

# Project BioTrack: Students' bio-related progression during year 1-3 at the Biotechnology program

Javier Linares-Pastén, Peter Rådström, Magnus Carlquist, Johan Svensson Bonde, Martin Hedström

Center for Applied Life Sciences (CALs), Department of Chemistry. Lund University.

**Abstract—** The aim of this project was to investigate the students' bio-related progression during years 1 to 3, through questions about the current educational focus of the program, current order of the bio-based courses, preparation during the 1 to 3 years for the future, and the general view from the students regarding the educational quality at LTH. The survey was sent to all active students starting the program 2009-2012, in total 169 individuals. A majority, 84 %, of the students were pleased with the sequence of the bio-courses. Four bio-based courses were highlighted as the most important in the survey. Together, they represent various aspects of the Biotechnology program and follow a clear progression i.e. Microbiology – Biochemistry - Bioprocess Technology - Gene Technology. In summary, a majority of the students were overall satisfied with the educational focus of the first three years. This shows that the students recognize the need to have a deep knowledge in biology, chemistry and mathematics before continuing with the next two years of the program and later on to work as Biotechnology engineers.

## I. INTRODUCTION AND AIMS

THE Biotechnology program is a five-year education program at the technical faculty at Lund University. During the first three years all program students take the same courses, and after that the students chooses a specialization, with courses focusing on their area of choice. The program ends with a half year long diploma work. The specializations are: Pharma, Food, Molecular Biotechnology and Bioprocess Technology. Previously, the specialization Technology Management was also available.

The overall aim of the project was to investigate the students' bio-related progression during year 1-3 at the Biotechnology program. To achieve this, we aimed at answering the following four more specific questions:

- 1) What is the current educational focus of the program (year 1-3)?
- 2) Are there any problems with the current order of the bio-based courses, or the overlap between the different courses?
- 3) Does year 1-3 prepare the students enough for rest of the education (the specialization), and for the future career?
- 4) What is the general view from the students regarding the educational quality at LTH?

## II. METHOD

All the courses in year 1-3 were defined as being bio-based or not bio-based, depending on the overall course content.

We deemed that students, recently completing year 1-3, was the most suitable group to use for this project. Unlike teachers, which in most cases are involved in only one or a few of the courses in the program, the students have a unique insight since they participate in every course of the program. A set of questions was therefore constructed to be used as a student survey. The questions were designed to give some general information about the students and their educational background, and to target the three main questions described above. The first set of survey questions was sent to a small group of students, as a pilot survey. After refining the survey questions, based on the students' comments from the pilot survey, a final set of questions were constructed.

The survey was sent electronically to all active students starting the Biotechnology program 2009-2012, in total 169 students. The group was spanning students that were just about to finish year 3, to students just about to, or recently had finished year 5. After sending a few reminders a total of 57 replies were obtained. Charts were prepared for questions giving numerical data. For free text questions, all the answers were compiled and keywords used by several students were identified and used to get an idea of the common views of the students.

## III. RESULTS AND DISCUSSION

### A. Student background

The students that answered the survey were 64 % women and 36 % men, primarily in the age groups 21-23 years old (46 %) or 24-26 years old (46 %). The starting year 2009 was slightly less represented (14 %) compared to starting years 2010-2012 (25 %, 34 % and 27 % respectively). The representation of the different specializations in the survey answers are described in Fig. 1 with Molecular Biotechnology being the dominating one (43 %).

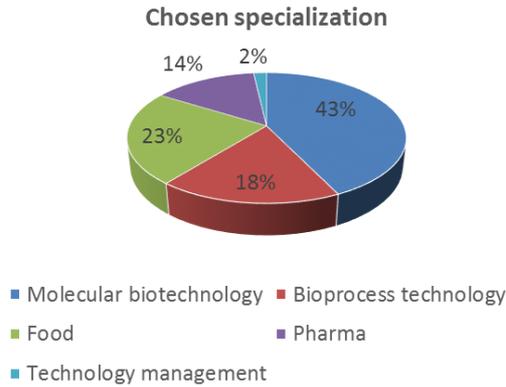


Fig. 1. Distribution of the specializations among the students answering the survey.

