Course analysis

BB2165 Biomolecular Structure and Function HT22-1

Course name: Biomolecular structure and function	Cycle: 2
Course code: BB2165	ECTS credits: 7,5
Term: HT23	Study period: P1
Course coordinator: Christina Divne	Examiner: Christina Divne
Number of new students 2023: 100	Students passed (all modules): 93 (as of 2023-12-07)
Degree of examination: 95.3 % (as of 2023-12-07)	Answer frequency LEQ: 50%

About the course

The course is the first course in the two master tracks "Medical Biotechnology", and "Industrial and Environmental Biotechnology". Structural biology of biomolecules is a cornerstone in modern biotechnology. Students are offered theoretical and practical knowledge and insight about the foundations of biomolecular structure, and how the structure relates to function. The contents range from fundamentals in structural biology to contemporary research, and the precise topics are subjects of change to appropriately reflect the research frontier. Instructive computer-based exercises and a “real-life” project based on contemporary cutting-edge research offer a teaching concept that is highly interactive and practical to increase and deepen the perception and understanding of biomolecular structure-function relationships. The students acquire skills and tools to retrieve, use, understand, and validate structural biology information available in 3D structure databases. They acquire expertise about the interaction of biomacromolecules with ligands and how to predict the 3D structure of a protein with unknown experimental structure. The course has a high content of computer-based learning and makes extensive use of the Canvas learning platform. Importantly, the course uses continuous examination where knowledge and skills are practiced and examined throughout the course (Fig. 1).

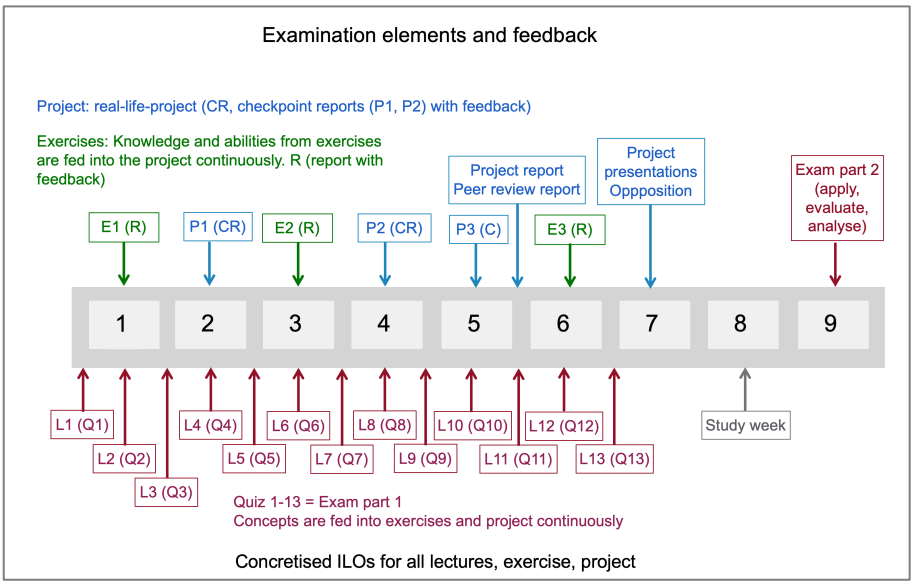

Figure 1. Scheme showing the process of continuous examination. The course weeks are numbered, and examination activities indicated by arrows. L=lectures, Q=lecture quiz, E=exercises, P=project, R=hand-in report. All examination activities have concretized intended learning outcomes that align constructively with the course’s ILOs.

1. Changes made for the course offering 2023 (based on analysis 2022)

- The 2022 students were very satisfied with the course and only some improvements were needed for the course round 2023.
- The importance of knowing the properties of amino acids for the final exam is emphasized from the start. Students should know the letter codes (one-letter or three-letter) and the principal properties of the amino acids, but do not need to be able to draw them.
- Some students wanted extended support for the PyMOL as software. This year it was made optional to use PyMOL for the project and tutorials were provided in canvas.
- The students wanted more relevant examples for the final exam, which was provided 2023.
- The canvas now also included guidelines for working with AI tools (chatbots etc.)

