Do A-Level results in Biology and Chemistry inform 1st Year Pass Rate for Biomolecular Sciences students?

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Abstract

With the constant pressure of performance in league tables and the current economic environment, Universities have to be more stringent in their choices of who they admit onto courses. This study investigates the correlation between entrance grades and 1st year pass results for Biomolecular Science students. The aim is to use this study to inform future admissions policy. Approximately 50% of 2009 student enrolments technically failed Level 1. However, students with A-level biology, chemistry or both did not fail. This paper discusses the reasons for failure and impact of widening participation on programme performance.

Introduction

The Government's initiative for 50% of 18-30 year olds to go to University by 2010 (DIUS 2002) means that Higher Education establishments have been required to admit more students. The Robbins (Robbins 1963) and Dearing (Dearing 1997) reports further requested that students from diverse backgrounds should be enabled to study in the Higher Education sector. Increased diversity means that there are more overseas students (DIUS 2009) who pay higher fees and more students from the lower socio-economic sectors 19% in 2006 compared with 17.5% in 2002) (DIUS 2008). The aim is also to increase the numbers of mature students (Denham 2008). It is therefore unsurprising that the pressure to achieve higher entrance grades has simultaneously increased so that students can gain admission on the course of choice at their preferred institution. Correspondingly, entrance qualifications are more diverse ranging from A-levels to BTEC, Access and Foundation courses. Foundation courses are becoming more popular not only to bridge the gap between school and university, but to lessen the burden of increased numbers in Higher Education (Aston 2003).

If A-levels are taken, fewer students take traditional combinations of subjects (Select Committee on Science and Technology 2006). Instead they take subjects where they have a history of achieving the highest grades (Select Committee on Science and Technology, 2006).

Additionally, there is a continual wave of reports that standards are falling and that there is a *"dumbing down"* of the educational system (Harris 2005; Henry 2007; Clark & Curtis 2009). This is happening even though school teaching standards have improved, the students are more aware of what is required, and the number achieving top grades is increasing each year (Joint Council for Qualifications 2008). There is also a disturbing decrease in the number of students taking science subjects with the preconception of such disciplines as being difficult, particularly chemistry and physics (The Royal Society 2004). This has led to the closure of traditional science undergraduate programmes in some institutions. Employers are also increasingly finding it difficult to separate students based on A-level grades alone since there are many students with the same high grades. With the instigation of admissions targets and consideration of retention

rates and degree classifications, Universities have consequently come under pressure to improve their standards. This standards issue is also relayed back to prospective students. Questions raised are whether to modify the degree courses so that students have better chances of achieving higher marks, or should admission procedures be more selective.

In response to the decrease in the number of prospective students with traditional science A-levels some Universities use a points approach to A-level scores (Universities & Colleges Admissions Service (UCAS) tariff tables 2009) rather than asking for specific grades in particular subjects. Students are now allowed entry onto degree courses with both science and arts (particularly English) subjects. In the past it was more common for students to have studied more traditional combinations of subjects, for example biology with chemistry and mathematics. Students then had background knowledge of several sciences. Today, they have knowledge of a wide background of subjects but with lower specific knowledge of the sciences as a whole. While the generic skills associated with learning will develop within any subject, the lack of specific depth of knowledge and breadth of understanding of science subjects is becoming problematic, although motivation still remains most highly correlated with degree outcome (Robbins et al. 2004).