The dominating high school education when applying to the Biotechnology program is the Natural Science program, and 89 % of the students have this background, based on the survey data (Fig. 2). When it comes to judging how well previous education has prepared the students for university training, the vast majority of the students feel prepared, with 91 % giving 3 or above on the 5 grade scale (Fig. 3).

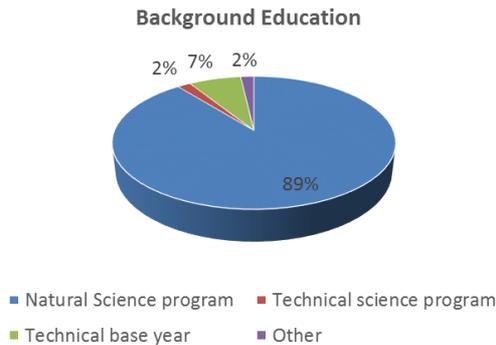


Fig. 2. Education prior to university for students at the Biotechnology program.

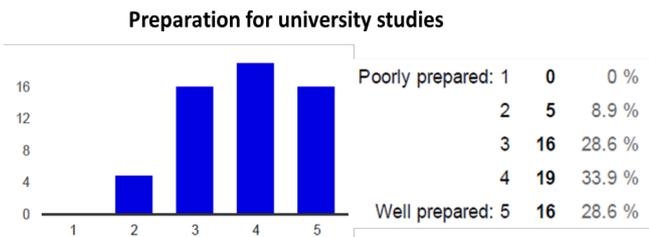


Fig. 3. The bar diagram shows, according to the survey, how well the student's previous education has prepared them for university studies.

The basic questions about the students and their background are important in order to see if it is a representative group that has answered the survey, and that no critical biases occur. Though not exactly the same numbers, the gender and specialization distribution among the survey answers seem to follow the same trends as for the students enrolled in the Biotechnology program. This is a good indication that the survey answers are representative for the Biotechnology program students as a whole, and that no major biases are in play.

The survey results showed that when the students start the Biotechnology program the group is very homogenous, in

terms of their previous education and how prepared they feel for university studies. The results suggest that the educational level of the fresh students is sufficient to manage the courses given in the program, and likely not a major cause if students fail with their university studies. The high number of applications to the program should lead to that only “high-performing” high school students are accepted, which can explain the general high level of perceived preparedness.

### B. Course evaluation

The students were asked in the survey to evaluate the most important courses, and also specifically BIO-BASED courses the first three years of the Biotechnology program.

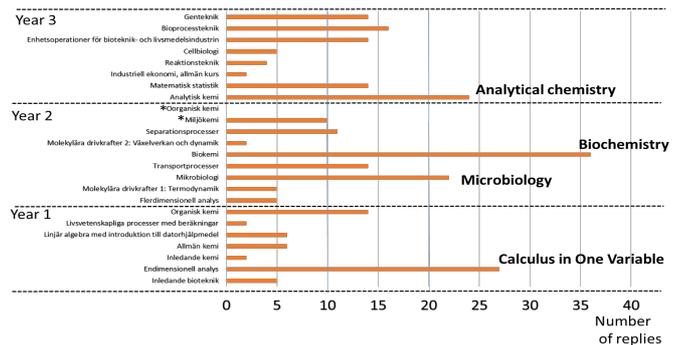


Fig. 4. The horizontal bar chart shows the most important courses the first three years of the Biotechnology program. The students have answered the question: “Which 5 courses do you think are the most important of ALL courses during the first three years of your university studies?” The word important was not explained. A list of all courses was enclosed.

The students have listed the five most important courses during the first three years of the university studies (Fig. 4). Based on the number of replies, the 24 courses may be divided into three groups, i.e. courses with more than 20 replies, courses with 10-20 replies and courses with less than 10 replies. Approximately 50 % of the courses have less than 10 replies. Biochemistry and Microbiology are the two most important bio-based courses according to the survey (Figs. 4 and 5). Analytical Chemistry and Calculus in One Variable are also courses with more than 20 replies in the survey. Gene Technology and Bioprocess Technology are also recognized as important courses when only the bio-based courses are ranked, also (Fig. 5).

