Working with learner generated examples in STACK

The 1st Northern e-Assessment Meeting

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Background

Fire av ti lærerstudenter strøk i matte

Resultatene fra høstens deleksamen i matematikk for lærerstudenter viser høye stryktall. En viktig forklaring er at flertallet allerede har strøket en gang tidligere.

- Goal: Provide several digital formative assessment quizzes (easy accecible) during their semester, with the aim of learn more mathematics.

- First quizzes consisted of «regular» tasks.

Omtrent hvor mange timer per uke (i gjennomsnitt hittil på dette studiet) brukes på:

Gjennomsnitt
Av alle
Allmenn-/grunnskolelærerutdanninger

Læringsaktiviteter organisert av institusjonen (inkludert all undervisning og veiledning, samt praksis hvis relevant)

15,2

Egenstudier (lese pensum, gjøre oppgaver, delta i kollokvier og annet gruppearbeid, etc.)

11,6

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2

- Learner generated example-tasks (LGE) based on work by Watson and Mason (2005).

- Main goal: Students construct their own examples.
- The student's answer consists of an example that satisfies some properties given in the task.

- Students in secondary school as well as undergraduate students rarely work with tasks where they construct their own examples (Wagner et al., 2016)

- Exercises with LGE can take various forms:
- Generating and using examples in a proving process
- A series of tasks with constraints

- The latter is the inspiration in my study.

- LGE have been implemented with digital tools included an online assesment system.

- Strenghts
- Ability to check any given answer by algebraic equivalence
- Immediate feedback

- Challenge:
- Ianonne et al. (2011) found no evidence that LGE are beneficial for students' learning.

- Working with LGE might be a method that engage pre-service teachers in "exploring, enriching, and extending their appreciation of mathematical structures, concepts, and connections among topics" (Watson & Mason, 2005, p. x).

Participants in this study

- Pre-service teachers (grade 1-7)

- Different mathematical background

- Mathematics course (second semester of mathematics)

- LGE-tasks was one part of their digital quizzes during the semester.

Designing the tasks

- Round one

- Aim: Students to investigate different linear lines.

- Wanted students to comment on slope/gradient, constant number, and maybe provide a formula of the linear function.

Task
Give an example of a straight line that passes through the point (4,2)
Give another example of a straight line that passes through the point (4,2)
Give an example of a straight line that passes through the point (4,2) **and** is horizontal.
Give an example of a straight line that passes through the point (4,2) **and** (0,0)
Give an example of a straight line that passes through the point (4.2) **and** have negative slope.
Give another example of a straight line that passes thorugh the point (4.2) **and** you think that no one in the class will provide.
Free text answer: What is similar with the lines you have provided? What is different with the lines you have provided?

Tidy STACK question tool | Question tests & deploye

Gi et eksempel på enda en rett linje som går gjennom punktet $(4, 2)$

$y = $ 2

Your last answer was interpreted as follows:

2

Results

- Students felt overwhelmed, discouraged and a feeling of hoplessness.

- «When I wrote the number 2, I always got the correct answer, but i don't know why»
- «What is *the* correct answer?»

- Conclusion: Change the tasks for the second round.

- Preparation?

Round 2

Task
Give an example to two numbers that have the sum of -2, that is x + y = -2.
Give another example to two numbers that have the sum of -2, that is x + y = -2.
Give an example to two numbers that have the sum of 2, that is x + y = 2.
Give another example to two numbers that have the sum of 2, that is x + y = 2.
Free text: What is similar with the sums you have provided? What is different with the sums you have provided?

