

# Teaching early mathematics through genuine card and board games: between fun, meaning and academic learning

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# Context of our communication

- If there is a **large consensus** in the research literature about **the importance of developing early number skills** in preschool (children aged 3 to 6) ...

(Jordan et al., 2009 ; Krajewski & Schneider, 2009 ; Ngyuen, 2016 ; Purpura & Lonigan, 2013, etc.)

... there is **no unanimity** on how **mathematics teaching** should be organised

(Bjorklund et al., 2018)

- Significant divergence of views in purposes of preschool education

(Little & Cohen-Vogel, 2016; Russell, 2011 )

➡ **Developmental logic** which frames the purposes of preschool as supporting the individual child's social, emotional, and cognitive development

➡ **Academic logic** which emphasizes acquisition of academic skills and content

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**GUIDED  
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(Weisberg et al.,  
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**Guided play** seems to meet both these important purposes of preschool:  
the **development of basic academic learning** such as early number skills, while respecting  
the **children's social and emotional development** and their need to play.

# Objective of the communication

## GUIDED PLAY

(Weisberg et al., 2013)

### Play

- Can any fun activity be regarded as a play/game?
- What types of play/games are most effective in achieving children's learning and developmental goals?

# Objective of the communication

## GUIDED PLAY

(Weisberg et al., 2013)

### Guided

- What is the teacher' role ?
- What is the nature of his/her intervention?

### Play

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# Objective of the communication

## GUIDED PLAY

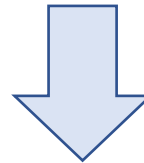
(Weisberg et al., 2013)

### Guided

- What is the teacher' role ?
- What is the nature of his/her intervention?
- When does he/she should intervene, during or after the game?

### Play

- Can any fun activity be regarded as a play/game?
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**Card and board games for the learning of early number skills**

# PART 1: **PLAY**



# To play or not to play?

- Play is not always considered as being an appropriate teaching approach for preschoolers
- The advocates of academic skills claim that formal direct instruction is the most effective approach to promote early mathematical skills, especially for children with difficulties (Daobler & Fien, 2013)
- Over the past few decades, this academic skills focus has increasingly come out on top for various reasons:
  - growing demands on schools for economically valuable outcomes and accountability (van Oers & Duijkers, 2013)
  - declining scores on standardised testing (Wickstrom et al., 2019)
  - desire to combat inequalities (Little & Cohen-Vogel, 2016)

However,

- Direct and intentional instruction is unsuitable for young children (Vogt et al., 2018), and may even increase anxiety and low self-esteem (Gasteiger, 2015)
- From a developmental viewpoint, play is particularly appropriate for young children, as it represents the main and most productive context for learning in children aged 4 to 7 (van Oers & Duijkers, 2013)

# Can any play activity be regarded as a play/game?

- **Guided play** is essentially defined in terms of **locus of control of the activity** : “adults initiate the learning process, constrain the learning goals, and are responsible for maintaining focus on these goals even as the child guides his or her own discovery”
- But what about **PLAY** ? There is no real consensus on a clear definition of play : role play? games?
- Which games ?
  - adult-led activities using fingers or physical material (Kullberg et al. , 2020)
  - adult-led board games (Ramani & Siegler, 2008)
  - traditional board games played in class in small groups, such as dice games, *Halli Galli*, *Shut the Box*, etc. (Gasteiger, 2015; Vogt et al., 2018).
- Necessary to distinguish between activities which are “genuine” games from other play situations, often initiated by adults, which are more like school tasks disguised as games, a bit like “**chocolate-covered broccolis**” (Vogt et al., 2018).

# « Genuine » games

**“Genuine” games based on well defined criteria** (Broström, 2017; Hassinger-Das et al. [2017](#); Vogt et al. [2018](#); Weisberg, Hirsh-Pasek, and Golinkoff [2013](#))

1) **Fun**

2) **Intrinsically motivated** ⇒ “the mathematical content needs to be part of the mechanics of the game” (Vogt et al., 2018, p. 592),

3) Requiring the child’s active engagement,

4) Taking place **under the control of children** and not adults, which refers to the idea of “**freedom**” advocated by van Oers and Duijkers (2013)

5) Characterised by interactions and **communication** between the players.