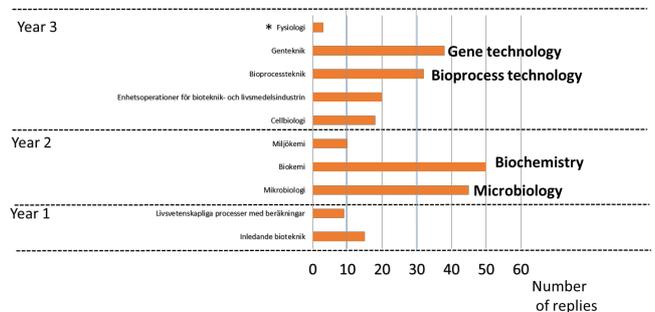


Fig. 5. The horizontal bar chart shows the most important bio-based courses the first three years of the Biotechnology program. The students have answered the question: “Which 5 courses do you think are the most important of BIO-BASED courses during the first three years of your university studies?” The word important was not explained. A list of all courses was enclosed.

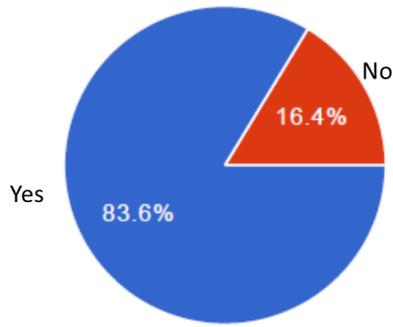


Fig. 6. The pie chart shows the numerical proportion of students that are pleased with the sequence of how the bio-based courses are given in the program.

83.6 % of the students are pleased with the sequence of the bio-based courses (Fig. 6). The inventory of bio-based courses may be used to follow the progression over the years and pin-point necessary and unnecessary course overlaps.

A	B	C	D	E
Lecture title	Keywords	Level of complexity (H:High, M: medium, L: low)	Lecture responsible	Link to lecture slide (if available)
KMB023				
1. Introduction	The scope of food microbiology Course organisation	M	Peter	
2. Growth and survival			Ed	
3. Microbial analysis	Conventional analysis of salmonella Principle of analysis Cultural techniques Indicator organism Analytical parameters Methods DEFT, spiral plater, MPN, HGMF Alternative methods	H H M M H M M	Peter	
4. Preservation			Ed	

Fig. 7. The excel sheet exemplifies the preliminary inventory of all bio-based courses in the program in order to record the content and level of complexity per lecture. KMB023 is for example the Food Microbiology course.

A majority, 83.6 %, of the students are pleased with the sequence of the bio-courses. Furthermore, existing course overlaps are recognized as needed repetitions. The content and sequence of bio-based courses are planned to be based on previous courses (see course plans). Thus, the gradual development of bio-oriented knowledge the first three years is substantial. However, alternative sequences of courses are not reflected in the survey. Four bio-based courses are highlighted as the most important in the survey. Together, they represent various aspects of the Biotechnology program and follow a clear progression i.e. Microbiology-Biochemistry-Bioprocess Technology-Gene Technology. The sequence of these four courses is planned to follow a structure from general knowledge to more specific engineering applications. In addition to Biochemistry and Microbiology, it is striking that the student's forward a course in mathematics and another course in chemistry among the most important of all courses during the first three years. Apparently, the students have identified Calculus in One Variable, Microbiology, Biochemistry and Analytical Chemistry as the most central in the Biotechnology program. These four courses, covering central aspects of the program, may be recognized as the most important from a program perspective according to the students.

C. Educational focus

From the list of courses given during the first three years in the Biotechnology program, four major educational focus themes were identified. These were: "BIO-courses", "mathematics", "chemistry" and "defining and solving engineering problems". To measure how the students considered the educational focus they were asked to scale their view of from 1-5 (where 1 was too little and 5 too much how).

