

# Teacher Training is the key ...and always will be!

Gerald Sagmeister | Tiago Hirth | Monika Musilek  
IEP, PH Wien | University of Lisboa | IBS, PH Wien

## Abstract:

Integrating strategy games into primary mathematics lessons in order to develop problem-solving skills only works if teachers have in-depth knowledge: Content knowledge, such as mathematical backgrounds of games and basic approaches of game theory on the one hand and pedagogical knowledge, such as discovery learning and problem solving on the other hand, have to be combined with game pedagogical knowledge. A concept of an in-service training is presented oriented towards the requirements of professional development and teacher training. Only if teachers have well-founded knowledge, a good transfer to the classroom is possible. The potential of using strategy games to promote mathematical skills and heuristic abilities can only be exploited if teachers are aware of and acquire a deep understanding on using games for educational purposes..

## Research Question / Starting Point

If one looks for reasons why mathematics education should be useful in everyday life, there are, according to Winter (1995), three basic experiences that should be made possible in teaching. Understanding the phenomena of the world, understanding mathematics as an ordered world and acquiring the interdisciplinary problem-solving ability (heuristic abilities). For Winter, problem-solving in mathematics also means promoting one's own thinking by gaining heuristic experience (see Winter 1996).

In the 8by8 project, an Erasmus Plus project with partners from Great Britain, France, Portugal and Austria, possibilities are being sought to make a beneficial contribution to the acquisition of heuristic abilities in primary school lessons through strategy games.

In Portugal mathematics games are widely used in class to improve students' attitude towards mathematics. Every year in Portugal a competition – the National Championship of Mathematical Games (CNJM) – is organised among others by the Ludus Association. In it hundred of thousands of pupils participate culminating in a single day final where 2000 students take part. It aims to motivate and attract to mathematical practice in an extracurricular fashion honing mathematical competences like abstraction, concentration, weighing options, etc. These are recognized by the local teaching body which integrates a structural part of the yearly organization of the CNJM. Due to this tradition, strategy games are already being used in class by teachers in a didactically reflective way.

In Austria there are no organised championships of mathematical games, and the teachers are not aware that the use of strategy games can make an important contribution to the acquisition of heuristic skills.

Since integrating strategy games into teaching is a relatively new field, at least in Austria, the central question is therefore:

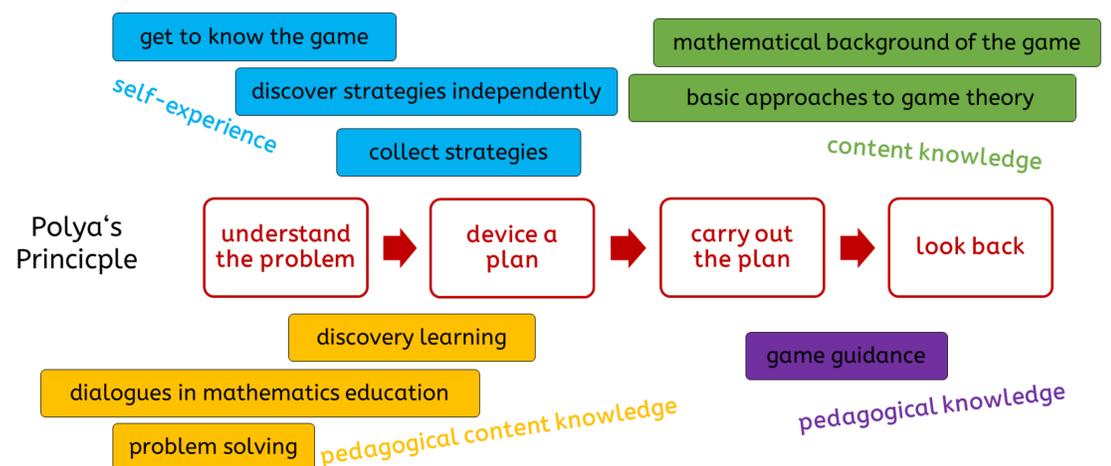
*Which contents, concepts have to be taken up in a teacher training course so that the potential of strategy games for the acquisition of heuristic skills in the primary level is exhausted and the games can be profitably integrated into the lessons?*