And in the context of card and board games:


6) Involving **a competitive aspect**, putting players against each other or against a common opponent, in order to determine a winner (Gasteiger, Obersteiner, and Reiss [2015](#); Hassinger-Das et al. [2017](#)).

## Why « genuine » games?

- It maintains the children's motivation and engagement.

*“According to Leontjev, **children play just in order to play; and because the child's motive is concordant with the object or goal of the action, the child experiences the play activity as meaningful**”* (Broström, 2017, p. 8)

- The more children are engaged in a game, the more they focus on the mathematical content involved in the game.

**“Genuine” games** provide more fun and meaning,  
 involving the children more in the task, leading them to pay more attention to the actions taken .... and therefore to mathematical knowledge.

## PART 2: GUIDED

# What is the teachers' role?

The benefit of the games was greater when

- the teacher **engages the children in discussing, reflecting on and representing the mathematical ideas** that have emerged in the activities (Bjorklund et al., 2018).

→ **to help the children to mathematise their play content**, in other words, to enable children to make the connection between the games they play and maths : **something that does not necessarily occur spontaneously to children, especially the weakest.**

# What is the teachers' role?

## BUT ...

- Adults should not intervene or direct the play activity too much. If the adult takes too much control, the play activity is likely to hamper the child's initiative, motivation and interest (Hassinger-Das, 2018).
- Teachers must be able to seize the moment and make use of occurring mathematical phenomena (Bjorklund et al., 2018).
- Teachers' interventions should build on children's own contributions (Broström, 2017).

→ **Challenging teacher's role!**

# What is the nature of the teacher's intervention?

High-level pedagogical content knowledge (PCK) is required :

## Teacher's professional noticing of students' mathematical thinking:

- ability to *identify* and *interpret* what children do and say during activities
- in order to *enhance* their mathematical thinking (Jacobs., et al. 2010).



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This type of expertise is similar to **responsiveness** (Bjorklund et al., 2018):

*“Different ways to respond to children’s mathematizing initiatives constitute different learning opportunities, in which the teacher’s responsiveness to the children’s acts and understanding is a key feature ”*

# What is the nature of the teacher's intervention?

## HOWEVER ....

This professional noticing is a complex task for teachers (Lee, 2017)

- Teachers' ability to *interpret* and *enhance* children's mathematical thinking was quite weak.
- Their ability to *interpret* what children say and do was significantly associated with their ability to *enhance* children's mathematical thinking.

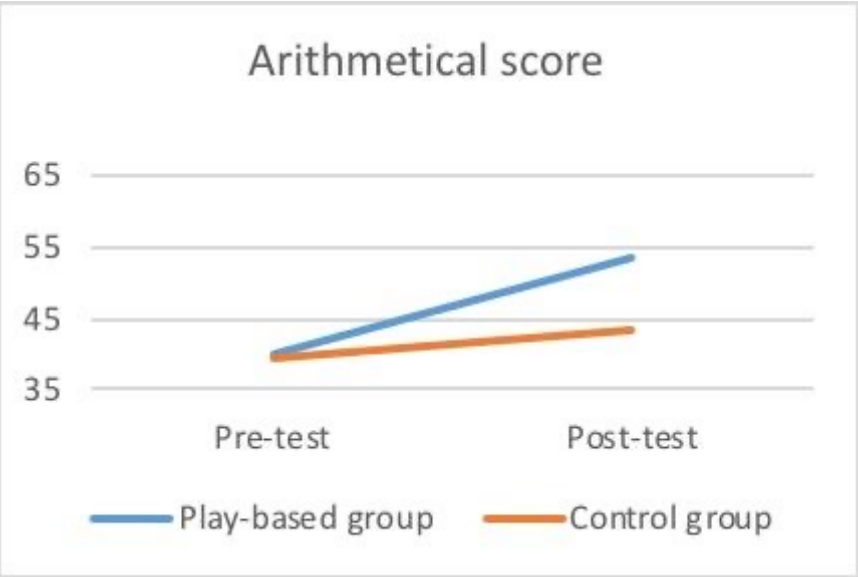
Guided play was rarely observed in classrooms (Wickstrom et al., 2019)

- Teachers found it hard not only to strike the right balance between free play and direct instruction,
- but also to understand how to follow children's lead in play, and provide optimal teacher involvement to support academic learning.