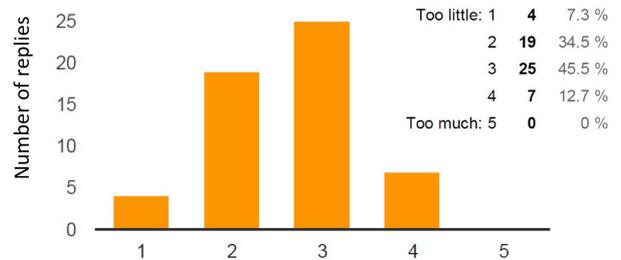


Fig. 8. The chart shows the student's view of the educational focus the first three years of the Biotechnology program. The students have answered the question: "Grade your view regarding the educational focus during year 1-3 in the Biotechnology program: - BIO-courses".

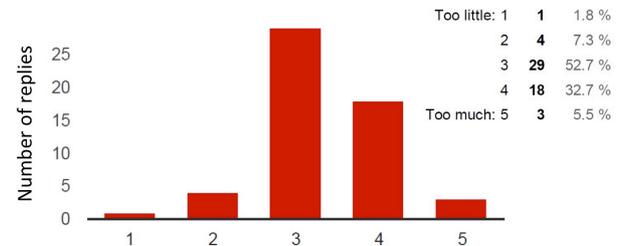


Fig. 9. The chart shows the student's view of the educational focus the first three years of the Biotechnology program. The students have answered the question: "Grade your view regarding the educational focus during year 1-3 in the Biotechnology program: - Mathematics".

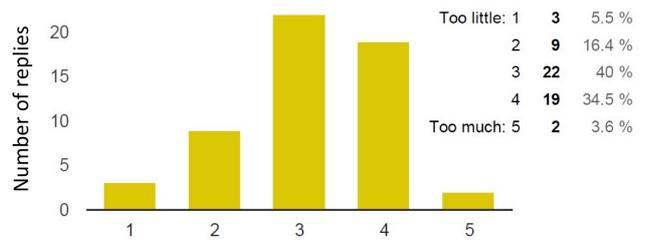


Fig. 10. The chart shows the student's view of the educational focus the first three years of the Biotechnology program. The students have answered the question: "Grade your view regarding the educational focus during year 1-3 in the Biotechnology program: - Chemistry".

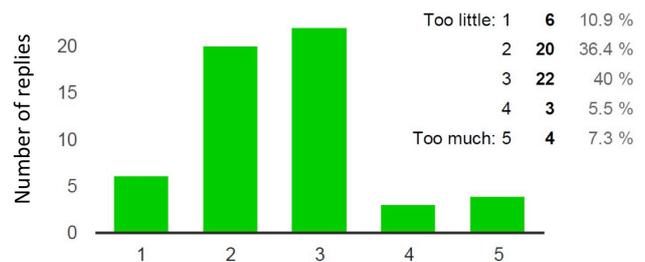


Fig. 11. The chart shows the student's view of the educational focus the first three years of the Biotechnology program. The students have answered the question: "Grade your view regarding the educational focus during year 1-3 in the Biotechnology program: - Defining and solving engineering problems".

A majority of the students considered that all of the four themes were in appropriate amount (Figs. 8-11). Furthermore, there were very few replies with 1 (too little) or 5 (too much) on the view for all four focus themes. With regards to BIO-based courses, the trend was that the students viewed the educational focus to be slightly too low (34.5%), while 12.5% viewed that it was too much (Fig. 8). With regards to chemistry and mathematics courses, the trend was the opposite with 32.7% and 34.5%, respectively, answered that the focus was too much (Figs. 9-10). The view on “defining and solving engineering problems” was that a majority of the students thought that it was of appropriate amount (40%), however there was a trend towards considering that it was too little focus on this theme (36.4%) as can be seen in Fig. 11.

