DYNAMIC NATURE OF MATHEMATICAL CONCEPTS - EXPERIENCES OF LEARNING MATERIALS IN MOODLE-STACK SYSTEM

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Abstract.

Dynamic geometry computer programs like Cabri and GeoGebra have opened a new approach to make dependencies of mathematical objects like points and point sets (e.g. segments and other curves) visible and available for experimenting and making conjectures. Technology can change and smoothen the road to mathematical thinking, so we have to take in serious consideration the relationships between mathematics, technology, teaching, learning and studying. It is also worth thinking about when the use of a dynamic presentation in mathematical question or problem promotes learning.

Basic abstract mathematical concepts like relations, functions and axiomatic linear space system properties like linear independence and basis are very abstract and new subjects and experiences for the University freshmen. Mental calculations of abstract objects, ability to imagine operations without actually doing them, or even this being impossible to do, is a general obstacle to learning fluent mathematical thinking and activity.

We have tried to develop learning materials and learning methods that aim to assist and support abstraction processes by nurturing the imagination of learners in situations where they have to make guesses, conjectures or assumptions about what the actual question is about. Important points of view in studying mathematics are the verbal and graphical or other visual features combined with their symbolic representations such as dressing up as functions or other relations. For example, we have found beneficial to use such dynamic representations of concepts that do not have any symbolic information that would promptly invoke instinctive reflex to try calculations; but instead they are faced with internal dependencies of the objects (e.g. points, segments, lines, vectors) in the dynamic figure. The purpose of these "black boxes" is to seduce and lead the student to experiment, to make observation-based imagery: to make the student think. Furthermore, dynamic figures can try to demonstrate that for example a function does not have to be explicitly defined by some formula, and also may behave unpredictably. In many cases it is important that the question cannot be solved without interaction with the dynamic figure; this

formula- and coordinate-free setting is meant to simulate abstract situations.

We present through concrete examples parts of the materials that we have developed for the ABACUS project in Moodle-Stack question environment. The materials - still under construction and revision - are being used in first year university mathematics courses Introduction to Mathematics (Matematiikan johdantokurssi) and Linear Algebra (Lineaarialgebra). The proportion of the final course mark achieved by Moodle exercises and partial exams is about 20%.

We want to point out, that most of our students are pre-service mathematics teacher students for secondary schools, and therefore the focus in their subject studies is in understanding concepts' interrelations and pedagogical facets, rather than mathematics for technical education. Our Moodle questions range from calculative problems to image-state-problems, in which the dynamic figure needs to be manipulated to a certain final state.

We will also tell about some technical and other issues we have encountered.

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