Aim

Core Level 1 modules for all the Biomolecular Science programmes in Liverpool John Moores University require some chemistry knowledge, although chemistry at A-level is not a requirement. In contrast, most Universities require A-level chemistry for Biochemistry-containing degrees (Kirk 2008). Admissions requirements impact on the 1st year pass rates, progression rates and ultimately league tables. Reasons behind failure are numerous and include: attendance (Gatherer & Manning 1998); the necessity to work in order to fund their time at University due to finance worries (Yorke & Longden 2007); illness or family problems (Sear 1983), and whether the students are pro-active in learning (Sear 1983; Robbins et al. 2004). However, background knowledge remains a critical aspect of student achievement especially in terms of motivation. The apprehension is that the level of chemistry used (although the level has not been increased) within the 1st year modules is too advanced for the students and that this demotivates students. Compounding this concern is that a higher proportion of students are passing with compensatable marks or after referral exams which means that student continue with an insufficient knowledge of chemistry into Level 2. If this persists, the marks in Levels 2 and 3 would also be adversely affected. The question then arises as to whether the students with A-level biology and chemistry achieve better marks in their 1st year on the Biomolecular Sciences programmes (Biochemistry, Forensic Sciences, Biomedical Science, Molecular Biology and Genetics and associated applied subjects) at Liverpool John Moores University than those with only one of these A-level subjects, or those with qualifications other than A-levels. The grades achieved at A-level in biology and chemistry have been correlated with the pass mark and rate at the end of the 1st year (June 2009). This research will enable the admissions requirements to be adapted so that students who are accepted onto the course will have a better chance of keeping up with chemistry. The advantage of this study is that in the 1st year, there are very few modules taken as options and so the results are indicative of the entire 1st year course (Foy & Waller 1987).

Methods

The data used in this study were obtained as part of the admissions process at the start of the degree courses. As the information is routinely collected for admissions purposes, there are no ethical issues according to the Regulations and Guidelines of the University's Ethics Committee (Liverpool John Moores Ethical Code of Practice). The study takes into consideration the right for confidentiality (regulation 14, Regulations and Guidelines for the use of Human Volunteers in Research Projects, Practical Classes and Consultancy). Pearson correlation data are grouped to prevent students from being identified, while the Pearson correlation coefficients alone are given for ungrouped data. After the mature students, and part time students and students who had discontinued had been removed from the cohort, this left 195 students the initial enrolled number was 215 students). Mature students were removed since they would have completed entrance qualifications a number of years earlier than the rest of the cohort or may have alternative experience rather than standard entrance qualifications.

Results and Discussion

The data show that in the 2008-2009 cohort of 195 students (total columns), 59% pass outright, 26% fail, and 15% achieve a compensatable fail at the first attempt. While one quarter of students fail the first year after 2 attempts; May exams and referral exams in August), if the students with a compensatable fail are included as a "technical" fail, this means that almost half of the students fail their first attempt at first year. Students have to adapt to University life. They need to adjust to the changes in learning environment from small classrooms to lecture theatres (where over 200 students are taught simultaneously). There is also an increase in the level of freedom; there is more freedom to study at University than at school. There is also an increase academic level. This is likely to be more difficult for the lower achieving students than the high achievers (Sear 1983). To combat these problems, outreach mentoring (Watt & Paterson 2000) has been put forward to aid student transition from school to University and this may be particularly pertinent for students from lower socio-economic backgrounds. The need for Foundation degrees (Aston 2003) to bridge the gap is another possibility since the students would have the opportunity to adjust to the University environment prior to undertaking a full degree.

Out of the 195 students, 102 students had passed A-level biology, A-level chemistry or both. Over 78% of students with A-level biology, chemistry or both pass outright increasing to 87% if the compensatable fails are included (Figure 1). This suggests that this cohort is not the cause of the high failure rate of the total student population. It is thus no wonder that admissions departments prefer students with A-levels (Watt & Paterson 2000) as they are thought to be a more predictable indicator of performance. When further analysed, it was found that a greater proportion of students passed outright if they had both A-level biology and chemistry in comparison to one science A-level (Figure 2). Students who had both A-level subjects were also less likely to fail at the first attempt than those with A-level biology alone (Figure 2). Several 1st year modules involve biochemistry and there is a chemistry module. It is therefore unsurprising that the students with both A-level chemistry and A-level biology have a higher pass rate than those who have studied only one subject as the students would be more familiar with the terminology and procedures. Only seven students had A-level chemistry alone and so the significance of this group cannot be accurately determined.