2. Summary of LEQ statistics 2023

From LEQ and comments, the 2023 course round was greatly appreciated and well received (Fig. 2; all students). The answer frequency was high for being an online questionnaire (50%).

Meaningfulness – emotional level
1. I worked with interesting issues
2. I explored parts of the subject on my own
3. I was able to learn by trying out my own ideas
4. The course was challenging in a stimulating way
5. I felt togetherness with others on the course
6. The atmosphere on the course was open and inclusive

Comprehensibility – cognitive level
7. The intended learning outcomes helped me to understand what I was expected to achieve
8. The course was organized in a way that supported my learning
9. I understood what the teachers were talking about
10. I was able to learn from concrete examples that I could relate to
11. Understanding of key concepts was given high priority
12. The course activities helped me to achieve the intended learning outcomes efficiently
13. I understood what I was expected to learn in order to get a certain grade
14. I received regular feedback that helped me see my progress
15. I could practice and receive feedback without being graded
16. The assessment on the course was fair and honest

Manageability – instrumental level
17. My background knowledge was sufficient to follow the course
18. I regularly spent time to reflect on what I learned
19. The course activities helped me to learn in different ways
20. I had opportunities to influence the course activities
21. I was able to learn by collaborating and discussing with others
22. I was able to get support if I needed it

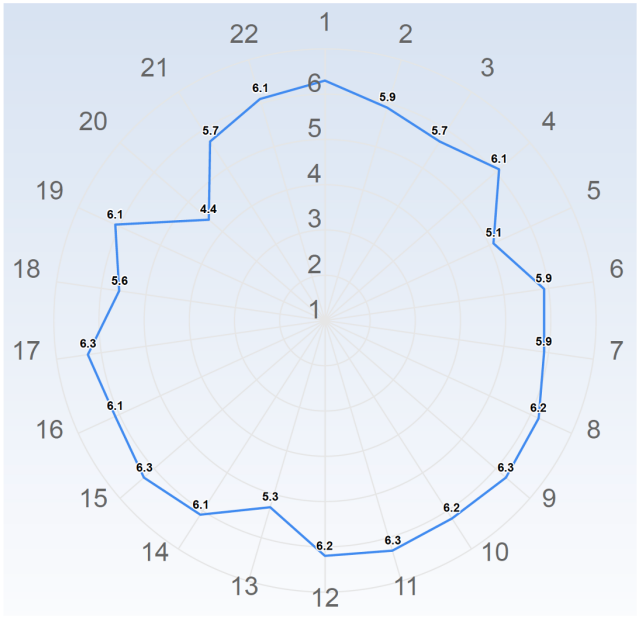

Figure 2. LEQ questions and spider diagram for 2023 (all students).

The reception of the course round 2023 is very similar to that recorded for 2022 and shows that the development actions implemented during the period 2021-2023 are reflecting a real and consistent improvement over time. All aspects (meaningfulness, comprehensibility, and manageability) score high, with the only exception being question 20 *"I had opportunities to influence course activities"*, which scored 4.4 – this is however still above average. The result is expected considering that the course is structured in detail to enable all learning outcomes to be reached by the end of the course.

It is rewarding to see that the following questions **scored >6**, which is very high:

1. *I worked with interesting issues*
4. *The course was challenging in a stimulating way*
8. *The course was organized in a way that supported my learning*
9. *I understood what the teachers were talking about*
10. *I was able to learn from concrete examples that I could relate to*
11. *Understanding of key concepts had high priority*
12. *The course activities helped me to achieve the intended learning outcomes efficiently*
14. *I received regular feedback that helped me to see my progress*
15. *I could practice and receive feedback without being graded*
16. *The assessment on the course was fair and honest*
17. *My background knowledge was sufficient to follow the course*
19. *The course activities enabled me to learn in different ways*
22. *I was able to get support if I needed it*

