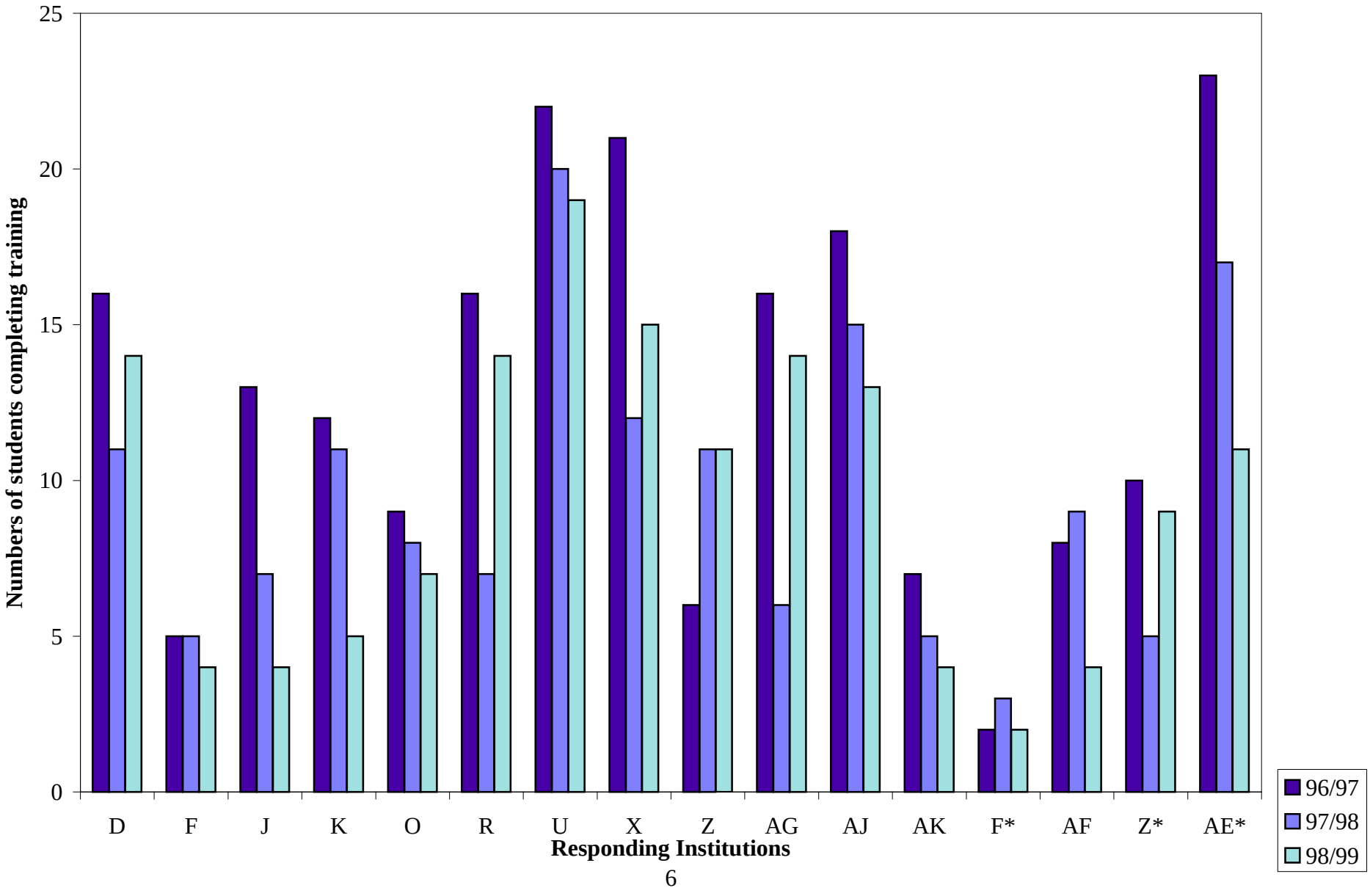


Figure 3: Completion numbers for Physics 1997-1999

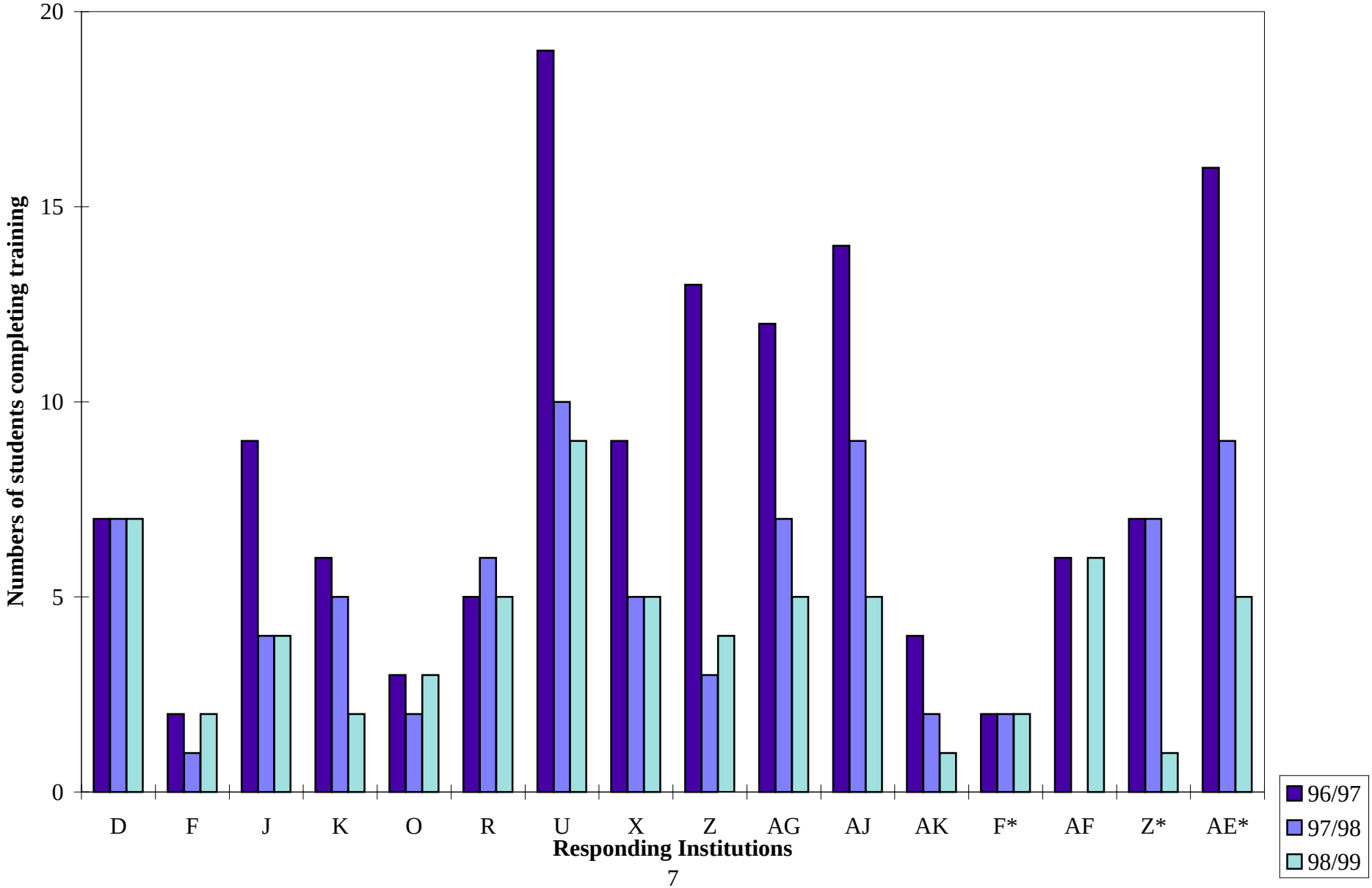
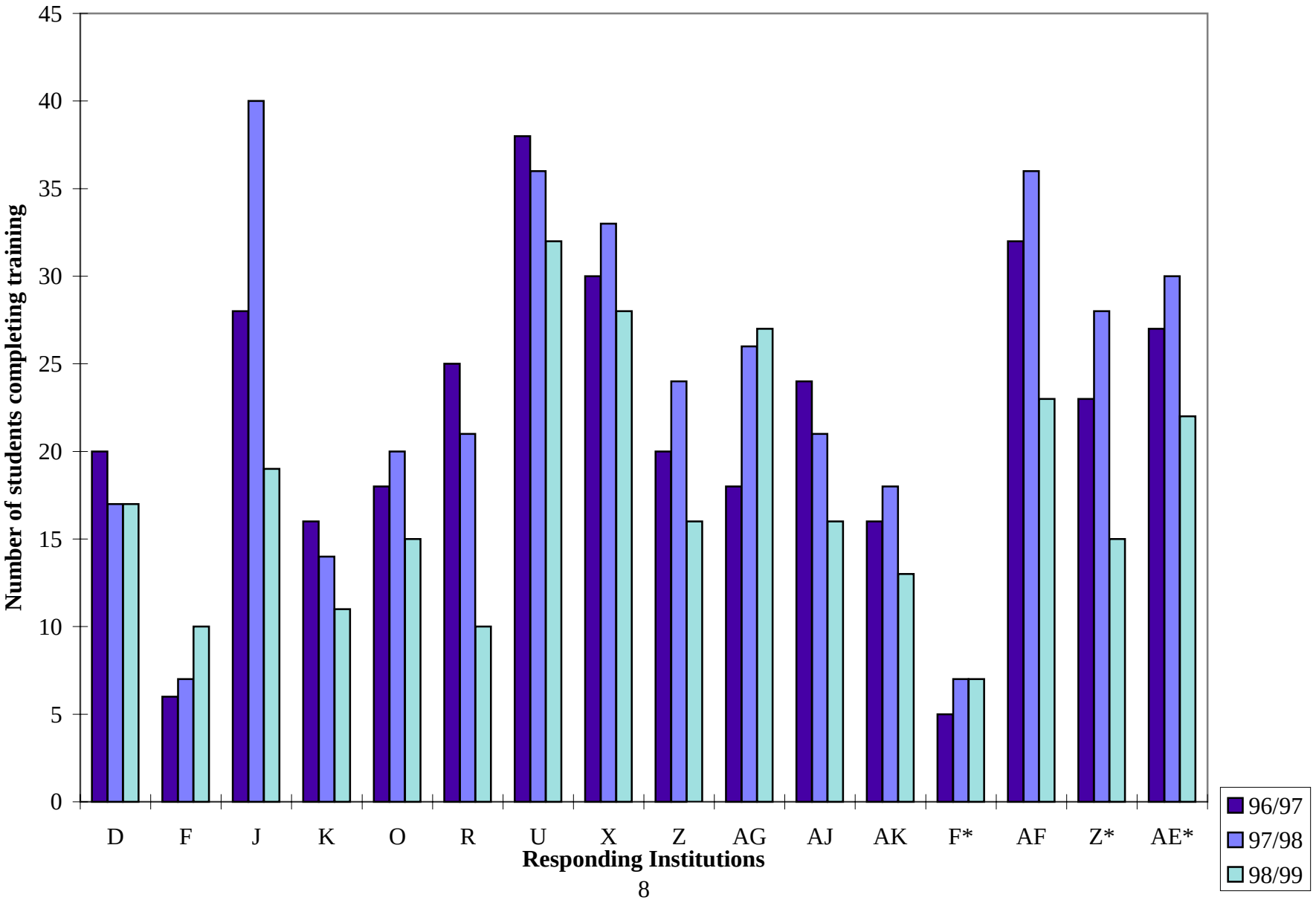


Figure 4: Completion numbers for Biology 1997-1999



For chemistry, a few institutions recorded an increase in their numbers between 1998 and 1999, but overall between 1997 and 1999 there is a clear drop. For physics, the fall-off rate is even more marked and for biology, while the numbers are considerably higher than those for the physical sciences, there are clear signs of a fall-off here also.