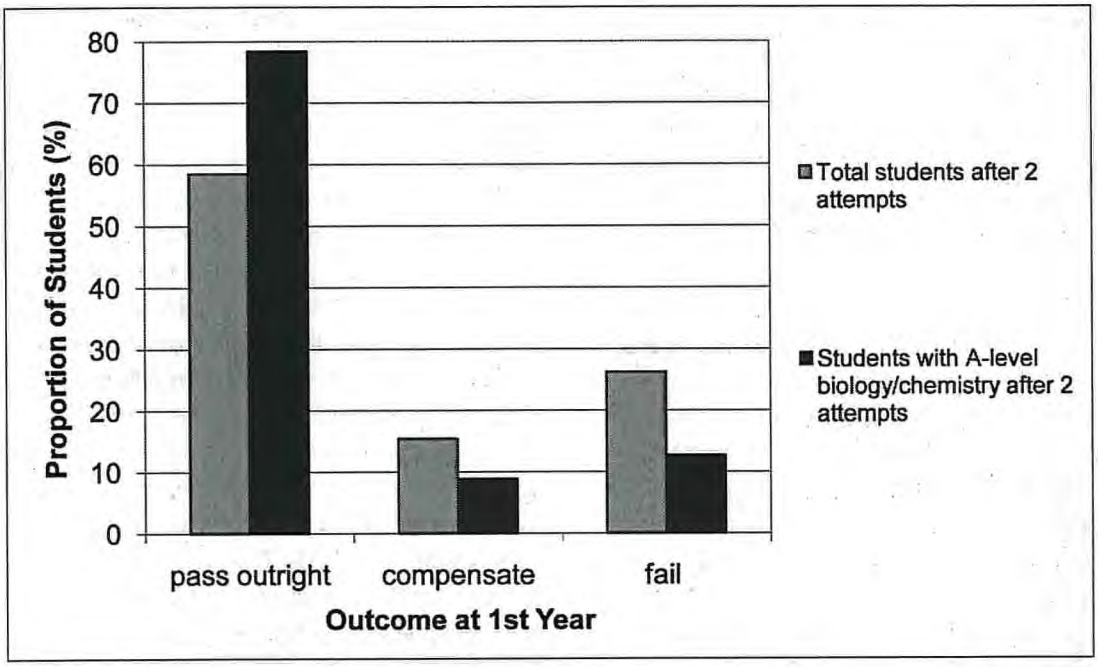


Figure 1 Graph showing outcome of 1st year Biomolecular Sciences students in the academic year 2008-2009 after exams in May and referrals in August. Students with A-level biology and/or chemistry are included. Data shown are % of the total number of students (n=195 students).

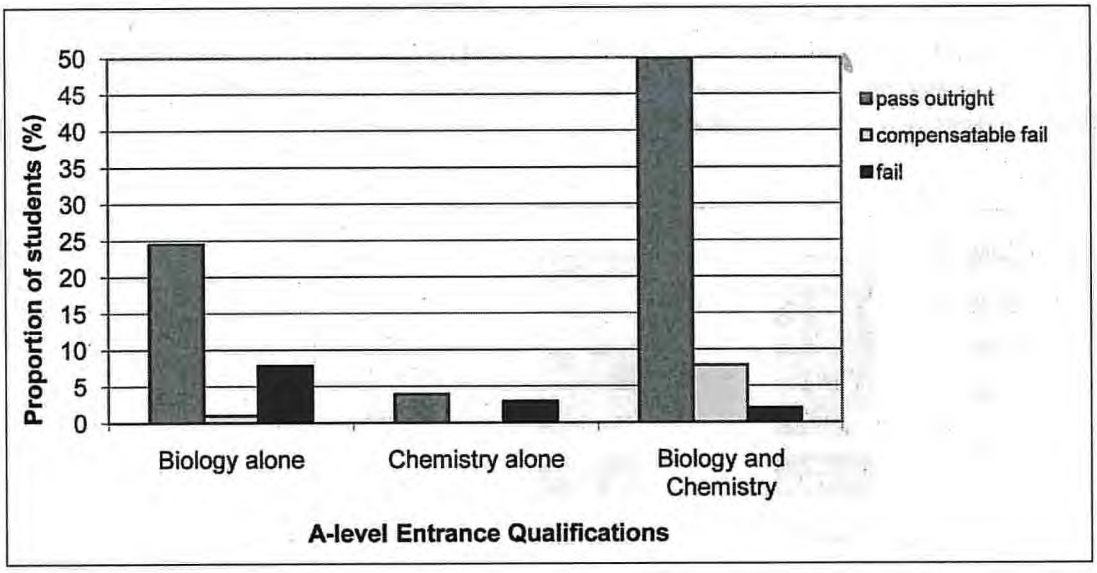


Figure 2 More students with both A-level biology and chemistry pass outright at 1st year than those with only one of these A-levels. Fewer students with both A-level biology and chemistry fail at the first attempt at 1st year in comparison to those with A-level biology alone. Proportions (%) were determined from n=102 students from the 1st year cohort from the academic year 2008-2009 after exams in May and referrals in August.