## Theoretical Background

Strategy games can be used for teaching heuristic abilities at primary level. The project focuses on games that can be played on 8 by 8 squares - i.e. on a chessboard. An essential requirement for the games is that they have very simple rules that can be taught in a very short time, but lead to sophisticated play. Ideally from game to game, children gain experience, can ideally develop strategies on their own and then use them in a very targeted way. To ensure that it does not just remain a game, but is actually linked to the teaching of mathematics, it needs to be adequately integrated into the lessons. And teachers are responsible for this transfer. (see Collins et al. 1989, Sylva et al. 2010) They need to have knowledge in the following areas, to help children to develop heuristic skills through games. First, they need a deep understanding of content knowledge (CK). Second, they need pedagogical knowledge (PK), an understanding of the methods and strategies of teaching that allows them to continually develop and refine their own practices. Third, they need pedagogical content knowledge (PCK) for understanding specific methods, resources, and strategies that are proven to work well when teaching a particular content area. This goes in line with suggestions of Shulman (1986) concerning teacher training.

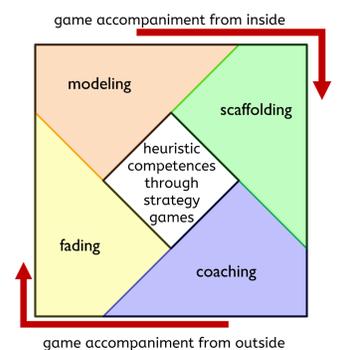
## Concept of Teacher Training

The basic concept of the Teacher Training is to follow Polya's steps in problem-solving. During the process inputs are given focusing on content knowledge, pedagogical knowledge and pedagogical content knowledge:



In the concept of the teacher training we highlight "game guidance" with respect to mathematics learning because we assume it is a new field for the participants. Vogt (2020) refers to the importance of game accompaniment in a pedagogical sense.

The point of accompanying the game from the inside is that there is great potential in the teacher playing along. Besides introducing the game, the teacher can serve as a model for thought processes: Actions are verbalised, reasons for a move are given, vocabulary can be promoted. This scaffolding phase provides support for learners' independent activities. Thus, in the coaching phase, the teacher withdraws but still accompanies the game. In this important phase of fading, the teacher increasingly reduces the support measures. The children play independently and can actually try out their strategies for the game. Reducing support leads to increasing understanding and more independence.



## Results / Outlook on Further Work

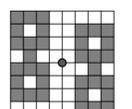
Knowledge of the effect of game pedagogical accompaniment and transfer to the classroom seem to be the essential prerequisites for success in order to be able to teach heuristic problem-solving skills through strategy games. The concept of the teacher training has been used and evaluated several times in training courses. The results of the evaluation show, that after the training, the participants feel well equipped to integrate strategy games into mathematics lessons in a didactically reflective way. They know how to use the potential of strategy games to help children acquire problem-solving strategies. The concept presented focuses primarily on enabling teachers to teach heuristic skills with the help of strategy games on a chess board. In the future, however, it should be extended to other games: Games - cleverly integrated into lessons - offer great potential for teaching mathematical skills at primary level, but only if teachers themselves acquire a deep understanding on using games for educational purposes.

## Literature

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing, and Mathematics. In L. B. Resnick (Ed.), *Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser* (pp. 453–494). Routledge.  
Shulman, L. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, 15(2), 4–14.  
Sylva, K., Taggart, B., Melhuish, E., Simmons, P., & Siraj-Blatchford, I. (2010). *Frühe Bildung zählt: Das Effective Pre-school and Primary Education Project (EPPE) und das Sure Start Programm* (1. Aufl.). Dohrmann.  
Vogt, F. (2020). Spielbegleitung. In M. Kübler, G. Buhl, & C. Rüdüsüli (Eds.), *Spielen und Lernen verbinden - mit spielbasierten Lernumgebungen* (E-Book): Theorie - Empirie - Praxis (1st ed., pp. 51–68). hep verlag.  
Winter, H. (1995). Mathematikunterricht und Allgemeinbildung. *Mitteilungen Der Gesellschaft Für Didaktik Der Mathematik*, 21(61), 37–46.

## Acknowledgement

The project 8by8 – Strategy Games in Primary Education was funded by the European Union.



Funded by the  
Erasmus+ Programme  
of the European Union