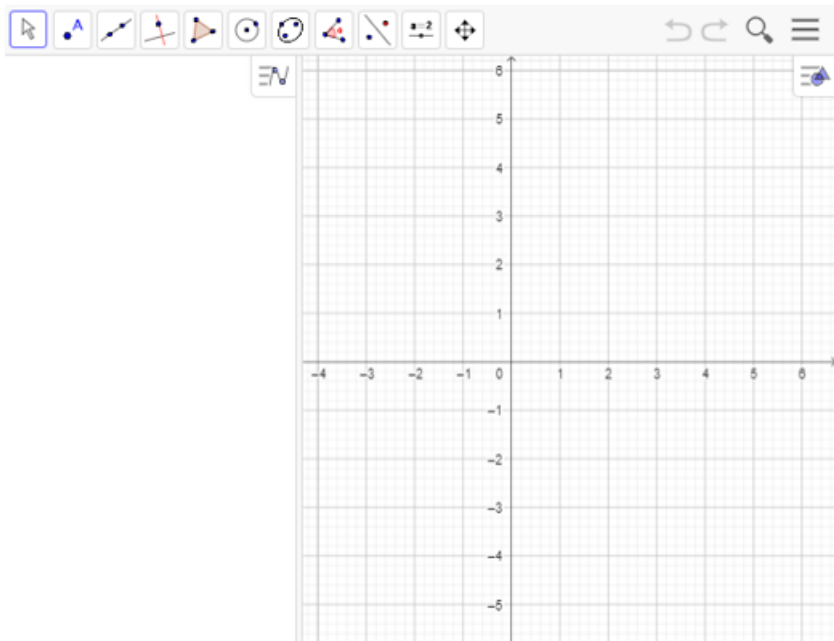| Task |
| --- |
| Give an example of a straight line that passes through the point (3,1) |
| Give another example of a straight line that passes through the point (3,1) |
| Give an example of a straight line that passes through the point (3,1) **and** is horizontal. |
| Give an example of a straight line that passes through the point (3,1) **and** (0,0) |
| Give an example of a straight line that passes through the point (3,1) **and** have negative slope. |
| Give another example of a straight line that passes thorugh the point (3,1) **and** you think that no one in the class will provide. |
| Free text answer: What is similar with the lines you have provided? What is different with the lines you have provided? |

Results

- "I struggled to figure out what the tasks were asking (…) because when I am used to work with functions, I create a table (…) and I put x and y into the table" (Student A)

- "I had no idea what to do, how to start working with the tasks. I had no clue …". (Student B)
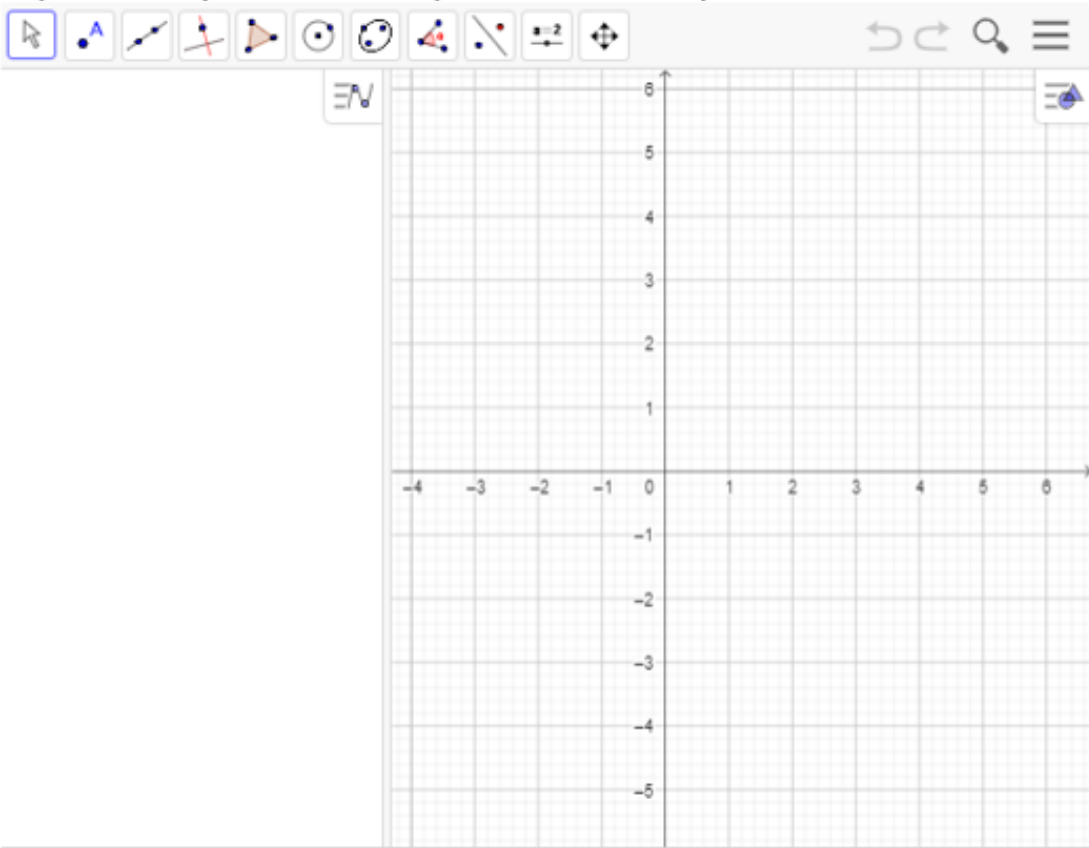
- One of the students enjoyed the tasks.