The reason for the high failure rate was further investigated. When compared to the students with alternative qualifications (Figure 3), the students with A-levels were also more likely to pass including those with compensatable fails; 87% pass rate for students with A-levels versus 59% for students with alternative qualifications. Since students with both A-levels were more likely to pass, this raised the question as to whether they were also likely to score a higher pass mark. Previous studies have shown that a good A-level score is more likely correspond to students who achieve a 2:1 but not a 1st class degree mark (Wheeler & Wheeler 1986). Students with good A-level grades are also less likely to drop out (Wheeler & Wheeler 1986). The mean pass mark at 1st year was calculated for each of the groups, and compared to the mean pass mark for the students who had entrance qualifications other than A-levels (BTECS, Access course passes, foundation degrees, Irish leaving certificates) and A-levels other than biology or chemistry. Students with A-level biology alone or both A-levels achieved a significantly higher mark at first year than the students with alternative qualifications (Figure 4). To identify whether the apparent poor pass rate for the students with alternative qualifications was due to any particular qualifications, the group was divided into their individual admissions qualifications. Although the students with foundations degrees are more likely to pass at 1st year (76%), the other groups (A-levels other than biology or chemistry, and BTECs) are only 50% likely to pass in each case Figure 5). This is in agreement with previous studies that have compared vocational qualifications to A-levels (Howard & Jersoch-Herold 2000; Huws & Taylor 2009). It thus raises the question of whether vocational qualifications can meaningfully be compared to A-levels. The answer to this question is difficult as the two types of qualifications are constantly evolving, but at different rates and they are assessed in different ways (Greatorex 2001). This could mean that the way that BTEC students are taught makes them less prepared for university life. The same set of students would never enrol for both types of qualifications for identical subjects, so some degree of expert judgement is required to make the comparison (Greatorex 2001). The increased rate of failure for students with alternative qualifications to A-levels begins to explain the fear that non-A-Level students are more likely to drop out (Watt & Paterson 2000).

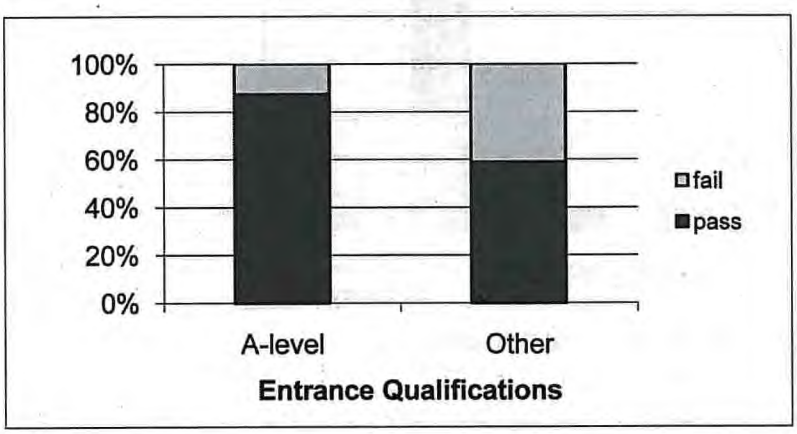


Figure 3 Students with A-levels are less likely to fail 1st year in Biomolecular Science Programmes after 2 attempts (May and August exams) than those with alternative qualifications. (n=102 with A-levels and n=90 with alternative entrance qualifications including BTEC, access courses and foundation degrees).

