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Adapting boardgames for the primary mathematics classroom: the Italian project "Numeri & Pedine"

Type of contribution: Game Demonstration

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Introducing games into the mathematics classroom can be challenging for several reasons, including the classroom setting and other practical arrangements. For example, bringing video-games into the classroom requires electronic devices. Boardgames are easier to transport, and they are usually cheaper than video-games and electronic equipment. Several authors have noted the potential of boardgames to introduce basic arithmetic concepts (e.g., Maffia & Silva, 2022; Peters, 1999; Ramani & Siegler, 2008). However, it can be difficult for some schools to provide enough copies of a boardgame for each student or group of students. In addition, boardgames usually have (lower and upper) limits on the number of players which may not be appropriate for certain classroom settings.

Over the last four years, within the Italian project "Numeri & Pedine" (Numbers & Tokens), we have proposed the use of boardgames in primary mathematics education. Together with primary school teachers, we adapted commercial games. The selection and adaptation of the games followed design principles that were developed and refined in the context of classroom experiments. After briefly presenting the aims of the "Numeri & Pedine" project, we will illustrate our design principles by presenting the adapted versions of the boardgames "Stone Age" and "Kingdomino".

The project "Numeri & Pedine"

The general aim of the "Numeri & Pedine" project is to develop socio-constructivist approaches to the teaching and assessment of mathematics based on the use of boardgames as didactic tools. The main activities of the project have been organised within communities of inquiry (Jaworski, 2006) composed of teachers and researchers. The work focuses on the design and refinement of (classical or commercial) boardgames suitable for the teaching/learning of selected mathematical topics (e.g. Maffia & Silva, 2022). Teaching experiments resulted in the design of dedicated teaching materials, including assessment and self-assessment tools. Within the project, boardgames are introduced in the regular mathematics classroom (not as an extracurricular activity) and to the whole class (including students with learning disabilities or other difficulties). Both mathematics teachers and special needs teachers are involved in the project. The pupils were never asked to buy the games or other materials. The main challenge was to adapt the boardgames so that they could be used with a whole class (more than 20 students) and to be realised with easily available materials.

Boardgames adapted for the classroom: Stone Age and Kingdomino

Among the boardgames used within the project, we present our adaptations of the commercial games "Stone Age" (by Bernd Brunnhofer, https://boardgamegeek.com/boardgame/34635/stone-age) and

"Kingdomino" (by Bruno Cathala, https://boardgamegeek.com/boardgame/204583/kingdomino). These games have been used to introduce the properties of multiplication and division in third and fourth grade. In order to adapt the games to the whole class setting, we have selected only some of the game mechanics both to reduce the difficulty of the game and to allow for the specific setting.

As a first design principle, we decided to select the mechanics that were mainly related to the focused mathematical topics and to the fantasy setting of the game. For example, in the case of "Stone Age", we decided to limit the first phases of the game to the mechanics of workers' placement, resource gathering, and construction of huts. The children have five tokens representing workers and they have to decide which resource each worker collects (food, wood, clay, stone, or metal). For each worker placed on a resource, the child will then roll a die. The number of resources received is the result of dividing the total on the dice by a number depending on the particular resource (2 for food, 3 for wood, 4 for clay, and so on). The players can use the collected resources to build huts and receive a score according to the value of the resources used (with metal being worth more than the others). In this way, children could still experience the fantasy setting of a Stone Age tribe building their village, but we removed other game mechanics to focus mainly on the phase of resource gathering, where the concept of division with remainder is central.

As a second design principle, we decided to use resources that are available for free or that can be realised with cheap materials. For example, the game "Kingdomino" consists of placing coloured domino tiles which can contain crowns. The player places the tiles so as to form a 5 by 5 square (each tile is 1 by 2) and a new tile must be next to a previous tile with a common colour. At the end of the placing, the final score is calculated as the sum of the points given by each surface of the same colour. The points given by a surface are equal to the multiplication between the area of this surface and the crowns it contains. To enable the game to be used in the classroom, we created digital domino tiles that can be randomly drawn on an interactive whiteboard. We also proposed to the teachers to realise personal domino tiles for children using paper and coloured pencils.

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