Appendix 3 compares the *acceptance* numbers for all **38** institutions listed in the GTTR statistics as 1-year PGCE specialist science providers. (These figures do *not* include the institutions listed as providers of combined science only.) The trends, however, are clearly similar.
(Note: The same institutions are represented by the same code letters throughout, in Figures 2-4 & Appendices.)

The questionnaire also provided information about failure to complete courses. The 1997/98 figures were updated from the second questionnaire and, since the results of this second questionnaire were received in July rather than in June, it is likely that the 1998/99 figures would be very close to the final figures at the end of the course.

The non-completion numbers were calculated for each of the **17** responding institutions offering specialist sciences and the % totals are shown in table 7.
For each institution and each science specialism in turn, the number of students failing to complete the course was calculated and expressed as a percentage of the total number of students starting the course. The mean percentages for each subject are shown below:

Table 7: % Non completion, by subject, per year

Mean non completion (%)	1996/1997	1997/1998	1998/1999
Chemistry	11.4	19.4	17.8
Physics	7.5	17.5	22.4
Biology	11.0	9.1	14.7

Despite the obvious variation from year to year, it appears that the drop out rate has increased much more for chemistry and physics than for biology.

(b) Combined sciences:
10 responding institutions listed by the GTTR as offering combined science *only* were able to identify separate science provision for the survey, but figures for all three years were complete for only **4** of them. These are the institutions listed as F*, AF, Z* and AE* (all in figures 2-4.)
The total number of students *starting* specialist science courses in these **4** institutions was **176** (1996), **172** (1997) and **131** (1998), and *finishing* was
161 (1997), **153** (1998) and **107** (1999).
For comparison, GTTR combined science *acceptance* figures for these entries were
189 (1996) (+ 1 biology specialist), **190** (1997) and **133** (1998).
The breakdown of these figures by the institutions concerned was -

Table 8: Nos. taking 'specialist' sciences within Combined Science in responding institutions

	Chemistry		Physics		Biology		Comb/Gen Science	
	start	complete	start	complete	start	complete	start	complete
1996/97	46	43	32	31	98	87	4	4
1997/98	41	34	24	18	107	101	6	6
1998/99	31	26	19	14	81	67	0	0

Complete figures for *all three years* were available for just **1** responding institution able to supply combined science figures *only*. The number of students *starting* this course was **33** (1996), **24** (1997) and **23** (1998), and *finishing* was **26** (1997), **18** (1998) and **18** (1999).

The other institution supplying combined science figures for all three years offered combined science *in addition* to specialist science provision. The numbers *starting* this course were **4** (1996), **3** (1997) and **2** (1998), and *finishing* were **3** (1997), **3** (1998) and **1** (1999).

Comparisons with GTTR *acceptanc*e figures are shown in Appendix 2.
The fall-off in numbers is evident throughout, but the sample size is too small for firm conclusions.

Appendix 4 compares the full GTTR figures for all institutions accepting combined students for courses alongside specialist sciences as well as in place of them.

Trends identified:

1. **It is increasingly difficult to recruit graduate science students to train as secondary science teachers.**
2. **The proportion of trainees with a first degree in the biological sciences is steadily increasing.**
3. **There is an even higher proportion of biological scientists training within the combined science courses than in the specialist subject provision.**
4. **It is worrying that an increasing proportion of trainees is failing to complete the course. This problem is more acute for physical scientists where it has moved from 1 in 10 to 1 in 5 during the three years.**

Comments from participating institutions

The comments attached to the questionnaires generally support and illuminate the conclusions from the statistics. It must, however, be stressed that the general difficulties of recruitment and retention are not felt universally. Local employment or unemployment spikes can affect individual institutions significantly, e.g.

1. *"Chemistry numbers have been buoyed up by a large industrial closure locally"*. (1998)

In general, biologists are being recruited above physical science graduates in a ratio above 2:1 and this is **after** many biochemists have been persuaded to register as chemists! Recruitment of chemistry specialists is becoming as difficult as physics specialists. Graduate recruitment to ITT courses is clearly in competition with alternative careers. Moves into PGCE courses are inhibited for new graduates by existing levels of debt. There is also an increasing **trend** for non-completion rates to be increasing which **may** be indicative of a lower level of commitment of applicants being attracted by the financial inducements. Overall trends will be complicated by the moves towards even greater financial rewards with training salaries coming in. The retention of teachers within the profession and the maintenance and enhancement of quality and the balance of training may not improve. The extra financial incentive for school based training beyond that for courses in partnership with courses in higher education institutions may, in the long run, have very serious implications for those institutions.

In the paragraphs that follow, respondents to the questionnaire are allowed to speak for themselves. Any authors' comments are in normal type.

