

Web-based teaching in Secondary School Mathematics

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Abstract

This paper describes the study of teaching mathematics by means of designed web-based exercises in a Finnish secondary school. The intention was to study if additional web-based exercises improve the learning results. The web-based exercises were designed particularly for this course: Numbers. Two classes were joining to the study almost for two months.

The experimental group consisted of 15 pupils and the control group of 19. They used a similar textbook on which the designed exercises were based. The experimental group had weekly web-based exercises and seven weekly tests. Both groups took part a similar pre- and post-test. After the course the experimental group answered questions about the web-based exercises.

According to the empirical results using additional web-based exercises as a part of the teaching was productive. In the pre-test the result of the experimental group was worse than the result of the control group, but in the post-test the experimental group was statistically better than the control group. According to the questions, which the experimental group answered after the course, the web-based exercises were found motivated and useful. The pupils think that web-based exercises help them to learn mathematics, and they hope to have more web-based exercises to further courses.

According this study web-based exercises improve the learning results. Interactive web-based exercises and programs should be invested when making plans for improving education in the future.

1. Introduction

In secondary school mathematics teacher's biggest challenge is to find a way how to get pupils' interest and make them learn new things. There are 20 pupils in the class and each of them has their own way to learn. How can one manage to find ways to make them all learn the things they should learn?

That is why teaching should be versatile and satisfy all pupils' need. Many equipments and technologies have been created for teaching mathematics, from games to songs. Pupils in the secondary school are children but they need a serious way to learn. One way is to take computer for a help. Today computers are almost in every home, and pupils in that age are already used to use it. Why not to make it part of practicing mathematics?

New platforms are created for mathematics. With help of these programs interactive problems can be created and they can be collected as assignments. Assignments can be

used at school or at home by using internet. The system grades exercises automatically to the grade book. Web-based exercises gives pupils new, stimulating way to learn and freedom to practice when and where it is suitable for them.

2. Web-based teaching

Using computer as a help in teaching is not so new idea. Already in the 1920 was created a machine, which could show multiple-choice questions and it kept track from correct and wrong answers. In 1970 computer became popular and people started to use them widely for useful tasks. According to Laitinen interactive learning is a system where student is practicing needed skills by using computer and is having feedback as result. The basic idea of interactive learning has not change much from that (Laitinen, 1988).

Today computers are in use in many schools. Especially internet gives us freedom to search for information from other side of the world. That is why the school is not as important, as a physical place, for teaching and studying than before. Web-based learning can be applied in the every subject.

A small group of scientist has been creating new technologies for teaching mathematics. Their own experiences and researches have been giving the direction for the development. Despite of successful teaching experiences at school most of the courses base on using book. Scientists are emphasizing that interactive web-based material should be appealing and clear. Most important for the students are an immediate answer, automatically graded assignments and perfect feedback (Seppälä, Caprotti and Xambo, 2005).

Mostly students are taking web-based exercise very well. They think that assignments are useful and help them to get better results. Teachers are scared of technical problems. This is the main reason why teachers are not so interesting in using computer as a help. Some researchers have reported problems with user accounts and platforms (Heck and Gastel, 2005). The research and development of technologies will make platforms and programs more reliable. In the future we should give more attention to these points.

3. The Experiment

3.1. The courses

The intention was to study how web-based exercises suit for teaching mathematics in the secondary school. Two classes were joining to the study for seven weeks (13.8.-1.10.2007). The experimental group consisted of 15 pupils and the control group of 19. They were ages between 12 and 13. The course was their first course in a secondary school: Numbers. Teaching of the experimental group was happening in the classrooms by the teacher and they were using web-based assignments created for them. The experimental group and the control group were using same textbook. Both groups took part in a similar pre- and post-test. The experimental group had weekly web-based exercises and seven weekly tests. Mostly students were practicing at school but they also had chance to do exercises at home via internet. They had a 75 min visit in the computer class every week and in the end of the lesson they answered to the weekly test. After the course the experimental group answered questions about the web-based exercises.

3.2. The questions and the assignments

Approximately 220 questions were created for this course by using MapleT.A., which WebALT Inc (www.webalt.com) gave for creating web-based questions. There are different kind of question types: multiple-choice, choosing pair, true/false, list, number or formula as an answer. Most of the questions are algorithmic and so question can be produced many times with different numbers. From the question bank 46 assignments for practicing and seven assignments for the tests were collected. While using assignments for practicing students could see hints to solve the problem and after they got the correct answer with feedback.

Question 1: (1 point)

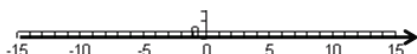
Simplify

$$5 + (-27) - 8$$

[Number](#)

Question 2: (1 point)

Simplify.



a) $|8| =$

b) $|-3| =$

Figure 1 Examples of two different kind of question type: number and list.

3.3. The Data

A questionnaire after the course gave information about if pupils liked or not to do web-based interactive exercises and if they think them useful help for practicing mathematics. There were 20 questions where they could answer I agree, I don't know or I disagree, and four open questions. Questions were: about their attitude to mathematics, habit of using computer, is the system easy to use and about its learnability and about the questions. Open questions were about their attitude to the course, if they like it or not and why.