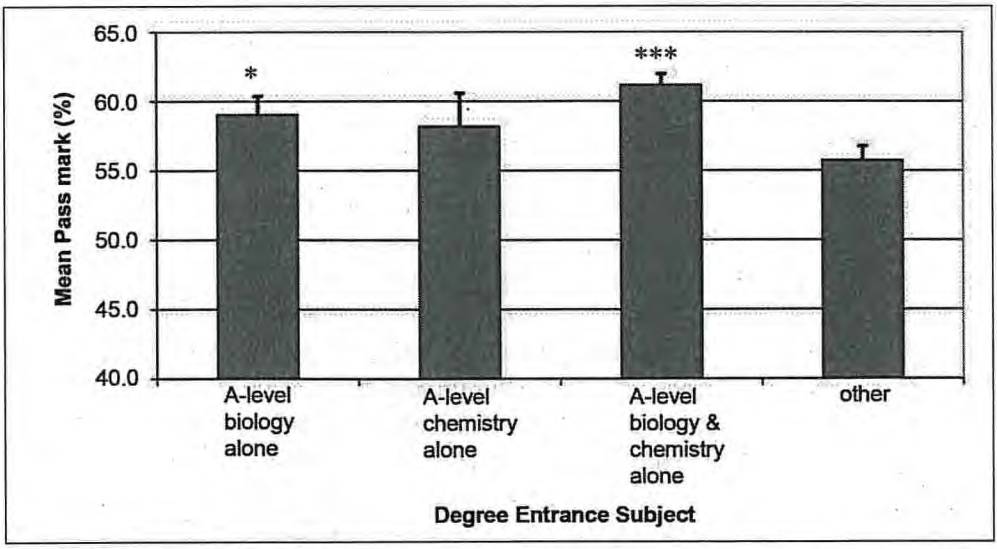


*Figure 4 Students with A-levels in both biology and chemistry on average score 3.3% better than those with alternative entrance qualifications other). Data shown are mean ± SEM after 2 attempts (May and August exams 2009), n=25 for A-level biology alone, n=4 for A-level chemistry alone, n=60 for both A-level biology and chemistry and n=53 for other qualifications including A-levels other than biology or chemistry, BTECs, Access courses and foundation degrees. * p<0.05 and p<0.001 students' t-tests when compared to the alternative entrance qualifications ('other' column).*

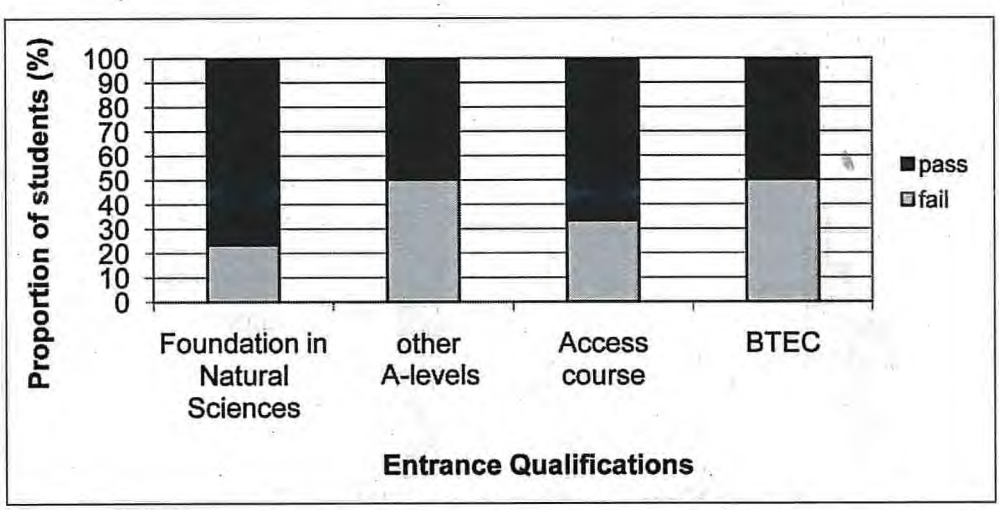
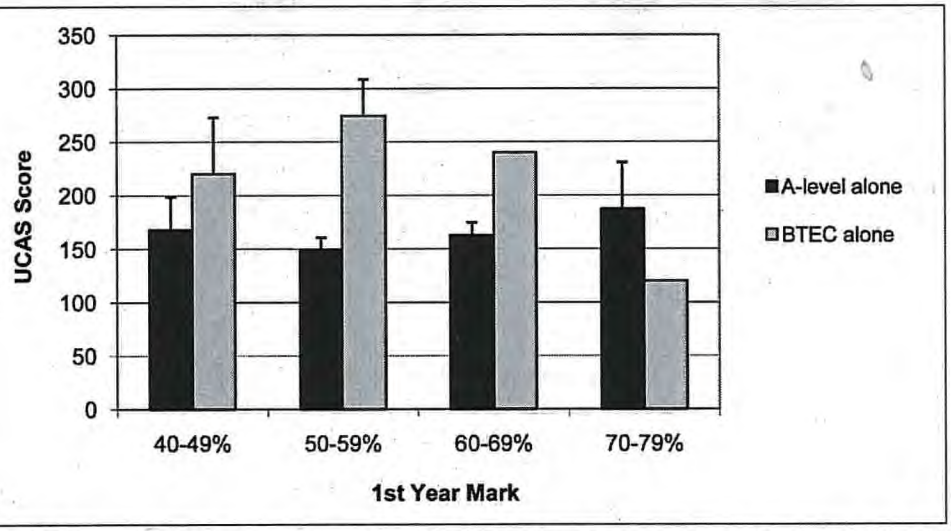


