

Chemistry students write brief essays in mathematics reports, inspired by guest lectures on how mathematics is used in chemistry research

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Programme, course, programme level and number of students:

Applied mathematics for chemists (AnvMatKem), compulsory course in block 3 of the first year of the bachelor degree programme in chemistry. In 2015/2016 there were approximately 80 active students.

In what way is the course skills-oriented?

This is an auxiliary course. The students acquire mathematics skills and an understanding of the mathematical models they will use in the subsequent courses on the bachelor degree programme in chemistry.

Motivation for activity:

It can be challenging for first-year chemistry students in block 3 of the first year to see why they need mathematics, and thus to find the motivation to learn it. However, as early as in block 4 of the first year, and in the rest of the courses in the chemistry programme, they will need basic mathematics skills to follow the classes. It is frustrating for both lecturers and students when, as often happens, some students do not have the basic mathematics skills to complete assignments and experiments.

In addition, it becomes a challenge later in the programme if the students are not trained to argue and explain in writing why they use one equation rather than another.

By bringing in guest lecturers and assigning the students short essays, I wanted to give the students insight into how mathematics is used in the subsequent chemistry courses and in chemistry research in general. The hope was that it would motivate the students to acquire better maths skills and improve their writing skills.

Key learning objectives with focus on how the activity is research-based:

To teach the students how mathematics is used in chemistry research.

To develop the students' ability to ask guest lecturers academic questions.

To develop the students' ability to communicate a research problem in writing and without the use of equations and figures.

Description of activity: what do you do, what do the students do, and when?

How do you plan and carry out the activity, and do you follow up on it?

The course is divided into three modules, which are concluded with a report and a multiple-choice test. For each module I invited two guest lecturers (i.e. a total of six guest lecturers on the course) who are affiliated with the Department of Chemistry as researchers. I asked them to present results from their own research by focusing their presentations on a chemistry research problem related to the course, and on how they used mathematics to solve this problem. The lecture could be about how the weekly topic is used in chemistry research. For example: "How are eigenvectors and eigenvalues used in chemistry?"

Each guest lecturer gave a presentation lasting approximately 25 minutes, after which the students were given approximately five minutes to discuss the presentation with the person sitting next to them and prepare a question for the guest lecturer. For approximately 15 minutes, the students asked the guest lecturer questions, and the guest lecturer replied. In general, the students asked many questions, both professional and personal, for example: "Which molecule is best at harvesting energy from the sun?" and "Why did you choose to become a researcher?"

The students were asked to write a report after each module. Normally, the students have to solve mathematical tasks with a chemistry angle. This time, two essay assignments were included in each report. The titles of the two essays were identical to the titles of the module's two guest lectures. The students were allowed to use the guest lectures as inspiration for the essays or find examples themselves. The format requirements for the essay were that it must be 200-300 words long and only contain one equation and one figure.

Links between classes and exam, e.g. whether and how the exam type supports the type of instruction:

The guest lectures and the exam have linked up well. The students were asked to write an essay for each of the six guest lectures. The six essays count for 1/10 of the student's overall grade for the course.

The benefits of the activity for the students (purpose/effect):

A quote from the course evaluations: "It was great that maths was linked with the chemistry problems so that you always had a sense of what you had to use it for in the long term." In the course evaluations, the students mainly had positive comments to make about the guest lectures and their relevance to the programme. The majority of the students can see why mathematics is relevant to the bachelor degree programme in chemistry and how it is used in chemistry research problems.

In the essays, by far the majority of students used examples from the guest lectures. Approximately 20% of the students chose to do their own "research" using other examples in the literature that are available on the internet. Many used Wikipedia. Most chose topics that were related to their own interests within chemistry.

The benefits in terms of research:

The students considered the research results presented in the guest lectures and asked good questions about them and their relevance to the programme. In this way, the students considered and communicated other people's research, both orally and in writing.

The aim of the activity is to motivate the students to become better at writing and communicating their own research results when they do their (optional) research internships or the compulsory bachelor project.

Personally I have benefitted from the course by gaining greater insight into my colleagues' research.

Strengths and weaknesses of the activity:

Strengths: The students see early on that mathematics is relevant to chemistry, and can practise their writing in connection with chemistry research.

Weaknesses: Some students find it difficult to see a connection between the guest lectures and the essay. A quote from the course evaluations: "Sometimes it was hard to write an essay about what the guest lecturer had talked about because their focus was on their own research (which was also very interesting!). But the essay topic itself was barely covered in their presentation." In future I would take time at the end of the class to give examples of how the subject of the presentation related to the essay if it was not made clear during the presentation.

At first, some of the students were against writing essays, either because they didn't have strong writing skills ("we do not read Danish") or because they couldn't see the relevance of writing essays ("maths is about equations"). In my experience, however, the students generally understood the aim of it when they wrote the essays. Several of the students commented that writing the essays helped them understand that they need to have a certain level of maths skills to get the most out of the next courses in the degree programme.

Additional information (about the activity, links or other materials):

Keywords:

Research-oriented, guest lectures, essay.