Using mathematical modelling activities to motivate biology students to learn mathematics

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Over the last decades, mathematics has become increasingly important in biological research (e.g. Cohen 2004, Steen 2005). This obviously places new demands on the education of future biologists. However, many biology students lack interest and motivation for studying mathematics (Steen 2005). One way of increasing motivation suggested by several authors (e.g. Brewer & Smith 2011, Steen 2005) is by a greater integration of mathematics and biology in the curriculum. As pointed out by Brewer and Smith (2011), crucial to such integration is the notion of mathematical modelling. This paper reports on the ongoing pilot phase of a developmental research project (Goodchild, Fuglestad & Jaworski 2013) aimed at increasing biology students' motivation for, interest in, and perceived relevance of studying mathematics through the use of mathematical modelling.

The pilot phase consisted of meetings with 12 first-year biology students from the University of Bergen on four occasions during the autumn of 2015. We will also present some data from a pre-pilot conducted with 10 students at one occasion in April 2015. The three-hour meetings took place in parallel with the one compulsory mathematics course included in the undergraduate biology program. (This course is a general-purpose course catering to a large number of different programs.) In the meetings a mathematician skilled in mathematical modelling and with extensive teaching experience worked with the students, presenting them with modelling tasks intended to bridge the gap between mathematics and biology, on which the students then worked in groups. Tasks included, for instance, estimating the population density of rabbits in an area based on the number of road-kill rabbits along a stretch of highway. All sessions were video-recorded. At the beginning and end of the first session we also distributed questionnaires consisting of likert scale (1-5, 5 being the most positive) and open items and aimed at exposing the students' attitudes towards mathematics and its role in biology, as well as their response to working with mathematical modelling tasks in biological contexts and how this might affect their motivation to pursue studies in mathematics. It is the results of these questionnaires that will be the focus of this short paper. We are well aware that the groups are very small, and that the results can only serve as indications of topics worthy of further research.

On most items of the initial questionnaire, the pilot and pre-pilot groups display similar results. They rate their enjoyment and competence in mathematics as relatively low, and the importance of mathematics in biology somewhat higher. This similarity makes the difference on the question concerning the relevance of their mathematics course to biology all the more noticeable. The pre-pilot group, who were halfway through their second semester, rated the relevance much lower (2,1 on average) than the pilot group (3,33), who had only just started their mathematics course. Although there can of course be many reasons for this difference, the question of whether the general-purpose nature of the mathematics course might negatively influence students' opinions of its relevance does suggest itself, and this is something that we would like to investigate further.

In their responses to the second questionnaire, again the students in both groups showed similar results. They found the activity interesting, enjoyable and highly challenging. Furthermore they reported that the activity had contributed somewhat to their understanding of mathematics, biology, and (to a higher degree) the applications of mathematics in biology. Also their rating of the importance of mathematics in biology had increased. There was a small indication (4,4 compared to 3,83) that the pre-pilot group responded more positively to the question of whether similar modelling activities would be useful in their regular mathematics courses. Again, there may be many reasons for this difference, but the very positive response from the first group, in conjunction with their low perceived relevance of the compulsory mathematics course, could be an indication that the incorporation of mathematical modelling activities might have a positive effect on students' attitude towards the subject, and we take this as an indication that continuing the project on a larger scale might be worthwhile. Also, we have yet to analyse the data from the actual sessions. These analyses will focus on the development of students' mathematical modelling competencies, as well as on the development of their mathematical discourse.

References

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