Figure 5 In a cohort of students with entrance qualifications other than A-levels in Biology or Chemistry, those who have completed the foundation in natural sciences are most likely to pass at 1st year in Biomolecular Sciences Programmes after 2 attempts (May and August exams). Other A-levels signifies those with A-levels other than biology or chemistry. Students with BTEC passes are more likely to fail at 1st year.

Although the pass/fail rate is important, the question of whether A-level or BTEC grades are a predictor of 1st year mark is equally vital for admissions departments. Whether A-level grades are a good predictor of achievement potential remains a key question. A-level results can be affected by a number of issues including the quality of the school and the exam board (Sear 1983). The subjects taken are also an important issue (Sear 1983). For example students may take human biology, biology

or applied sciences. For this study, the first two have been considered as A-level biology. As they are different exams, more than likely from different exam boards, this may not be the best method but relatively small numbers means that individual analysis is not possible. The UCAS scores (UCAS tariff tables 2009) were calculated for each student and plotted according to their 1st year mark, which was grouped to make the data anonymous. The courses in Biomolecular Sciences request students with 240 UCAS points, normally with two A2 levels in at least one science. However, the courses do not get fully subscribed and so students with lower grades end up being admitted through clearing to fill quotas mean score is 207, (standard deviation 70, range 60-360 UCAS points). While there is a trend that the A-level students achieving highest 1st year pass marks have higher UCAS scores (Figure 6), there are no significant differences between the groups ($p>0.05$, students' t-tests). Furthermore, when the A-level students are separated and a correlation graph is plotted, the Pearson correlation coefficient is 0.02 (equation of correlation $y = 0.0796x + 3.1813$). This level of correlation is similar to published studies (Sear 1983, Foy & Waller 1987). In comparison, there is no trend of higher UCAS scores for BTEC students giving rise to higher 1st year pass marks (figure 6). This is in agreement with previous studies (Howard & Jerosch-Herold 2000) although there are problems associated with this analysis. Certainly majority of Biomolecular Sciences students have a narrow range of A-level grades (majority have Ds or Es) making correlations of UCAS points with 1st year mark more difficult. This problem occurs in other courses e.g. medicine where students with only the highest A-level grades are admitted (James & Chilvers 2001). The results suggest that BTEC results are not as reliable at informing performance as A-levels, and that they are not as meaningful (Greatorex 2001). It was not possible to look at the results of students with Access courses or Irish Higher Certificates due to the numbers being too low.



Mean UCAS score was calculated for students who had achieved pass marks in the band widths of 40-49%, 50-59%, 60-69% and 70-79% after 2 attempts May and August exams). Data shown in mean ± SEM, n=5 for A-level 40-49%, n=44 for A-level 50-59%, n=40 for 60-69%, n=8 for A-level 70-70%, n=4 for BTEC 40-49%, n=7 for BTEC 50-59%, n=1 for BTEC 60-69% and 70=79%.