Additionally, the following questions **scored 5-6**, which is also very good:

2. *I explored parts of the subject on my own*
3. *I was able to learn by trying out my own ideas*
5. *I felt togetherness with others on the course*
6. *The atmosphere on the course was open and inclusive*
7. *The intended learning outcomes helped me to understand what I was expected to achieve*
13. *I understood what I was expected to learn in order to obtain a certain grade*
18. *I regularly spent time to reflect on what I learned*
21. *I was able to learn by collaborating and discussing with others*

As mentioned above, the only question that scored below 5 was no. 20:

20. I had opportunities to influence the course activities (4.4)

Course analysis

Since the course has a diverse student composition with program master students and international master students it is interesting to deconvolute the statistics based on this diversity, as well as based on disability to monitor that all students receive equal conditions, opportunities, and support. Based on the deconvolution of national/international students (Fig. 3), it is particularly interesting, and positive, to see that the international students scored 7 on interest in the course topic, and very high on how the amount of support they received, that the course was challenging in a stimulating way and several other aspects (highlighted in green).

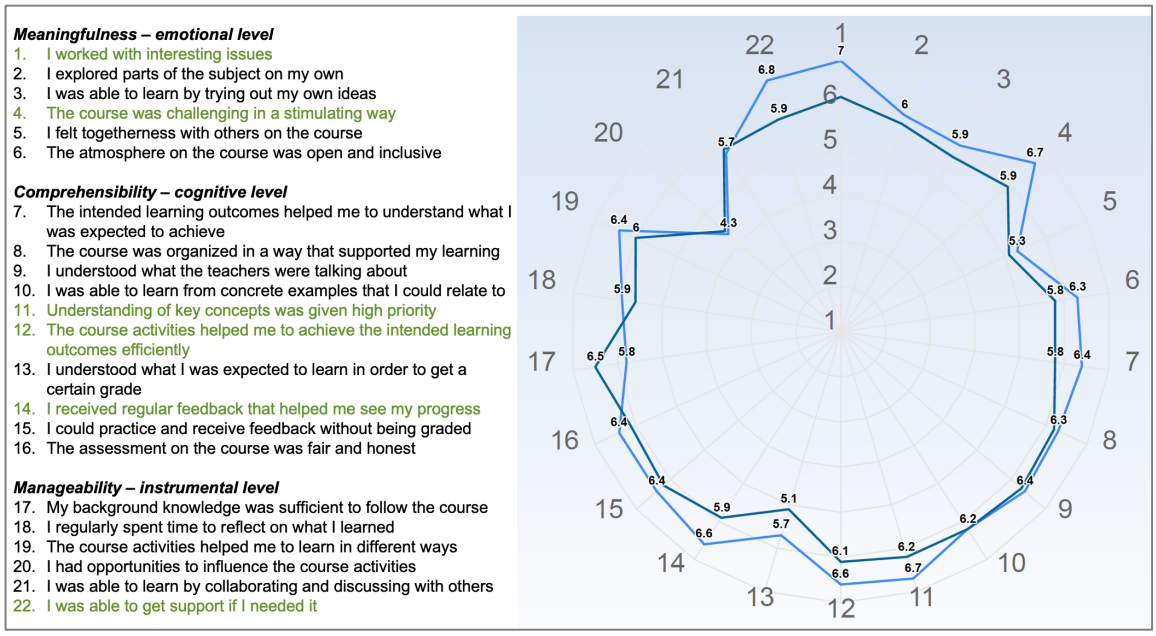

Figure 3. LEQ spiders for 2023 national (dark blue) and international (light blue) students. Questions that score particularly high are highlighted in green.

Inspecting the LEQ result based on disability (Fig. 4), a similar positive result (and even slightly more positive) is noted for students with disabilities compared with the result for all students.

