Programming in Scratch and Mathematics: Augmenting Your Geometry Curriculum, Today!

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ABSTRACT

Algorithms and programming are and will be essential cultural techniques used in creating the future, yet most students barely encounter them in their Mathematics curriculum. Using geometry, we studied how to integrate programming & algorithms in the current curriculum in grades 6/7.

Categories and Subject Descriptors

K.3.2 [**Computer and Information Science Education**]: Computer science education; Curriculum

Keywords

Education; Programming; Geometry; Scratch

1. INTRODUCTION AND MOTIVATION

Programming has inherent advantages for teaching Mathematics, as pointed out by Feurzeig et al. in their seminal article [1]: It contributes to rigorous thinking, key insights to concepts such as variables & functions, generalizing & talking about problems, and especially problem solving skills.

We see programming as an essential technique that should be treated just like any other mathematical tool: To be used when appropriate, not to be applied when other tools are more useful, and not taught for it's own sake.

2. GEOMETRY AND PROGRAMMING

Describing a geometrical construction is nothing less than giving an appropriate algorithm for it; furthermore, only describing the construction algorithmically enforces checking the correctness of every single step of the construction. [2]

According to Schmidt-Thieme [5], the final form of the description of a geometric construction is the algorithm, which then can be translated to a computer language. Constructing step by step, the geometric computer program can be developed iteratively, with errors being attributable to elements of the own code. Just as in a constructive proof, the students can modularize different parts of the construction, testing them separately, and lastly joining them together.

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3. OUR SCRATCH APPROACH

We use the classic and well proven concept of Turtle graphics, cf. [3, 6], integrating it into a standard curriculum in the grades 6/7 as a valuable tool for a deeper understanding and using programming at the same time. Specifically, we chose the graphical language Scratch, which has been used to augment the teaching of Mathematics, cf., e.g., [4], and can be used throughout secondary education in Mathematics.

Our classroom studies were performed in a high school in northern Germany, in the same class with roughly one year of time in between, using the standard mathematical topics of (i) polygons and tessellations for grade 6, and (ii) congruent triangle constructions for grade 7.

4. SUMMARY

The concepts of Turtle graphics were directly translatable into Scratch, with regular polygons giving a first start into programming algorithms. Furthermore, the subsequent topic of tessellations illustrated the relevance of exactness and the need for modularization in programming. Scratch proved to be a viable tool in constructing congruent triangles, allowing for a propaedeutic view on the function of dynamic geometry environments. Based on our results, we plan to conduct further studies with Scratch and Geometry.

5. REFERENCES

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