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Math-Bridge

Report on user feedback collection process and results (final version)

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e*Content*plus

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[1] OJ L 79, 24.3.2005, p. 1.

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Contents

1 Introduction

In the first part of the deliverable *D-8.2 Report on user feedback collection process and results*, the feedback instruments of the Math-Bridge project as of May 2010, the implementation of the feedback collection process and its relation to the procedure in other projects were described.

In this final report on user feedback, we update the information about feedback instruments (in particular, the feedback questionnaires have been modified) and outline the feedback received by the users of Math-Bridge.

Section 2 describes interviews with representatives of university courses, i.e. experts who gave important feedback on the system, its presentation and its content. After an outline of the interview design we present, for each interview, the key statements of the interviewees and give a summary of their comments useful for Math-Bridge. The full transcripts of the interviews with university courses are contained in the appendix (separate file).

Section 3 deals with feedback from students. After presenting the revised feedback questionnaires, we describe the particularities of the various bridging courses held in the framework of the project and present the most important results of students' feedback. Next, we deal with correlations and dependencies among data representing users' judgments and the setting of the courses. Finally, we address the instrument of social feedback (feedback buttons) by which users my rate individual learning objects.

In Section 4 two local studies relevant for Math-Bridge (by Kassel/Paderborn and OUNL) and their results are presented.

In Section 5 we draw conclusions for the future of Math-Bridge.

Throughout this report we will use the following abbreviations for the project partners' institution:

- **ELTE** Eötvös Lorand University Budapest
- **KS** University of Kassel
- **OUNL** Open University Netherlands
- **PB** University of Paderborn
- **TUT** Tampere University of Technology
- **UC3M** Universidad Carlos III de Madrid
- **UCBL** Universite Claude Bernard Lyon
- **UM2** Universite Montpellier 2
- **UV** University of Vienna

We use cursive type to indicate direct quotations from interviews or personal reports.

2 Interviews with representatives of university courses

In summer 2011, a number of interviews with representatives of university courses have been performed. In the following we summarize the most relevant information from these interviews, the full transcripts can be found in the appendix. Throughout this section, citations are indicated by cursive type.

2.1 Interview design

The interviews were provided by the partners from UM2, OUNL, KS, and TUT. All interviewees have personal experience in teaching mathematics in bridging courses. The interviews started with a few questions on the teaching experience of the interviewees and their personal opinion on e-learning. Then the interviewer gave a short introduction into Math-Bridge and let the interviewee test the system. After that, the interviewees were asked for their first impression of Math-Bridge and for comments on the usability and functionality of the system. All interviews were performed between May 30 and June 20, 2011. At that time, some functionalities of Math-Bridge were still not stable enough to be presented to the interviewees. Thus the interviewees could only see parts of the system and encountered some bugs that are now fixed. Moreover it is impossible to explain the whole system in detail within half an hour. Therefore the interviewees were in general not aware of all features included in Math-Bridge and had only seen a couple of learning objects. Nevertheless, some very useful critical comments could be extracted from the interviews.

2.2 Interview 1: Germany (performed by KS)

Date: June 16, 2011

Interviewee: Lecturer at the University of Kassel

Teaching and e-learning experience of the interviewee The interviewee has first gained teaching experience as a tutor for mathematics. She is now giving bridging courses to students aiming at a teaching degree in mathematics for secondary schools. As typical deficits she mentions calculating with fractions, trigonometric functions and weak skills in geometry.

Personal opinion on e-learning technologies The interviewee uses e-learning components in her own bridging course, which she would classify as a blended learning course with a high level of compulsory attendance. She is not very convinced of e-learning as a replacement for traditional courses, but appreciates such technologies as supportive material. However she does not think that e-learning is really necessary in teaching mathematics.

Summary and useful comments for Math-Bridge The interviewee likes the concept of an adaptive learning system. However, she would like to have the opportunity to see all content in the system, including those parts the system does not classify as appropriate for her educational level. She appreciates the ability of the system to recognize intermediate steps in the evaluation of exercises performed by a learner. The interviewee is concerned that the book generation is too complicated and takes to long. Users might not create their own courses when this process requires too many clicks or too much time. She suggests to organize the content a bit more and to implement more interactive features[2]. Altogether the interviewee would be interested in using Math-Bridge in her own course, as soon as the system is ready.

[2]Meanwhile there are many interactive exercises and examples in the system.

2.3 Interview 2: Germany (performed by KS)

Date: June 15, 2011

Interviewee: Lecturer at the University of Kassel

Interview/translation by: Pascal Fischer, University of Kassel

Teaching and e-learning experience of the interviewee The interviewee has been teaching freshmen in bridging courses since 2007. He has never taught at schools, but has been giving private lessons to pupils for many years. His experience is that first semester students often do not even have most basic skills in algebra.

Personal opinion on e-learning technologies Although he uses e-learning material in his own course, he has doubts on the usefulness e-learning technologies in teaching mathematics. His main concern is that studying by means of e-learning courses requires a high level of self-discipline not many students have. He has a some experience with e-learning software, but not with any adaptive e-learning system like Math-Bridge.

Summary and useful comments for Math-Bridge In the interactive exercises in Math-Bridge, he likes the possibility to get hints, especially that there are hints for intermediate steps as well. He would recommend Math-Bridge as supportive material for bridging courses.

2.4 Interview 3: Netherlands (performed by OUNL)

Date: June 15, 2011

Interviewee: Senior lecturer at the Department of Quantitative Economics, Maastricht University

Interview/translation by: Léon M.H.E. Driessen, Open University Netherlands (OUNL)

Teaching and e-learning experience of the interviewee The interviewee has been teaching mathematics on a university level for more than twenty-five years. Moreover he was involved in setting up a new curriculum based on the idea of problem driven education. At his faculty all courses are held in English. For freshmen the faculty offers an online summer course in mathematics. This course is based on the e-learning software ALEKS[3].

Personal opinion on e-learning technologies The interviewee has a positive view on e-learning systems and he is also optimistic for the future development of e-learning technologies. He points out that e-learning systems are necessary to offer students individual learning paths in bridging courses. As a disadvantage of e-learning methods he refers to the fact *that there is less close contact between the tutor and the student and hence students need to have a strong motivation to keep themselves on track.*

[3]ALEKS stands for Assessment and LEarning in Knowledge Spaces and is commercial e-learning system.

Summary and useful comments for Math-Bridge

- What an e-learning system should provide: *The advantage of using e-learning systems is that you can find out which items each individual student understands and which not. In that process diagnostic tests are very important, and hence are crucial in each e-learning system. Next you can point the student to theory and exercises that exactly match his individual needs. These individual learning paths are only possible with digital tools.*
- On the mathematical content available in Math-Bridge: *Advantages of the commercial e-learning systems that we are using (like ALEKS, see www.aleks.com) are that they are very consistent, systematic and structured. If multiple different individuals or institutes contribute to the contents of an e-learning system like Math-Bridge, then everybody adds what he or she likes, and the end-result will become eclectic, rather unpredictable. Some topics are covered well, some topics just slightly, some subjects are dealt with differently by different parties, and some items are offered in contexts, other items are only dealt with in pure mathematical exercises. In particular weak students do need a clear structure. That is what is lacking in Math-Bridge as far as I can judge it by now.*
- On the exercises contained in Math-Bridge: *The individual exercises in ALEKS and those in Math-Bridge are very similar. But it is important to be able to easily select an ordered set of exercises that properly covers a subject to the required level of quality and difficulty. It is not clear to me how to do this in Math-Bridge. Proper feedback is a prerequisite too. If someone enters the wrong answer to an exercise, then the feedback "The answer is wrong." does not help that much. What is required is information about what is wrong in the answer and why, possibly with a hint how to improve the answer or with a link to the text (book) where to find the appropriate theoretical background.*[4]

2.5 Interview 4: Netherlands (performed by OUNL)

Date: June 17, 2011

Interviewee: Lecturer at Delft University of Technology

Interview/translation by: Léon M.H.E. Driessen, Open University Netherlands (OUNL)

Teaching and e-learning experience of the interviewee The interviewee has eighteen years of teaching experience, mainly in mathematics. During the last eight years he has been concerned with the organization of a refresher course for first year students. In this context he got interested in e-learning systems and soon got more and more involved in this topic: *I joined a group of mathematicians that started SIGMA*[5]*. The first SIGMA conference resulted in the NKBW-project*[6]*. I participated in this NKBW-project and its successor TELMME*[7]*. Delft is not involved in the new SURF-project ONBETWIST (improve teaching with mathematical exams, see www.onbetwist.org).* At the interviewee's faculty, three different e-learning systems are used: *TELMME, MUMiE*[8] *and MapleTA.*

Personal opinion on e-learning technologies The interviewee points out that the way students use e-learning materials differs from the structure of a classical course: *Students do not follow a digital*

[4] Math-Bridge contains many exercises for which the system gives exactly such specific feedback, e.g. the exercises provided by OUNL.

[5] Special Interest Group Mathematical Activities, see http://www.surffoundation.nl/nl/themas/innovatieinonderwijs/sigs/Pages/Wiskundeaansluiting.aspx.

[6] NKBW stands for Nationale Kennisbank Basisvaardigheden Wiskunde (, i.e. National Database basic skills Mathematics, see www.nkbw.nl.

[7] Technology-Enhanced Learning of Mathematics for Masters Education, see www.telmme.nl.

[8] Berlin University, see www.mumie.tu-berlin.de/math/public/local/index.html.

course line by line from the start. They hop through the material and if they see something they want to know more about they expect a fast link (e.g. hyperlink) to that information.

Summary and useful comments for Math-Bridge

- On the course generation within Math-Bridge: *From what I have seen, I cannot really judge how difficult it will be for a lecturer to assemble a course, a book, from the available material. But it should be very easy to find the material that he needs for his course.*
- On the mathematical content available in Math-Bridge: *It seems to me that all parties at random add the content they like, slightly chaotic. If the international parties come together to consider the contents, then Math-Bridge has a real advantage compared to commercial systems: one has an influence on the way material is presented..*

His overall conclusion is that the ideas are fine, but the implementation not yet.

2.6 Interview 5: Netherlands (performed by OUNL)

Date: June 20, 2011

Interviewee: Lecturer at Eindhoven University of Technology

Interview/translation by: Leon M.H.E. Driessen, Open University Netherlands (OUNL)

Teaching and e-learning experience of the interviewee The interviewee has been teaching mathematics for more than twenty years on various levels and for several faculties. Moreover he has been doing research on e-learning technologies for mathematical content and was involved in developing a system similar to ActiveMath. He joined the NKBW-project six years ago and he is currently leading the SURF-project ONBETWIST.

Personal opinion on e-learning technologies *The advantage of an e-learning system is that you can present your material to interested people at any moment in time, and provide feedback on what they are doing. The feedback can be as simple as good/wrong, but preferably it is much more advanced. Providing intelligent feedback is by far the most important aspect of an e-learning system. Standard books, in paper, do not offer feedback. An e-learning system cannot replace the human teachers, but it is a valuable addendum to the normal interaction between students and teachers. We should use e-learning systems because of the benefits they offer and not blame e-learning systems for what they do not (yet) offer. An e-learning system is an add-on. You may learn basic skills from it, but not all concepts. Learning and understanding the concepts can be done later. An e-learning system must at least fulfill the following requirements:*

- *A perfect rendering, presenting mathematics in an attractive way.*
- *An easy and simple way to specify mathematical input.*
- *Intelligent feedback, matching the actions of the user in the best possible way. It is a very important aspect, though difficult to achieve.*
- *Many many exercises. Theory can be found in books.*
- *"Nice to haves" are interactive applets for playing around with functions and graphic drawings.*

Summary and useful comments for Math-Bridge

- On the complexity of Math-Bridge: *In Math-Bridge many of the features that you see in e-learning system are combined. That is good, that is an advantage. But a risk too! If a single part is not running well, then – with a high probability – the students will dislike the entire system. It is very difficult to develop and maintain a system that can do that many things. It should be possible to tune the system to the particular usage or users. Different courses do have different requirements. And the set of features that you want to offer depends on the maturity of the user. Hence it is important that features can be switched on and off.*
- On the multilingualism of Math-Bridge: *Multiple languages can be useful, but I do not attach much value to it. Students should be able to do everything in English. Most lecture notes are written in English. Master courses are in English. I do believe that within a few years all university courses are in English. And that is fine! Students need to be able to express themselves in international settings. Feedback is most important! Actually all exercises should be supplied with intelligent feedback. The focus should be on providing feedback, not on multiple languages.*
- On the evaluation of exercises in Math-Bridge: *What I miss in Math-Bridge are marks, real marks expressed in digits, not in color codes. Marks, even per exercise. Concrete feedback, that is what students like.*
- On competitive products: *The current commercial systems are not that versatile, but they do have a clear focus. And what they do, they do it well. Math-Bridge has many opportunities, but it will cost a lot effort to put it all together and to bring it all to a high level.*

In total, the interviewee appreciates Math-Bridge as an appealing and admirable project, yet he is also a bit skeptical: *I am in favor of Math-Bridge, but I do have my doubts regarding certain choices. What bothers me is that I do not hear that much from or about the project. The website shows little information.*

2.7 Interview 6: France (performed by UM2)

Date: May 30, 2011

Interviewee: University lecturer
Interview/translation by: Alice Ernoult

Teaching and e-learning experience of the interviewee The interviewee taught tutorial classes in mathematics with Math-Bridge. His students were studying geology.

Personal opinion on e-learning technologies The interviewee likes the playful aspect of e-learning technologies, e.g. to plot a function, change a certain parameter in the formula and see how the graph of the function changes.

Summary and useful comments for Math-Bridge The interviewee has supervised a tutorial class using Math-Bridge. He has the impression that the software is not finished yet. His students were working on interactive exercises in Math-Bridge. The evaluation of some interactive exercises was incorrect - *it's irritating when you give the right answer and it says it's wrong.* There were still many bugs in the system, which was the major reason why the students did not like it very much as they got frustrated very quickly. However, he would use Math-Bridge regularly if all the bugs would be eliminated and if the content would be well organized. *It is a good tool but there should be less bugs so as to make it work well.* Moreover he has the impression that it is rather complicated to generate new exercises within Math-Bridge possibly making the system a bit less attractive.

2.8 Interview 7: France (performed by UM2)

Date: June 17, 2011

Interviewee: University lecturer

Interview/translation by: Alice Ernoult

Teaching and e-learning experience of the interviewee The interviewee has been teaching mathematics at universities since 2005.

Personal opinion on e-learning technologies The interviewee appreciates software like Maple or Mathematica that helps checking calculations. She is not sure about the value of using software to learn mathematics. However, she likes the idea of adaptivity of such a system. In her opinion it is important that adding new content to an e-learning platform is always easily possible.

Summary and useful comments for Math-Bridge The interviewee has supervised a course using Math-Bridge. She mentions problems of the system to manage the work of several students at the same time. The system crashed when there were more than twenty students working on the same exercise simultaneously. To use Math-Bridge regularly for bridging courses, a permanent support for the system has to be provided in order to eliminate bugs. She says that the content was not so clear organized. Students could not find the things they were looking for so easily. The formula tool was not so easy to use, the students had problems with finding the right symbols when entering formulas.

2.9 Interview 8: Finland (performed by TUT)

Date: June 13, 2011

Interviewee: University lecturer

Teaching and e-learning experience of the interviewee The interviewee has been working as a teaching assistant since the middle of the nineties. He was only teaching at universities and no other subjects than mathematics. His personal impression is that almost every student has difficulties with basic school mathematics and therefore bridging courses are very important and participation should be compulsory.

Personal opinion on e-learning technologies The interviewee has been using Moodle, but has not much experience with e-learning platforms designed especially for mathematical content. In his view, a mathematical e-learning software should contain many exercises on most elementary algebra skills. These basic exercises may then be done by the students online while they are at home.

Summary and useful comments for Math-Bridge The interviewee is skeptical about Math-Bridge. He spent some time with testing Math-Bridge and got the impression that it is "nowhere near ready" and that the content appears rather disorganized. He likes the possibility to switch to another language. The interviewee would like to be able to create his own interactive exercises within Math-Bridge. He suggests to make the content more coherent and to provide a short tutorial with examples for users logging in for the first time[9]. He does not like the approach of mixing the content from different universities and cutting everything into small learning objects from which books shall be automatically

[9]Meanwhile, a short tutorial video for first-time users was created and can now be found on the dashboard.

generated. The interviewee regards the incoherence of the content a major problem in this respect. However, he could imagine using Math-Bridge as supportive material in a course after the system has improved.

2.10 Interview 9: Finland (performed by TUT)

Date: June 13, 2011

Interviewee: University lecturer

Teaching and e-learning experience of the interviewee The interviewee has started working as a teaching assistant in 1987. He has designed bridging courses in mathematics for engineers. Her impression is that the level of mathematical competencies of freshmen varies a lot.

Personal opinion on e-learning technologies The interviewee has not used many e-learning technologies for mathematics. She is slightly skeptical about e-learning in general, since any such system can never replace face-to-face contact with a teacher. In her opinion, a good mathematical e-learning platform should most of all be easy to use. In this context she prefers websites to systems requiring the user to log in.

Summary and useful comments for Math-Bridge The interviewee has a positive impression of Math-Bridge. Yet she would like to have more animations[10] in the system. She would not base a course on it, but recommend it as supportive material.

2.11 Summary of the interviews and what we should learn from them

All interviewees confirm that many first year students have deficits in their mathematical education. They do not only have problems with higher mathematics like differentiation and integration. Often they are also lacking basic algebra skills or elementary knowledge of analytic geometry. Bridging courses are considered to be an appropriate action to help students to improve their mathematical competencies before or at the very beginning of their studies.

The role and usefulness of e-learning technologies in bridging course scenarios is controversial. While e-learning software is generally appreciated as supportive material to a classical course, there is some skepticism against pure online courses. Since there is less or even no face-to-face contact with a tutor, students are "let alone" and need to have a strong motivation and self-discipline to work through all the course material. On the other hand, e-learning systems allow to present the course material to students anywhere and at any time and thus one can reach students who would not be able to participate otherwise as bridging courses are typically offered before the beginning of the semester. Despite the fact that e-learning courses cannot fully replace traditional face-to-face learning environments, they have some essential advantages over textbooks. In particular, adaptive learning systems like Math-Bridge provide customized courses generated according to the needs of the learner. Moreover the system gives intelligent feedback and chooses the material depending on the current knowledge status of the learner. Such a feedback cycle cannot be offered by a text book.

The reaction of the interviewees to the presentation of Math-Bridge was quite positive. Especially the adaptivity of the system, the large number of interactive exercises and the exercises assistant that gives intelligent feedback were very much appreciated. The multilingualism of Math-Bridge was also seen very positive, although not all interviewees regarded this feature as particularly valuable for their

[10] There are many animations contained in Math-Bridge, but their frequency of occurrence varies throughout the content.

own faculty. The number of students with language problems may be insignificant, depending on the university. On the other hand, some international universities in Europe have already switched to English. However, all interviewees would recommend Math-Bridge as soon as the system is ready, at least as supportive material for a course. Yet there were also critical remarks that might trigger a revision of the system and a significant improvement of its usability. A typical statement was, "In principle, Math-Bridge is a great tool, but there are too many bugs in the system". Meanwhile most of the bugs were eliminated, but a permanent support for the system is favored. Of course there was not enough time during the interviews to give an elaborate presentation of Math-Bridge going beyond a quick look at typical content and showing a few features of the system. Nevertheless, some comments relevant for the automatic course generation with Math-Bridge could also be extracted. In this respect, a clear wish for simplicity was evident. Generating courses, optionally also implementing new exercises and adding new content should be as easy as possible. The most critical remarks considered the coherence and consistency of the content and its organization. *Some topics are covered well, some topics just slightly, some subjects are dealt with differently by different parties, and some items are offered in contexts, other items are only dealt with in pure mathematical exercises. In particular weak students do need a clear structure [Interview 3].* The phrases, "the content seems a bit disorganized/incoherent" appeared in several interviews. It is crucial that finding a suitable piece of content is as simple as possible and does not require deeper knowledge of the system. *Students do not follow a digital course line by line from the start. They hop through the material and if they see something they want to know more about they expect a fast link (e.g. hyperlink) to that information [Interview 4].* In fact, the presentation of the content in the interface has meanwhile improved and is now much more structured. The problem of the incoherence of the material provided from different institutions was partially solved by restricting the content from which courses can be generated in a customized way for each partner. Automatically generating an expedient course out of different sources requires an extremely high degree of coherence and consistency of the content. To achieve this, a continuous improvement process is necessary, triggered by users testing the system.

3 Student feedback

3.1 Questionnaires

The main instruments of the Math-Bridge project for gathering feedback from users are four *online questionnaires*: a pre- and a post-questionnaire for teachers, and a pre- and a post-questionnaire for students. Accordingly, the data collected from these questionnaires, in particular the post-questionnaire for students, provided the main feedback material from users.

The first versions of these questionnaires have been described in the deliverable *D-8.2 Report on user feedback collection process and results (first version)* from May 2010. In February and March 2011 the post-questionnaires were modified in order to eliminate redundant questions and to include questions on the course setting and on how students use the system in practice.

Since the teacher questionnaires were completed only by project partners, the information contained therein has been integrated into the text describing the various courses and course settings in Subsection 3.2. The students' answers – along with the respective log files – provide the raw material for the main part of this Section.

3.1.1 New post-questionnaire for teachers

Math-Bridge Teacher Post-Questionnaire

Math-Bridge

Teacher Post-Questionnaire
to the results

lectures and tutorials

Did you provide tutoring regarding MB students activity? Please describe the scenario.

structure of the courses

Did you tell your students that using Math-Bridge is...

- optional
- compulsary
- supplementary (to be used in case of problems or interest)
- very important
- deeply integrated into the course
- other

How much of the material was covered by MB content?

How much would you weight the volume of the content you presented in MB with respect to the content presented by other means

Which percentage of the MB material used by your students was authored collaboratively by your pedagogical

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=teacher-post-survey&lang=en&requireLogin=1[27.02.2012 07:49:38]

Math-Bridge Teacher Post-Questionnaire

team?

Please describe

1. When did your course start, when did it end?
2. How many days & how many hours of compulsory attendance to lectures & to tutorials did you offer to the students?
3. How many percent of the days did you expect from your students to be attendant at least.

Example:
E.g. you might have a bridging course for 4 weeks that begins at Sept, 19th 2011 and ends at October 14th 2011. You offer as a whole 6 days of attendance with lectures of 3 hours and 2 hours of tutorials per day. But you might only expect the students to be attendant at the first 2 days and at 1 further day, you expect them to be at 50%.

	Strict supervision			No supervision at all
How strictly did you control the attendance at lectures?				
How strictly did you control the attendance at tutorials?				

Please specify for your course scenario the role of lectures and tutorials

Example:
You might have a course in which the lectures consist of two parts: One part the is strictly used two answer all questions from the students (here the lectures are used for coaching) and another part which is strictly used for teaching content (traditional knowledge transfer). Tutorials might be used for all questions by students, can be used for training exercises, for explainig content or for organisational problems for instance.

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=teacher-post-survey&lang=en&requireLogin=1[27.02.2012 07:49:38]

Math-Bridge Teacher Post-Questionnaire

the phases of self-regulated learning

Did you suggest your students how long a session should be?

No

Yes. Please specify

	(almost) always	mostly	sometimes	seldom/never
Did you regulate the phases of learning with MB by giving instructions or homework to the students?				

If yes, please specify

the learning system

How did you use the Math-Bridge system?

the teacher generated a book
I generated a book myself
I used automatic book generation
I used the search functionality for specific learning
I did not work with books but with one or more collections as such

embedding into a Learning Management System

Did you use a Learning Management System (such as Moodle, ...) in your course?

No

Yes. I used

Please rate the quality of this feedback (for each of the types separately)

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=teacher-post-survey&lang=en&requireLogin=1[27.02.2012 07:49:38]

Math-Bridge Teacher Post-Questionnaire

	very good			very bad	no experience
feedback by the system in general					
feedback by the system concerning the exercises					
feedback by peers					
feedback by the teacher/ tutor/ online-tutor					
feedback concerning technical support					
feedback by the learner model					

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=teacher-post-survey&lang=en&requireLogin=1[27.02.2012 07:49:38]

3.1.2 New post-questionnaire for students

Math-Bridge Student Post-Questionnaire

Math-Bridge

Student Post-Questionnaire

to the results

Lectures and tutorials

	Yes	No
Were there lectures or tutorials in addition to MB?		

