# An Educational Math Game with a Teachable Agent and a Social Chat

Annika Silvervarg[1], Lena Pareto[2], Magnus Haake[3], Thomas Strandberg[3], and Agneta Gulz[1,3]

[1] Department of Computer Science, Linköping University, Sweden
{Annika.Silvervarg,Agneta.Gulz}@liu.se
[2] Media Production and Informatics Departments, University West, Sweden
Lena.Pareto@hv.se
[3] Lund University Cognitive Science, Sweden
{Magnus.Haake,Thomas.Strandberg,Agneta.Gulz}@lucs.lu.se

We present an educational math game, including a teachable agent and a social chat, that trains basic arithmetic skills with a focus on grounding base-ten concepts in spatial representations. It employs a board-game design with a variety of different sub-games, game modes and levels of difficulty. When a student has learnt to play one of the sub-games, she may teach it to her Teachable Agent (TA). In the *observation mode* the TA "watches" the student play and picks up on game rules and on the student's responses to multiple-choice questions, such as "Why did you choose this card?" Proper (or improper) choices of cards and answers promote corresponding skills in the TA throughout the game. In the *try-and-be-guided mode*, the agent is allowed to propose cards. The student either accepts the agent's suggestion or rejects it and exchanges the agent's card for another one. Again the agent asks for the reasons for the student's behaviour, using the multiple-choice format. In other words, the basic game with the TA contains a form of *on-task* conversation between agent and student. But the game architecture also has been extended with *a chat* where the student can engage in conversation with the TA, writing freely by means of the keyboard and bring up basically any topic in a chat-like manner. We refer to this as *off-task conversation* and distinguish within it between on-domain conversation and off-domain conversation, the former referring to chat conversation related to school, math, the math game, etc., and the latter to any other topic. One reason to include off-task conversation is to enrich the game and its motivational qualities for the age group in question (12-14 year olds). Another is to be able to explore whether such a conversational module can enable pedagogical interventions, such as supporting pupils math self efficacy and change negative attitudes toward math in general. Notably the on-task and off-task conversations have very different formats, but are still designed as two interrelated and complementary activities. A recent study [1] indicates that the added off-task conversation module can i) improve students' game experience, ii) improve learning outcomes, and iii) engage learners in voluntary on-domain chat.

## Reference

1. Gulz, A., Haake, M., Silvervarg, A.: Extending a Teachable Agent with a Social Conversation Module – Effects on Student Experiences and Learning. In: Biswas, G., et al. (eds.) AIED 2011. LNCS (LNAI), vol. 6738, pp. 131–138. Springer, Heidelberg (2011)

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