## **PART 3: EFFECTIVENESS ?**

# Scores in pre- and post-tests and learning gains

(Vlassis et al, 2023)

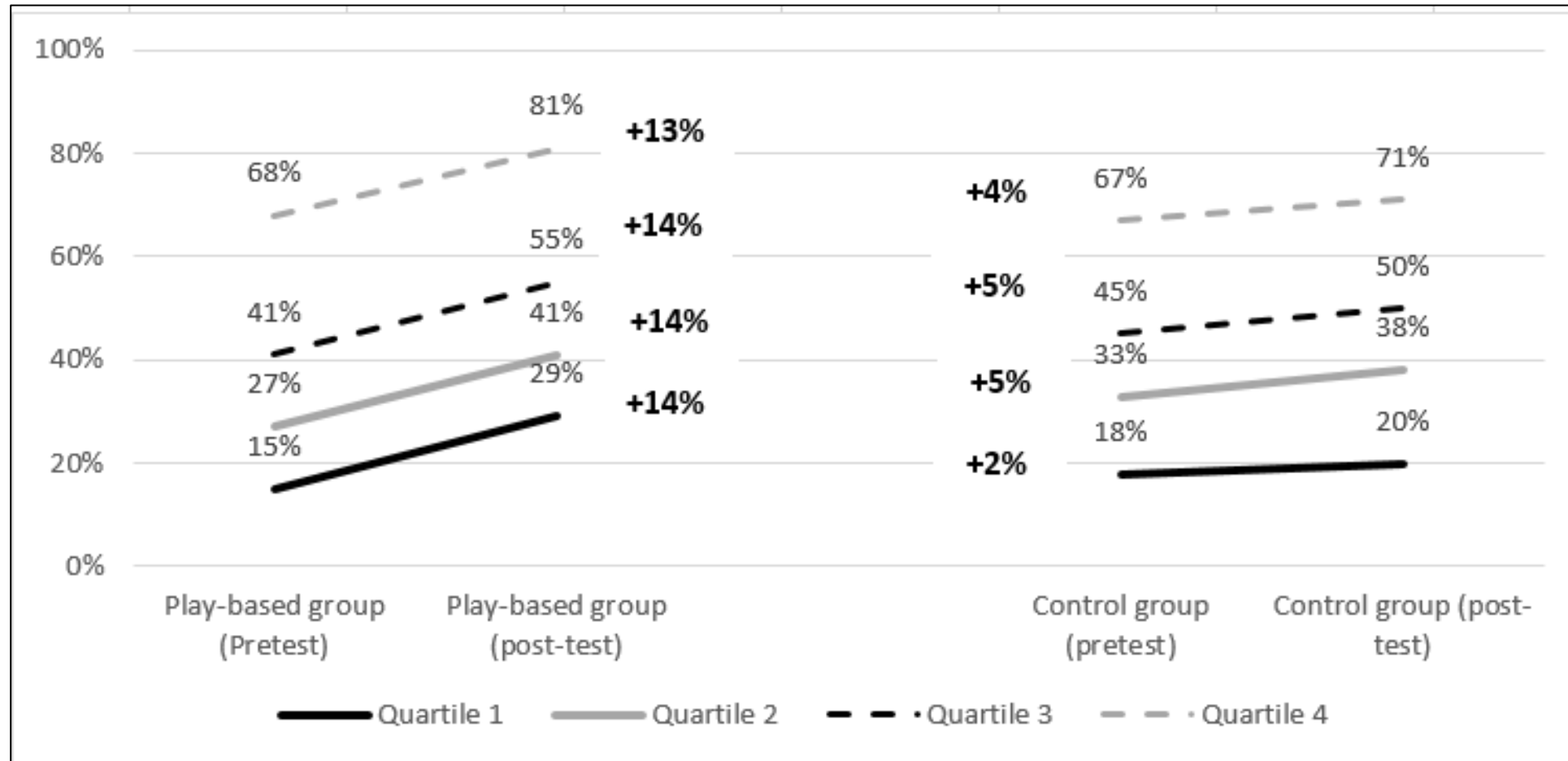


## Method : main elements

- These data come from a larger study (de Chambrier et al. 2021)
- Focus on **arithmetical skills** ((de)composition of numbers; addition)
- Research design : **prétest – intervention - post-test**
- **Test** largely inspired by the **TEDI-MATH** (Van Nieuwenhoven, et al. 2001) and **TEMA-3** (Ginsburg and Baroody 2003) test sets.
- **194 children** attending grade K (**5-6 years old**)
  - 104 children (**Play-based group - PbG**)
  - 90 children who followed the business as usual programme (**Control group - CG**).
- **Four genuine games** (four 20-minute play sessions/week). Four weeks
- After being introduced to the rules, the children played in small groups relatively independently
- **Discussions guided by the teachers after the games**

	M (SD)	M (SD)	M	Effect size
	Pre-test	Post-test	Learning gains	D <sub>ppc2</sub>
Play-based group (PbG) (N=104)	39.90 (24.63)	53.46 (26.32)	+13.56	0.40
Control group (CG) (N=90)	39.44 (21.90)	43.67 (25.06)	+4.23	

# Improvement between pre- and post-test according to initial proficiency level



- In PbG, this progress was made by all children, regardless of their initial level : “weak” pupils benefited as much from the intervention as “strong” ones.
- However, the intervention did not reduce the performance gaps between these two extremes.
- In the control group, the performance gaps between the subgroups of children were just as great, but the gap tended to increase slightly to the detriment of “weak” children.