If Yes, please specify

	Yes	No
I used Math-Bridge the way the teacher/tutor suggested?		

If not, please tell us in which respect and why!

structure of the course

Where did you use Math-Bridge (%)?

at home

at the university

in tutored rooms

in untutored rooms

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=student-post-survey&lang=en&requireLogin=1[27.02.2012 07:50:20]

Math-Bridge Student Post-Questionnaire

How many percent of lectures and tutorials did you attend?

answer as percentage from 0-100%

	More teaching should be offered	the relation was ideal	more self-regulated learning with Math-Bridge should be offered
Please rate the relation between phases of teaching (lectures and tutorials) and the phases of self-regulated learning with Math-Bridge			

the phases of self-regulated learning

	1-4 weeks	>1-3 months	>3-6 months
Overall, I have been working with Math-Bridge for...			

Overall, I have been working with MB this many hours per week...

	I decided completely by myself	the teacher and me decided equally	the teacher decided for me completely
Who was responsible for the choice of topics and structuring of learning in the the phases of using Math-Bridge?			

the learning system

Please rate for each feature if it was...

	very		not helpful	I didn't use this	I didn't know it

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=student-post-survey&lang=en&requireLogin=1[27.02.2012 07:50:20]

Math-Bridge Student Post-Questionnaire

	helpful			at all	feature	exists
Static Exercices						
Intelligent Exercises						
Book Generation						
Language Switch						
Look up the definition of a notion						
Study my learning model						
Equation Editor						
Intelligent Feedback						
Contextual Feedback						
Glossary						
Search Functionality						
Learner Model						

How did you use the Math-Bridge system?

the teacher generated a book

I generated a book myself

I used automatic book generation

I used the search functionality for specific learning

I did not work with books but with one or more collections as such

	Do not agree			Strongly agree
I think Math-Bridge is unnecessarily complex.				
I think Math-Bridge provides all functions needed to effectively carry out my working tasks.				
I think that the navigation within Math-Bridge supports an efficient way of working.				
I think the Math-Bridge navigation is NOT easy.				
I think Math-Bridge reacts to input as I expected it to.				

The content itself

	Do not agree			Strongly agree
The content is explained comprehensively				
I could learn the content completely by myself				

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=student-post-survey&lang=en&requireLogin=1[27.02.2012 07:50:20]

Math-Bridge Student Post-Questionnaire

I think Math-Bridge DOES NOT provide me with enough content to learn the material of the course.				
I think the content in Math-Bridge has appropriate level of difficulty				
Math-Bridge helped me to clarify difficult concepts.				
Math-Bridge DID NOT help me to develop problem solving abilities.				
Math-Bridge challenged me intellectually.				
Working with Math-Bridge DID NOT contribute to my learning in this course.				
The wording in assignments, theorems and other texts was clear.				

the lecturers and tutors

	Do not agree			Strongly agree
Without the lectures I would not have understood the content				
Without the tutorials I would not have understood the content				
I would like to learn with this teacher in the future				
I would like to learn with this tutor in the future				

support and feedback

Please rate the quality of this feedback (for each of the types separately)

	very good			very bad	no experience
feedback by the system in general					
feedback by the system concerning the exercises					
feedback by peers					
feedback by the teacher/ tutor/ online-tutor					
feedback concerning technical support					
feedback by the learner model					

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=student-post-survey&lang=en&requireLogin=1[27.02.2012 07:50:20]

Math-Bridge Student Post-Questionnaire

	Do not agree			Strongly agree
I frequently need colleagues or experts to support me when working with Math-Bridge.				
I could imagine that most of the users would be able to learn operating with Math-Bridge quickly.				

Please you can give us positive or negative feedback, so that we can improve Math-Bridge

general validation

	Do not agree			Strongly agree
I would decide for using MB again				
Math-Bridge provided a meaningful learning experience for me.				
Working with Math-Bridge DID NOT increase my interest in the subject.				
Math-Bridge DID NOT provide me with opportunities for practicing new skills.				
I enjoy working with Math-Bridge.				
I would recommend (the use of) Math-Bridge to my friends.				
I think Math-Bridge is useful.				

http://system.math-bridge.org/mathbridge/surveys/survey.cmd?survey=student-post-survey&lang=en&requireLogin=1[27.02.2012 07:50:20]

3.2 Feedback from individual courses

3.2.1 What is shown

In the following we give some basic information on the bridging courses and university lectures held since autumn 2010 at the partner institutions, and some important pieces of the feedback by students from these courses. For each course, we first display – whenever available – data on the duration, number of students, whether the use of Math-Bridge was compulsory, the percentage at which the Math-Bridge content covered the course content, number of students using Math-Bridge, number of students using Math-Bridge more than one hour, and the course setting.

In order to give an impression on the satisfaction of the users of a particular course, we display graphical representations of the distributions of students' answers to 8 selected questionnaire items:

- I enjoy working with Math-Bridge.
  (This item addresses the most important motivational aspect of general satisfaction with Math-Bridge.)
- I would decide for using Math-Bridge again.
  (This item represents a personal summary over all aspects encountered when working with Math-Bridge .)
- I think Math-Bridge provides all functions needed to effectively carry out my working tasks.
  (This item specifically addresses the actual usefulness of Math-Bridge with respect the students' tasks.)
- The wording in assignments, theorems and other texts was clear.
  (This item addresses an important aspect of the pedagogical quality of the content.)
- Math-Bridge helped me to clarify difficult concepts.
  (This item addresses the usefulness of Math-Bridge specifically for the learning of mathematical concepts (which are usually perceived as difficult by students.)
- I think Math-Bride DOES NOT provide me with enough content to learn the material of the course.
  (This item addresses the rate of coverage of usual bridging course content by Math-Bridge, another important aspect of content quality.)
- Feedback on static exercises and on intelligent exercises.
  (These two items address the users' satisfaction with two of the most important functionalities of the Math-Bridge system.)

In total, these 8 items cover key aspects of the system and the content and the users' jugdement.

In order not to misinterpret the students' feedback, it should be stressed that – in addition to the different pedagogical settings of the various courses – the earliest of them was held in autumn 2010, within the pilot phase of Math-Bridge, whereas the latest ones were given in autumn 2011, within the phase of the large scale evaluation. In between, the layout of the user interface of Math-Bridge had been changed, and the quality of the content had been improved.

In some of the courses listed here, no data are available to present in this deliverable because they were run as prestudies in which the use of the system was tested.

3.2.2 Feedback from course(s) held at ELTE

Description of the course setting(s):

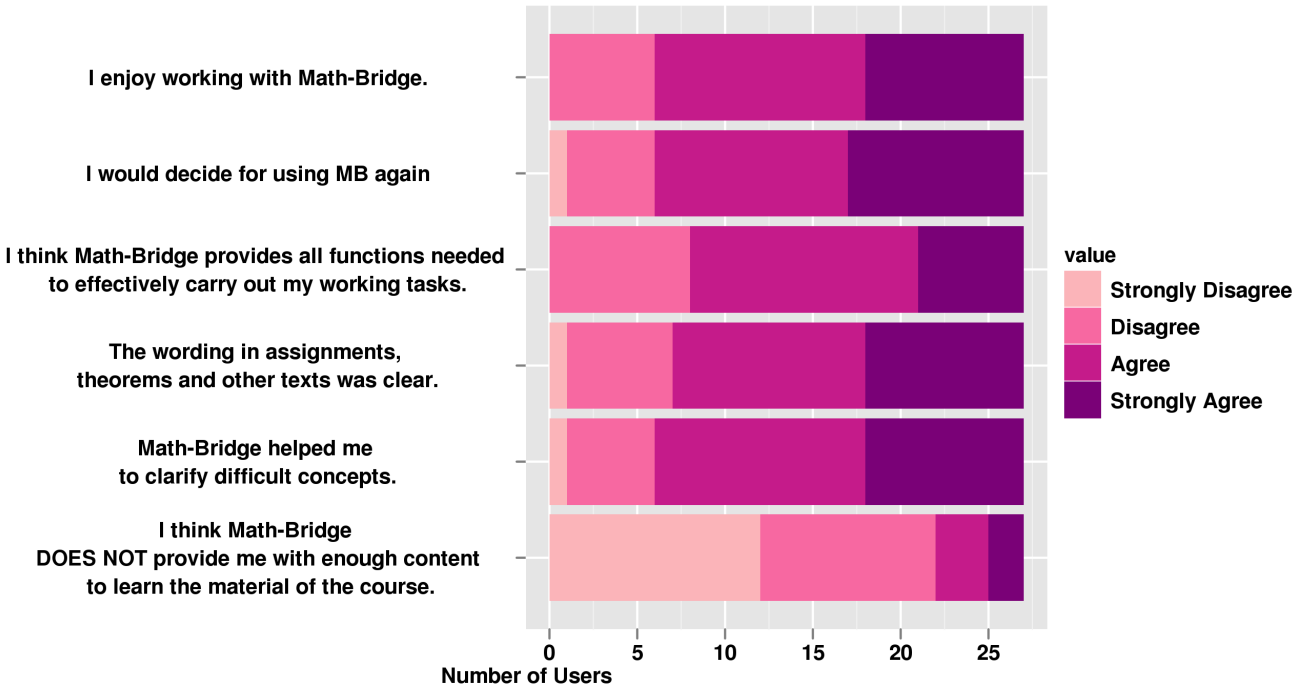
- Autumn 2010 and Summer 2011:

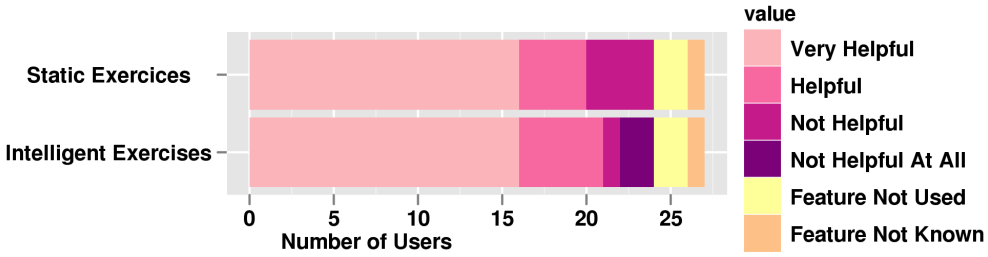
Type of the course	Bridge course for math BSC students	Bridge course for nature sciences BSC students
Duration	56 × 45 min	28 × 45 min
Total number of students	250	350
Was Math-Bridge compulsory?	No	No
How much of the content of the course covered by Math-Bridge?	50 %	60 %
Students using Math-Bridge	n.a.	n.a.
Students using Math-Bridge >1h	n.a.	n.a.
Conditions	Blended learning	Blended learning

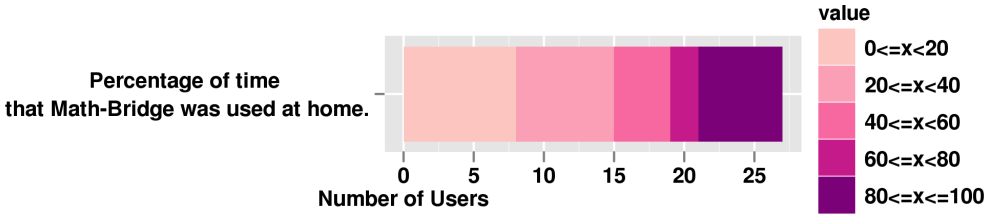
- Autumn 2011:

Title of the course	Matematikai felzárkóztató kritérium tárgy (Remedial maths criteria)
Period and duration	05.09.2011–16.12.2011 (14 weeks)
Total number of students	∼ 400
Was Math-Bridge compulsory?	no
How much of the content of the course covered by Math-Bridge?	70 %
Students using Math-Bridge	295
Students using Math-Bridge >1h	59
Field of study	mathematics, physics, environment, geology
Conditions	Integrative learning

Student feedback by questionnaires, Autumn 2011:







3.2.3 Feedback from course(s) held at KS

Description of the course setting:

- Summer 2011:

Title of the course	Vorkurs Mathematik
Duration	6 weeks/4 weeks
Total number of students	1100 ($\sim$ 400 using MB)
Was Math-Bridge compulsory?	Yes (for the MB groups)
How much of the content of the course covered by Math-Bridge?	50%
Students using Math-Bridge	n.a.
Students using Math-Bridge >1h	n.a.
Field of study	Maths bachelor, maths teacher (primary and secondary education), scientists (physics, chemistry, biology), engineers (electrical, construction, environmental engineers,...), computer sciences
Conditions	Blended learning with extended e-learning

- Autumn 2011:

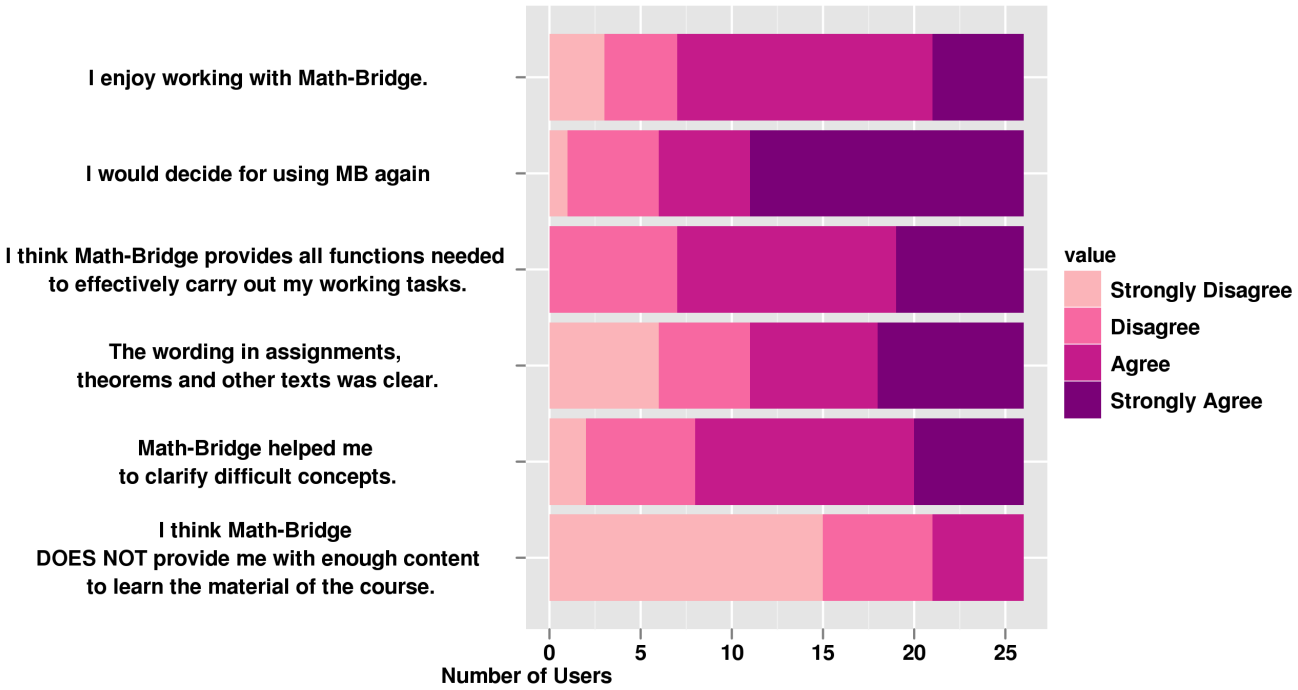
Title of the course	Vorkurs Mathematik
Period and duration	05.09./19.09.2011–14.10.2011 (6 weeks/4 weeks)
Total number of students	1200 (600 using MB)
Was Math-Bridge compulsory?	Yes (for the MB groups)
How much of the content of the course covered by Math-Bridge?	90%
Students using Math-Bridge	600 (together with **PB**)
Students using Math-Bridge >1h	456 (together with **PB**)
Field of study	Maths bachelor, maths teacher (primary and secondary education), scientists (physics, chemistry, biology), engineers (electrical, construction, environmental engineers,...), computer sciences
Conditions	Blended learning

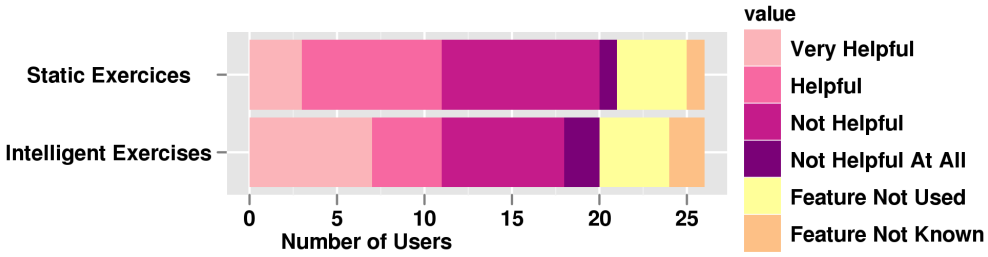
Additional information for the courses in Autumn 2011:

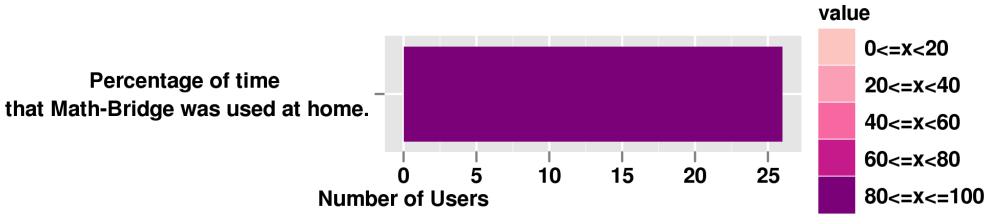
- Dates and numbers of students:
  - 05.09. - 14.10.2011 course P1 (electrical engineer, computer sciences), approximately 150 students, 1 teacher, 5 tutors

  - 19.09. - 14.10.2011 course P2 (mechanical, construction, environmental engineer), approximately 250 students, 1 teacher, 10 tutors
  - 19.09. - 14.10.2011 course P3 (maths bachelor, teachers for high schools, sciences), approximately 150 students, 1 teacher, 3 tutors
  - 19.09. - 14.10.2011 course P4 (teachers for primary and secondary schools), approximately 100 students, 1 teacher, 3 tutors
  - 19.09. - 14.10.2011 course E1-E4 (same fields of study, course has less days of attendance and more e-learning), approximately 550 students, 2 teachers, 2 tutors
- Structure of the courses:
  - P-courses: blended Learning, usually at least three days of attandance at university with lectures and tutorials, phases of self-regulated e-learning steered by teacher with homework.
  - E-courses: 6 days of attendance, rest is for self-regulated e-Learnig, no steering of self-regulated learning by teacher, online-support by tutor from Monday - Friday 9-17 o'clock.
- Further comments:
  - The teachers are very motivated and have all experiences in university teaching.
  - Anonymous interviews were performed, and each test is linked with the corresponding questionnaire for every person. But they are not linked with the log-data of the Math-Bridge system.

Student feedback by questionnaires, Autumn 2011:







3.2.4 Feedback from course(s) held at OUNL

Description of the course setting:

- Summer 2011:

Title of the course	Basiscursus wiskunde
Duration	10 weeks
Total number of students	90
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	20%
Students using Math-Bridge	4
Students using Math-Bridge >1h	3
Field of study	diverse
Conditions	blended learning and distance teaching

- Autumn 2011:

Title of the course	Basiscursus wiskunde
Period and duration	13.09.2011–22.12.2011 ($\sim$ 3 month)
Total number of students	n.a.
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	50%
Students using Math-Bridge	7
Students using Math-Bridge >1h	3
Field of study	diverse
Conditions	blended learning and online teaching

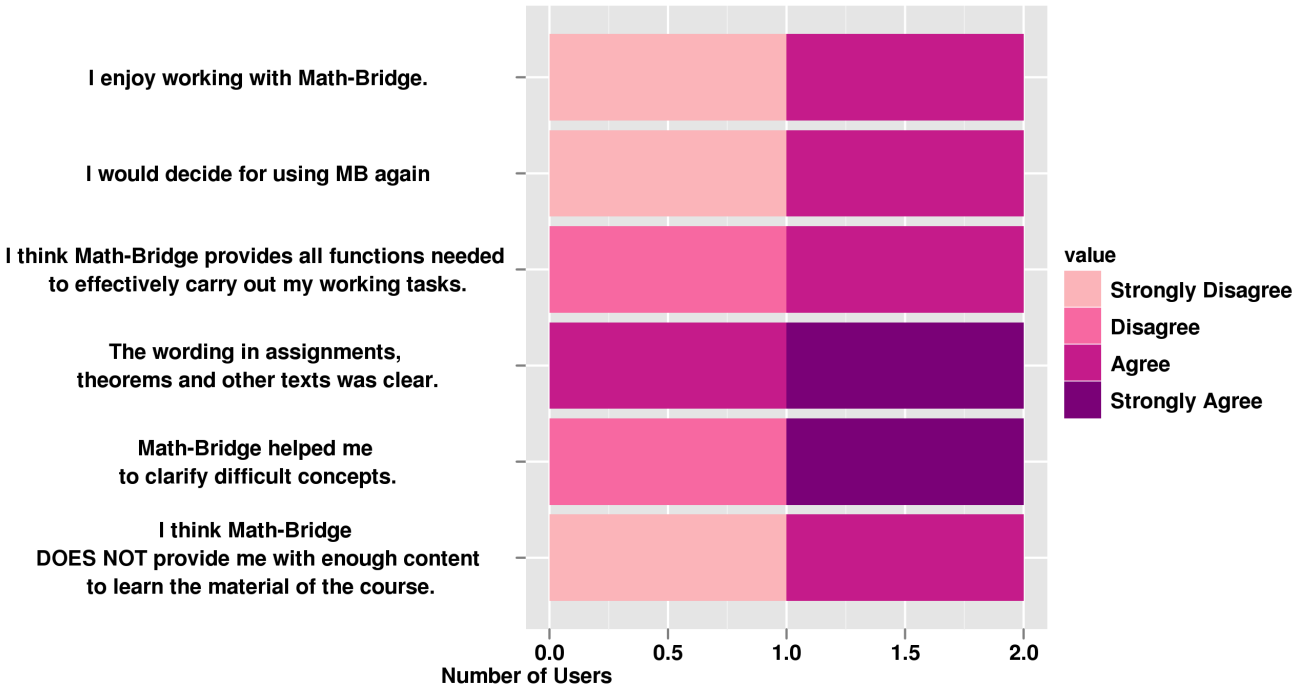
Additional information for the course in Autumn 2011 (provided by Josje Lodder):

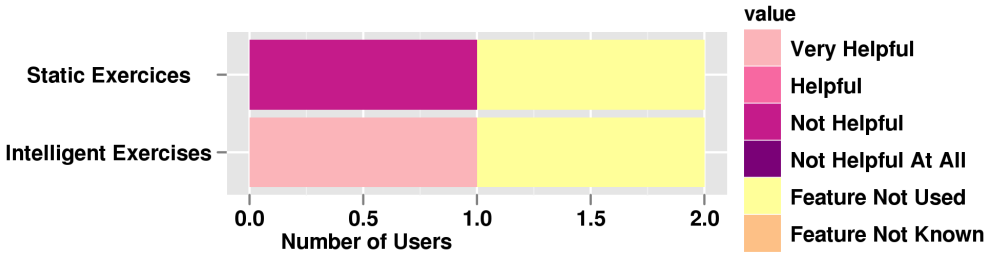
- Structure and content of the course:

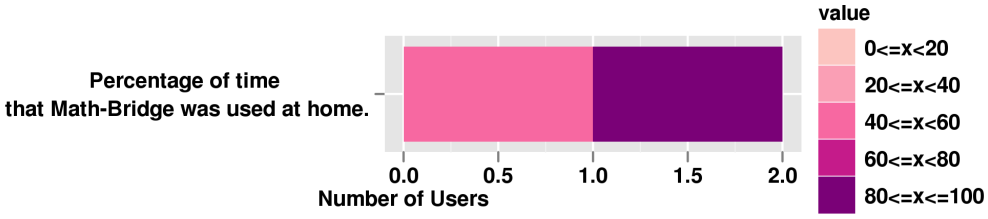
  The course consisted of 20 lessons which took 4 hours each; these lessons were meant for students who didn't choose enough math in their final high school years. Hence they have to take an extra exam before they are admitted for certain studies at the university. This course is the first of a set of preparation courses for these exams. Subject of this first course are basic mathematical skills: Numbers and operations, first order functions and equalities, second order functions and equalities, algebra, exponential functions, derivatives. During the lessons the teacher gives instruction, but students also make lots of exercises. In the classroom they use a textbook. The group consisted of 12 students. There was also an online group planned, but this group was skipped since there were not enough participants.