- Creativity

- Think in a different way

- Other students said the tasks were difficult and overwhelming.

- Some students said that the tasks did not contain nessecery information in order to solve it.

- Lack of stategies to use when solving a tasks that was not in a «traditional form»

- Where to start? (Frequent question during this attempt)

Third round

- Students were better prepared.
- Used LGE-taks in class.
- Used to STACK.
- Integrated GeoGebra.

Task number:	Task text:
2	Give an example of two numbers that have a sum of 2, which means that x + y =2.
3	Give another example of two numbers that have a sum of 2, which means that x + y =2.
4	Give another example of two numbers that have a sum of 2, which means that x + y =2.
5	Give another example of two numbers that have a sum of 2, and you think that no one else in the class will give. Which means that x + y =2.
6	One can let the variables x and y be coordinates for points (x,y) in a coordinate system. Plot at least 4 points with coordinates (x,y) that satisfy x + y =2 in the coordinate system below.
7	What similarities do you see between the points (x,y) you plotted in the coordinate system above?

Task number:	Task text:
18	Plot one at a time the three cases with points having coordinates (x,y) where $x + y = 2$, coordinates where $x + y = -2$, and coordinates (x,y) where $x + y = 5$. Tips: It may be wise to plot at least 4 points with coordinates from each case.
19	Describe the similarities and differences between the three cases, namely $x + y = 2$, $x + y = -2$, and $x + y = 5$.

Results

- Interviews with 4 students

«Often it is like.. «plot some coordinates and draw the graph»-kind of tasks, here you were supposed to compare several graphs, and I feel like I got to work in a different way (…) you got to figure out how things are related» (Student 1)

«The tasks were not difficult on their own, the hard part was to explain how it was all connected» (Student 2)

«GeoGebra made it more visual for me. It was a nice tool to help me..I think I had to draw it on a sheet to be able to see the connections in the tasks, but maybe I wound't if i did not have GeoGebra there..» (Student 3)

«Usually when I have worked with mathematics digital, the tasks askes you to find the one correct answer, or find a number on a number line, it is basically just a «papertask» where you plot the answer on a computer (…) but here you had to plot, move, drag, and explain. It was a different way of working digitally.» (Student 4)

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- Students were able to connect the sums with a linear function, and then compare three linear functions.

- Mathematical explanations in the free-text

- Saw usefulness related to own teaching.

- Had never thought of mathematics in this way.

- Enjoyed the visualization of GeoGebra.

Challenges

- Find a level that suits the students.
- How much knowledge should the students have to LGE as a method?

- Create tasks with feedback, without «giving it all away».
- Have to check the free-text tasks.