# CONCLUSIONS

1. An approach such as guided play based on “**genuine**” **games** meet both developmental and academic learning objectives
2. It has some **effectiveness, even with weakest students**
  - This challenge the idea that it is better to confine at risk students to activities directed step by step by the teacher (Daobler & Fien, 2013).

3. It could be objected that **more teacher-directed “games”/activities have also proved effective for pupils’ learning** (e.g. Ramani & Siegler, 2007; Kullberg et al., 2020; ...).

In a study, effects of guided play based on card and board games with those of a teacher-directed training programme were compared (Vogt et al., 2018)

- It has been showed that the play-based approach was at least as effective as the training programme,
- but with the difference that **the former meets the needs of young children** whereas the second is much less suitable
- and in the training programme, teachers expressed some concern about **children becoming bored** with the instructional setting.



4. In guided play, the role of the teacher is crucial for the development of children's mathematical learning :

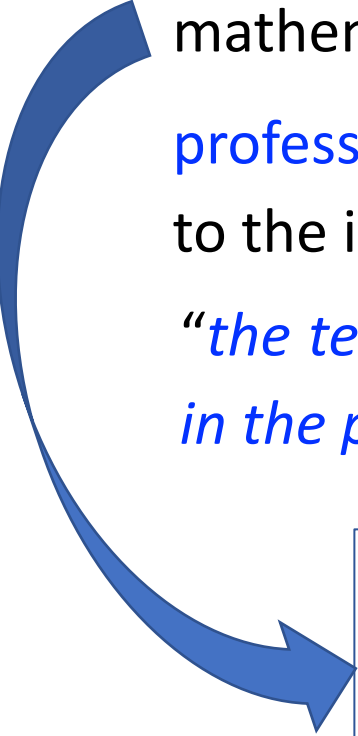
professional noticing of pupils' mathematical thinking" (Jacobs, et al., 2010) comparable to the idea of responsiveness :

*"the teachers' responsiveness to the children's ideas is likely the most essential feature in the play and teaching activities"* (Bjorklund et al., 2018, p.478)

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The results of our study could have been even more effective, especially for the at risk children, with **more effective teachers' interventions** during and after the guided play (Vlassis et al. , 2023).