- On the use of Math-Bridge in the course:
  - *Students could use Math-Bridge in the first part of the course. This was optional: the teacher stimulated the students to practice with MB at home.*
  - *The teacher planned to let the students use MB in the computer lab; but since the only browser on these computers was IE7, (we are not allowed to install browsers in the computer lab), this was not possible. Hence students could only work with MB at home. Only half of them tried, and they had lots of problems with the formula-editor; in fact the teacher reported that they told him that they just entered a random answer because in this way they could evaluate their own answer.*

Student feedback by questionnaires, Summer 2011:







3.2.5 Feedback from course(s) held at PB

Description of the course setting:

- Autumn 2010:

Title of the course	Vorkurs Mathematik
Duration	4 weeks
Total number of students	600
Was Math-Bridge compulsory?	Yes
How much of the content of the course covered by Math-Bridge?	6%
Students using Math-Bridge	n.a.
Students using Math-Bridge >1h	n.a.
Field of study	electrical engineers, mechanical engineers, computer sciences, chemistry, teachers for primary and secondary education
Conditions	blended learning with extended e-learning

- Autumn 2011:

Title of the course	Vorkurs Mathematik
Period and duration	05.09.2011–30.09.2011 (4 weeks)
Total number of students	600
Was Math-Bridge compulsory?	Yes
How much of the content of the course covered by Math-Bridge?	90%
Students using Math-Bridge	600 (together with **KS**)
Students using Math-Bridge >1h	456 (together with **KS**)
Field of study	electrical engineers, mechanical engineers, computer sciences, chemistry, teachers for primary and secondary education
Conditions	blended learning and online teaching

Additional information for the courses in Autumn 2011:

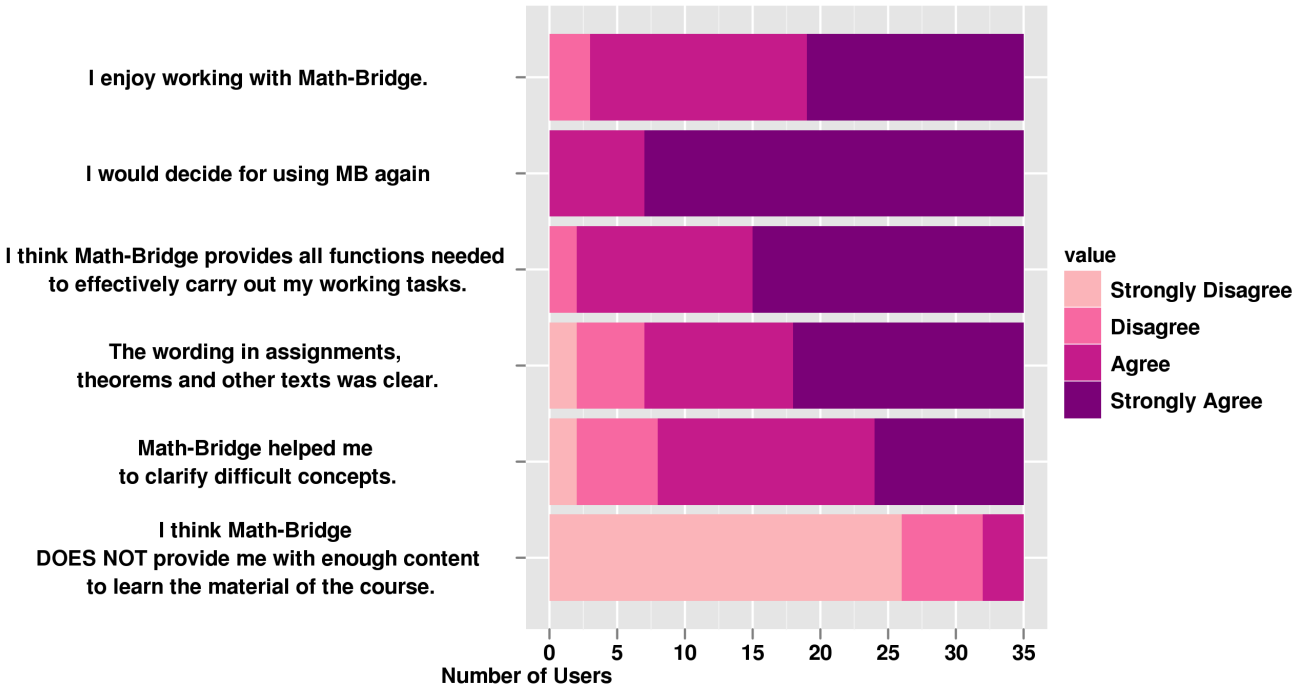
- Dates and numbers of students
  - 05.09. - 30.09.2011 course P1 (electrical engineer, computer sciences (without maths as minor subject), mechanical engineering, chemistry) 300 students, 1 teacher, 6 tutors
  - 05.09. - 30.09.2011 course P2 (mathematics bachelor, teachers for High Schools and comprehensive schools, computer sciences (with maths as minor subject)) 100 students, 1 teacher, 4 tutors
  - 05.09. - 30.09.2011 course P3 (teachers for primary and secondary schools) 40 students, 1 teacher, 4 tutors

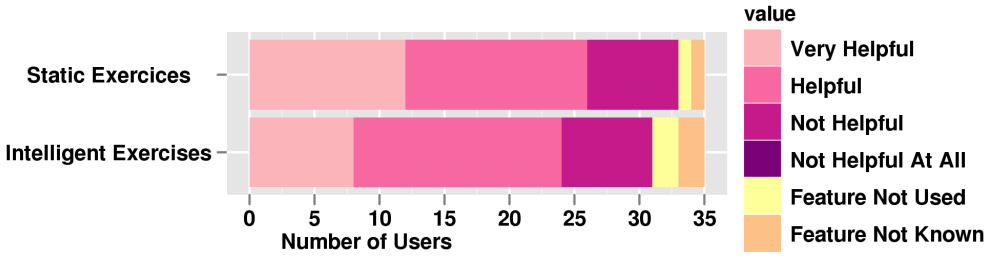
  - 05.09. - 30.09.2011 course E1-E3 (same fields of study, course has less days of attendance and more e-learning) 150 students, 1 teachers, 3 tutors

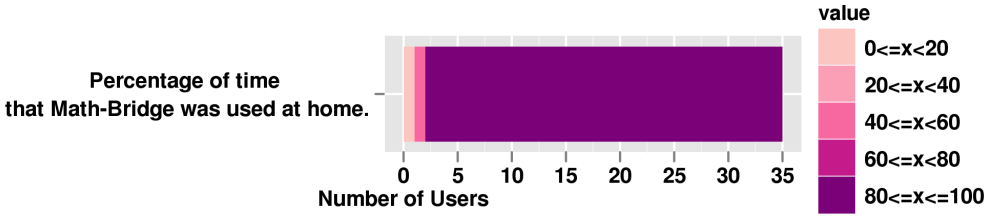
- Structure of the courses:
  - P-courses: Blended Learning, usually at least three days of attendance at university with lectures and tutorials, phases of self-regulated e-learning steered by teacher with homework.
  - E-courses: 7 days of attendance, 2 days of it are compulsory the rest are so-called "learning centers" concentrating on specific mathematical topics in working groups with teachers. Rest of the time is pent on self-regulated e-learning, no steering of self-regulated learning by teacher, online-support by tutor for 8 hours during a week (Mo, Mi, Fr 16-18h and Do 10-12h)

- Additional comments:
  - Math-Bridge features that were used: prerecorded books (VEMA as basis, enriched with content from other partners), STACK-exercises, IDEAS-exercises, remedial scenarios, MB is used obligatory in all courses. Kassel is control group and uses the VEMA-system.
  - The teachers are very motivated and have all experiences in university teaching.

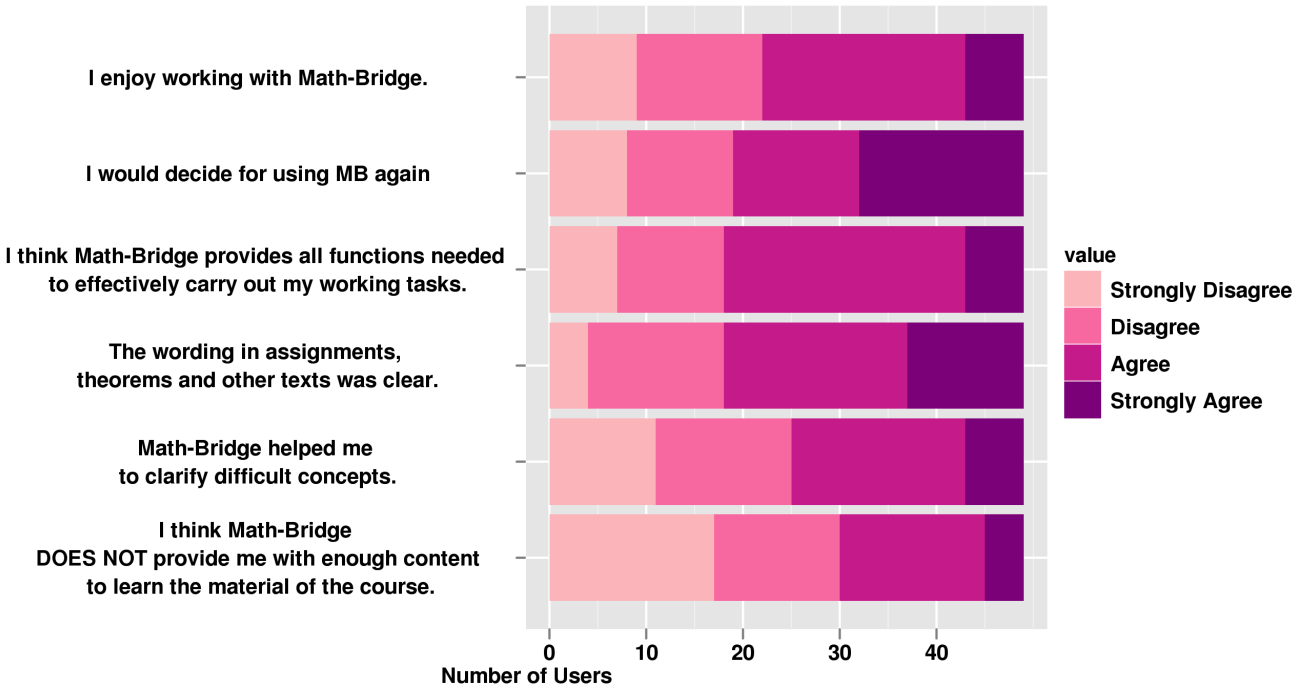
Student feedback by questionnaires, E-courses, Autumn 2011:

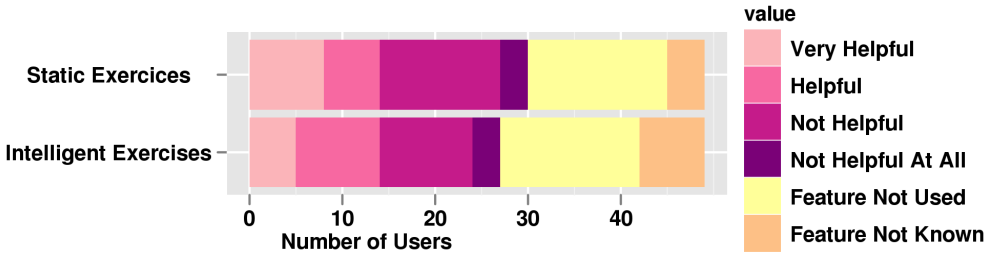


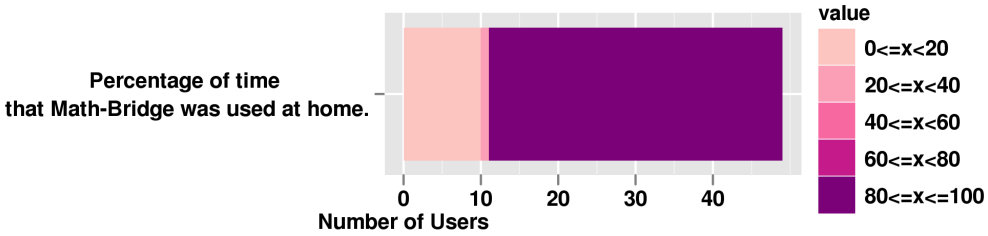




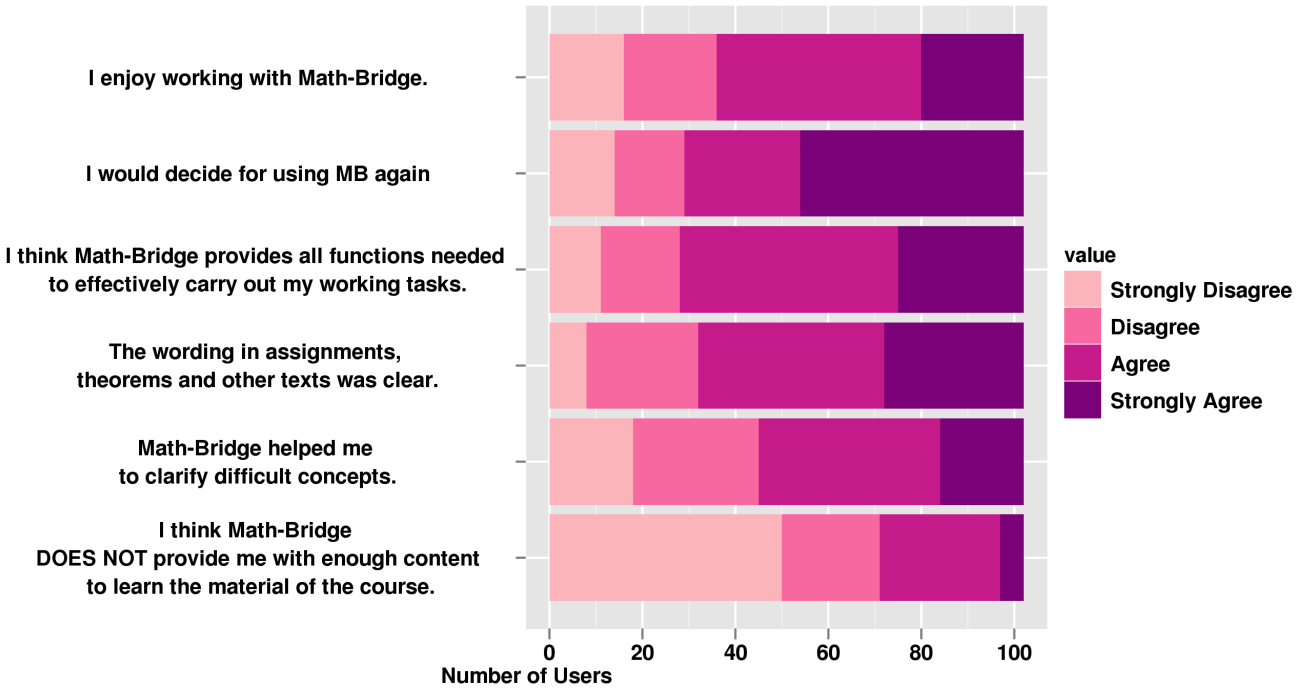
Student feedback by questionnaires, P-courses, Autumn 2011:

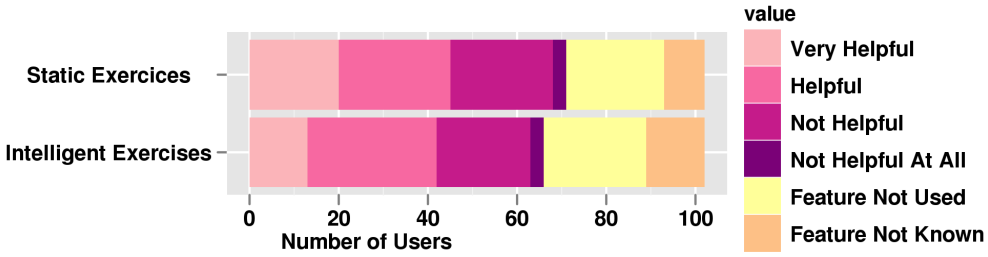


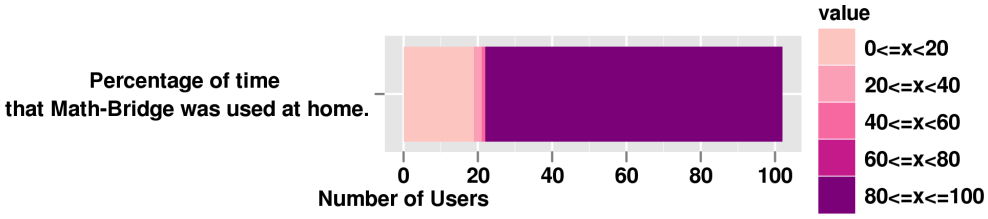




Student feedback by questionnaires, all courses, Autumn 2011:







3.2.6 Feedback from course(s) held at TUT

Description of the course setting:

- Autumn 2010:

Title of the course	Matematiikkajumppa (Mathematics Remedial Instruction)
Duration	$\sim$ 4 weeks
Total number of students	$\sim$ 200
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	70%
Students using Math-Bridge	n.a.
Students using Math-Bridge >1h	n.a.
Field of study	All study programs at TUT (Master of Science)
Conditions	Mainly distance learning, some face-to-face teaching

- Autumn 2011:

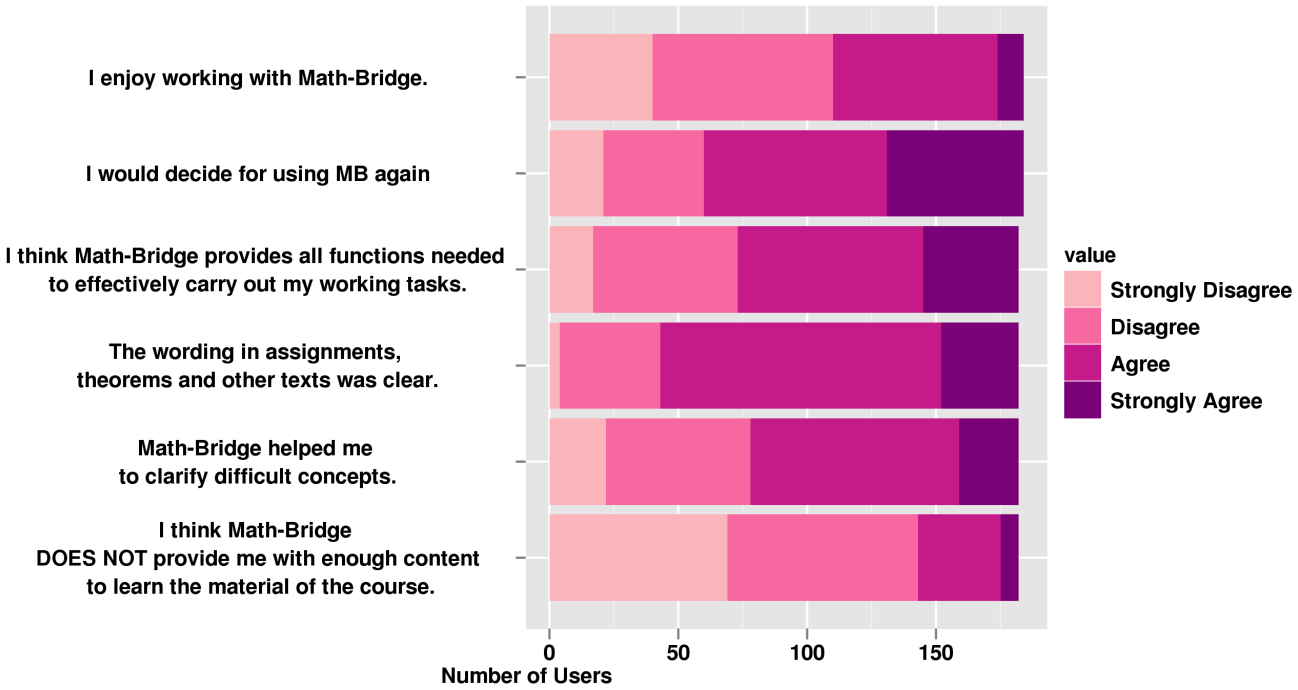
Title of the course	Matematiikkajumppa (Mathematics Remedial Instruction)
Period and duration	Mid September to mid October ($\sim$ 4 weeks)
Total number of students	$\sim$ 200
Was Math-Bridge compulsory?	Yes
How much of the content of the course covered by Math-Bridge?	100%
Students using Math-Bridge	122
Students using Math-Bridge >1h	54
Field of study	All study programs at TUT (Master of Science)
Conditions	100% online with supportive tutorials (up to 2 hours per week for 2-4 parallel tutorial groups) and an opening lecture (2 h) in the beginning of the course

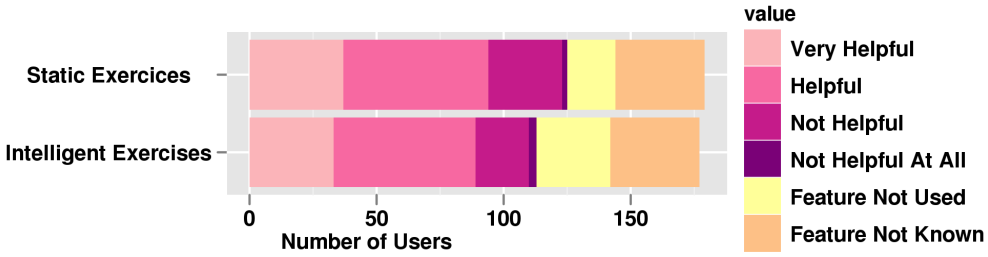
Additional information for the course in Autumn 2011 (provided by Thumas Miilumäki):

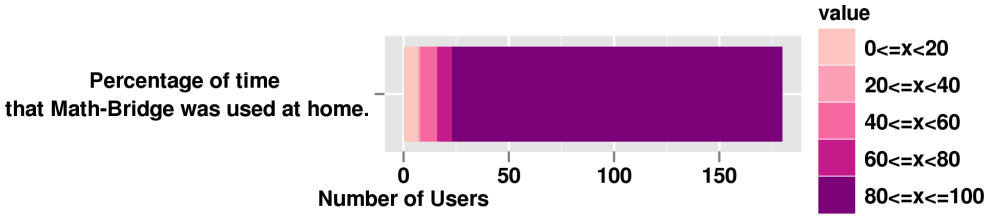
- Structure and contents of the course:
  - *There was only one course, Mathematics Remedial Instruction (MRI). It was set up for students that failed Mathematics Basic Skills Test (BST) in the beginning of their studies in fall 2011. Altogether, there were 172 students that failed in BST and were directed to participate MRI. Moreover, it was possible for any other student to participate MRI even if she/he had passed BST. Thus, there were over 200 students studying MRI topics.*

- *MRI took four weeks and it was based on pure e-learning scenario. There were two mandatory parallel two-hour opening lectures arranged in the beginning of MRI. In this opening lecture MRI itself was described and Math-Bridge system was demonstrated. Furthermore, there was a paper and pencil pre test arranged in the opening lecture.*
- *During the four weeks students were supposed to study mathematics remedial materials in Math-Bridge. In the system there was a recbook called Mathematics Remedial Instruction, that included all material to be studied during the course. The recbook included 71 interactive TUT STACK exercises that were mandatory to be solved during the four weeks of MRI. These 71 mandatory exercises were also presented in a separate recbook called Remedial Exercises, so that students, that felt themselves skillful enough, could execute them without studying definitions, examples etc. etc. LOs that were included in Mathematics Remedial Instruction recbook. After finishing all 71 interactive STACK exercises, students took rerun of BST. This time they could do it by themselves at home etc. Moreover, two mandatory parallel two-hour closing lectures were arranged. In this lecture some general difficult issues in MRI's interactive exercises were discussed and in the end of the lecture students took a paper and pencil post test.*

Student feedback by questionnaires:







Discussion: Open student feedback is concentrating on the buggy experiences of Math-Bridge usage. It can be still said that the most students were more or less satisfied with the materials and functionalities provided by the Math-Bridge system.

