

FlexiMath – Game-enhanced learning environments for development of flexible arithmetic competence

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Project summary

Basic knowledge and skills in mathematics are important for an active citizen in contemporary society. The concept of “*mathematical literacy*” captures this idea. A basic level of mathematical literacy is to master arithmetic concepts and skills, for example to understand *the number concept* and to be able to add and subtract natural numbers. Procedures for counting are also central. However these *counting* skills must also – even on the very elementary level of counting up to ten – be grounded in *conceptual knowledge*.

Children start to develop number concepts and learn to master basic arithmetic at a relatively early age – normally even before school starts. At home and in pre-school they take part in activities where mathematics is used. In school and to some extent also in pre-school arithmetic is formally taught. Teaching and instruction is important, but as a number of researchers have pointed out, instruction often relies on memorization and use drill-and-practice to promote the memorization of isolated facts by rote or procedural strategies for counting. This kind of instruction is less productive in promoting conceptual understanding.

In research carried out by the Swedish and Finnish research teams behind this application we have argued that there is a set of core competences that are critical for mastering number concepts and subsequently to the development of a flexible number system and a *flexible arithmetic competence*. In resonance with the work of other colleagues we have designed, developed and researched *digital mathematical games* (Fingu and NumberNavigation) that can support the development of such core competences. Early results are encouraging, both in terms of the development of games and learning effects. Furthermore, the games engage children in mathematically meaningful activities.

In FlexiMath we will take the research carried out in the two groups a step further. The overall aim is to design a set of mathematical learning activities, supported by the mathematical games we have developed, and additional games developed elsewhere, which will help foster the development of flexible arithmetic competence. The learning activities are targeting competences that are critical to this overall development.

Another aim is to work together with schools and pre-schools in Sweden and Finland on integrating these games and activities in practical teaching, which then will be studied.. Working with schools in both Sweden and Finland makes it possible to compare implementations and generalize across different pedagogical cultures.

More specific research questions are:

- How can mathematical games targeting arithmetic key competences be integrated into a learning environment that supports the development of flexible mathematical competences?
- How can we design and develop a set of mathematic games that support learning arithmetic key competences?
- What are the learning and developmental gains of engaging in the game-enhanced learning environments?