Recruitment

2. *"Extremely slow even with 'aggressive' recruitment evenings"*. (1999)

3. *"Taster Days: we run 6 per year, well attended. This year recruitment from those who attended is very low, well down on previously"*. (1999)

4. *"Our locality suffers (!) from a high employment rate leading to a drop in recruitment"*. (1999)

Nature and quality of intake

5. *"In chemistry we receive an increasing number of weak applicants (could be contributing to increased drop-out rates) and recruitment is very slow. Numbers withdrawing after accepting a place, due to financial problems, are not helping recruitment. Might soon have to resort to taking on biologists with good chemistry 'A' and <u>some</u> chemistry in the degree"*. (1999)

6. *"No real difference in profile – still variable – maybe more students being rejected due to weak academic background"*. (1999)

7. *"Age profile – fewer and fewer 22 year olds coming in (too much debt) – more mature students (worrying – they are less mobile when job hunting*)" (1999*)*

8. *"Profiles are changing – we accept more diverse degrees now for physics and chemistry, e.g. geologists (chemistry), engineers (physics). This current year we have a GP who trained very successfully and a physicist"*. (1999)

9. *"Many more unsuitable applicants – more interviewed, fewer accepted"*. (1999)

10. *"More mature entrants – age profile of group getting older"*. (1999)

11. *"The most worrying feature is that due to the plentiful supply of high quality biology students, schools tend to go for those students even if a physical scientist may be required. If this trend continues the vast majority of science teachers will be biology specialists – a downward spiral for physical science"*. (1999)

12. *"The standards of physics and chemistry in terms of commitment is lower than in biology. The academic qualification standards (A-level grades, degree chemistry) is also declining, but we do have some stars"*. (1999)

Balance

13. *"Physics and chemistry about one third of total"*. (1999)

14. *"Biologists outnumber physical scientists 2:1"* (1999)

15. *"Predict approximately two thirds of recruits will be biology*" (1999)

16. *"The biological/physical science ratio appears to be similar to previous years, viz.: 3:1"* (1999)

17. *"Ratio biology/chemistry/physics = 15/12/0 by mid-June"*. (1998)

Shifts

18. *"Very few 'pure chemists' – lots of biochemists, geochemists etc."* (1998)

19. *"This year we are obtaining a number of applicants from biochemistry backgrounds and we are trying to persuade successful applicants to focus on chemistry"*. *(1999) (See also quotes 5, 8, 11, 12)*

Concern for 'subject knowledge'. (Relevant comments also from the three previous sections).

20. *"A separate but relevant issue. Students' knowledge of science at KS3 continues to cause considerable concern. The thought of all those biologists trying to cope with chemistry and physics at KS3 is worrying, to say the least"*. (1999)

21. *"Our biggest challenge has been with candidates from **modular degree** courses who **superficially have science degrees** (e.g. BSc Biological Sciences) who we find have significant areas of weakness not only in physics and chemistry but in aspects of biology too"*. (1999)

Effect of quotas/university squeeze etc.

22. *"Overall picture difficult to assess as my TTA quota has been cut by 25% this year, so I am now recruiting to target"*. (1999)

23. *"Course dropped for this year – too difficult to recruit scientists of the right calibre, uneconomic and constant Ofsted inspections. Poor completion rate of science students"*. (1999)

24. *"A small course like ours has had its viability questioned by the institution again this year and we are only just surviving"*. (1999)

Effects of financial inducements

25. *"Numbers have not been improved due to the money on offer. Recruitment, if anything, is slower than last year"*. (1999)

26. *"Very low – up until the government announces the 'golden hello'. Since then we have been deluged with biology applicants and a few extra chemists. <u>Very few</u> physicists, though."* (1999)

27. *"Few applicants to date for full-time PGCE. £5,000 bursary having no magical effect"*. (1999)

Other courses (2 year conversion PGCE / KS2/3)

28. *"Recruitment for this is slightly up on last year and much interest on taster days. But, as ever, problems lie with the marginal relevance of the degrees of many applicants – we are looking for genuine laboratory-based science or applied science"*. (1999)

29. *"Our KS 2/3 course hardly attracts any physical scientists"*. (1998)

Disparate views

30. *"Chemistry remains buoyant. Recruitment was initially slow but has improved considerably over the past few months"*. (1999)

31. *"Applications from chemistry specialists almost identical, biology significantly down and physics up"*. (1999)

32. *"More chemistry this year – last year was uncharacteristically low"*. (1999)

<u>Conclusions</u>

The messages for secondary science teacher education are clear:

- there is a shift towards a more 'biologically qualified' entry. There is a clear and increasing shortfall of teachers with a background in physical sciences.

- differential financial inducements seem only to be effective at the margins and may attract less committed and less well qualified applicants. It seems that the balance between biological and physical scientists is unaffected.

- there is a trend towards a more mature entry (Teaching as a second career – this may be a bonus.)

- subject knowledge across the whole range of the sciences is an issue for all applicants.

- the gender balance may be evening out – the image of the male scientist may be fading.

Trends are especially clear in regard to the shift of recruitment even further towards biology specialists. (This is not a new phenomenon.) In view of the inherent quality issues it is difficult to disagree with the heartfelt comment:

33. *"Thank God for biologists – they boost the numbers. Some of our recent biologists have been excellent, especially the mature entrants". (1999)*

Do we want to populate science departments with chemists and physicists at any cost to quality? It seems that **numerically** the battle has already been lost. There is a really serious message in quote 11: schools prefer a good science teacher with a biology background to a mediocre one who is a chemist or physicist (and so would most parents). Undoubtedly many such biologist-science teachers teach chemistry and physics really well. Perhaps we need to be more concerned about the continuing chemical education support and professional development of all good science teachers to enable them to provide a balanced science education for all our pupils. No beginning science teacher, however well qualified, will be fully competent to teach even his/her specialist subject without careful prior preparation (see also quotes 20 and 21). All those concerned with the quality of science education must ensure that the continued LEARNING of teachers and their ENTHUSIASM for science are supported and valued.

