Study tips – to beginner students in mathematics-heavy sciences

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ABSTRACT: Through our work with teaching and learning mathematics at university level, we experience that students can benefit from tips on how to study, and in particular how to study mathematics. The Department of Mathematics at the University of Oslo (UiO) published in autumn 2016 a booklet entitled “Studietips – til begynnerstudenter i matematikktunge realfag” (Study tips – to beginner students in mathematics-heavy sciences). It was handed out to the beginner students at the Faculty for Mathematics and Natural Sciences (MN) and published on the web for anyone to use.

The booklet gives good advice on how to study, in particular how to study mathematics, and on life as a student. It is based on surveys conducted amongst older students, on our experiences teaching and supervising beginner students and earlier work on study tips and mathematical thinking.

We have also given a seminar on study tips for the students. Prior to this seminar we sent out a “study tips survey”, giving the students the opportunity to reflect upon how they work with mathematics. The answers to the survey revealed that many beginner students reflect very well and have good intentions about their studying. However, we were also able to make some students reconsider their thoughts.

In this paper we will discuss the study tips and the “study tips survey”. In particular, we will consider some of the challenges one faces in the transition between upper secondary school and university when it comes to teaching and learning mathematics.

1 INTRODUCTION

In our experience, students can benefit from tips on how to study, and in particular from tips on how to study mathematics.

This was also pointed out in the national mathematics survey conducted by the Norwegian Association of Higher Education Institutions (UHR) in 2013 amongst university and university college teachers and beginner students in mathematics [2]. One of the beginner students said the following regarding the transition between upper secondary school and university (translated):

The biggest problem is not that the mathematics one learns is difficult, but rather that one has no experience with the workload and the ways of working at the university. If the students aren’t prepared that one has to work differently and a lot more than one did in school, things can go wrong.

In this paper we report on a “study tips project” for beginner students in mathematics-heavy sciences at UiO consisting of:

- a booklet
- two surveys – one to older students and one to beginner students
- a two-hour seminar to beginner students, which was given and adjusted to various study programmes

Autumn 2016 we published a booklet in Norwegian on study tips for beginner students in mathematics-heavy sciences [1]. In the introduction we emphasise that many students feel it would be nice with some help to start their studying. We also say that it takes time to find new ways of working, and it will often involve struggle and frustration. The booklet contains good advice that might help the

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students to succeed with their studying. It was handed out to the students attending the seminars and to anyone we thought might find it useful.

As part of the work on the booklet, we sent out a survey to older students (in their second year) asking them for advice and comments on their studying, and the booklet contains many student quotes, e.g. (translated):

Probably, there are many people besides me who are used to learning things easily, and are a bit surprised that some subjects suddenly appear difficult. It is important not to give up when subjects start becoming difficult even though one is not used to it being like that. The subject matter will mature towards the exam, and it will suddenly become easier than it was in the beginning.

We gave a two-hour seminar on study tips to the beginner students at MN, UiO in the beginning of their first term (autumn 2016). A couple of weeks before the seminar the students received an online survey. The survey to the beginner students had two purposes; one was to make the students start thinking about their study habits, the other was to give us relevant and fresh data to present at the seminar. We also used data from the survey to the older students in the seminar. The survey to the beginner students and the seminar were adjusted and given to various study programmes, and we ended up giving 15 two-hour seminars in August and September. In the seminars we talked about strategies (when it comes to studying, in particular mathematics) and structure (in the day, week and term). The students spent quite a lot of time being active in the seminar, and we had time to interact with the students.

We would like to point out that we have not tried to make this study tips project into a research project as such (at least not yet), but we feel that we have many experiences from this project that others might benefit from. Hence, we don’t present the results as statistically significant – although we do have a few numbers to share – but rather we present the methods we used and our reflections on why, and share results and experiences from these actions. Finally, we have some concluding remarks.

2 METHODS, REFLECTIONS AND RESULTS

The booklet on study tips contains the following sections (translated):

- How to study mathematics
  - Thinking about thinking
  - How to read exercises/mathematics
  - How to solve exercises
  - How to present solutions to exercises
- The everyday studying
  - Individual work
  - Lectures etc.
  - Mandatory assignments
  - Study groups
  - Web resources and the library
  - Exam
- Life as a student
  - Plan your day
  - Where to find help

The booklet is based on our experience with talking to, teaching and supervising beginner students. It contains material on what we feel and see that the students might need in order to take responsibility for their own learning, i.e. we have tried to pinpoint some “invisible knowledge”.