→ Although the teachers all participated in professional development with a focus on the teacher's role in the games, the time and exchanges devoted to this aspect was not enough to maximise the effectiveness of the teachers' interactions with the children during the games.

## **5. Major challenge for teaching and research : teachers' responsiveness**

If we want approach such as guided play to live up to its promise as an effective tool for mathematical learning that is consistent with children's development,

we must provide the appropriate forms of professional support for pre- and in-service training that will guide and support teachers in the implementation of this effective but complex pedagogical approach.

**THANK YOU FOR YOUR ATTENTION!**

# When does the teacher intervene?

## During the game?

Teachers might enhance children's learning by co-playing along with the children and asking open-ended questions about what children are finding (Weisberg et al., 2013; DeLuca et al., 2020)

⇒ risk to transform the guided play in a teacher directed play

⇒ It could contravene the fact that the children themselves should control the game

# When does the teacher intervene?

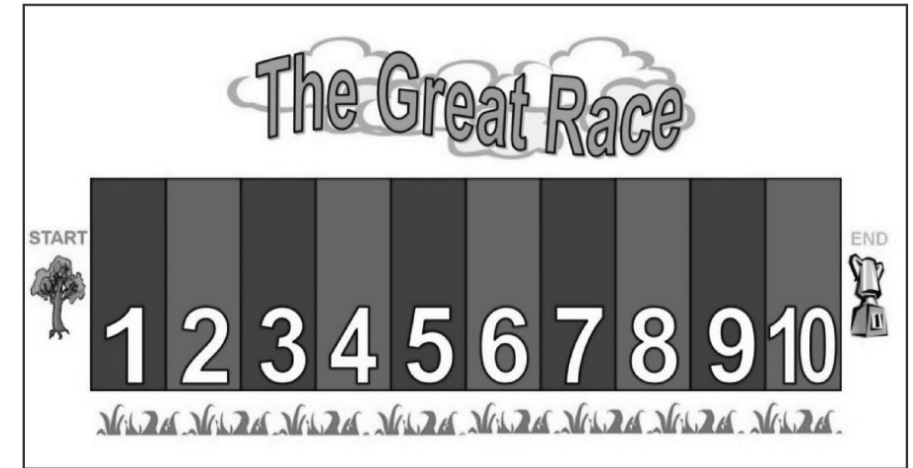
## After the game?

- In the context of card and board games, we suggest that, after initiating the game, the teacher should only intervene occasionally during the game so as not to interfere with its progress (Hassinger-Das et al., 2018; Bjorklund et al., 2021)
- However, in order to help students to mathematise their play content, it is important for teachers to organise short discussions after a game:
  - about the strategies used by the children during the game
  - to talk them through some fictitious games in order to take things further
- **During the game**, the teacher should ***observe*** and ***interpret*** what the children do and say, so that they can ask suitable questions during these short discussions and ***enhance*** the children's mathematical thinking

# An example of a “chocolate covered broccoli” game: *The Great Race*

(Ramani & Siegler, 2008; Ramani, Siegler & Hitti, 2012; ...)

**Objectives:** number line estimation, comparison magnitude; counting from 1 to 10, and reading the numbers on the path.



- A game with 10 spaces with numbers from 1 to 10 listed consecutively in each space.
- Groups of two or three children play together with the support of an adult (2012)
- The players take turns spinning a spinner with a half “1” and a half “2” and advance their piece the number of spaces indicated by the spinner (either 1 or 2).
- The children must say aloud the number indicated by the spinner and the numbers on the spaces he or she crosses. For example, a child who is on space 3 and spins a 2 should say aloud “4, 5” while moving.
- If the children make a mistake or are unable to name the number, the adult names it correctly and then asks the children to repeat the names while moving the piece.
- The first to finish the course wins.