Compared with the situation 30 years ago the science background of most graduates in biology and the biological sciences is much richer in chemistry (and more quantitative). Indeed many of these with a strong chemistry component will already have been included in the 'chemistry' category of the statistics presented. (Since many see that calling themselves 'chemists' enhances their value on the job-market.) This report will, therefore have *understated* the shortage. Clearly then, it is important that we make the most of the best quality science education applicants who come forward for training. The crucial issue for us is how we sustain and develop their confidence, enthusiasm and learning in chemistry to enable them more effectively to contribute to a balanced science curriculum.

(A corollary to the relative 'over supply' of biology specialists in schools is that those 'good' physical scientists, who are in schools, tend to spend a greater proportion of their time teaching chemistry or physics at KS4 or above and do not really provide a balance of science for their pupils nor experience one themselves. At what stage, therefore, *should* chemists teach only chemistry?)

Appendix 1

Numbers of students on courses represented by responding institutions

(Note that direct comparisons cannot be made since the samples are not the same.)

	*Chemistry		*Physics		*Biology		#Comb/Gen Science	
	start	complete	start	complete	start	complete	start	complete
1996/97	266	237	169	144	459	412	321	285
1997/98	214	176	132	97	507	452	330	306
1998/99	158	131	77	62	322	268	188	157

*as specialist science only (not part of 'official' combined science course)
#either combined science only, or combined science alongside specialist science

Appendix 2 (a): Chemistry and Physics

	1996		1997		1998			1996		1997		1998	
	Chemistry							Physics					
	GTTR	CERG	GTTR	CERG	GTTR	CERG		GTTR	CERG	GTTR	CERG	GTTR	CERG
Institution	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Institution	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Acceptance	(Start) Complete
C	8	(3)3	9	(1)1	4	(-)-	C	8	(3)3	11	(1)1	7	(-)-
C*	*	(-)-	*	(-)-	*	(2)2	C*	*	(-)-	*	(-)-	*	(3)3
D*	*	(-)-	*	(-)-	*	(6)6	D*	*	(-)-	*	(-)-	*	(0)0
D	18	(17)16	16	(14)11	18	(18)14	D	8	(7)7	10	(10)7	11	(10)7
F	22	(8)5	5	(6)5	6	(5)4	F	7	(3)2	0	(3)1	4	(3)2
H	(-)-	(-)-	(-)-	(-)-	(-)-	(-)-	H	(-)-	(-)-	(-)-	(-)-	(-)-	(-)-
I	7	(-)-	8	(5)4	5	(5)3	I	9	(-)-	3	(3)3	10	(10)7
F*	*	(3)2	*	(4)3	*	(4)2	F*	*	(2)2	*	(2)2	*	(2)2
H*	*	(9)7	*	(6)6	*	(-)-	H*	*	(6)5	*	(6)6	*	(-)-
K*	*	(-)-	*	(1)-	(-)-	(-)-	K*	*	(-)-	*	(1)-	(-)-	(-)-
J	14	(14)13	8	(9)7	6	(5)4	J	12	(10)9	5	(5)4	5	(5)4
K	11	(12)12	13	(13)11	8	(7)5	K	9	(9)6	7	(7)5	4	(3)2
M	8	(10)7	5	(5)4	3	(-)-	M	3	(3)3	3	(2)1	2	(-)-
O*	*	(7)6	*	(3)3	*	(-)-	O*	*	(2)2	*	(4)3	*	(-)-
O	9	(9)9	11	(11)8	9	(10)7	O	3	(3)3	5	(4)2	3	(3)3
Q	19	(19)16	19	(18)14	16	(-)-	Q	15	(15)7	16	(16)10	9	(-)-
R	19	(19)16	8	(8)7	15	(15)14	R	6	(6)5	8	(7)6	7	(6)5
U	25	(24)22	22	(20)20	20	(21)19	U	20	(20)19	18	(18)10	11	(10)9
V	22	(23)23	18	(18)16	8	(-)-	V	12	(11)11	8	(7)5	4	(-)-
X	33	(25)21	22	(17)12	17	(18)15	X	13	(11)9	9	(7)5	7	(5)5
T*	*	(-)-	*	(-)-	closed	closed	T*	*	(-)-	*	(-)-	closed	closed
Z	7	(6)6	11	(11)11	11	(11)11	Z	17	(15)13	3	(3)3	5	(4)4
AC	17	(18)16	13	(11)8	13	(-)-	AC	8	(7)6	9	(10)9	7	(-)-
AD	11	(11)9	8	(8)7	14	(-)-	AD	13	(13)13	6	(7)7	12	(-)-
W*	*	(2)2	*	(1)1	*	(-)-	W*	*	(1)1	*	(0)0	*	(-)-
X*	*	(-)-	*	(-)-	*	(-)-	X*	*	(-)-	*	(-)-	*	(-)-
AE	10	(-)-	3	(-)-	5	(5)4	AE	8	(-)-	5	(-)-	6	(6)3
AF	*	(8)8	*	(10)9	*	(4)4	AF	*	(6)6	*	(0)0	*	(7)6
Z*	*	(12)10	*	(7)5	*	(11)9	Z*	*	(8)7	*	(8)7	*	(1)1
AG	16	(17)16	8	(8)6	15	(15)14	AG	12	(14)12	8	(8)7	5	(5)5
AH	6	(5)5	*	(5)4	*	(-)-	AH	0	(1)1	*	(1)1	*	(-)-
AB*	*	(4)4	*	(3)3	*	(-)-	AB*	*	(2)2	*	(1)1	*	(-)-
AJ	18	(19)18	18	(18)15	18	(18)13	AJ	13	(15)14	11	(11)9	5	(5)5
AE*	*	(23)23	*	(20)17	*	(12)11	AE*	*	(16)16	*	(14)9	*	(9)5
AK	9	(10)7	9	(9)5	3	(5)4	AK	6	(6)4	3	(3)2	1	(2)1