3.2.7 Feedback from course(s) held at UC3M

Description of the course setting:

- Autumn 2010:

Title of the course	Curso Cero MathBridge
Duration	12 hours in 3 days
Total number of students	40
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	15%
Students using Math-Bridge	n.a.
Students using Math-Bridge >1h	n.a.
Field of study	Aerospace Engineering, Computer Science

- Autumn 2011:

Title of the course	Curso Cero MathBridge
Period and duration	31.08.2011–14.09.2011 (2 weeks)
Total number of students	4
Was Math-Bridge compulsory?	Yes
How much of the content of the course covered by Math-Bridge?	100%
Students using Math-Bridge	4
Students using Math-Bridge >1h	4
Field of study	Aerospace Engineering, Computer Science, Telecommunication Technology Engineering
Conditions	100% online (except for the 1st class)

Additional information (provided by Angel Garcia Olaya):

- *For the course a book was generated, from content provided by TUT. The content of the course was the same as the regular course one: a total of 9 topics. Topics were: Expressions, Linear Equations and Inequations, Trigonometry, Matrixes, Analytic Geometry, General Knowledge on Functions, Limits, Differential Calculus and Integral Calculus.*
- *From the 25 positions opened, only 4 students registered into the course. After the ECTS implementation, semester starts the first Monday on September, which gives almost no time to deliver courses, so the bridging courses overlap the first week of regular classes. This, in addition with the fact that bridging courses have no academical value and do not appear in students' records, leads usually to a high rate of drop offs. It has to be noticed that students pay a small fee (40 Euro this year) to attend the course.*

Discussion and personal report (provided by Angel Garcia Olaya): The Spanish fall evaluation was performed in the framework of the regular Cursos Cero (bridging courses) offered to students by UC3M. These are voluntary courses offered to new students just before the semester starts. Prior to the ECTS system implementation at UC3M, during 2008-09 academic year, the semester used to start at the beginning of October. That allowed the bridging courses to take place during September and to last about two weeks, with daily classes. But after the ECTS implementation, semester starts the first Monday on September, which gives almost no time to deliver courses, so the bridging courses overlap the first week of regular classes. This, in addition with the fact that bridging courses have no academical value and do not appear in students' records, leads usually to a high rate of drop offs. It has to be noticed that students pay a small fee (40 Euro this year) to attend the course.

From the 25 positions opened, only 4 students registered into the course. There are some facts that could help to understand the reasons for such a low interest of students in the course. First, according to UC3M bridging courses responsible, this year the number of students registered in these courses has fallen in comparison to last years. Second, the Math-Bridge course was a totally on-line alternative to a regular course, which was taught by different professors. The university decided to keep the same price for both the on-line (Math-Brige) and the regular bridging course in order not to compete in price. Students could choose whether to have an on-line course or a regular one. It seems that they prefer the regular one. Maybe the best option would have been a blended course, with Math-Bridge supporting the regular course. But professors teaching the regular course were reluctant to use any e-learning system. We decided to offer Math-Bridge as an standalone course, with only one professor, who agreed to teach it. Even this professor was skeptical about e-learning, but it has to be noticed that students did not meet him, as the only non-online session was given by the Math-Bridge team. Despite his skepticism about the system, the professor communicated with the students by email, corrected their exercises, etc.

For the course a book was generated, from content provided by TUT. The content of the course was the same as the regular course one: a total of 9 topics. Topics were: Expressions, Linear Equations and Inequations, Trigonometry, Matrixes, Analytic Geometry, General Knowledge on Functions, Limits, Differential Calculus and Integral Calculus. Instead of attending to the 11 hours of class of the regular course, the students were asked to read one topic a day, during the 9 weekdays. After reading, they had to perform the exercises and send them daily to the professor. The initial idea was to use only the exercises that can be done on-line. But they were not working properly so we asked the students either to scan the solutions and send them to the professor, or to let a paper copy into his mailbox. To our understanding this has been one of the weakness of the system evaluation. If the interactive exercises included in TUT content had worked well, the students would have been used the system more in deep. Only 2 of the students sent exercises to the professor, the other 2, though sometimes using the system, never delivered an exercise.

Due also to system problems we decided to perform the pre and post test in pen and paper. The pre-test was done during the first session at class, on August 31st. The post test was sent by email the last day of the course and the students were asked to fill it and deliver the results in paper into the professor mailbox. As said, only two students completed the post-test.

The academical results of the course are: from the 4 students enrolled, 2 were marked as not attending the course, 1 failed to pass it (due to little work at home and a not so good final post-test), and only 1 passed the course.

As conclusions and lessons learned, for next year we recommend to use blended learning. Math-Bridge will be an important part of the course, but we think that face-to-face contact is important, at least to encourage students to do their homework. We would like also to foster the use of interactive exercises, which we believe is the most useful Math-Bridge feature for our students. Other interesting features like the learner model or the ability to create self personalized books seem to be less applicable

to our students, given the low level of commitment they usually have. Both features need the students to explore the system and to be willing to learn by themselves, which is rarely the case in first year students.

3.2.8 Feedback from course(s) held at UCBL

Description of the course setting:

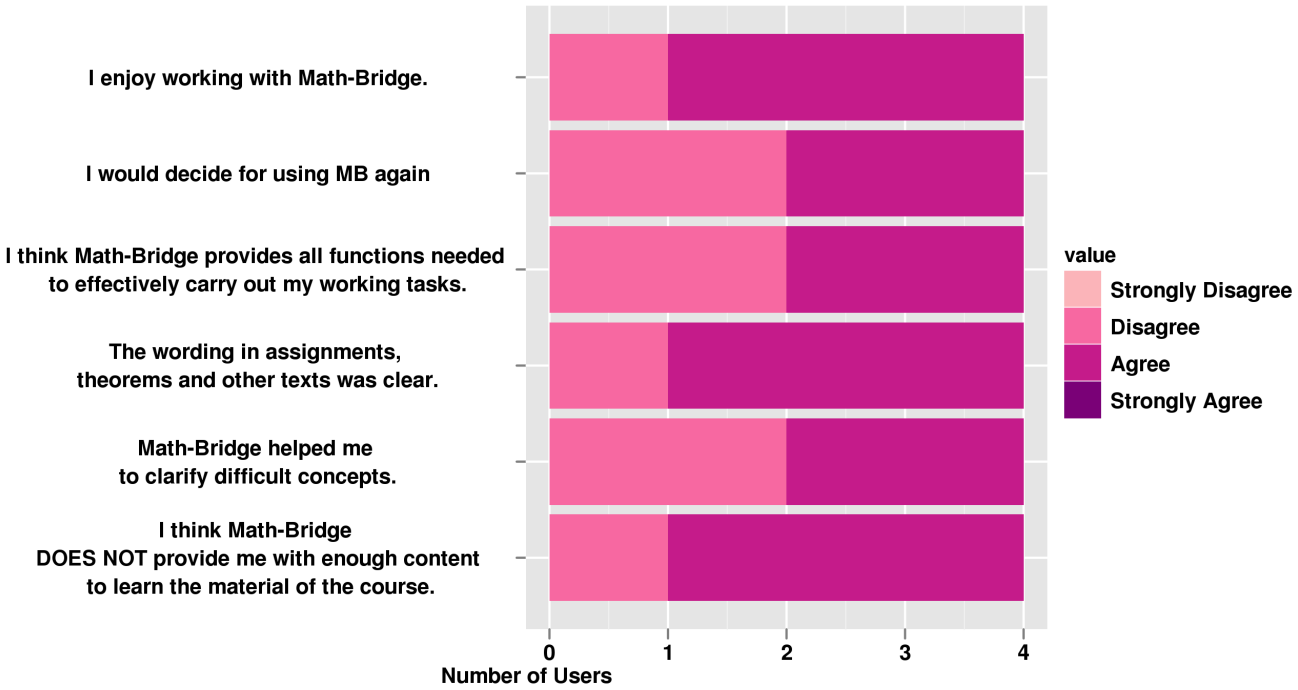
- Autumn 2011:

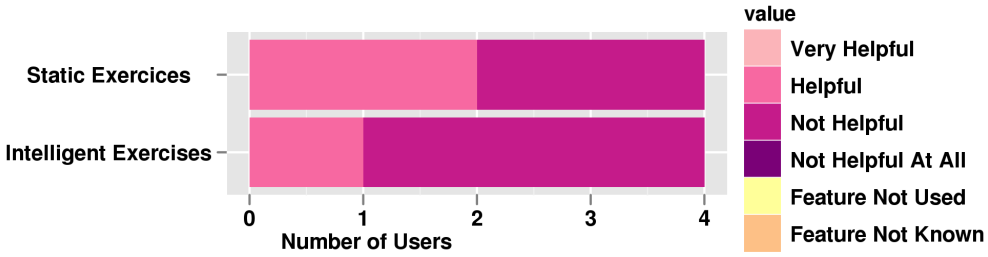
Title of the course	Analyse I - Les réels et les fonctions - MAT1007L
Period and duration	20.09.2011– mid January, evaluation in mid November (36h - 13 weeks reduced to 9 weeks)
Total number of students	90
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	80%
Students using Math-Bridge	78
Students using Math-Bridge >1h	42
Field of study	Math/Physics/CS/Biology
Conditions	Blended learning

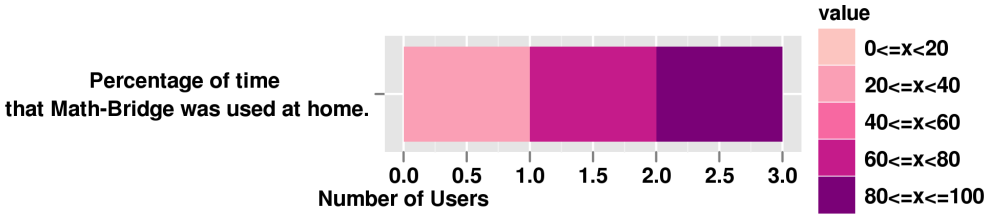
Additional information:

- Structure of the course: Blended Learning, mainly pure traditional learning without computer tutor groups.
- Contents of the course:
  - The real line, rationals. Supremum, infimum. Real sequences, limits, convergence criteria, Bolzano-Weierstrass theorem, Cauchy criterion. Logic applied to proofs.
  - Real analysis. Graph of a function. Continuity: definition and study. Heine (min/max) theorem. Intermediate value theorem. Elementary functions.
  - Derivatives. Definition, rules. Mean value theorem, monotony, variations. Min/max problems. Derivative of reciprocal functions. Primitives, linear differential equations of order one. Hospital rule.
- Additional comments: The use of MB is compulsory but does not influence the mark.

Student feedback by questionnaires:







3.2.9 Feedback from course(s) held at UM2

Description of the course setting:

- Summer 2011:

	Course 1	Course 2
Title of the course	Linear Algebra	Calculus
Total number of students	250	250
Was Math-Bridge compulsory?	Yes	
How much of the content of the course covered by Math-Bridge?	80 %	
Students using Math-Bridge	396	
Students using Math-Bridge >1h	272	
Field of study	Natural Sciences, Computer science	Natural Sciences, Computer science
Conditions	Blended learning	Blended learning

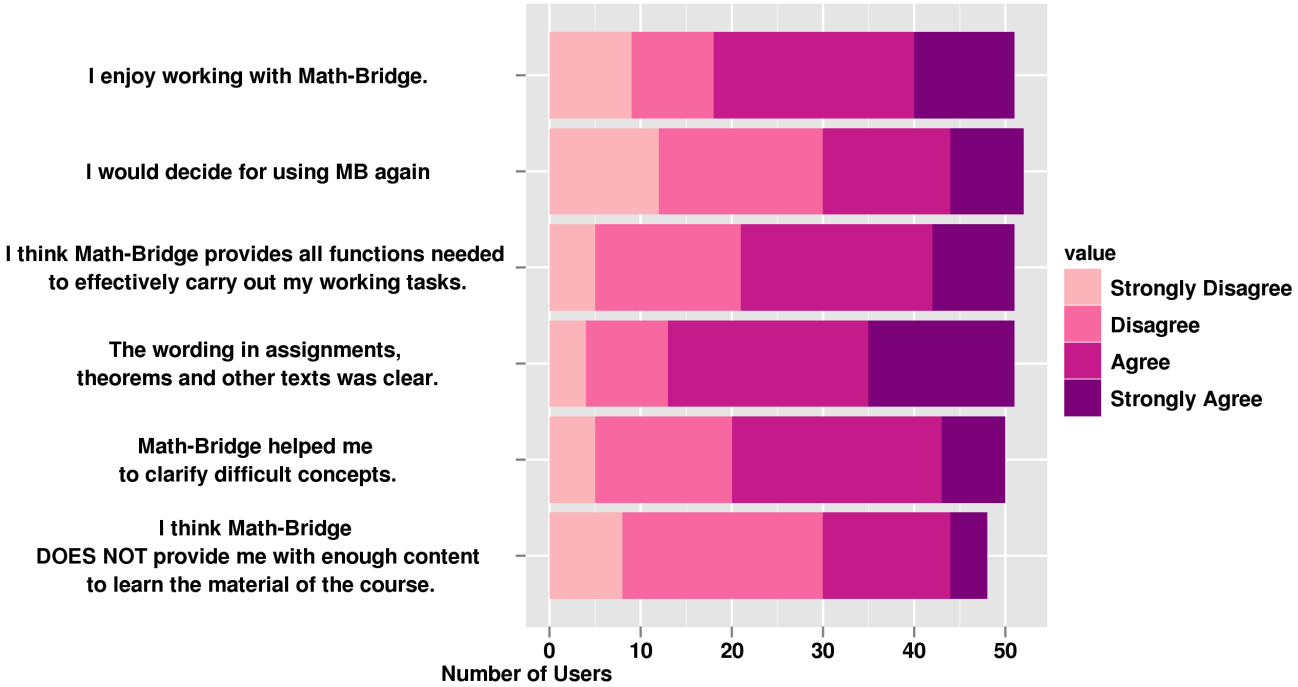
- Autumn 2011:

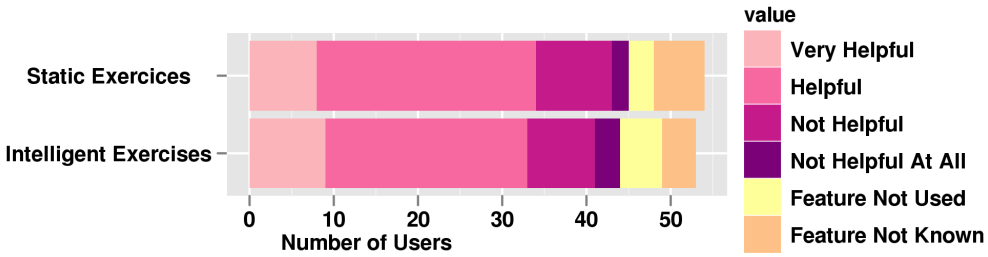
	Course 1	Course 2
Title of the course	semaine "Bilan Compétences" (semaine zéro)	GLMA101 (Calculus and Algebra)
Period and duration	05.09.2011–09.09.2011 (1 week)	12.09.2011–09.01.2012 (1 semester)
Total number of students	n.a.	500
Was Math-Bridge compulsory?	No	
How much of the content of the course covered by Math-Bridge?	25%	20%
Students using Math-Bridge	178	
Students using Math-Bridge >1h	81	
Field of study	Natural Sciences, Engineering	Natural Sciences, Engineering
Conditions	Mostly traditional face to face teaching with some voluntary MB sessions	Voluntary use of Math-Bridge

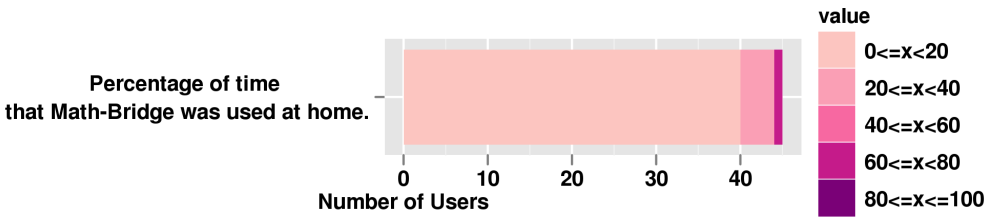
Additional information for the courses in Autumn 2011 (provided by Julianna Zsido):

Altogether there were approximately 500 students in the GLMA101 course, divided into 20 groups with different teachers. Students were encouraged to use Math-Bridge on their own and to explore it for themselves. They received a tutorial how to register in Math-Bridge. There were no organized sessions with Math-Bridge. Due to a bug in the system the data for the group identity variable was lost. Therefore it was not possible to discriminate between the groups/courses.

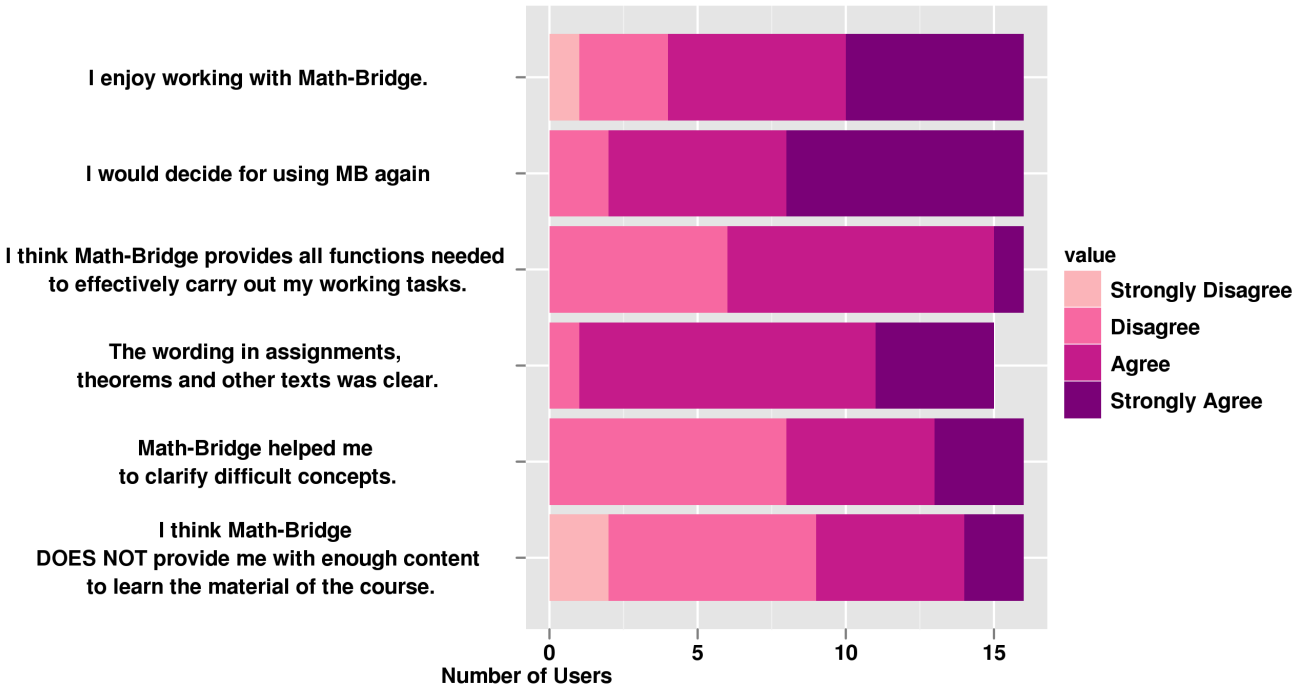
Student feedback by questionnaires, Summer 2011:

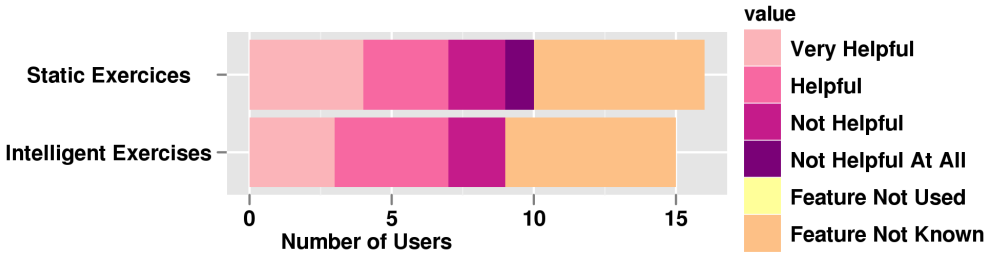


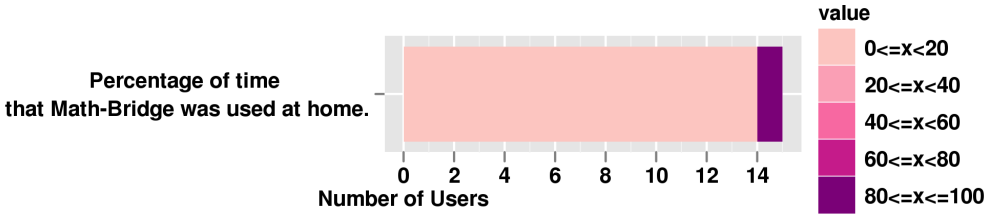




Student feedback by questionnaires, Autumn 2011:







3.2.10 Feedback from course(s) held at UV

Description of the course setting:

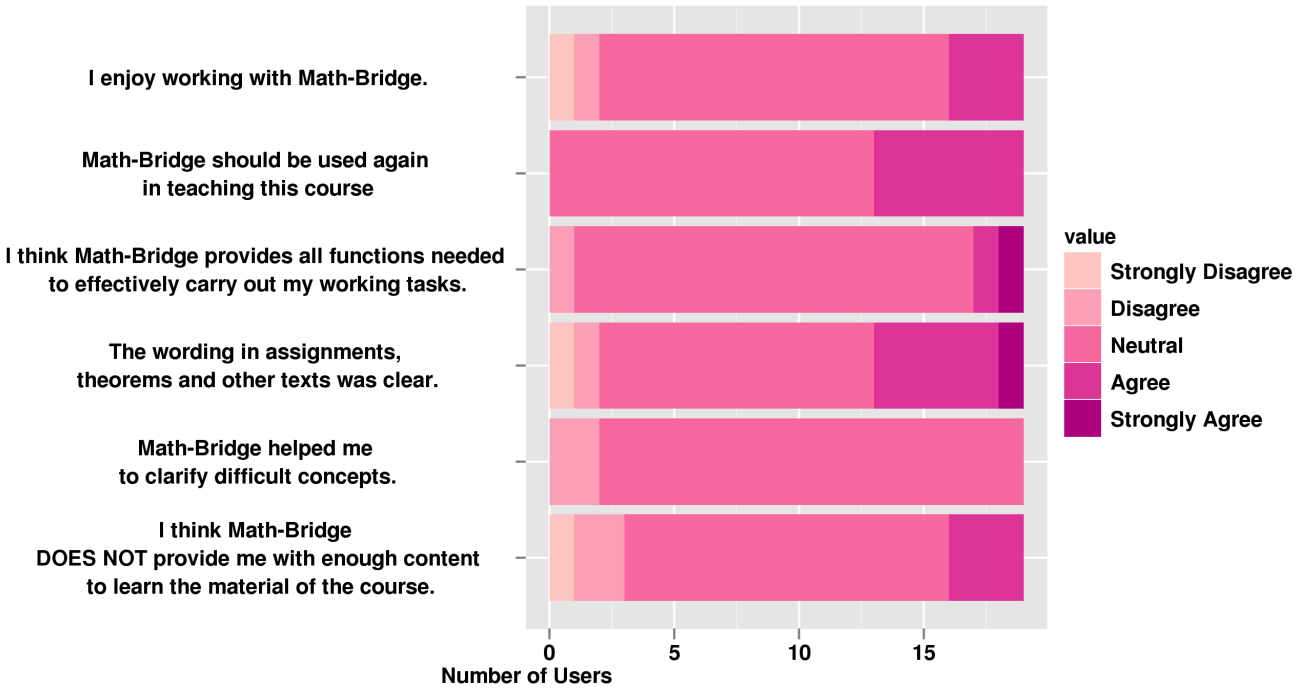
- Autumn 2010 and Summer 2011:

Title of the course	Einführung in das mathematische Arbeiten	Einführung in das mathematische Arbeiten
Duration	5 weeks	4 weeks
Total number of students	200	250
Was Math-Bridge compulsory?	No	
How much of the content of the course covered by Math-Bridge?	20%	
Students using Math-Bridge	143	190
Students using Math-Bridge >1h	43	70
Field of study	Mathematics	
Conditions	MB is used supplementarily	

- Autumn 2011:

Title of the course	Einführung in das mathematische Arbeiten
Periiod and duration	03.10.2011–14.11.2011
Total number of students	200
Was Math-Bridge compulsory?	No
How much of the content of the course covered by Math-Bridge?	20%
Students using Math-Bridge	149
Students using Math-Bridge >1h	30
Field of study	Mathematics
Conditions	MB is used supplementarily

Student feedback by questionnaires, Autumn 2011:



3.2.11 Return rates and usage

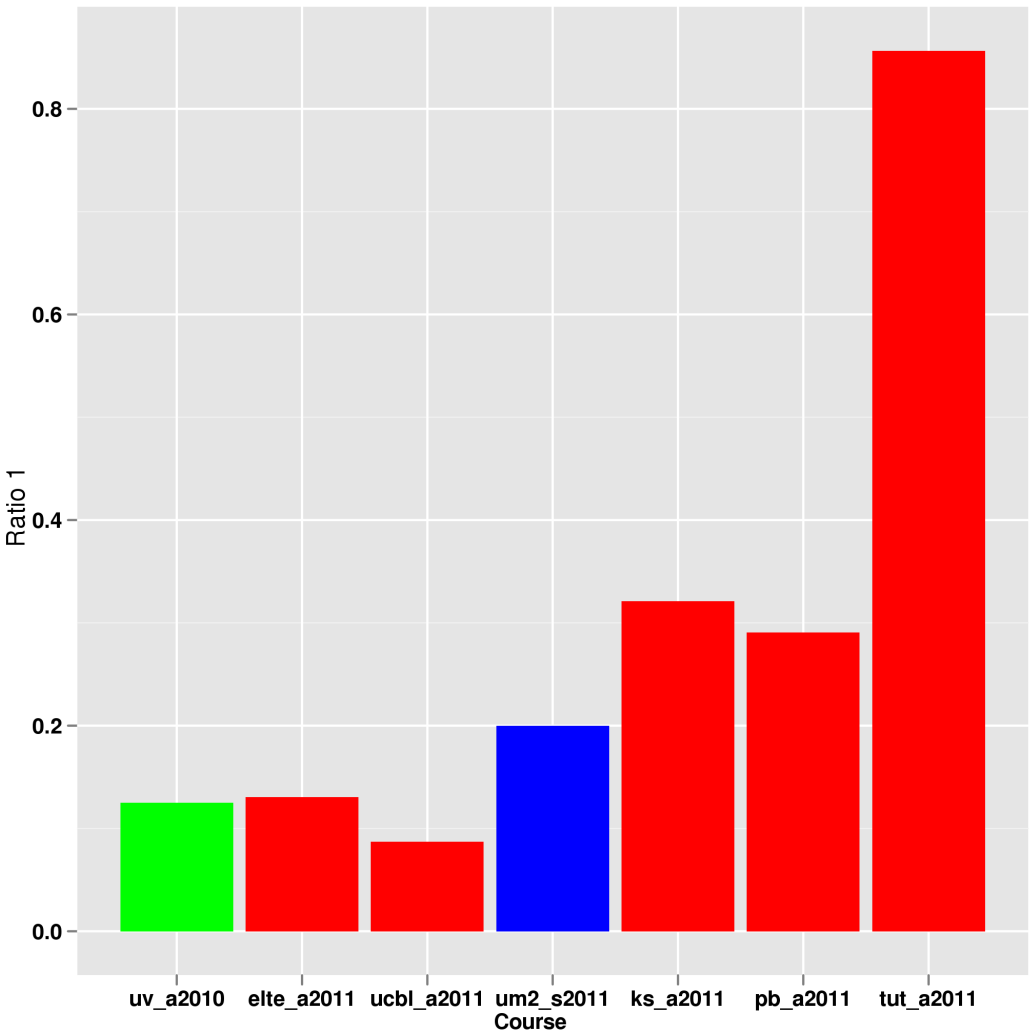
This section discusses the users' response to Math-Bridge in terms of asking the following two questions:

- How many of all users that filled in the pre-questionnaire did also complete the post-questionnaire?
- How many of all registered users were using Math-Bridge longer than one hour?

We use different colors to discriminate between courses that were held during different semesters:

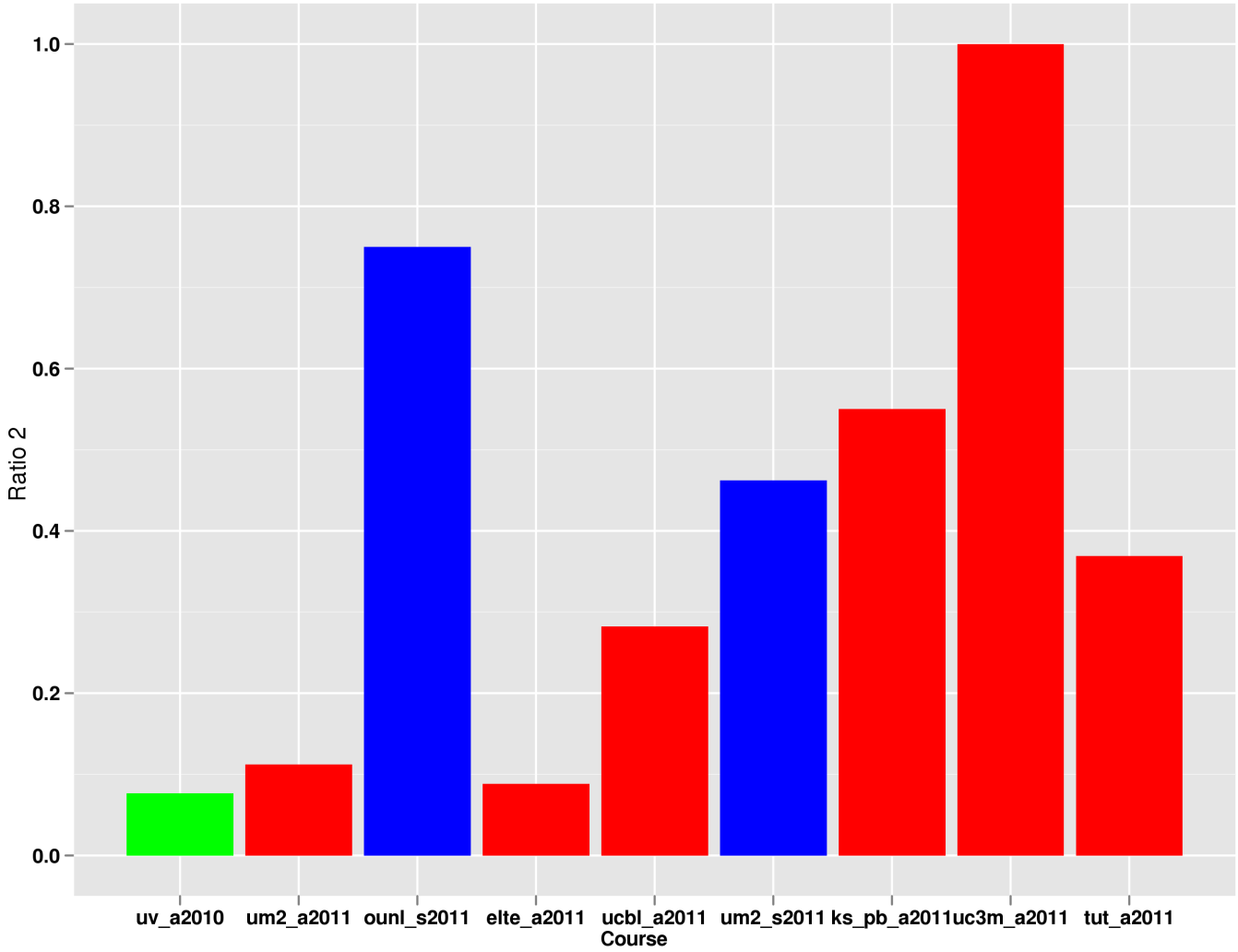
- Courses held in autumn 2010 are represented in green.
- Courses held in summer 2011 are represented in blue.
- Courses held in autumn 2011 are represented in red.

Ratio of post-questionnaires to pre-questionnaires: The variable Ratio 1 is defined as the number of completed post-questionnaires divided by the number of completed pre-questionnaires.



The different figures among the courses is mainly reflecting the level of integration of Math-Bridge in the bridging course. The return rates for post-questionnaires are generally rather low except for courses with a strong integration of Math-Bridge.

Ratio of users >1h to all users: The variable Ratio 2 is defined as the number of users that spent more than one hour in Math-Bridge divided by the number of all users.



Again, the different return rates among the courses reflect the level of integration of Math-Bridge in the bridging course. It can be said that for courses in which the use of Math-Bridge is voluntary, the number of users spending more than one hour in the system is quite low. This is not too surprising since Math-Bridge is a rather complex system and users need guidance by a tutor to learn how to use it. Since most of the bridging courses are actually held only after the semester has started – typically in the first weeks of September in case of the winter semester – it has to be considered that students attending those bridging courses are already very busy with other lectures, problem sessions etc. and also with organizing their studies. Thus there is not much time left for other things, especially if they are voluntary.

3.3 Correlations and dependencies

3.3.1 Definition of statistical variables

In the feedback questionnaires various aspects of users' satisfaction are addressed. In order to reduce this variety in the overall analysis, three scales representing three bundles of closely related aspects (satisfation in general, satisfaction with the system and satisfaction with the content) were constructed.

Based on the design of the questionnaires, three categories were chosen in order to build scales accordingly. What follows is a short description of those scales. This description is by no means complete and aims to provide a quick overview of the variables involved. The same scales were used in all courses, with the exception of old questionnaires where certain questions were not available (those were simply omitted). The considerations on reliability given below refer to both the "Large Scale Evaluation" courses as to the "Pilot Studies", with the notable exception of courses with samples below 10 users, which are deemed not fit for such methods. Questions that are not included in the scale but seem appropriate with regard to the questionnaire design were discarded on the basis of either obtaining better reliability by dropping them or on the basis of unsuitable wording.

General Satisfaction Scale

- "I would decide for using MB again"
- "Math-Bridge provided a meaningful learning experience for me."
- "Working with Math-Bridge DID NOT increase my interest in the subject."
- "Math-Bridge DID NOT provide me with opportunities for practicing new skills."
- "I enjoy working with Math-Bridge."
- "I would recommend (the use of) Math-Bridge to my friends."
- "I think Math-Bridge is useful."

For this scale, Cronbach's Alpha was well above 0.75 and below 0.9 for *all* courses. In connection with the design of the questions, this should indicate a valid and reliable scale.

System Satisfaction Scale

- " I think Math-Bridge is unnecessarily complex".
- "I think Math-Bridge provides all functions needed to effectively carry out my working tasks."
- "navigation_supports_working"
- "I think the Math-Bridge navigation is NOT easy."
- "I think Math-Bridge reacts to input as I expected it to."

For most courses, Cronbach's Alpha was between 0.65 and 0.8, with the only exepction of one course with rather small sample size. As in the "General Satisfaction Scale", together with the wording of the questions we infer a valid and reliable scale.

Note also that Pearson correlation coefficient between "General Satisfaction Scale" and "System Satisfaction Scale" is 0.62. Considering the sample size we may infer a rather strong correlation between those scales.

Content Satisfaction Scale

- "The content is explained comprehensively."
- "I think the content in Math-Bridge has appropriate level of difficulty"
- "Math-Bridge helped me to clarify difficult concepts."

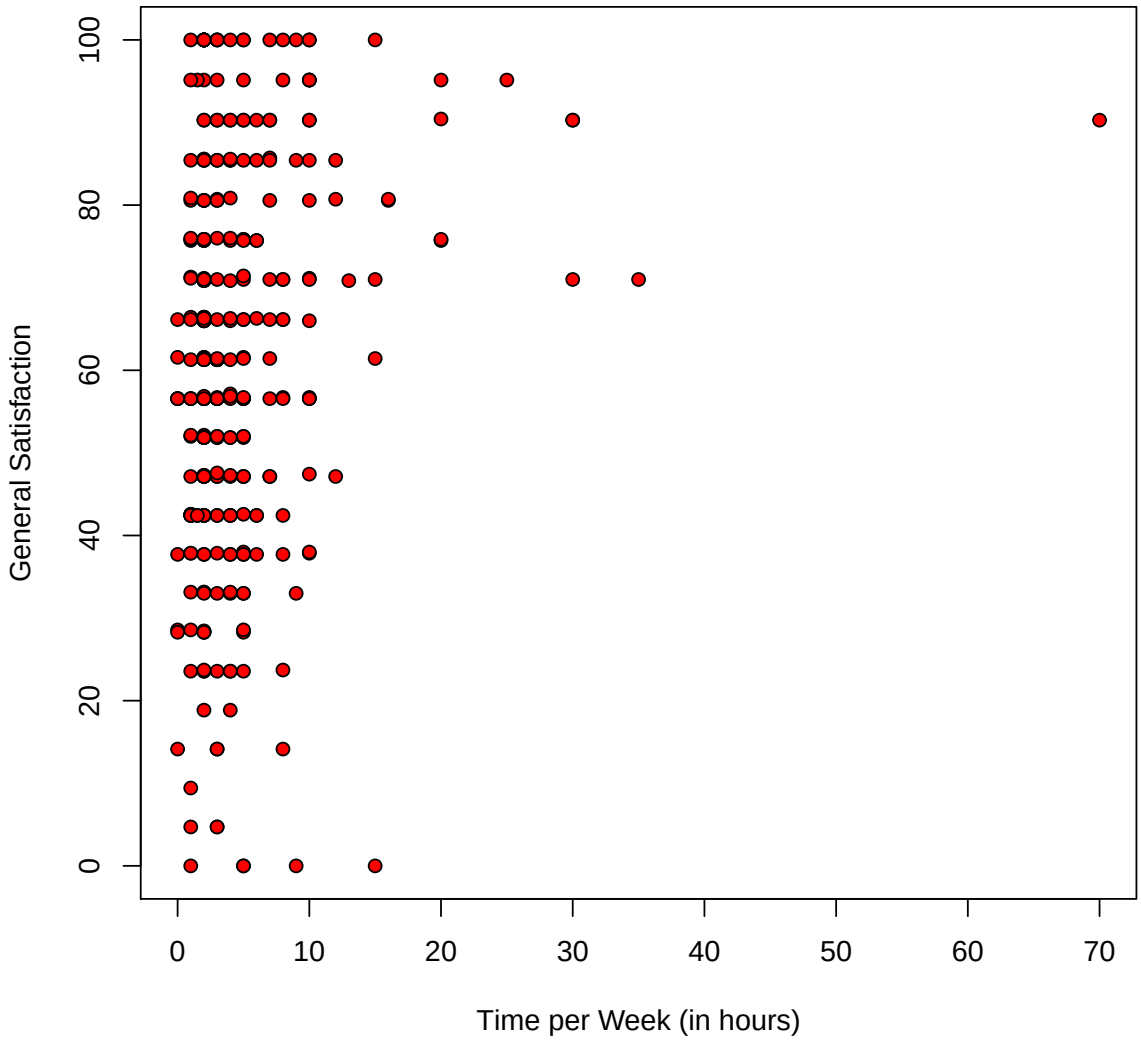
- "Math-Bridge DID NOT help me to develop problem solving abilities."
- "Working with Math-Bridge DID NOT contribute to my learning in this course."
- "The wording in assignments, theorems and other texts was clear."

Judging by Cronbach's Alpha, this scale seems to be the least reliable one. Attempts have been made to improve the reliability of the scale by using different sets of questions. The most successful attempt was the set presented here, with values for Alpha well above 0.6 for all courses in the "Large Scale Evaluation". Most of the other courses give rise to values still above 0.5. Still, this scale should be viewed as an partially insuccessful attempt, since by observing the exact wording it is also not obvious that grouping this questions is the best choice for building the scale.

3.3.2 Correlations in student data

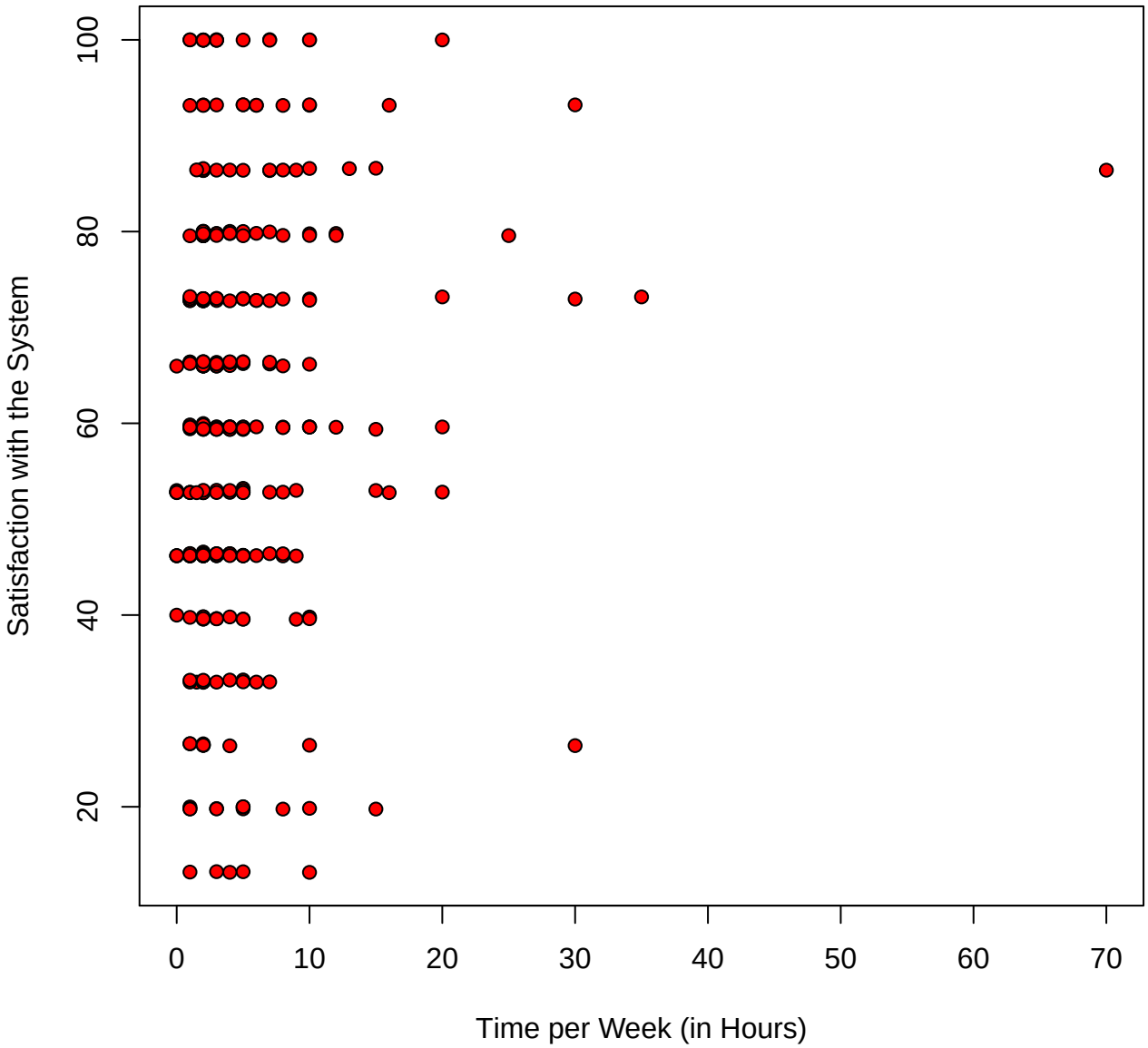
We will now present some correlations in the data of students from courses held in autumn 2011, the phase of large scale evaluation. Correspondingly, the data points are depicted in red color.

General satisfaction with respect to time spent with Math-Bridge according to questionnaire data: The following plot shows how the general satisfaction of our users (as defined in Section 3.3.1) is related to the time per week (in hours) the users declared to have spent using Math-Bridge (in the questionnaires).



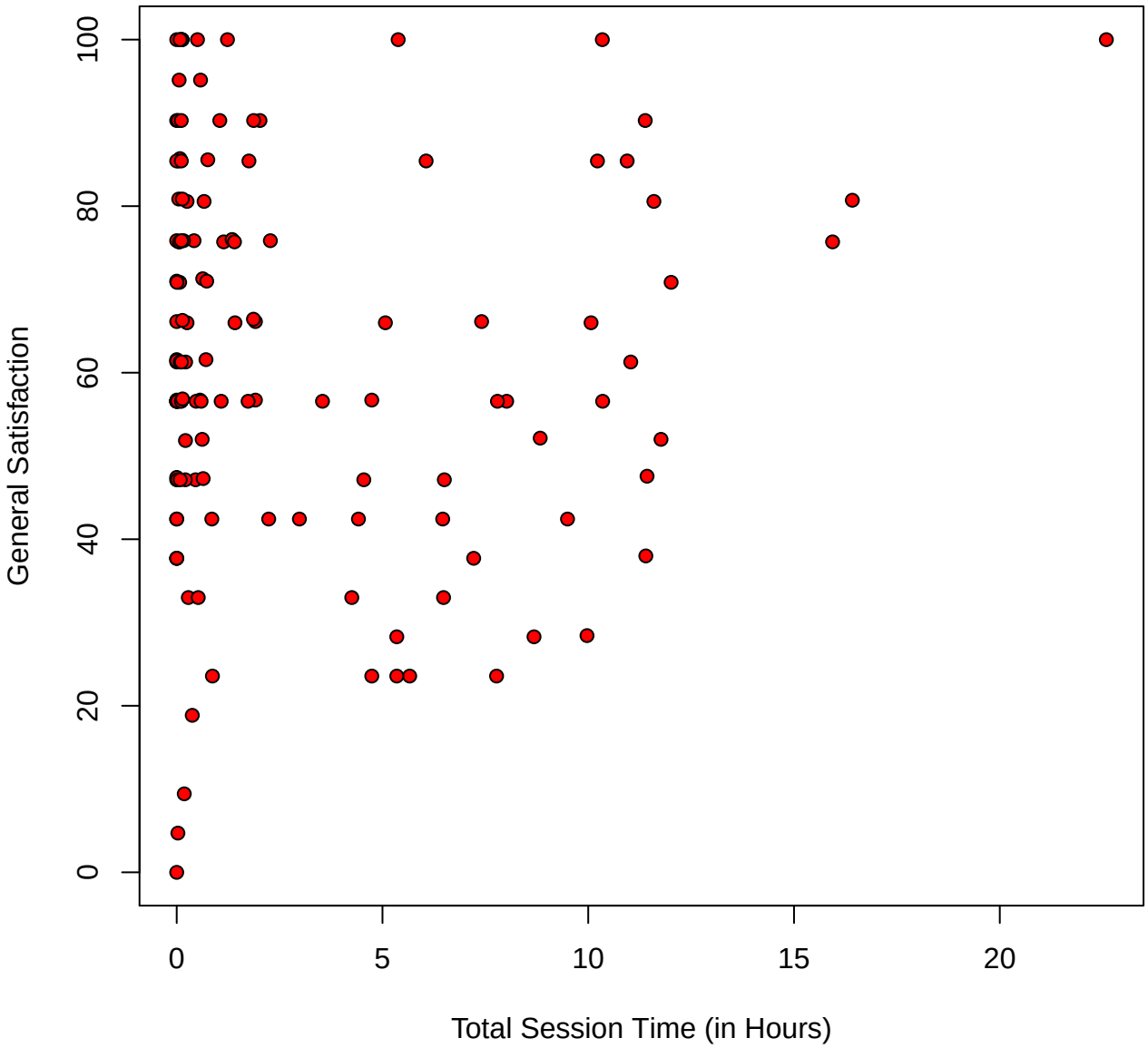
There is a weak tendency (with Pearson correlation coefficient 0.21) that the general satisfaction increases with the average time per week a user spends working with Math-Bridge. In fact, *all* users spending 20 hours or more with Math-Bridge have a general satisfaction of more that 70%. In addition, there are only very few users with a general satisfaction value of less than 20%.