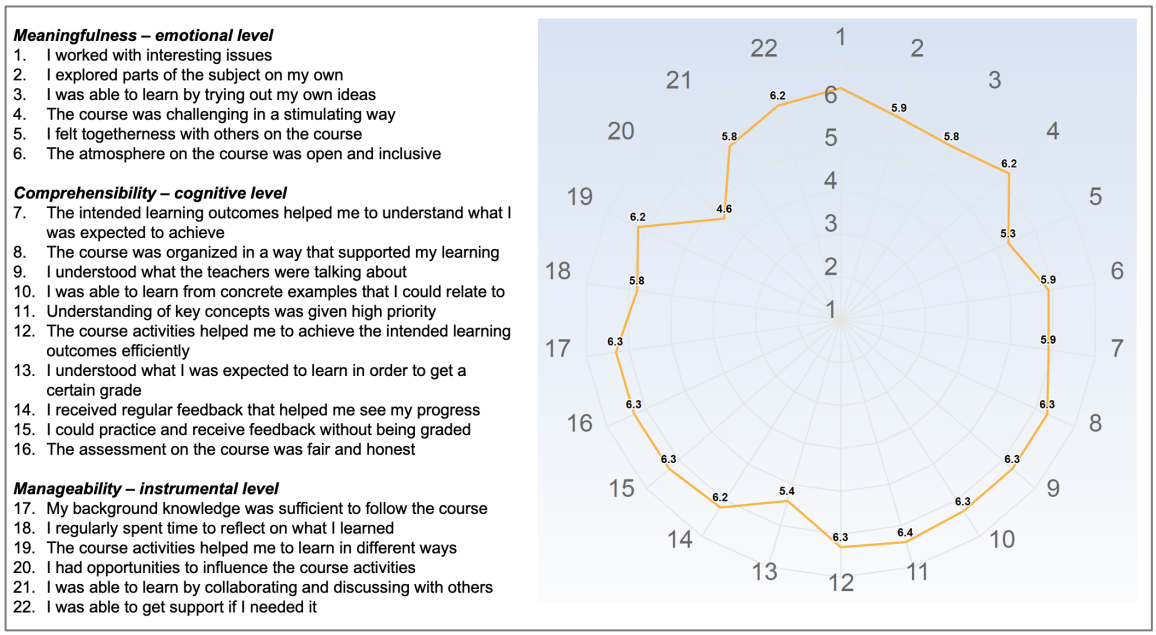

Figure 4. LEQ spider for 2023 based on disability. The results are very similar to Fig. 2.

To conclude, the results are very reassuring since I consider it to be of utmost importance that the course meets the needs for as many students as possible, regardless of disability or country of origin.

Course analysis

3. Summary of feedback from students 2023

   a. *Strengths of the course:*

   - Interesting topic/content.
   - Course organization, well structured.
   - Teacher support and feedback (quick response).
   - Hands-on – apply knowledge and skills (exercises and project).
   - Lectures on campus but available recorded lectures in Canvas.
   - Mandatory quizzes to help stay ”on track”.
   - Exercises helped to understand lectures.
   - The Canvas.

   b. *What can be improved:*

   - Clearer instructions for project (this was improved for 2023 but will be clarified more).
   - Extended support for PyMOL (some exercises may be possible to do with PyMOL).
   - Make navigation easier in Canvas (this will be changed).
   - Smaller project presentation groups (next year we will probably reduce the group to 6 students per group).
   - Extended support in class (hopefully we can have one more teacher next year).
   - All exam rooms should be at Albanova.
   - Sign-up for practical sessions did not work well (will try to find another system).