*only combined science figures available from GTTR

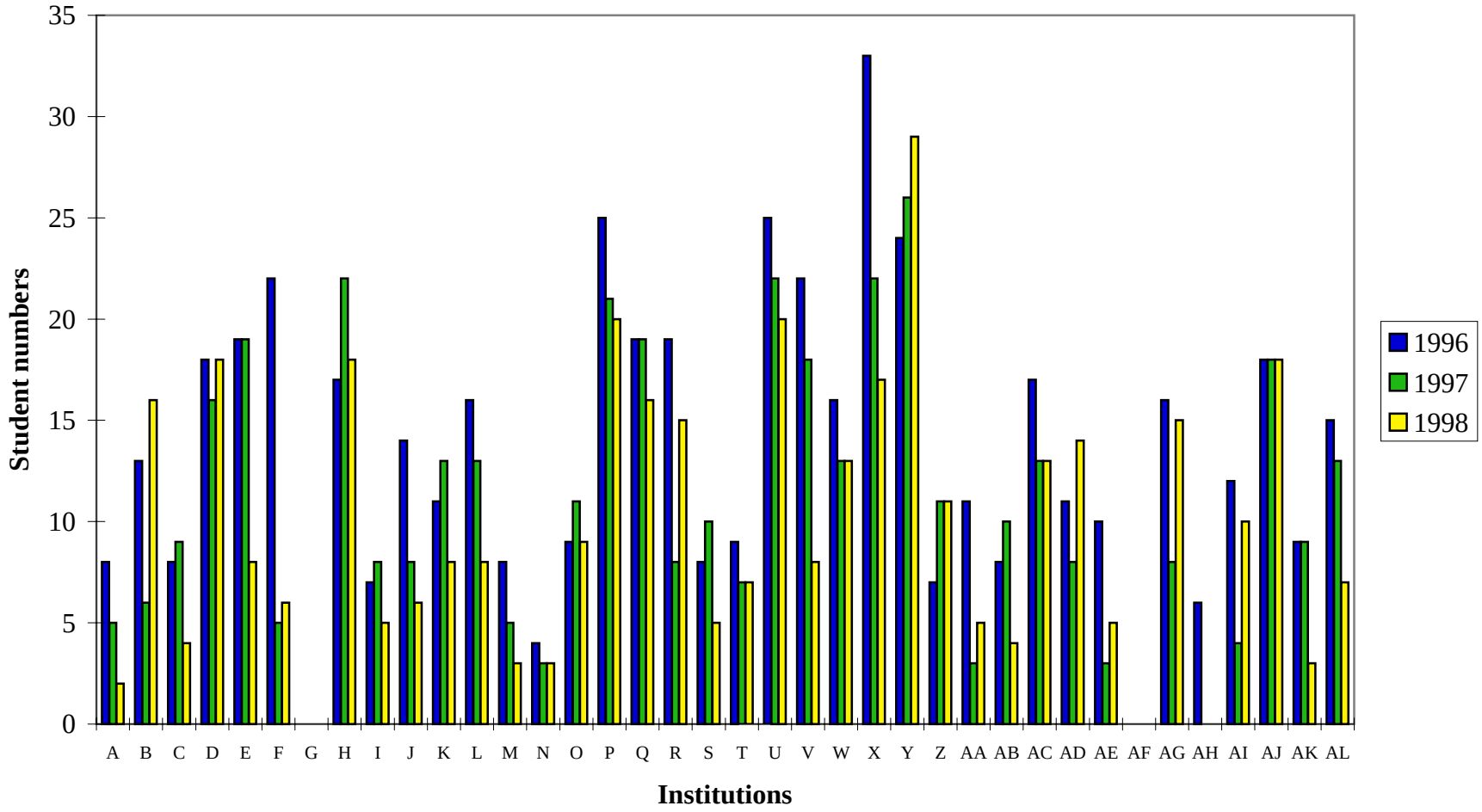
Appendix 2(b): Biology and Combined Science