As a part of this project, we sent a survey to older students. This survey contained questions on how much time they spent on various learning activities (such as reading course material, attending lectures and classes, doing self-driven course activities and preparing for the exam), and they were asked to evaluate the different learning activities in terms of experienced learning outcome.

We also asked the older students the following questions: “If you had a time machine and could travel back and meet yourself at the beginning of your first term, what advice would you give to yourself
when it comes to ways of studying and working?” and “If you had the opportunity to give a good advice to the students who start this term, what would you tell them?” We asked both these questions, as we experience that we often are more firm and honest when it comes to giving advice to ourselves – hence we often get different advice from these two questions. One of the students gave the following advice (translated): Another useful reading technique is that one does the heavy stuff early in the morning.

As a preparation for the study tips seminars, we also sent a survey to the beginner students. The seminars were attended by most of the beginner science students in mathematics-heavy study programmes at UiO autumn 2016 (365 students). The seminars and the surveys were adjusted to the individual study programmes (physics, geosciences, chemistry, mathematics, science teacher programme etc.). We aimed at having around 30 students and two lecturers in each seminar, and so we ended up with four people giving 15 seminars in total – some in parallel.

One of the intentions behind the survey to the beginner students was to make the students start preparing for studying by giving them some questions to think about. The survey included questions such as:

a) What is your school/study/mathematics background?
b) How do you work with mathematics?
c) What are the most/least useful ways of working when learning mathematics?
d) Do you work alone?
e) How much time do you spend on a mathematical problem before you give up?
f) How long do you dwell on the problems you solve?
g) Where do you find help when you are stuck?
h) What advice would you give to your fellow students?
i) How many subjects do you plan to study this term?
j) How much time do you plan to spend on your studies?

Since all science students at MN, UiO have a mathematics course in the beginning of their bachelor programmes, it was natural to focus on mathematics. In the seminar we used both the survey to the older students and the survey to the beginner students as a basis for our presentation. We could then present and compare the results and mix in our own advice along the way, and make some reference (and transference) to the various other subjects.

The responses to the various questions to the beginner students had a rather big variation, although the focus was on studying mathematics in particular. This makes it difficult to draw any statistically significant conclusions from our material (over 200 student responses). However, we are able to see certain trends. Also, it was very valuable to present these results to the students – they were then able to see what their fellow students (sitting in the same room) had answered on the various questions.

The survey showed that 70-80 % of the students work alone (cf. question d). One of activities we emphasised and encouraged during the seminar was to have the students form study groups (“kollokvier”). The survey also showed that quite a few students planned to spend too little time on their studying – in our opinion (cf. questions i and j). In most of the study programmes, over 50 % of the students answered that they planned to spend less than 35 hours a week on their studying.

On the questions related to how the students work when learning mathematics (cf. questions b and c), most students answered that they mainly read the text book (in particular, the examples) and solve exercises (with emphasis on the latter!). A few students mentioned making summaries, and even fewer working through the proofs. Solving exercises was given as the most useful way of learning mathematics by almost all students. In addition, they mentioned activities like following the lectures and working with the material afterwards, working with theory, examples, exercises over and over again – in general, being active in the learning process. Some of the least useful ways of learning that were mentioned were just reading, cramming and watching others work – being passive.

We didn’t have a separate question on preparations for lectures etc. to the beginner students. But the older students gave this as an advice, which we then could point out at the seminar; to come prepared for the various learning activities. In particular for the group sessions (“gruppeundervisning”) offered to the students – the place where the students are expected to be active. This is also related to the recent survey conducted by the Norwegian Agency for Quality Assurance in Education (NOKUT) in
2016 amongst the scientific staff at various higher education institutions [3]: One of the results from this survey show that the teachers are not satisfied with the students’ working effort in their studies, in particular, they are not satisfied with the students’ preparations for the teaching activities.