System satisfaction scale with respect to time spent with Math-Bridge according to questionnaire data: The following plot shows how the users' satisfaction with the system (as defined in Section 3.3.1) is related to the time per week (in hours) the users declared to have spent using Math-Bridge (in the questionnaires).



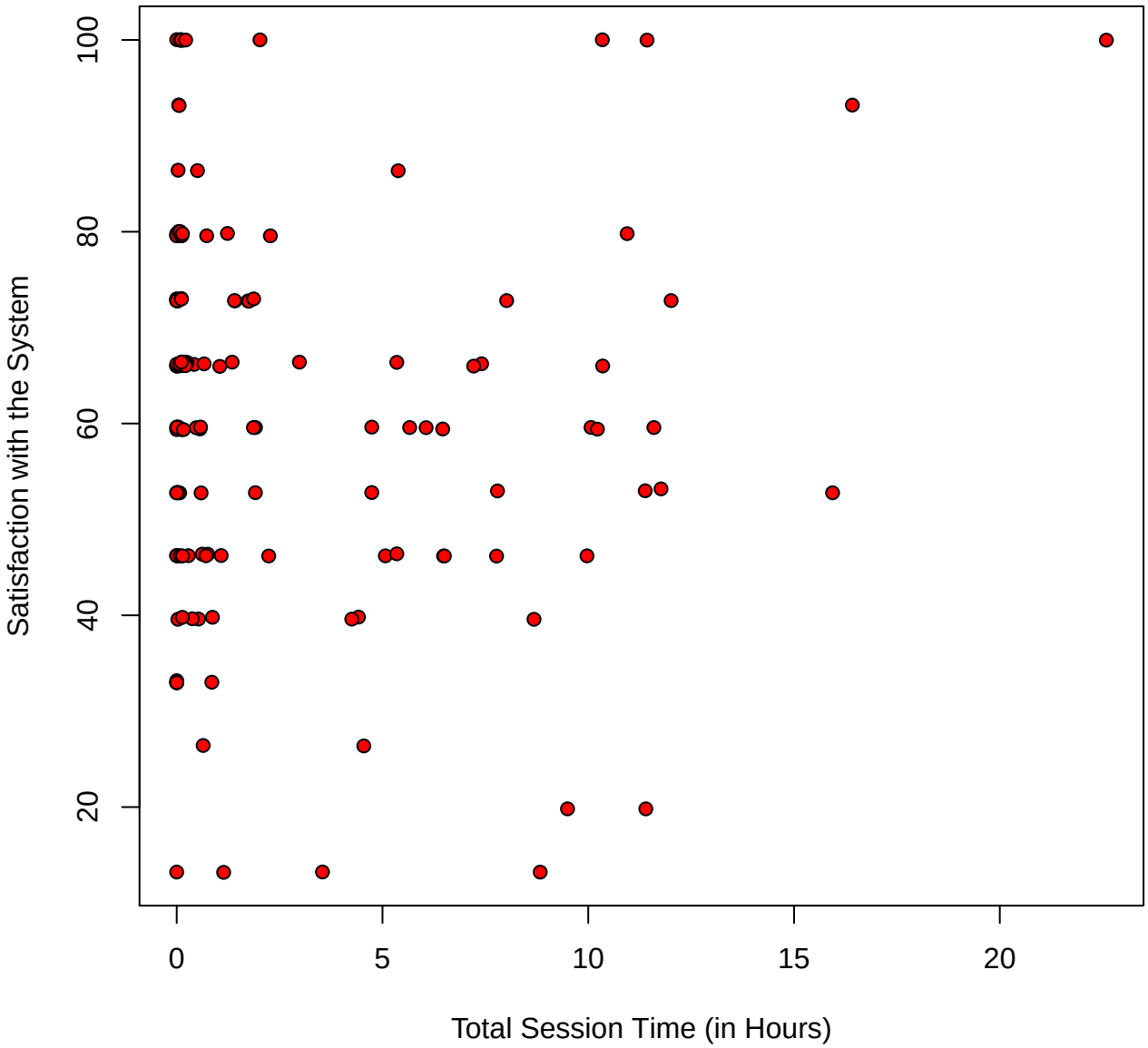
As for the general satisfaction, users' satisfaction with the system slightly increases with the time spent working with the system (Pearson correlation coefficient 0.13). However, the proportion of users who are not satisfied with the system is larger in comparison to the general satisfaction plot in the last paragraph. A possible explanation is that there are some users who are quite satisfied with the content but not with the system.

General satisfaction scale with respect to time spent with Math-Bridge according to log files: The following plot shows how the general satisfaction of our users (as defined in Section 3.3.1) is related to the time (in hours) the users actually spent in Math-Bridge (according to the log files, i.e. the number of seconds they were logged in).



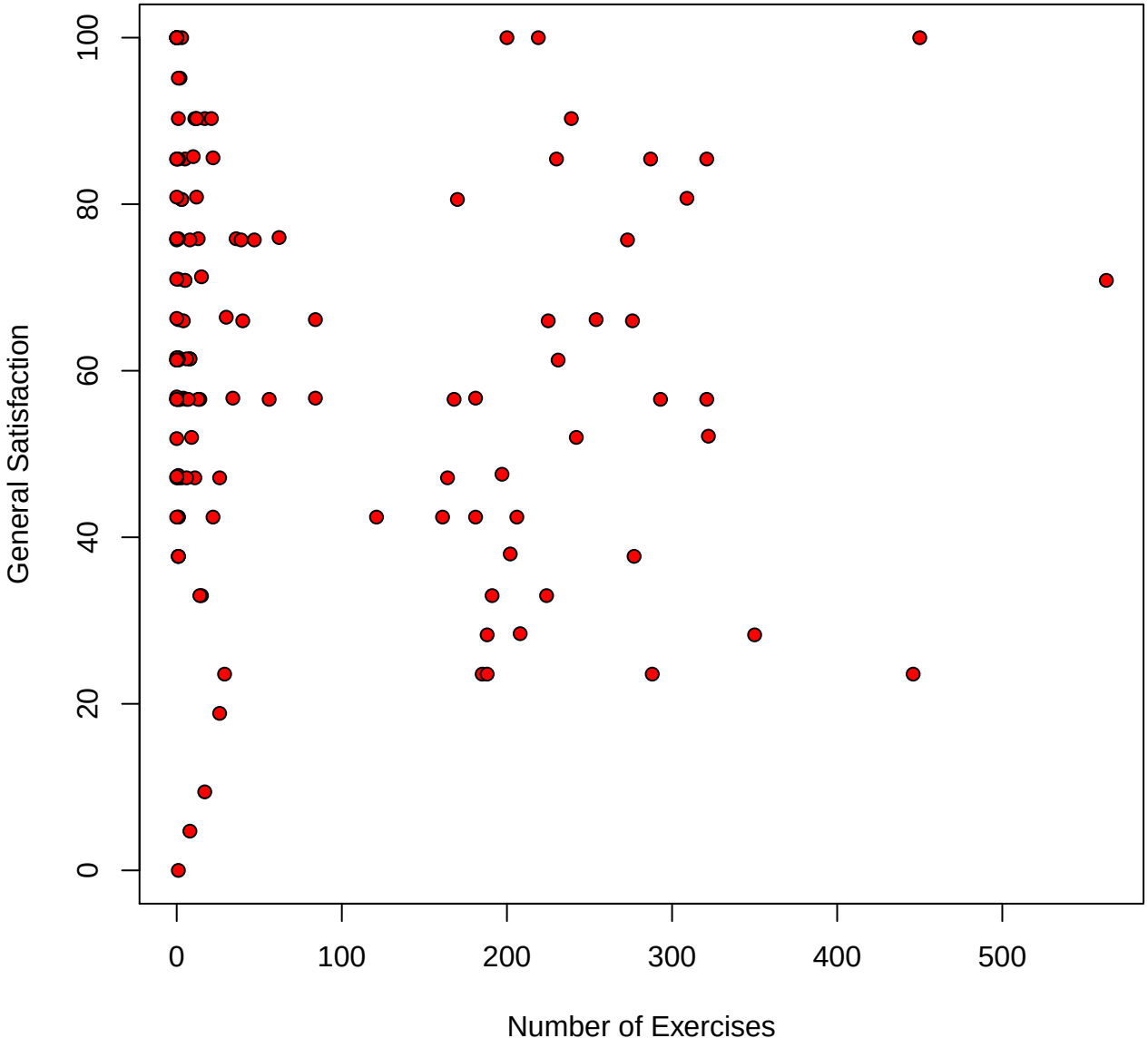
Althought the Pearson correlation coefficient for the complete data set is -0.02 (error probability $>$ 5%), the graphical representation of the data suggests that for ambitious users the general satisfaction increases with the total session time users spend working with Math-Bridge. In fact, the correlation coefficient, when restricted to users spending more than 3 hours in the system, is 0.50, thus indicating a strong correlation. In total, the spread in total session time is significantly larger than for the time spent with Math-Bridge per week according to the questionnaires. Some users might forget to log out after completing their Math-Bridge session. This might partly explain the discrepancy between the log file data and the actual session time. Of course, the questionnaire data are only estimates by the users themselves and thus not very accurate.

System satisfaction scale with respect to time spent with Math-Bridge according to log files: The following plot shows the users' satisfaction with the system (as defined in Section 3.3.1) with respect to the time (in hours) the users actually spent in Math-Bridge (according to the log files, i.e. the number of seconds they were logged in).



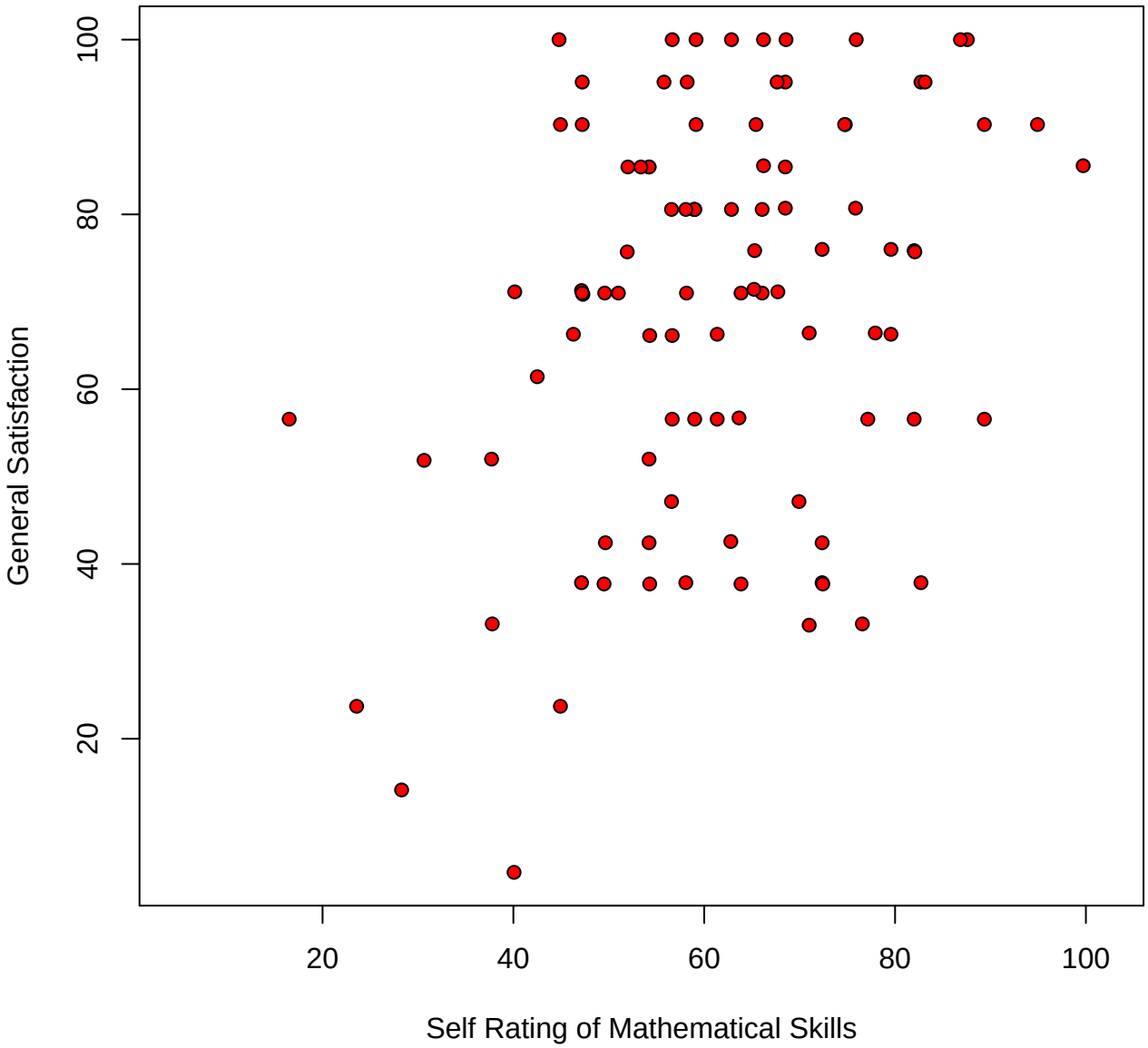
As it is the case for the general satisfaction scale, the total session time according to the log files shows a larger spread than the time per week estimates by the users themselves. An increase of satisfaction with total session time at least for the ambitious users is still recognizable (the correlation coefficient, when restricted to users spending more than 4 hours in the system, is 0.45), yet it is less distinctive compared to the general satisfaction. (The correlation coefficient for the complete data set is again -0.02).

General satisfaction in dependence of number of exercises run: The following plot shows how the general satisfaction of a user (as defined in Section 3.3.1) is related to the number of exercises run by the user.



In total, the correlation coefficient is -0.11. When restricted to ambitious users (> 100 exercises), there is a slight tendency that those running more exercises are also more satisfied (correlation coefficient 0.20).

General satisfaction in dependence of self-rating: The following plot shows how the general satisfaction of our users (as defined in Section 3.3.1) is related to their self-rating (see Section 3.3.1). The latter variable was constructed from 14 additional questions in the questionnaires of Kassel and Paderborn Universities.



There is weak but significant positive correlation between the users' self-rating and their general satisfaction with Math-Bridge (Pearson correlation coefficient 0.33).

3.3.3 Student data and course settings

Course settings: Among the bridging courses and university lectures held at the partner institutions, 10 courses provided log and feedback data suitable for statistical evaluation. A major question is whether – and how – the users' satisfaction and their way to use Math-Bridge depends on the course setting provided. Of course, the settings of the various courses differed in many respects. In order to have a rough measure at hand how deep Math-Bridge was integrated into a particular course, two criteria are used:

- Was the use of Math-Bridge compulsory ($u = 1$) or optional ($u = 0$)?
- What percentage (p) of the course content was covered by the Math-Bridge material offered to the students?

Taking both criteria into account, a reasonable measure is provided by $u + p/100$, leading to the following order from not integrated to deeply integrated (in brackets the abbreviations used in the following plots):

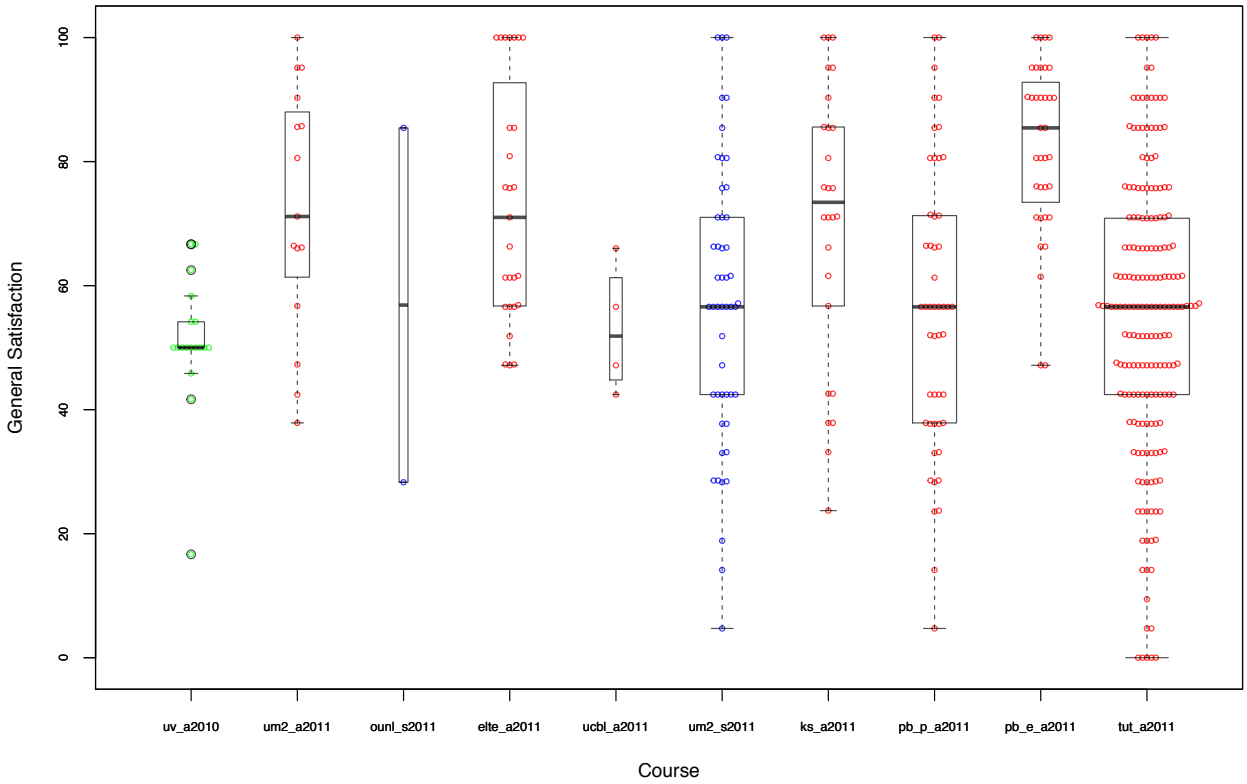
1. UV, autumn 2010 (uv_a2010)
2. UM2, autumn 2011 (um2_a2011)
3. OUNL, summer 2011 (ounl_s2011)
4. ELTE, autumn 2011 (elte_a2011)
5. UCBL, autumn 2011 (ucbl_a2011)
6. UM2, summer 2011 (um2_s2011)
7. KS, autumn 2011 (ks_a2011)
8. PB, autumn 2011, P-course (pb_p_a2011)
9. PB, autumn 2011, E-course (pb_e_a2011)
10. TUT, autumn 2011 (tut_a2011)

The Kassel/Paderborn courses ks_a2011, pb_p_a2011 and pb_e_a2011 are collectively denoted by kspb_a2011. The order is not to be taken too rigorous. In particular, the TUT course tut_a2011 ranges as the highest-integrated one because its content covering by Math-Bridge is 100%, whereas the corresponding figure is 90% in the case of the Paderborn E-course pb_e_a2011.

Further factors constituting the different conditions of the courses (that may not easily be quantified) have been described above in Section 3.2.

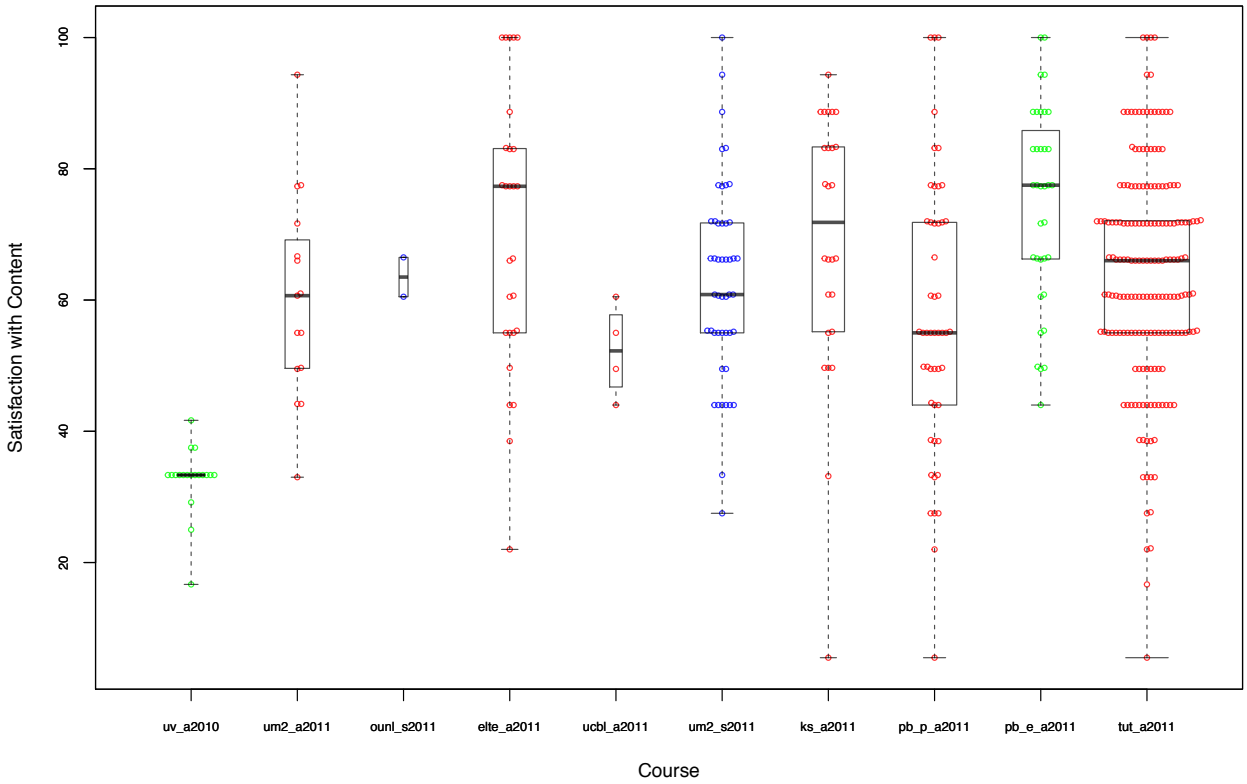
In the following figures, the courses are displayed in this order, thus giving a rough impression of the dependence of the respective variables on the degree of integration of Math-Bridge into a course.

General satisfaction scale by course: The following plot shows how general satisfaction of our users (as defined in Section 3.3.1) depends on the particular courses and on the degree of integration.