	1996		1997		1998			1996		1997		1998	
	Biology							Combined Science					
	GTTR	CERG	GTTR	CERG	GTTR	CERG		GTTR	CERG	GTTR	CERG	GTTR	CERG
Institution	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Institution	Acceptance	(Start) Complete	Acceptance	(Start) Complete	Acceptance	(Start) Complete
C	19	(25)24	21	(13)11	21	(-)-	C	3	(-)-	**	(-)-	**	(-)-
C*	*	(-)-	*	(-)-	*	(13)13	C*	24	(-)-	17	(-)-	17	(-)-
D*	*	(-)-	*	(-)-	*	(8)7	D*	19	(-)-	16	(-)-	14	(-)-
D	21	(21)20	19	(18)17	21	(19)17	D	**	(-)-	**	(-)-	**	(-)-
F	1	(9)6	0	(9)7	5	(10)10	F	**	(-)-	16	(-)-	17	(-)-
H	40	(40)39	41	(43)41	34	(40)34	H	**	(-)-	(-)	(-)-	(-)	(-)-
I	26	(-)-	26	(24)18	15	(16)10	I	**	(-)-	**	(1)1	**	(-)-
F*	*	(6)5	*	(7)7	*	(11)7	F*	16	(-)-	15	(-)-	14	(-)-
H*	*	(7)7	*	(12)8	*	(-)-	H*	24	(-)-	27	(-)-	28	(-)-
K*	*	(3)3	*	(3)-	(-)	(-)-	K*	3	(-)-	5	(-)-	(-)	(-)-
J	31	(30)28	45	(41)40	23	(20)19	J	**	(-)-	**	(-)-	**	(-)-
K	18	(17)16	17	(16)14	17	(15)11	K	**	(-)-	**	(-)-	**	(-)-
M	10	(2)2	6	(5)5	24	(-)-	M	12	(19)16	22	(20)17	8	(-)-
O*	*	(13)9	*	(16)15	*	(-)-	O*	21	(-)-	23	(-)-	23	(-)-
O	20	(19)18	23	(22)20	22	(18)15	O	**	(-)-	**	(-)-	**	(-)-
Q	33	(33)25	37	(37)31	37	(-)-	Q	**	(-)-	**	(-)-	**	(-)-
R	28	(28)25	27	(22)21	10	(10)10	R	**	(-)-	**	(-)-	13	(-)-
U	42	(42)38	46	(40)36	40	(38)32	U	**	(-)-	**	(-)-	**	(-)-
V	26	(22)22	24	(21)19	26	(-)-	V	**	(4)4	2	(6)5	1	(-)-
X	48	(38)30	61	(44)33	57	(37)28	X	**	(-)-	**	(-)-	**	(-)-
T*	*	(-)-	*	(-)-	closed	closed	T*	7	(-)-	7	(-)-	closed	closed
Z	18	(20)20	24	(25)24	18	(16)16	Z	20	(-)-	**	(-)-	**	(-)-
AC	36	(36)31	32	(31)28	28	(-)-	AC	**	(-)-	**	(-)-	**	(-)-
AD	16	(16)14	18	(19)18	17	(-)-	AD	**	(-)-	**	(-)-	**	(-)-
W*	*	(12)11	*	(15)14	*	(-)-	W*	14	(-)-	17	(-)-	15	(-)-
X*	*	(-)-	*	(-)-	*	(-)-	X*	33	(33)26	23	(24)18	21	(23)18
AE	19	(-)-	20	(-)-	16	(15)10	AE	**	(-)-	**	(-)-	**	(-)-
AF	1	(34)32	*	(37)36	*	(24)23	AF	46	(-)-	49	(-)-	37	(-)-
Z*	*	(26)23	*	(29)28	*	(23)15	Z*	49	(-)-	46	(-)-	31	(-)-
AG	23	(20)18	30	(31)26	25	(30)27	AG	**	(-)-	**	(-)-	**	(-)-
AH	20	(20)20	*	(15)15	*	(-)-	AH	**	(-)-	23	(-)-	22	(-)-
AB*	*	(13)12	*	(5)5	*	(-)-	AB*	20	(-)-	7	(-)-	9	(-)-
AJ	28	(25)24	25	(25)21	20	(22)16	AJ	**	(-)-	**	(-)-	**	(-)-
AE*	*	(32)27	*	(34)30	*	(23)22	AE*	78	(-)-	80	(-)-	51	(-)-
AK	20	(21)16	20	(19)18	16	(16)13	AK	5	(4)3	3	(3)3	7	(2)1

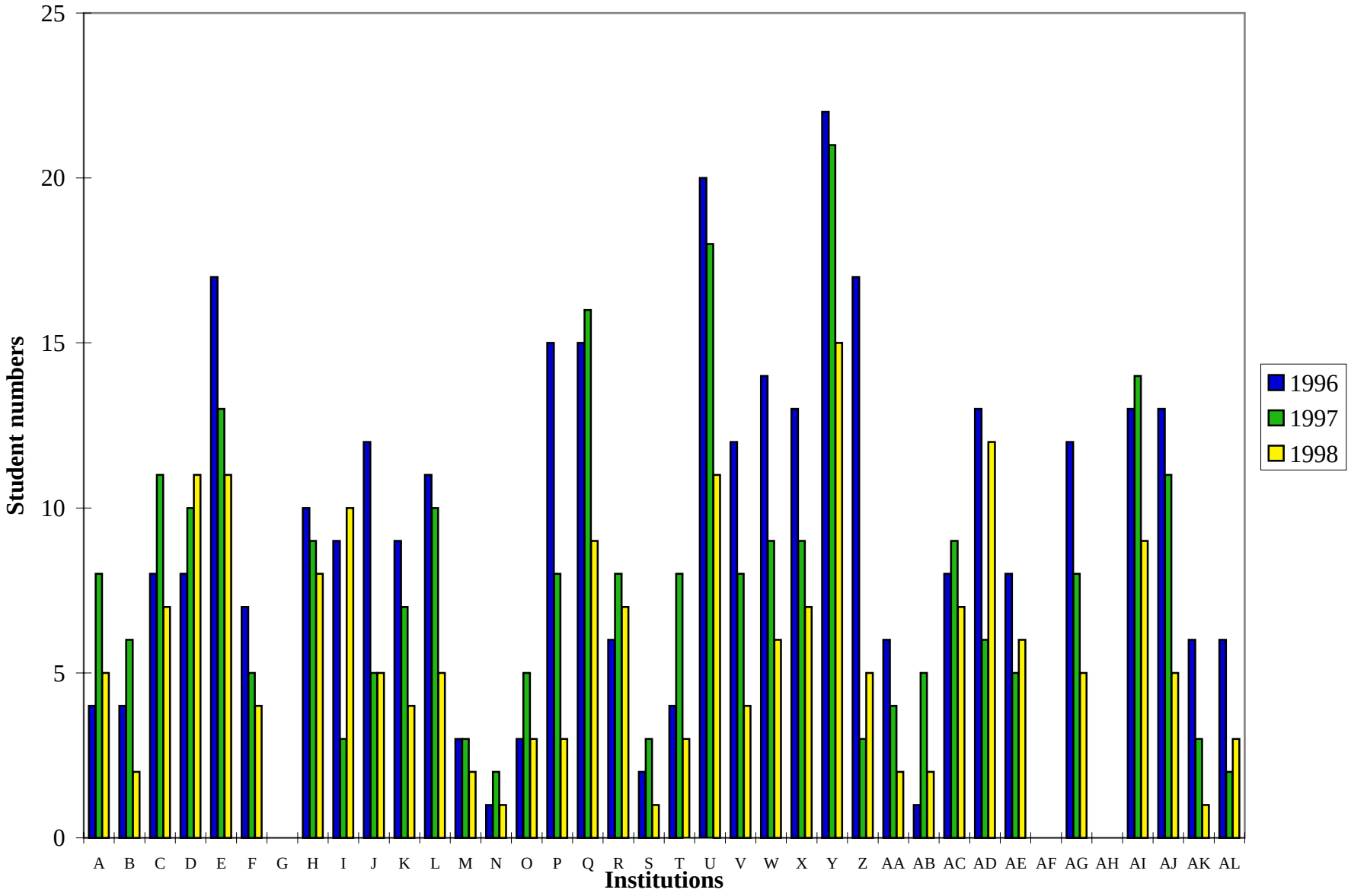
*only combined science figures available from GTTR