4. Teacher’s reflections

The continuous examination (Fig. 1) was greatly appreciated. The students appreciate the course topics and the interactive setup with coupled lectures exercises and project. They enjoy the real-life practical training enabled by the project to understand, validate, and use biomolecular structure data; and that there is a close connection to the research front of the topics covered, and implementation in the project. They also appreciate access to study sheets and study kinemages and the teacher support/feedback. This emphasizes that the course format is working well and that no major changes should be made for the next course round in 2024. Below a few student quotes from the LEQ comments that highlight the above:

- *I really liked the structure of the course, the mix of lectures, exercises and the project. In the lectures we learned the concepts, during the exercises we could train the concepts by ourselves but could get help from each other and from the teacher. And then for the project we used the concepts we had learned. I wish other courses had the same structure because I really feel that I learnt a lot during this course and that the structure of the course is very though through. I also really liked to be on site for the exercises because then you could get help from other students and teacher, you heard others asking the questions you also were wondering about and learnt through that. Much better than doing exercises on Zoom, please keep it this way! Also the self correction of exercises 1 and 2 were an excellent way to understand the concepts better, I wished more exercises in other courses would be done in the same way.*
- *I really appreciated the project, and the fact it was guided by the computer lab sessions and the teacher's feedback on the reports. I also enjoyed the diversity of the topics tackled in the course and the plurality of concrete examples that were used to illustrate them.*
- *I enjoyed that the course was very well planned and thought out. Every exercise and project session contained subjects that required own analysis and the type of critical thinking that should be applied when doing the project and the final exam. I also liked that we had the quizzes to examine 'easier' knowledge, and that you had endless opportunities to get full score within a certain time.*
- *The formatting of the exam was by far the best yet (I've taken the bachelors programme at KTH). It was captivating applying knowledge and somewhat solving problems and not just memorization of the course material*
- *As someone who's on their 5th year at KTH, this is by far the best course I have taken. I wasn't necessarily super interested in protein structures and this whole field before starting the course and therefore, as many times before, I dreaded the course start a bit because I was ready for it to be very hard and having no support from the professor (which unfortunately is often the case). However, I turned out to be SO wrong. Christina is the best professor I have encountered at KTH and it's not just that "she's nice etc" but it is very obvious that she makes a great effort in really TEACHING her students rather than just reading off of her slides and expecting us to know everything. The course is so well organized and thought-out and it is really designed to make you succeed. So really, it only depends on you as a student to make use of all the material and learning opportunities that are being handed to you and ask questions when needed (even via email because the response time is very fast).*

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- *I really feel that I learnt a lot of new concepts in this course and also to use the software KiNG. I'm sure that the knowledge on predicting reliable protein models will be very useful in the future for me. So, thank you very much for this course, I really enjoyed it!*
- *Christina Divne is a blessing and it is inspiring to see professors like her and i hope to be similarly invested in my field later in life*

Based on the students' suggestions of what can be further improved there are a few things that stand out as particularly important. First, the number of students had increased from 80 in 2022 to 100 in 2023. Being the only teacher in the course made it difficult for me to provide as much support and feedback as I would like to. Although the LEQ shows that the vast majority of the students were still receiving the support they needed (question 22 was one of the highest scorings with 6.8 of 7.0), it is important that the small number of students that felt they did not get enough support are listened to. I will discuss with the program director to see if there is a possibility to have additional help in the course round 2024.

Another issue related to the large increase in number of students is the access to stationary computers in RB33. Each exercise is already given four times to make sure that there is no crowding in the computer room, however, the system where students can sign up for the preferred session does not seem to work since there are some sessions that are overbooked and others with almost no students. The booking system needs to be improved somehow, and I will think of possible solutions.

Although the project instructions were improved for the 2023 round, there are still some students that wish to have further improvement of the instructions. I will investigate this and make necessary revisions.

As in the LEQ 2022, a few students prefer the PyMOL software over KiNG and want more of the computer exercises to be performed in PyMOL. For most students, PyMOL is a more difficult software to use and a lot more time would be needed to help these students. Furthermore, PyMOL is a quite licensed software which KTH would need to buy and install on the stationary computers, which is not within my power to decide. KiNG is free for everyone and is also specifically developed for education. I will consider to maybe reformat one of the exercises to use PyMOL instead of KiNG.