In summary, a majority of the students were overall satisfied with the educational focus of the first three years of the Biotechnology program. This shows that the students recognize the need to have a deep knowledge in biology, chemistry and mathematics before continuing with the next two years of the program and later on to work as Biotechnology engineers. There was a weak trend towards viewing the focus on BIO-based courses being too little, however this is not surprising since this is probably the largest interest for many of the students in the Biotechnology program. It should not be interpreted as there is a desire from the students to increase the number of BIO-courses on the expense of chemistry and mathematics. The trend towards viewing the educational focus on “defining and solving engineering problems” towards being too little may reflect that there is a desire to understand more how to apply the basic knowledge in the biotechnology engineering profession. It may thus be seen as an indicator that there is a need to increase the number of examples from where the basic knowledge is applied already during the first three years of the education. On the other hand this is more the focus of the specialization in remaining 2 years of the Biotechnology program.

**D. Knowledge overlap**

One of the aims in this study was also to investigate the amount of knowledge overlap for the courses available during the BIO-track education.

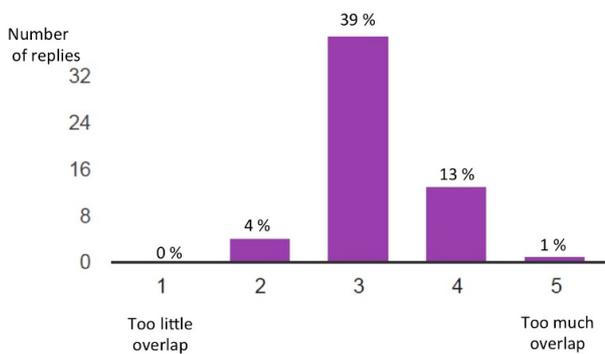


Fig. 12. Overlap between courses according to the students. The students have answered the question: Grade (from 1 to 5) your view regarding the amount of overlap of the taught information between the different courses in the program.

The highest percentage of students (39%) have graded with 3 in a scale from 1 to 5 that there is overlap of the taught information between the different courses in the program. While 13% have graded with 4 (Fig. 12). Gene technology, Cell Biology and Microbiology were the courses identified with most of the overlaps (Fig. 13), particularly Gene Technology and Cell Biology. Concerning to the preparation of the student for the Specialization, most of the students (49.1%) graded with 4 over 5 the theoretical knowledge.

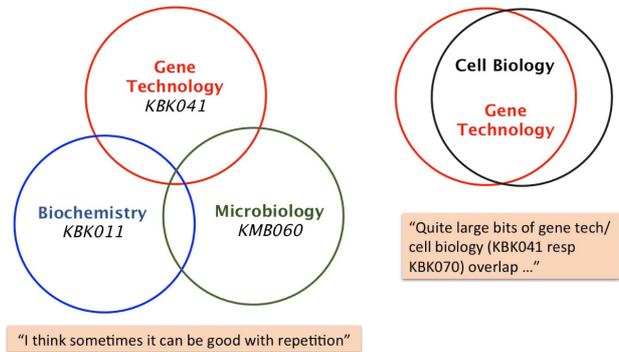


Fig. 13. Courses too much overlapped. The students have answered the question: Please specify courses with too much overlapped information. Most of the students have answered that Cell Biology and Gene Technology are the most overlapped courses. In boxes are shown a couple of the students’ opinions.

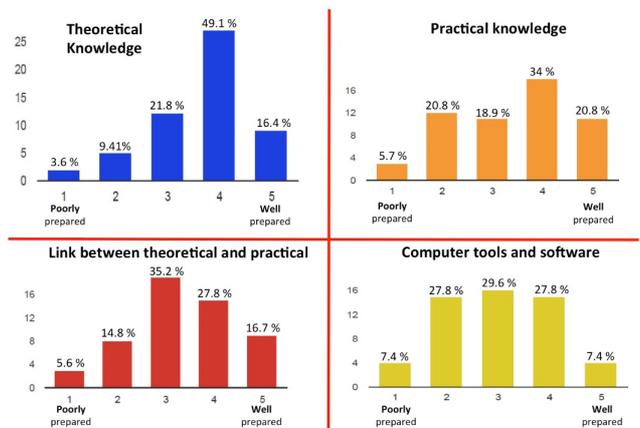


Fig. 14. Specialization: Theoretical knowledge, practical knowledge, link between both of them and computer tools and software. The students have answered the question: How did the first three years in the biotechnology program prepare you for your specialization?