**GTTR figures for separate sciences only

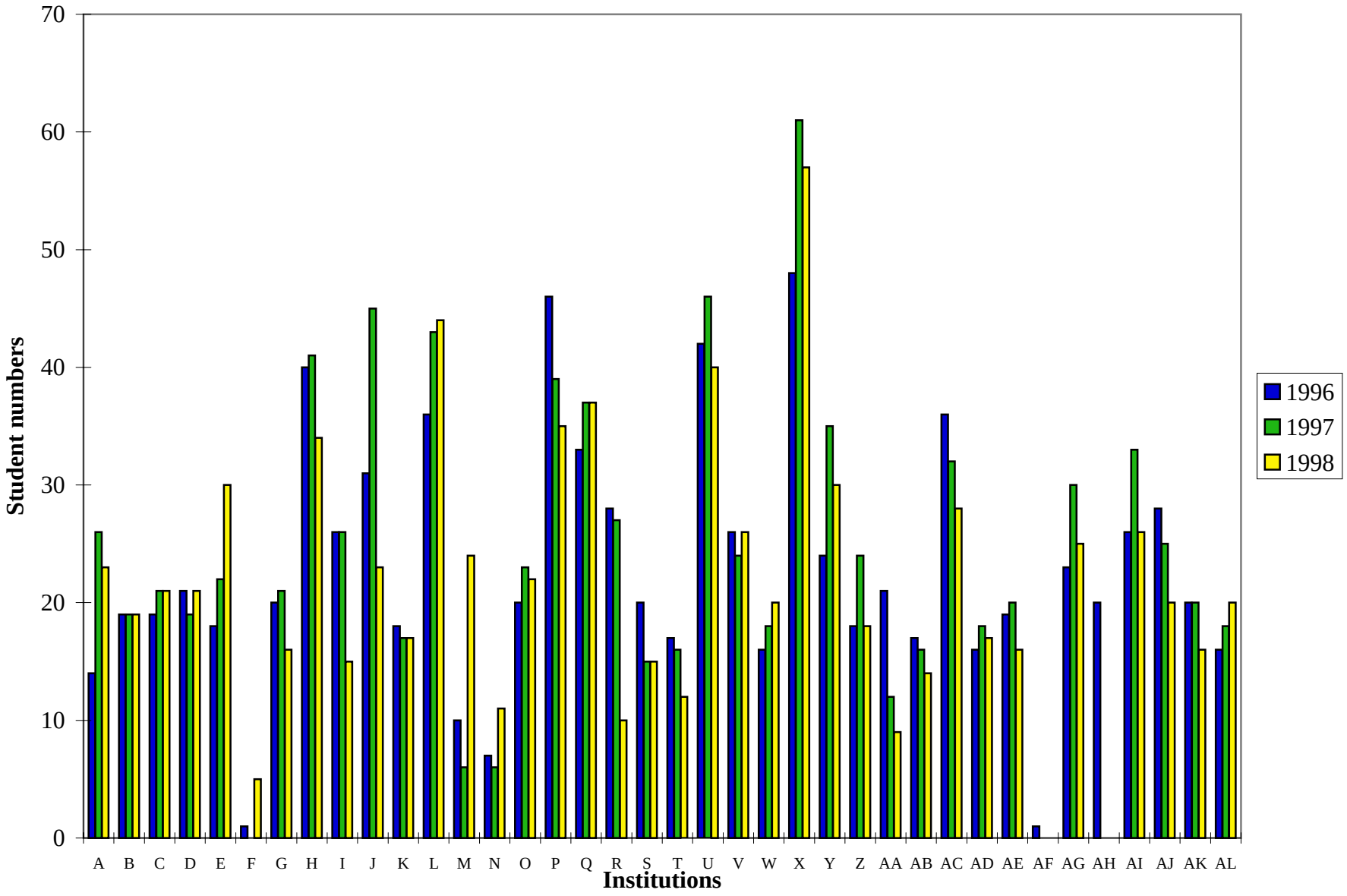
Appendix 3(a): Chemistry acceptances 1996/1997/1998



Appendix 3(b): Physics acceptances 1996/1997/1998



Appendix 3(c): Biology acceptances 1996/1997/1998



Appendix 4: Combined Science acceptances 1996/1997/1998