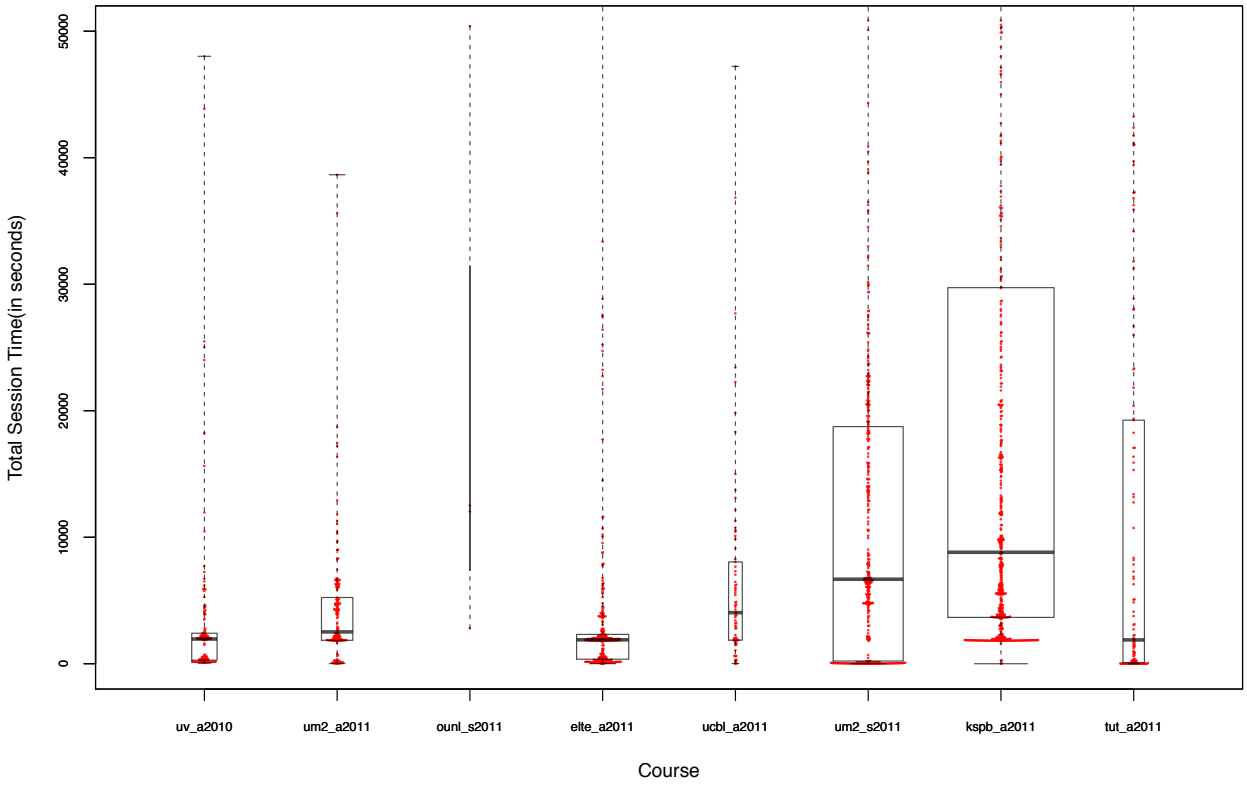
The plot shows that the distribution of users' general satisfaction in courses with high degree of integration tends to have a larger spread as compared to low-integrated courses. This is probably a selection effect arising from the fact that the use of Math-Bridge was optional in the low-integrated courses. The course with highest users' satisfaction is the Paderborn E-course.

Content satisfaction scale by course: The following plot shows how the users' satisfaction with the content (as defined in Section 3.3.1) depends on the particular courses and on the degree of integration.



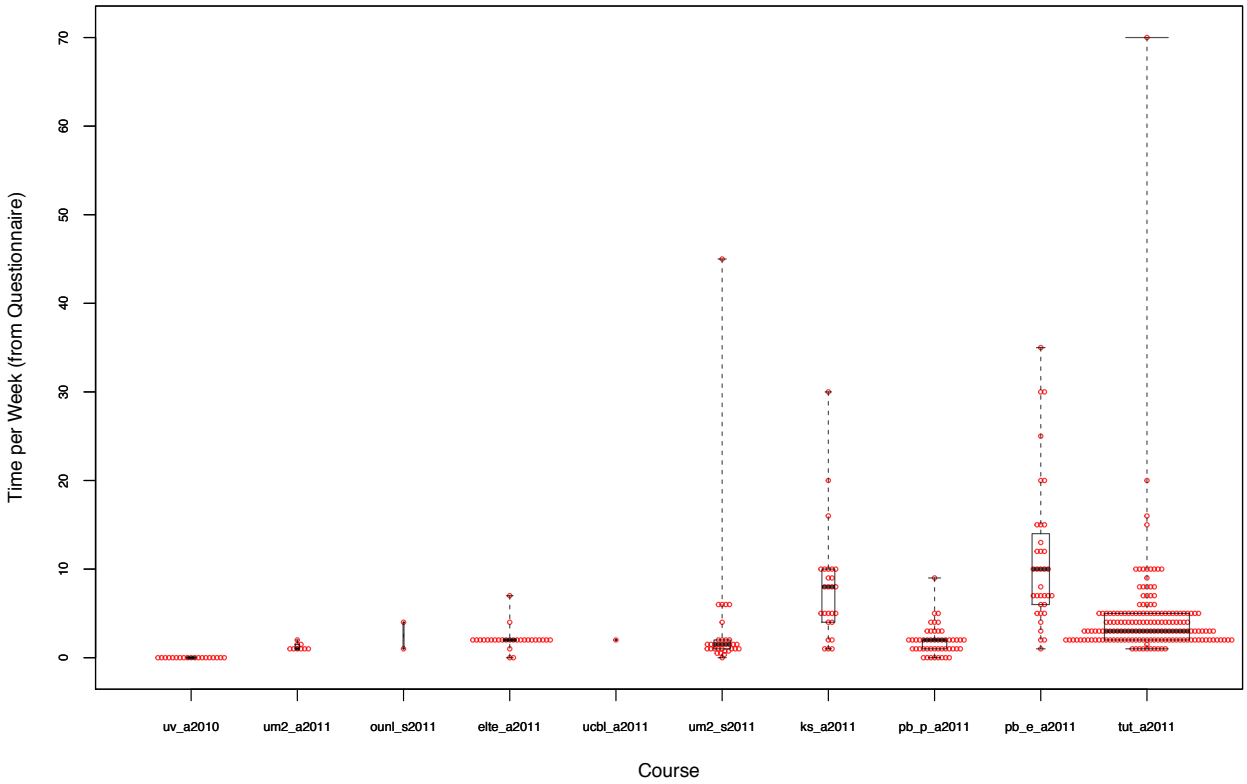
Not surprisingly, the users of the Paderborn E-course whose work heavily relied on the Math-Bridge content, rate the content better than users of all courses. It should be noted here that UV and ELTE used the same content, although it is rated quite differently by the users of these two courses! This illustrates that the rating of content is not a matter of the content alone but also depends on the particular course settings.

Total session time by course: The next plot shows the total session time (in seconds) of the users.



It clearly displays a tendency that users in high-integrated courses spend more time in the system than users in low-integrated courses (with the TUT course being an exception). Again, the Paderborn E-course has the highest median.

Time per week by course: In the feedback questionnaires, the students were asked how many hours per week they worked with Math-Bridge. The next plot shows the their answers by course.



Students from the Paderborn E-course and the Kassel clearly outdate all other courses, in particular the Paderborn P-course. On the other side of the spectrum, the UV students spent very little time in the system, due to the low degree of integration of Math-Bridge.

3.4 Social feedback - ratings of learning objects by feedback buttons

The Social tab located in the right panel gives users the possibility to express their opinion about a learning object. Figure 1 shows an example of the social tab for a learning object.

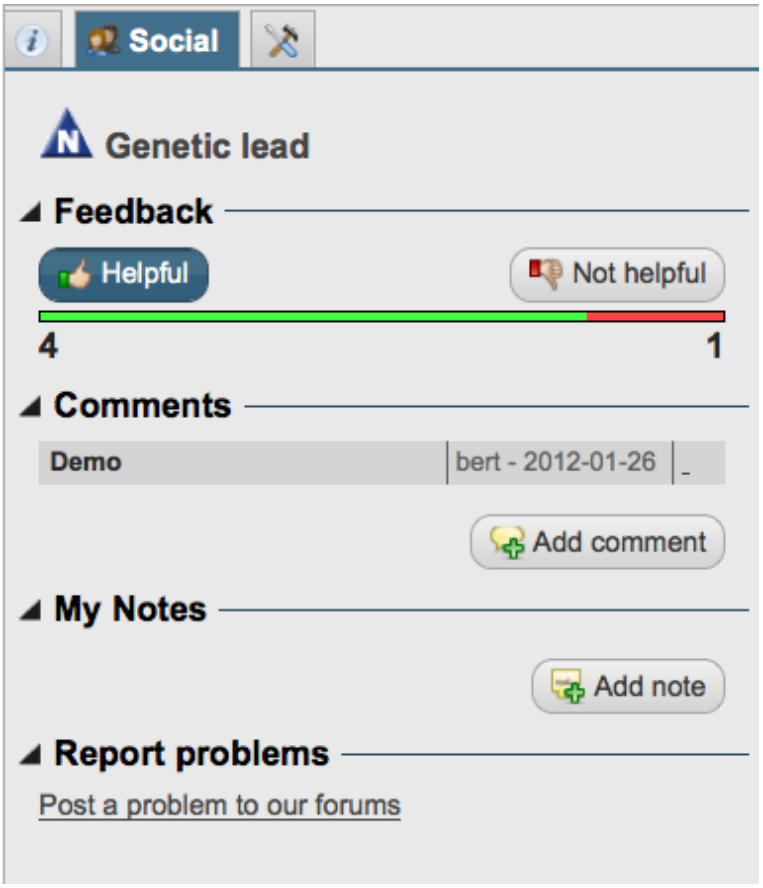


Figure 1: Social Tab

Users can provide simple feedback by either clicking the green thumbs up button to express they liked the learning object or the red thumbs down icon to tell they didn't like the learning object. Removing provided feedback is done by clicking the previously selected button and changing the feedback is done by clicking the opposite button. See Figure 2.

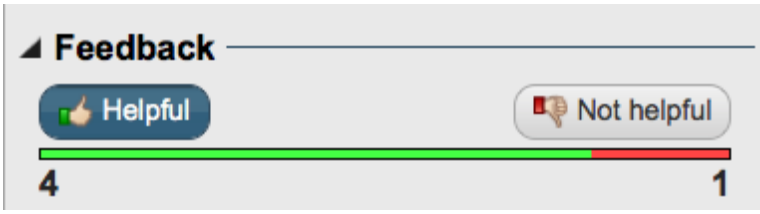


Figure 2: Simple Like/Dislike Feedback

If the learners want to provide more elaborate feedback they can post a public comment about the selected learning object. A given comment can be deleted again by clicking the red X icon. Of course comments can only be deleted by the author of the comment. In Figure 3 a new comment is written.

In case a learner encountered a problem with a learning object she can file a problem report in the Math-Bridge forum by following the "Post a problem to our forum" link.

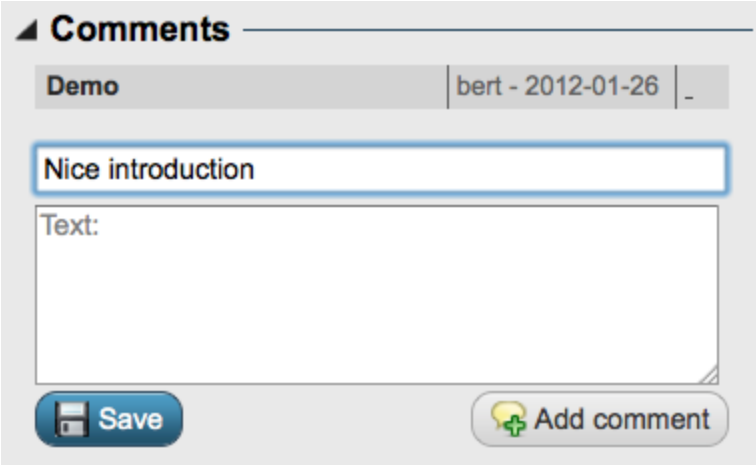


Figure 3: Add a comment

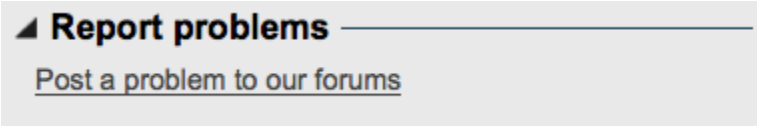


Figure 4: Report a Problem

The last option provided by the social tab is to write a private note about a learning object, like hints to solve an exercise or to easier understand an example. The student will see his private notes about a learning object listed in the "My Notes" section.

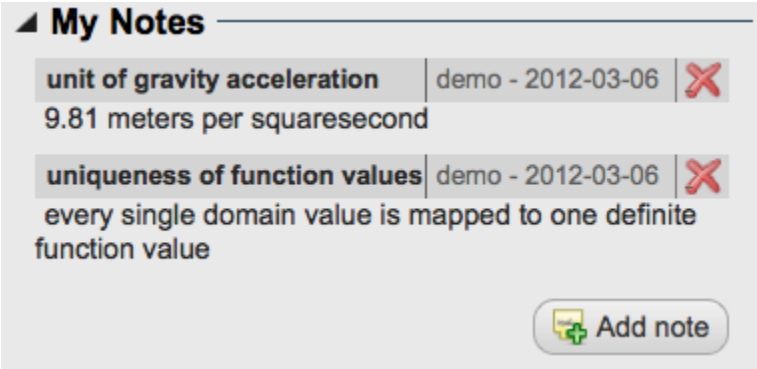


Figure 5: List of users private notes

Data from feedback buttons: It has to be noted that very few users took the opportunity to rate individual learning objects. Typically there was at most 1 click per learning object. Written comments are practically non-existent. Except for the courses at **UM2** the number of clicks on feedback buttons is negligible. However, the data from **UM2** show that the rating of the content is very positive on the average. The insignificant amount of social feedback might be related to the fact that the buttons for giving feedback on individual learning objects are not visible when the sidebar is closed. Students thus might not take notice of this possibility unless the teacher tells them.

4 Additional local studies

4.1 Comparative study of Math-Bridge and VEMA - Universities of Kassel and Paderborn, 2011

This chapter was provided by Pascal Fischer and Thomas Wassong. It describes the additional study that was implemented in Kassel and Paderborn during the evaluation study in fall 2011. The partners in Kassel and Paderborn are involved in the VEMA project that developed content as well as course scenarios for bridging courses and implemented them for several years. The comparable study tries to evaluate the additional benefit of Math-Bridge towards the VEMA material.

The chapter starts with a short description of the study. This includes a brief description of the VEMA material and the differences to the Math-Bridge system. It also describes the design of the study and the measuring instruments. The second part of this chapter contains the presentation of selected results.

4.1.1 Description of the study

The VEMA material in comparison to the Math-Bridge system:

The VEMA project was founded in 2003 at the University of Kassel by Prof. Dr. Biehler and Prof. Dr. Wolfram Koepf. Until 2012 the project extended to the Technical University of Darmstadt (Prof. Dr. Bruder), the University of Lüneburg (Prof. Dr. Hochmuth) and the University of Paderborn (Prof. Dr. Biehler). The target of the project is to develop eLearning based content for bridging courses, to implement blended learning course scenarios, to evaluate the bridging courses and to re-develop the content and to re-implement the course scenarios based on the evaluation results. In this context the partners in Kassel and Paderborn have experiences with bridging courses for several years on the one hand and also an established infrastructure concerning content and course scenarios of bridging courses on the other hand. A comprehensive overview of the project can be found at TMO[11].

For the described study some aspects of the content design has to be described more detailed. The content in VEMA is structured into smaller packages called "modules". Each module focuses on one mathematical topic and is structured in knowledge units. This structure of module-units is the same for each module. The well-defined and consistent structure supports the learners in their navigation in all modules. The layout of the content is adjusted to this well-defined structure with a consistent navigation frame in the top of the content which uses recognizable icons for each knowledge unit as seen in the following screenshot. Nonexistent units are greyed out.

A description of the knowledge units can be found at TMO-Paper and at D1.3[12]. The knowledge units are ordered with different priority: a module starts with the overview unit. Afterwards the units introduction, info, info/interpretation/explanation, application, typical mistakes and exercises. Here the regular order ends, what is also supported by the layout: the next button switches to a restart button which links to the overview unit. The units visualization and supplement are not part of the regular order and contains content for special needs. If a learner wants to open these units, he explicitly has to click the icons in the navigation frame. The content of VEMA contains mostly static html pages with several interactive JavaScript exercises, flash films and Java applets. Some important parts of the content ("learning objects") are labeled with their function in the text. So

[11] TMO stands for the publication: Biehler, Rolf, Fischer, Pascal R., Hochmuth, Reinhard, Wassong, Thomas (2011). Self-regulated learning and self-assessment in online mathematics bridging courses. In: Angel A. Juan, Maria A. Huertas, Sven Trenholm, Cristina Steegman (eds.): Teaching Mathematics Online: Emergent Technologies and Methodologies. IGI Global

[12] D1.3 stands for the publication Biehler, Rolf; Hochmuth, Reinhard; Fischer, Pascal; Wassong, Thomas (2010): EU-Project Math-Bridge - D1.3: Pedagogical Remedial Scenarios

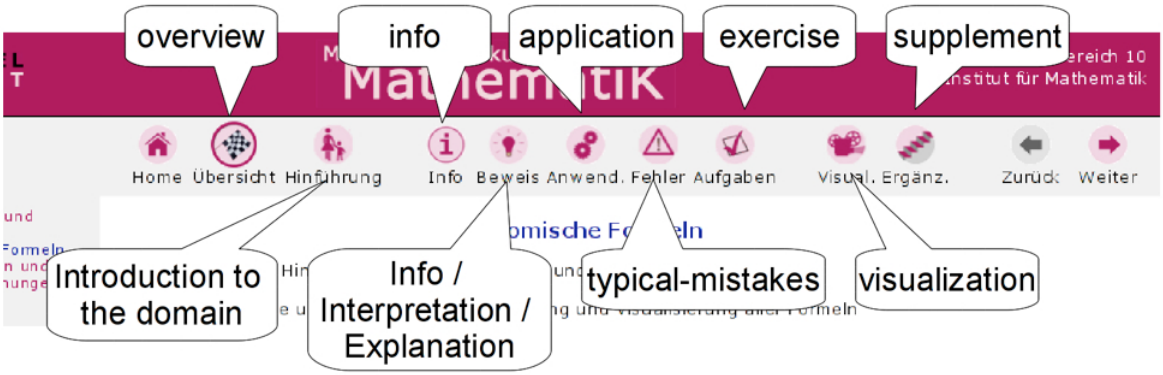


Figure 6: Screenshot of the VEMA navigation bar

definitions, theorems, axioms, exercises and examples are highlighted in the text but not every part of the content is highlighted. In addition all highlighted parts of the content are numbered concerning the corresponding module.

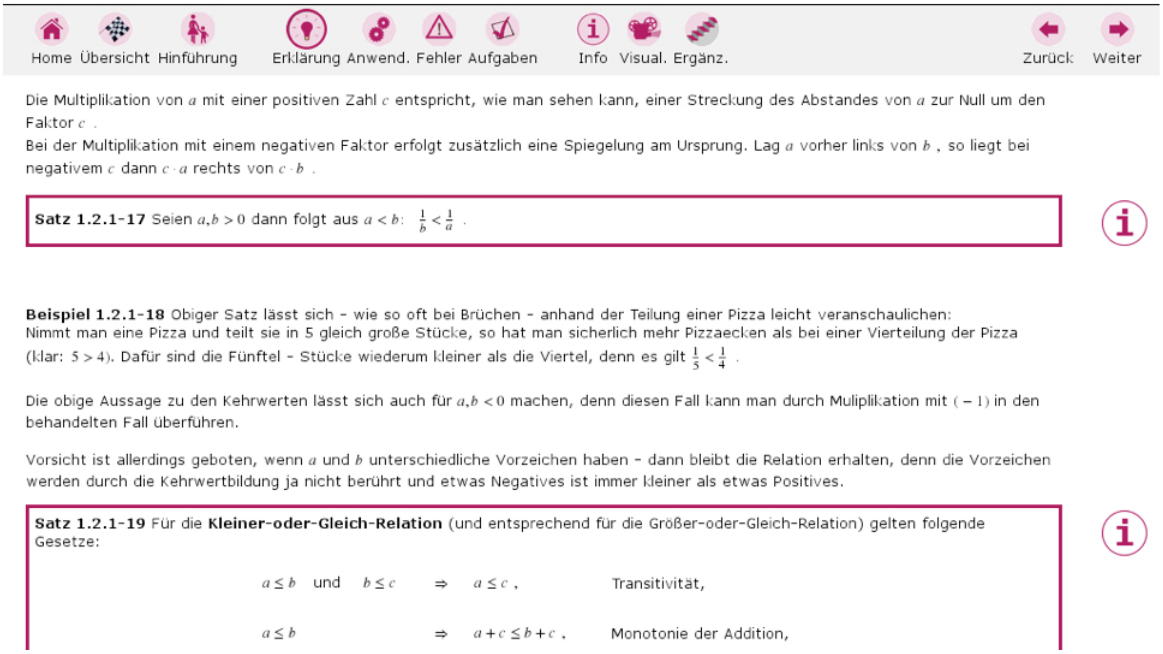


Figure 7: Screenshot of the VEMA material

For the Math-Bridge project, the partners in Kassel and Paderborn added the VEMA material as content to the adaptive learning system. The material needed to be transformed into the omdoc-format to be compatible with the Math-Bridge system as done in workpackage 2 of the project. One important step of the transformation process was to slice the complete content into small learning objects (LOs) and to enrich these LOs with metadata, for instance the type of the learning object. This process had different consequences: (1) The content was divided into smaller pieces without any hints for the order. Many pedagogical and didactical ideas were lost. (2) The necessity to divide into LOs and to enrich them with metadata leads to more data than intended from the VEMA project. Especially the data of the type of learning object was never in mind of the authors in the VEMA project.

The first consequence was compensated by reordering the LOs in the original order in a pre-recorded book (cf. D1.3). The knowledge units were organized in chapters of the book with the same titles as the knowledge units. This has been done for each module as one pre-recorded book. During this process another consequence of the transformation process becomes obvious: the handling and

presentation of the knowledge units as described above could not be reimplemented for Math-Bridge. The representation of the knowledge units as chapters disallow on one hand the classification of the last two units as additional units beyond the regular order. On the other hand the use of the VEMA-icons was not possible.

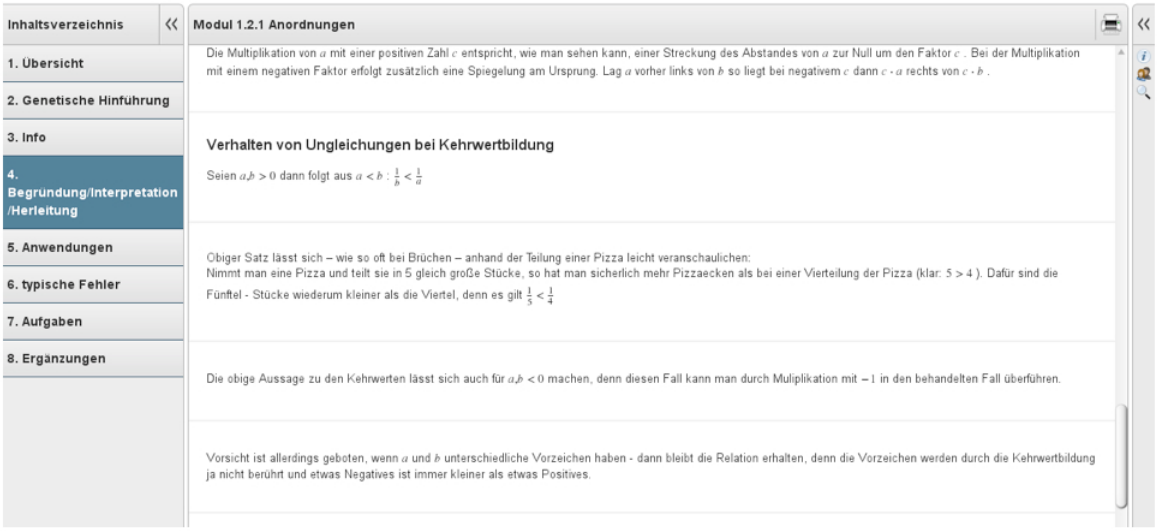


Figure 8: Screenshot of the VEMA Material in Math-Bridge

But the transformation of the content into the Math-Bridge system offers an interesting opportunity: the content from other partners were also available in the Math-Bridge system. This content was also sliced into learning objects and single LOs could easily be added to the described pre-recorded books. The enriching process was done for all VEMA modules with suitable LOs from all partners. Besides enriching the modules with additional LOs we also enriched the feedback opportunities of the material: adding STACK and IDEAS exercise or exercise from the LeActiveMath content the pre-recorded books also provides the complete feedback opportunities of the Math-Bridge system. An important aspect concerning this discussion is that not the complete VEMA material could be integrated in Math-Bridge due to licensing problems. Accordingly some of the VEMA material is not available in the Math-Bridge system which is important for the design of the study. Another additional feature of the Math-Bridge system that was used during the study was the use of the remedial scenarios as described in D1.3.