Similar trend is observed for the practical knowledge. The link between theory and practice shows a satisfactory trend in the student survey, however the computer tools and use of software do not show a clear trend (Fig. 14). Concerning to the preparation of the student for the Career, there is a satisfactory trend about the theoretical knowledge, however in the practical knowledge the highest percentage of students (43.9%) graded 2 over 5.

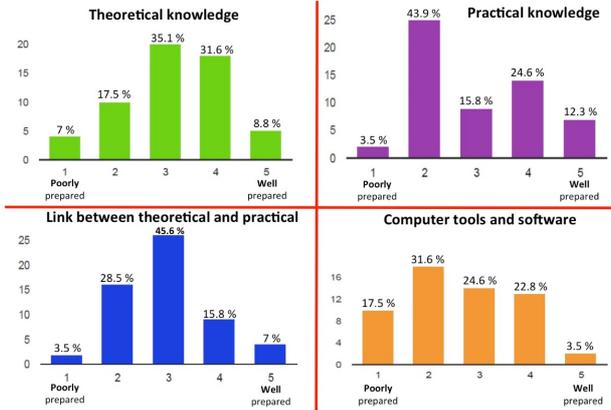


Fig. 15. Career: Theoretical knowledge, practical knowledge, link between both of them and computer tools and software. *How do you feel that the first three years in the biotechnology program prepare you for your career?*

This trend to low grade in practical aspects, somehow, is reflected in the link between theory and practice as well as in computer tools and software where the highest percentages of students graded between 3 and 2 over 5.

Clearly, the courses Gene Technology, Cell Biology and Microbiology are overlapped in information. In some cases the repetition of some information would be useful to enforce the knowledge of fundamental principles. Thus, one of the students has comment: "I think sometimes it can be good with repetition" (Fig. 13). On the other hand, Gene Technology and Cell Biology are courses highly overlapped in information, therefore, the contents of these courses should be revised. A majority of the students were satisfied with the theoretical knowledge both for their preparation for Specialization as well as for Career. However, regarding to the practical knowledge, there is some discrepancy: While a majority of the students were overall satisfied with the practical knowledge for the Specialization, there is an important group, representing 43.9%, have graded low (2 over 5) the practical knowledge for the Career. These results would suggest two groups of students with different point of view respect to the practical knowledge for their Career.

*E. General comments from the replying students*

The survey conducted in this study imply that the participating students generally are content with the bio-based education received at LTH. However, there are some issues that, according to the replying students can be improved. One of these things are the experienced unbalance where more Excel training would be appreciated on the account of the use of MATLAB.

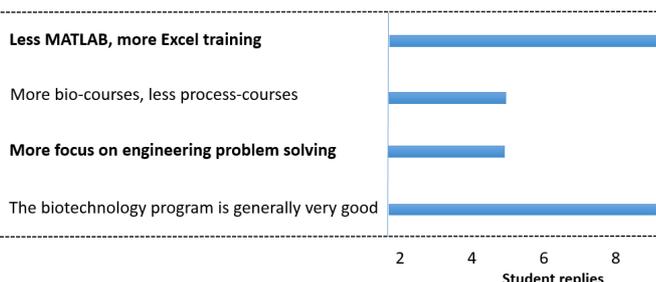


Fig. 16. General comments in the survey from the replying students.

It is also evident that the amount of bio-based courses could be increased on the account of the process-based courses given in the education program. Another issue that can be that can be discerned in the study, is the need for more traditional engineering problem solving. Clearly, a not insignificant fractions of the students have identified this issue as a key to success for the future.

*'I love the biotechnology program <3'*  
*'I think that the biotechnology program is good'*  
*'The education is in general ok'*  
*'I like everything'*

Fig. 17. A clear trend in the survey was that the replying students generally were pleased with their biotechnology education and the related Bio-track.

IV. CONCLUSION

This work shows that the majority of the students are overall satisfied with the educational focus of the first three years. The students recognize the need to have a deep knowledge in fundamentals of biology, chemistry and mathematics to continuing with the specialization in the next two years of the program and later on to work as Biotechnology engineers.