On question g (Where do you find help when you are stuck?), most of the students answered “ask somebody (a teacher, fellow student, parent), search the web, read the text book”. The older students’ advice was to read alternative literature. One of the answers was (translated) go to sleep, try something different and come back in a week. This answer is related to the question on how much time you spend on a mathematical problem before you give up (question e). The beginner students said that they usually spend 5-30 minutes before they give up. This question was also given to the older students, and we saw a trend that the older students were willing to spend more time on a problem than the beginner students. This has probably to do with the fact that the students are not used to working for a long time on a problem in school mathematics. This is one of the things the beginner students need to be made particularly aware of – when they start studying, it is important to realise that “things take time”. The students answering the survey did say that it is important to dwell on a problem.

Another part of the seminar was working with mathematical problems on their own and in pairs (an activity that was related to the questions above). We spent a considerable amount of time on one problem in particular. The problem text we used in most of the seminars introduced a machine that produces numbers according to certain rules. The students were set exercises that required them to find out how the machine works. This did not require a lot of prior knowledge in mathematics – in fact it is a possibility that the problem might have been easier to handle without too much prior knowledge – but it did require understanding the text.

The reason for choosing such an exercise was to challenge the way the students think when they meet a mathematical problem [4] – to make it relevant to the subject they are studying. We wanted to make the students conscious of the fact that they need to spend time to understand a text, and that it is important to read and discuss what the text actually says. The students had to work a long time with understanding the problem with the machine. We experienced that many of the students misunderstood, and we had to ask them to read it again. Even then, many of the students weren’t 100% sure they understood, and asked questions like “Does this sentence still apply?”, which indicates that they had lost the overview of which rules that applied in the problem. – When you are stuck on a problem, be sure that you don’t carry with you any irrelevant information, and remember that you can always go back to the source (definition) to see what to do. It is important to ask yourself questions when trying to solve a problem, e.g. “What are you doing?”, “Why are you doing it?”, and “How is it going to help you?” [4].

In the seminar we also talked about planning the students’ everyday – including studying, exercising, socialising, etc. We made the students start filling out a plan for their week and for their whole term. This turned out to be an eye-opener to many of the students, as they realised they might not have time to do all the things they had planned. Hence they had to start prioritising their workload. Towards the end of the seminar we could also present advice to the students from the fellow students sitting in the same room, e.g. (translated): Do exercises with others and have fun! Don’t accept that you can’t do an exercise, ask for help.

In general, we experienced that the students were satisfied with, appreciated and saw the relevance of the seminar and the booklet on study tips. In the evaluation of the seminar, the students commented that they had found the study tips very useful and interesting, that it was very good to get tips on how to work as a student, and that they had realised that “no one has perfect study habits”. They also found it useful to get some help to organise and plan their day and week – one of the students said that (translated) the structure of my study plan was much worse than I thought. Also, they realised that it was important to create good study environments, and as one student put it (translated) study groups are a must.

However, we did experience that the commitment from the students and the degree to which we managed to reach out to the students varied. For one thing, we believe the seminar can be improved further by replacing the mathematics problem with a problem related to the respective study programme – at least for some of the programmes. In that way, one can use such a seminar to introduce the students to the various subjects’ way of thinking alongside giving tips on how to study.
We might not have taught the students too much in a two-hour seminar, but it was an attempt to make the students more conscious about their future studying. That is also why it was very good to have a booklet to hand out after the seminar; the students could then study this more carefully after the seminar and hopefully find more useful tips. We also believe that this project would have an even better impact if we could follow up the seminar by a “revisit” a few months later.

3 CONCLUDING REMARKS

We have experienced that it is important to tell the beginner students some of the things we see in the transition from upper secondary school to university when it comes to teaching, learning and working. We are never sure whether we have picked out the right “invisible knowledge” to give to the students, but we feel that the booklet and seminar is very relevant to mathematics studying in particular.

By using advice from older students, the beginner students have the opportunity to learn from others. We hope that we have helped in starting a process within the students when it comes to study habits, and that they don’t need to copy others, but can find their own way. “It’s not just what you know; it’s how, when and whether you use it.” (Quote from [4].)

As one of the students said after the seminar (translated): It is important to be structured, and not to give up even though it is difficult.

We also hope that you feel you can benefit from our experiences. Please let us know if you have been inspired and try out similar activities with the students. We would very much like to hear and discuss your experiences.

4 ACKNOWLEDGMENTS

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