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Another additional feature of the Math-Bridge system that was used during the study was the use of the remedial scenarios as described in D1.3.

4.1.2 The design of the study

In Kassel and Paderborn we decided to make a comparative study with two different settings: a bridging course scenario where the VEMA material with its special layout and its navigation on one hand was used and a scenario using the Math-Bridge system with a new layout and with enriched content and new feedback opportunities provided by other partners on the other hand. Tests as well as the Math-Bridge questionnaires were provided in both settings. Moreover further questions for the direct comparison of the two learning systems were added to the questionnaires.

The study was implemented at the Universities of Kassel and Paderborn as a comprehensive study during the bridging courses in fall 2011. In both universities the bridging courses were organized and

held in a comparative way. Both offered two different course scenarios: one blended learning scenario with an extended part of attendance at the university (so-called "p-courses") and a blended learning scenario with an extended part of self-regulated eLearning (so-called "e-courses"). (cf. TMO)

The e-courses in both universities took four weeks, the students needed to be attended at the university only one day per week. In Kassel the learners were then divided into four groups in view of their study programme. In Paderborn the learners were able to choose their group two days before the attendance from a number of topics that would be discussed in the groups by a tutor.

The p-courses were split concerning the study programmes of the participants. In Kassel there were four groups, in Paderborn three groups. In both universities the courses consist of four weeks instead of one course in Kassel with six weeks. The attendance at the universities spanned over three days a week.

For the comparative study two groups were defined: the group VEMA, which only learned with learning material using the VEMA-system, and the group MB which mostly used the Math-Bridge system. In both groups moodle was used as central learning and communication platform, here all the content was offered.

Group VEMA: The VEMA group used the complete VEMA material. Therefore the links to the content pointed to the VEMA material.

Group MB: The MB group used the Math-Bridge system, hence the respective links pointed to the corresponding pre-recorded books in the Math-Bridge system. For some topics there were additional links to a chapter from the IDEAS-exercises collection with adequate exercises for individual training. As described above not each topic from the VEMA material could be transformed to the Math-Bridge system due to licensing problems. For these topics the links then pointed to the corresponding modules of VEMA. This allowed us to ask questions concerning the direct comparison of the systems. Moreover for the MB-group we integrated links to the Math-Bridge system that enabled automatic book generation based on the remedial scenarios as described in D1.3 (vgl. D1.3).

The group MB involved all participants of the e- and the p-courses in Paderborn. Two further groups from the e-courses in Kassel also used the Math-Bridge system. The remaining two groups of the e-courses in Kassel as well as all p-courses in Kassel were assigned to the group VEMA.

With this group assignment several comparison aspects were considered: Math-Bridge was tested in both course scenarios. Using VEMA and the Math-Bridge system in Kassel for the e-course scenario also enabled to compare the systems in groups from the same University.

The total number of participants in group MB was 778, in group VEMA participated 1141 students.

4.1.3 The measuring instruments

Having described the settings of the study the following subchapter will describe the measuring instruments that are used for this study.

This additional study concentrates on the learners aspects concerning the use of the material. Therefore we used pre- and post-tests as well as pre- and post-questionnaires.

Both groups were tested with the pre- and post-tests as described in deliverable D9.1.

The students in both groups had the students pre- and post-questionnaires mainly as described above. Instead of Math-Bridge with used the moodle feedback plugin for both questionnaires.

- For the group MB the complete pre- and post-questionnaires were used. In addition the learners got five questions concerning the comparison of Math-Bridge and VEMA:
  - I missed the numbering of the learning objects from VEMA. This questions was measured with a Lickert scale with four options: (1) I don't agree ... (4) I agree
  - Which design do you prefer?
  - Which design is clearer?
  - Which system supports you better in your learning process?
  - Which system-variant would you suggest to a friend/a fellow student? These last four items were measured with a Lickert scale with five options: (1) Math-Bridge ... (3) neutral ... (5) VEMA
- For the group VEMA we adapted the post-questionnaires for the purposes of this group: the questions concerning the feature of the Math-Bridge system were deleted, the questions concerning the content and concerning the use of the system were adapted: instead of the term "Math-Bridge" that occur in most questions the term "interactive bridging-course material" was used. The three left questions without the term "Math-Bridge" were used as described.

The results described in the next subchapter concentrates on the post-questionnaires and the described additional five questions.

4.1.4 Presentation of selected results

One of the first conspicuous results of this study was, that only very few students answered to the final questionnaires: Of about 778 students of the MB-group, only 128 students attended the final questionnaire.

Taking a look at all comparative questions, where the students had to decide between the Math-Bridge system and the VEMA-system in view of specific features of the systems, we can acknowledge that most of the participants (between 57.03% and 66.63%) answered these questions with "(3) neutral". This is not very surprising since the content provided in both systems is almost the same and the designs of the systems are both well-elaborated, so that this comparison is in general on a very high level. This is underlined by the results of the User-Feedback as presented in the chapters before: The students are very pleased with system, content and its design.

Nevertheless, all comparative questions also show tendencies that cannot be neglected: Looking especially at all students that decided for one system in the respective questions, they always prefer the MB-system in the average. But let's have a closer look at the results in more detail:

In the first comparative question "Which design do you prefer?" (BAABridgeVema2) we find an arithmetic mean of M = 2.53 (SD = 1.08) that indicates a slight preference of the Math-Bridge design. While 60.94% of the students answered with "neutral" and hence could not decide between one of the systems, only 7.03% of the students preferred the VEMA-design (options (4) and (5)) while 32.03% of the students decided for the Math-Bridge's design (options (1) and (2)).

Excluding those students that chose "(3) neutral", we calculate 82% of the rest of the students preferring Math-Bridge and 18% preferring VEMA.

We asked the students to decide, which design is more clearly arranged in their opinion (Item BAABridgeVema3). Again, the mean M = 2.59 (SD = 1.14) indicates, that the students prefer Math-Bridge.

Here, 57.03% of the students did not decide for one system, 10.94% of the students preferred VEMA and 32.03% of the students preferred the Math-Bridge design. Concentrating on those 42.97% of

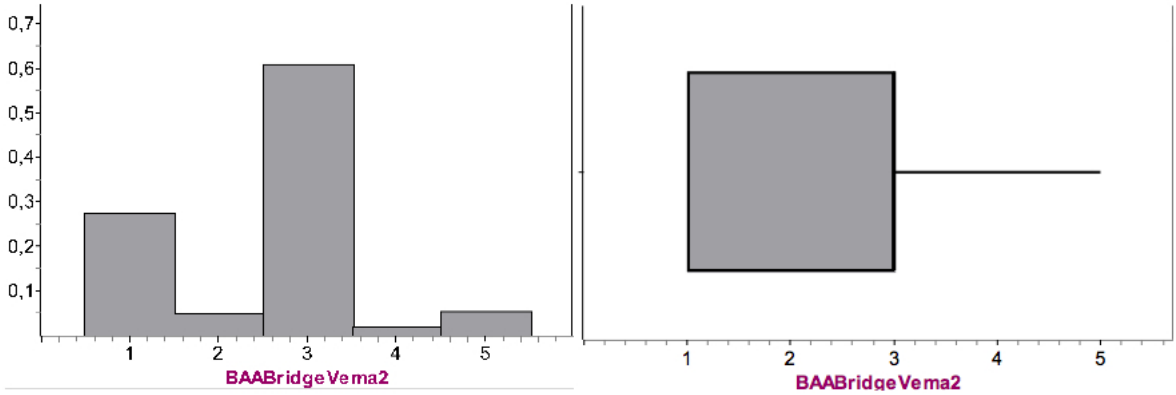

Figure 9: Results to the question “Which design do you prefer?”.

the participants, which decided for one design, 74.55% participants decided for Math-Bridge and the remaining 25.45% for VEMA.

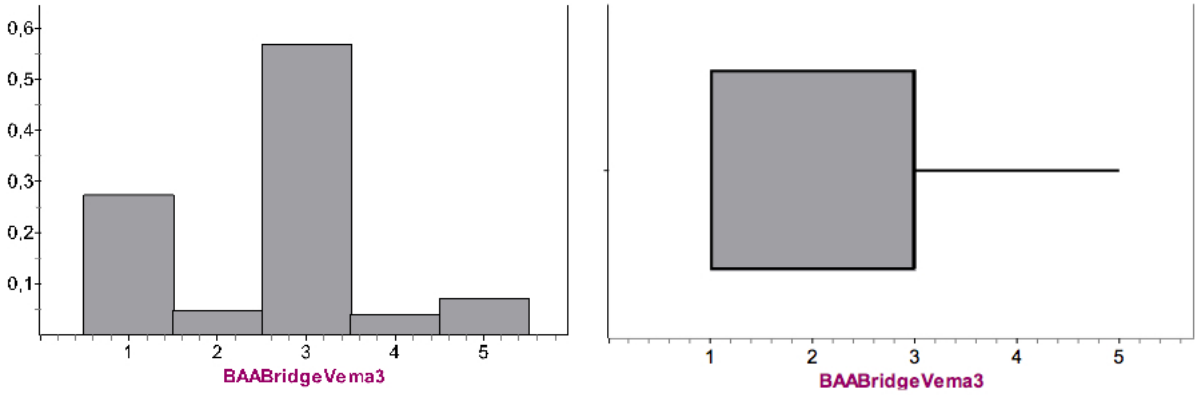

Figure 10: Results to the question “Which design is clearer?”.

Next to the design of the system, one of the most central question was “Which system supports you better in your learning process?” (BAABridgeVema4). Here the mean of M = 2.75 (SD = 1.02) indicates a more definitive decision for the Math-Bridge system. Looking at the quotients we find 23.44% of the interviewees choosing the Math-Bridge system and only 10.94% choosing VEMA. 65.63% could not decide between the two systems. Extracting those students from the analysis results in 68.18% of the students voting for Math-Bridge and 31.82% for VEMA.

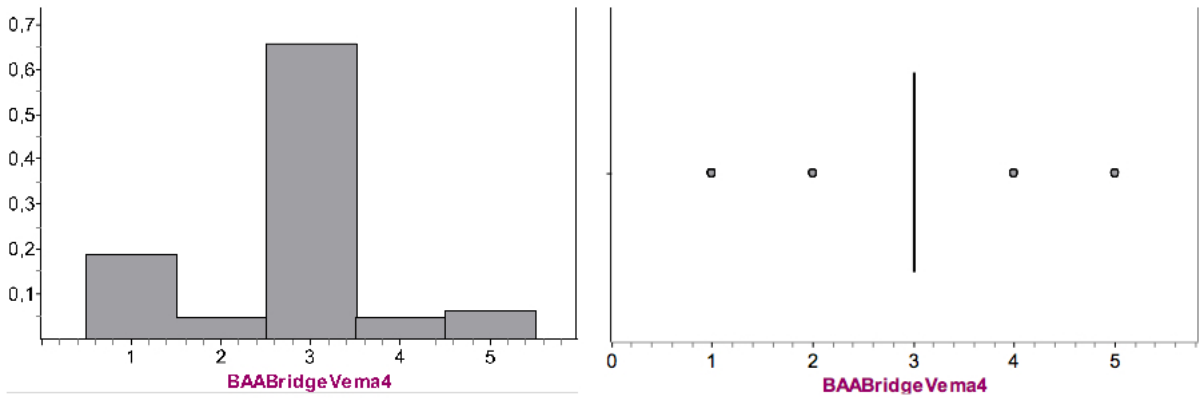

Figure 11: Results to the question “Which system supports you better in your learning process?”.

For the last comparative question we used a statement that can be used for a more general weighting of the system: The students' answers to the question "Which system-variant would you suggest to a friend/a fellow student?" (BAABridgeVema5) should indicate, if a student preferred Math-Bridge or VEMA in general.

Again the mean of M = 2.52 (SD = 1.1) indicates a slight student's preference of the Math-Bridge system. Here only 57.81% of the students could not decide for one system, 34.38% would recommend Math-Bridge to their friends and only 7.81% VEMA. The contrast of the results can again be sharpened concentrating on those students, that decide for one system:

Analyzing the remaining 42.19% of the students that did not answer "neutral" we can find 81.48% of the remaining students deciding for Math-Bridge and 18.52% for VEMA.

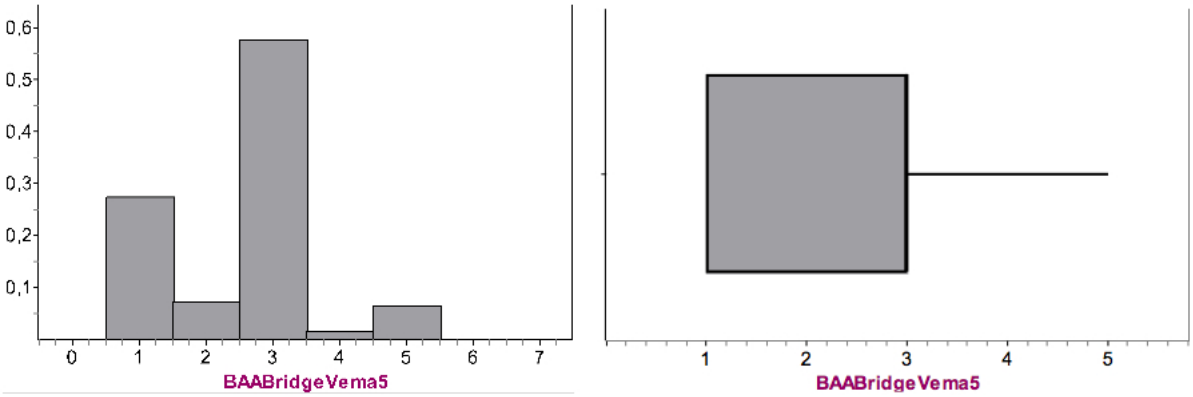

Figure 12: Results to the question "Which system-variant would you suggest to a friend/a fellow student?".

Making a reliability analysis of all comparative questions we found out that these four comparative questions build a reliable scale with a Cronbach's Alpha of 0.912 and good values for the corrected item-total correlations between 0.784 and 0.822. Hence it is not only statistically possible but also sensitive to build a common scale that gives a more general measuring instrument for the comparison of the two systems. This scale has been calculated as mean of the student's answers to all four items and measures a general preference for one system.

The mean of this scale (Variable "Scale_Comparison") is $M = 2.6(SD = 0.97)$, which shows a general preference of the Math-Bridge system. With this scale it can now be easily calculated that in the average only 45.31% of the participants did not decide for one system in general (Scale_Comparison = 3), while 40.63% of the students decided for Math-Bridge (Scale_Comparison <3) and only 14.06 for VEMA (Scale_Comparison >3).

We added a fifth question which was very specific for the VEMA-material. This question concentrates on the numbering of the learning objects within VEMA which is missing in the Math-Bridge system. This numbering is used in bridging-course lectures to explicitly point to special learning objects and hence to support the students in searching for specific content and making notes during the lectures.

Since we were not sure if this numbering was essential for the students and hence was missed using Math-Bridge, we asked the additional question "I missed the numbering of the learning objects from VEMA" (BAABridgeVema1) using a Likert-scale with four answering options: (1) I don't agree ... (4) I agree. The options 1 & 2 denote a rejection of the statement and options 3 & 4 for an affirmation. The theoretical mean would hence be at 2.5.

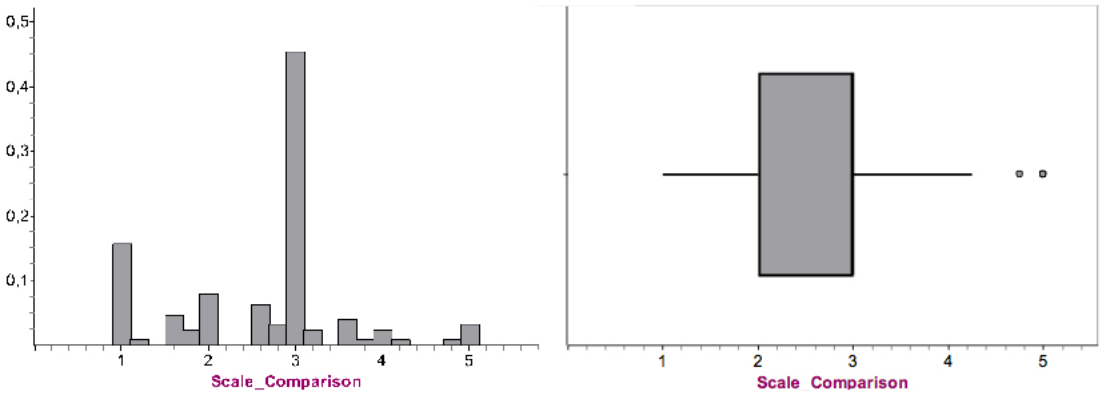

Figure 13: Results to the Scale concerning the general comparison of the two systems.

The results show that the numbering does not seem to be so important for the students: With a mean of M = 2.1 (SD = 1.01) the students rejected the statement in the average. The percentage of students answering with options 1 & 2 is 59.38%, this also reveals that the numbering was only missed by 40.62% of the participants.

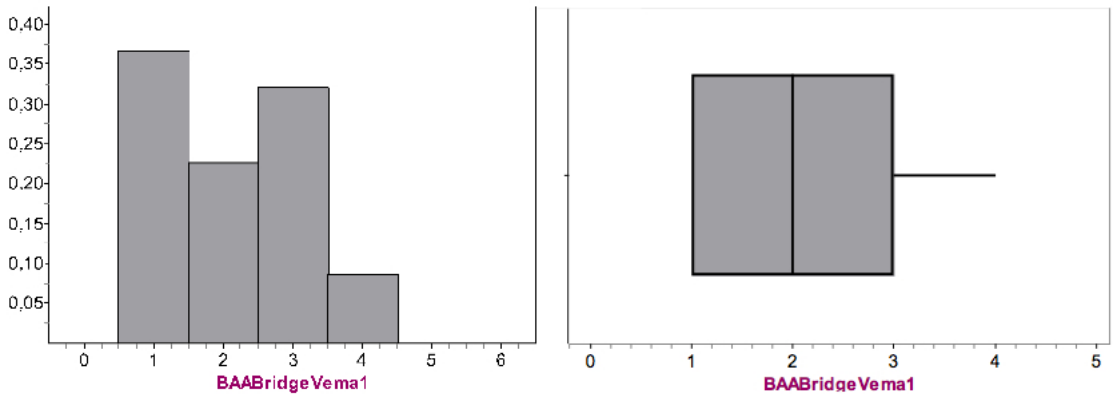

Figure 14: Results to the question “I missed the numbering of the learning objects from VEMA”.

4.1.5 Summary

All comparative questions showed that the students which have worked with both systems preferred Math-Bridge in the average. The high percentage of students that could not decide for one system variant highlights the quality of both systems that are well-established and have been revised and improved over years now. This is also underlined by the results of the questionnaires as presented in the chapters before.

Although VEMA is currently a well established learning-system that is used in different bridging course scenarios at various German Universities, the direct comparison of both systems shows the advance of the Math-Bridge system. Having the VEMA-content brought to the Math-Bridge system we can now combine new system features that support the individual learning of the students with well elaborated content provided by the VEMA-group and other partners.

Moreover the use in Kassel and Paderborn showed that Math-Bridge can be used successfully in different blended learning scenarios.

Literature

- *TMO:* Biehler, Rolf, Fischer, Pascal R., Hochmuth, Reinhard, Wassong, Thomas (2011). Self-regulated learning and self-assessment in online mathematics bridging courses. In: Angel A. Juan, Maria A. Huertas, Sven Trenholm, Cristina Steegman (eds.): Teaching Mathematics Online: Emergent Technologies and Methodologies. IGI Global
- *D1.3:* Biehler, Rolf; Hochmuth, Reinhard; Fischer, Pascal; Wassong, Thomas (2010): EU-Project Math-Bridge - D1.3: Pedagogical Remedial Scenarios

4.2 Video registration study of a student working with Math-Bridge by OUNL

This chapter was provided by OUNL.

Student description Female, age 47 year, is studying sociology since 2 years, and needs mathematics for courses on statistics. She subscribed for an online bridging course at the OUNL, but this course was cancelled. She grades her high-school knowledge of mathematics as belonging to the lowest 20% group. Her daily computer use is more than 2 hours a day, she uses internet several times a week, but she has no experience with web-based courses or bridging courses.

Setting The student (we will call her HS in the sequel), came to the studycenter of the OUNL in The Hague, where she worked with MB during an hour. Josje Lodder (JS) prepared a set of tasks, concerning the different aspects of working with MB. The complete list of tasks can be found in the appendix (separate file). There was a video-camera which registrated keyboard and screen, and HS had a microphone, and she was asked to think aloud. A transcription of the complete session can also be found in the annex.

Main remarks and conclusions HS remarked several times that she liked working with MB and preferred this over the use of a book. (She had prepared herself a bit by working with WisWijs, a Dutch book for bridging courses). The main reason for this was the immediate feedback on exercises. Her main critic was on the input-editor for formulas. Without instruction she couldn't find out how to use this, or even what was the function of the editor. More in general it was not always clear what the system expected from a student, working on an exercise. (for example, the format of the answer, no input for self-evalution exercises,...) It took some time before she understood the navigation in MB, for example the use of the dash-board, or the description of the 3 panels in the help, but in the end navigation was clear. (She skipped watching the video, this might have helped). Although 1 hour is too short to value the possibility of bookgeneration, she liked the possibility. She found a bug in the scrolling, and a didn't find the errormessage in the registrationform, JS reported these as JIRA-issues. Searching, using the tabs with exercises, using the social tabs caused no problems, she could easily work with these features.

Main results of the student post-questionnaire:

- Evaluation of the learning-system:
  - possibility to change the language: not very useful
  - possibility to look up a definition: very useful
  - formula editor useful
  - other options: not used of didn't know that these exist
- Working with Mathbridge:

  - unneccisary complicated: disagree
  - offers functions to complete tasks efficiently: agree
  - navigation is efficient: agree
  - navigation is not easy to understand disagree
  - MB reacts as I expect disagree (here she said that you have to get used to it)
- Feedback:
  - general feedback : good
  - feedback on exercises: good
- General:
  - I would use MB in the future: agree
  - I like working with MB: agree
  - I would advise colleagues to use MB: agree
  - I think MB is useful: agree

  Conclusion: overall HS seems to like the system, and thinks it is useful.

5 Summary and consequences for the future of Math-Bridge

In this deliverable we have presented various forms of feedback by experts and by users of Math-Bridge. In this last section we draw some conclusions important for the future of Math-Bridge.

- Math-Bridge is an advanced learning system. It passing the test of direct comparison with other systems, as revealed by the local Kassel/Paderborn study.
- However, a successful implementation of Math-Bridge relies on the degree of integration into a bridging course. In those cases where Math-Bridge was presented to the students as an integral part of the course, just as a lecturer's script, the students
  - used Math-Bridge extensively (as measured by the total session time, the time of usage as reported by the students themselves or the number of exercises accomplished)
  - and were satisfied with the system and its content to a considerable degree.

  On the other side of the spectrum, when Math-Bridge was only weakly integrated, and not backed by the lecturers, the usage as well as the satisfaction were considerably lower. Hence, in future applications of Math-Bridge, it should be pointed out to bridging course teachers that it is not sufficient to just provide access to the system and to recommend it as a completely optional supplement.
- Moreover, users' satisfaction increases with the time spent learning with Math-Bridge and with the number of exercise run. Since the use of Math-Bridge was compulsory in some courses (which means there was no choice), this indicates that it takes some time until users come to terms with the system.
- In the data there is a weak but significant tendency that students estimating themselves good in mathematics are more satisfied than those rating themselves weak in this subject. Thus, future developments of the system and authoring of new content should especially focus on the weaker students.
- The feedback of experts (interviews) contains a number of valuable suggestions whose realization is beyond the scope of the project but can provide a good basis for future developments. In particular, it was pointed out that it should be easier for authors to create new content and that more exercises should be supplied with intelligent feedback.
- The possibility of providing social rating by feedback buttons was only poorly used by the students. The reason might be that only few objects have been annotated so far, so that a "critical mass" of information provided by users for other users has not yet developed.