Figure 6 Mean UCAS score of A-level students informs 1st year pass mark in Biomolecular Sciences Programmes but BTEC scores do not.

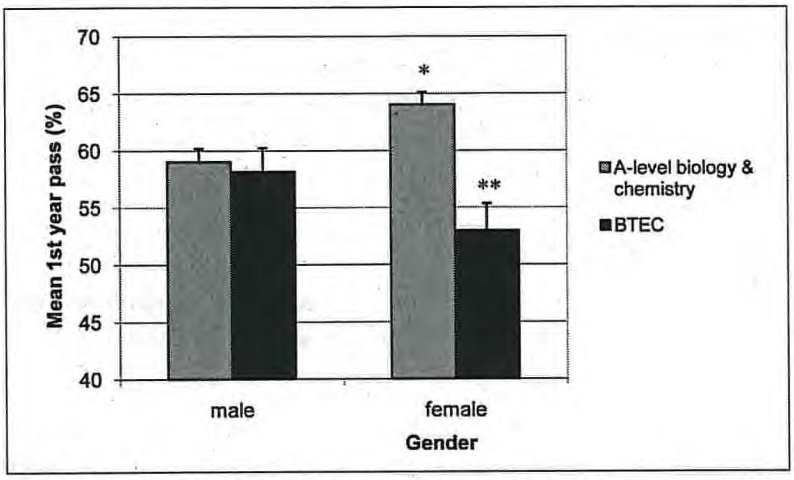


*Figure 7 Female students with both A-level biology and chemistry, but not BTEC, attain a higher mark at 1st year than male students after 2 attempts May and August exams, 2009). Data shown are mean % ± SEM, n=30 male students and n=27 female students with A-level biology and chemistry, n=9 female students and n=6 male students with BTEC qualifications, * p<0.05 between male and female A-level students, ** p<0.01 between female A-level and female BTEC students, students' t-test.*

Finally, since there are now more female than male students in Higher Education (Higher Education Statistics Agency HESA) 2009), the trends in gender are becoming increasingly studied. Out of the 195 students enrolled on Biomolecular Sciences programmes there are 56% females and 44% males. Previous studies have shown that female students perform better than males (Smith & Naylor 2001, Sharif et al. 2003). In this study, the same trend is also apparent for students with both A-level biology and chemistry, but not for the BTEC students (Figure 7). Interestingly, the male A-level and BTEC students perform equally, whereas female BTEC students achieve a significantly lower (approximately 10% lower) mark at 1st year than the female students with both A-level biology and chemistry ($p<0.01$, students' t-test). Before admissions can use this data, the study must be expanded as outlined above. It is particularly important to identify whether the same trend occurs for these students in their final year before changes to admissions can be made as students will develop at different paces (Barnett 1988).

Conclusions

The results of this study suggest that it would be more beneficial to only admit students with A-level biology or chemistry, and preferably both, rather than students with alternative qualifications. Although widening participation is the initiative (Dearing 1997), it has had a detrimental impact on the progression rate and results of the 1st year undergraduates in Biomolecular Sciences in 2008-2009. This is in agreement with previous studies investigating the backgrounds of learners (Watt & Paterson 2000, Howard & Jerosch-Herold 2000; Huws & Taylor 2009). Widening participation must therefore be looked upon as an increase in the number of students completing a degree rather than an increase in the number of students achieving a high grade 2:1 or 1st class) (Huws & Taylor 2009). Because of this, the debate that standards are falling is likely to continue. Factors that reduce retention and progression rates are likely to be costly both financially and for human resources. It is necessary for institutions to statistically evaluate their own performance, although the effectiveness of the assessments within the modules is rarely studied (Barnett 1988).

Ultimately, the results are vitally important to the University as they improve league table performance with the hope of attracting better students in the future. In contrast, if admissions criteria were changed to admit only students with A-levels or foundations degrees, it is not inclusive and is against government edicts although the statistics would not be as bleak. The University would risk turning away some potentially good students. With the economic climate currently being so poor, the issue of whether the University can afford not to make such changes remains pertinent.

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