## *The Great race ...*

Although the competition aspect is present (Criterion 6), the **Great race** cannot be regarded as a genuine game:

- **In terms of the way it progresses**, the game bears a closer resemblance to “**teacher-directed play**” than to guided play, as the context is exclusively controlled by the teacher, and not by the children
- **In terms of the game itself**, one of the main problems is that mathematical content is not integral to the mechanics of the game (Criterion 2)
  - In The Great Race, reading out 4, 5 or naming the number is not an action that is necessary to achieve the aim of the game, namely to arrive at the end of the course first.
  - Moreover, saying 4, 5 after starting from space 3 is counter-intuitive, as the child in reality counts 1, 2 spaces corresponding to the 2 indicated on the spinner.
- In addition, in this teacher-directed game, **the child has little freedom** (Criterion 4),
  - This lack of freedom combined with the artificial nature of the mathematical actions to be taken, is likely to mean that children engage less (Criterion 3), and have less fun (Criterion 1).



# An example of a genuine game:

## *The extra card*

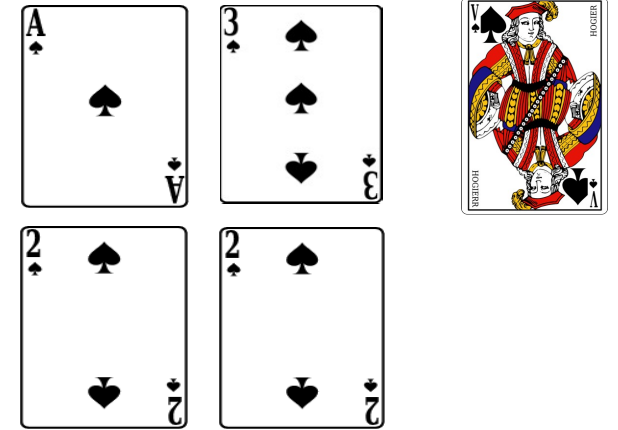
(de Chambrier et al. 2020; Vlassis ... & Fagnant, submitted)

**Objective :** (de)composition of numbers and addition

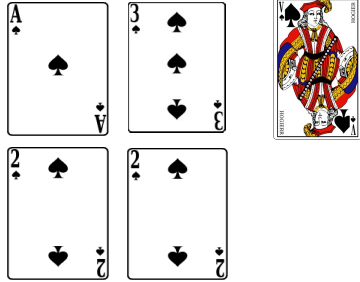
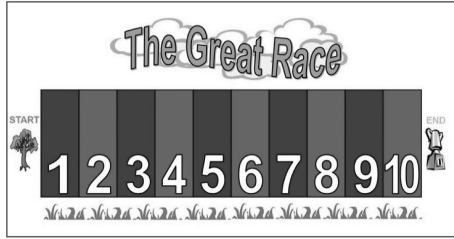
- This game is based on the rules of the ***Black Jack*** .
- A number is determined at the beginning of the game (for example **4**), and all the cards below this number are included in the game.
- One “extra card” is also included, for example a *jack* or a *queen of spades*.
- The children (4 -6 years old) must form pairs of cards that correspond to the given number and put them on the table.
- The winner is the first player to get rid of his/her cards, while the player ending up with the “*extra card*” loses.

After being introduced to the rules, the children played in small groups relatively independently, but discussions with the teacher took place at the end of the games about strategies and mathematics involved in the games (de Chambrier et al. 2020).

The cards used in this game are standard playing cards with **countable patterns**, so that children can use different strategies.



# Comparison between *the Extra-card* and the *Great race*

Criteria	The extra-card	The great race
		
1. Fun	We hope so	?
2. Mathematics are integral to the mechanics of the game	YES	NO
3. It implies active engagement from the children	YES	?
4. The game is under the control of the children	YES	NO
5. Negotiations and discussion	YES	?
6. Competitive aspect	YES	YES