Prospective teachers constructing mathematical activities for gifted pupils using dynamic geometry software

Mirela Vinerean[1], Maria Fahlgren[1], and Attila Szabo[2]

[1]Karlstad University, Department of Mathematics and Computer Science, Sweden,
mirela.vinerean@kau.se, maria.fahlgren@kau.se
[2]Stockholm University, Department of Mathematics and Science Education, Sweden,
attila.szabo@edu.stockholm.se

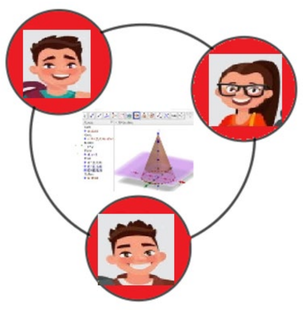
BACKGROUND

Mathematics teachers in Sweden are supposed to implement educational activities in order to stimulate every pupil's learning, that is, also the learning of gifted pupils. In addition, pupils' use of digital tools in mathematics is highlighted in the Swedish curriculum. Consequently, in order to prepare prospective mathematics teachers (PMT) to be able to address these issues, mentioned perspectives should be included in the education programme for mathematics teachers.

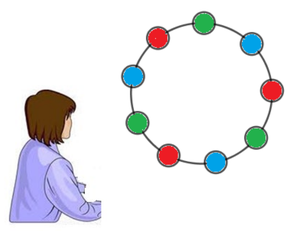
In order to stimulate their mathematical development, gifted pupils should work with complex problems, experience problem posing or be engaged in series of constructive activities that may lead to generalizable results (e.g., Leikin & Sriraman, 2017). Accordingly, we suggest the use of Dynamic Geometry Software (DGS), where pupils are encouraged to explore mathematical relationships, to make and to verify conjectures, to generalize (if possible) and eventually to construct a proof (Fahlgren & Brunström, 2014).

THE STUDY

In the present study, as a part of assignment in a geometry course, upper-secondary PMTs are asked to construct geometrical activities for all pupils – that is, also for the gifted – using a DGS environment. The detailed plans of constructed DGS activities will undergo peer assessment; in addition, peers, acting as pupils, will perform the mentioned activities.
The aim of this study is to investigate PMTs´ construction of mentioned activities, by using the Dynamic Geometry Analysis Framework (Trocki & Hollebrand, 2018). This framework provides guidance in developing and assessing DGS activities in terms of prompts to achieve specific learning goals. The main idea is to differentiate levels of mathematical depth and types of technological action that are included in the activities designed by prospective teachers.



Stage 1: Students construct activities for pupils that include problem solving, using a DGS environment.
In order to develop participants' critical reflection, mentioned activities undergo peer assessment and are tested by peers, acting as pupils.



Stage 2: Seminar with discussions and feed-back
Every group gives a short presentation of the activities. The assigned response group gives its feed-back. All students are the invited to discuss, comment and give feed-back.
The teachers' role during this session is to overview the discussions and give feed-back.
The group uses the input to improve the constructed activities.

THE INTERVENTION

In April 2020, an instructional intervention with the objective to increase the PMTs ability to challenge gifted pupils in the ordinary classroom, with a particular focus on task design, was conducted.

Participants

In total, 24 PMTs were enrolled in the course. Most of the PMTs were at the end of their first year of a five-year teacher education program. The PMTs had average results in previous mathematics courses.

The intervention

- ***One seminar on mathematically gifted pupils:*** In preparation for the assignment (1 ECTS credit), the PMTs were offered (as part of the course) one seminar on giftedness in mathematics. That was the first occasion in the PMTs education program when they encountered or discussed characteristics of mathematically gifted pupils.
- ***One home assignment on task design:*** The aim of this assignment was to draw students' attention to the quality of DGS tasks. As a basis for the assignment, the three example tasks that Trocki and Hollebrands use to demonstrate various levels of DGS task qualities (based on the coding made by their framework) were used.
- ***One follow-up seminar on the home assignment:*** At this seminar, the students discussed the homework assignment in small groups before a whole-group discussion.
- During the whole course, aspects of problem-solving that might address the needs of the gifted were discussed, for example, attention was accorded to these pupils' ability to swiftly generalize mathematical results and relations.

REFERENCES

Fahlgren, M. & Brunström, M. (2014). A model for task design with focus on exploration, explanation, and generalization in a dynamic geometry environment. *Technology, Knowledge and Learning*, *19*(3), 287–315. https://doi.org/10.1007/s10758-014-9213-9

Leikin, R., & Sriraman, B. (Eds.) (2017). *Creativity and giftedness – Interdisciplinary perspectives from mathematics and beyond*. Cham, Switzerland: Springer International Publishing. https://doi.org/10.1007/978-3-319-38840-3

Trocki, A., Hollebrands, K. (2018). The development of a framework for assessing dynamic geometry task quality. *Digital Experiences in Mathematics Education*, 1–29. https://doi.org.10.23917/jramathedu.v1i1.7547