The files of the MapleTA system gave information about how many assignments and when pupils did and how many points they got.

4. The Results and conclusions

According to the empirical results using additional web-based exercises as a part of the teaching was productive. In the pre-test the average points of the experimental group was 20 and the average points of the control group was 20.53. In the post-test average points of experimental group was 21.63 and the average points of control group was 19.54.

Points, average	Pre-test max 25 p	Post-test max 25 p
Experimental group (n=15)	20	21,63
Control group (n=19)	20,53	19,54
Differences between groups: experimental group - control group	-0,53 (-2,6 %)	+2,09 (+10,7 %)

Figure 2 Differences between the experimental group and control group in the pre- and post-tests.

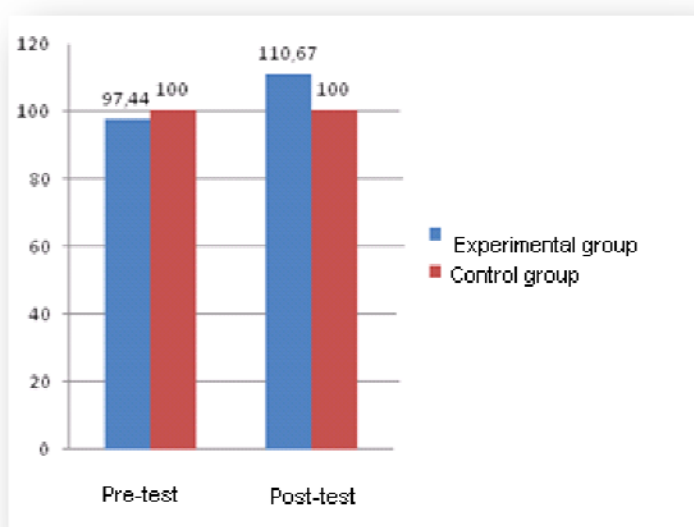


Figure 3 The percentage differences between the average points of the pre- and post-tests in the experimental and control groups. The results of the control group is standardized to 100 % in the both tests, as a result of traditional way of learning, and the result of the experimental group is counted from that (pre-test 97,44 % and post-test 110,67 %).

According to the questions, which the experimental group answered after the course, the pupils think that web-based exercises help them to learn mathematics, and they hope to have more web-based exercises to further courses. Their teacher reported that pupils are very motivated and eager to go to the computer class and do exercises.

There was one visually handicapped pupil taking part in the course. According the pupil, her parents and the teacher web-based exercises were very useful and a great help for learning. By changing the font size and color of the screen she could see the text. According the pupil the biggest help was an immediate answer and feedback to the question. She did web-based assignments at school and as homework. It is hard to say if the exercises affect on her result or not because the average points of her post-test (17.5 points) was lower than pre-test (22.5 points).

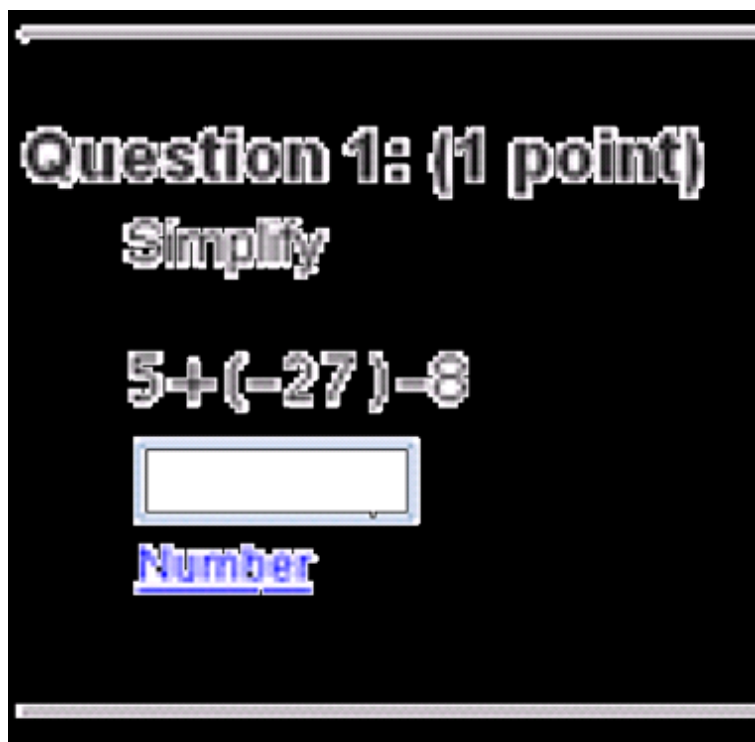


Figure 4 The visually handicapped pupil saw the question 1 (compare to figure 1) like this or even bigger.

According to this study, web-based exercises improve the learning results in the secondary school. Interactive web-based exercises and programs should be invested when making plans for improving education in the future. Web-based exercises can open new possibilities for learning mathematics for the students who have special needs.

5. References

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