Preschool children’s learning from mathematical games on interactive tables

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Interactive tables
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Preschools should provide opportunities that support children to:

- develop their ability to use mathematics to investigate, reflect over and test different solutions to problems raised by themselves and others,
- develop their ability to distinguish, express, examine and use mathematical concepts and their interrelationships,
- develop their mathematical skill in putting forward and following reasoning

(Skolverket, 2011, p. 10)
Piaget and his colleagues considered that:

Young children’s mathematical thinking is *informal*, because it depends upon the actual presence or mental representation of concrete entities (e.g., sets of concrete objects) and the transformation of those entities.

(Starkey, Klein & Wakely, 2004, p. 100)
• Drawing on the work of Vygotsky

Mathematical thinking is conceptualized as a form of thinking about quantitative and spatial relationships with the help of symbolic means. The construction of symbolic forms (like schemes, diagrams, drawings) and the between these forms and their meanings is essential for mathematical thinking.

• (Dijk, van Oers & Terwel, 2004, p. 73)
Thinking processes

- Can range from memorization to the use of procedures and algorithms (with or without attention to concepts, understanding, or meaning) to complex thinking and reasoning strategies that would be typical of “doing mathematics” (e.g., conjecturing, justifying, or interpreting)

- (Henningsen & Stein, 1997, p. 529).
van Oers

- We actually cannot maintain that very young children (1 to 3 years old) perform mathematical actions, even when they may carry out actions that we, as encultured adults, may recognise as mathematical. As long as these actions are not intentionally and reflectively carried out, we cannot say that children perform mathematical actions.

- (2010, p. 28)
Learning

- involves becoming progressively conversant with the collectively and culturally constituted forms of reflection.
- is “not just about knowing something but also about becoming someone” (Radford, 2008, p. 215).
- In this way, the object of learning is not only within the awareness of the learner, but the learner himself/herself is part of what is to be appropriated in the learning process.
Socialisation and Education

• Biesta (2007) considered socialization to be “insertion of ‘newcomers’ into existing cultural and socio-political settings” (p. 26).

• Education as defined by Kant was about the self-education needed to achieve rational autonomy to become fully human.

• Biesta (2007) postulated that education would be better considered as preparation for an uncertain future, where he stated freedom “needs to be realised again and again” (p. 32).
7 affordances of ICT for young children

- Bringing mathematical ideas and processes to conscious awareness
- Encouraging and facilitating complete, precise explanations
- Supporting mental “actions on objects”
- Changing the very nature of the manipulative
- Symbolizing mathematical concepts
- Linking the concrete and symbolic with feedback
- Recording and replaying students’ actions
- (Sarama & Clements, 2009)
Research question

- How are conjecturing, justifying and interpreting learnt by children playing a game on an interactive table?
- How does this learning contribute to children being able to deal with uncertainties in their futures?
- What aspects of the game/table appear to contribute to this learning?
- What aspects of the game/table appear to hinder this learning?
Conjecturing

- Albin looking towards the pan on Anna's side of the scales and pulls up a red 2 cube. He points to two yellow cubes on Anna's side.

- Albin: Then you can take the two.

- Anna pulls up two yellow cubes in the balance.

- Teacher: Will it be the same then?

- Anna: Yes.

- Anna put her arms in the short and looks pleased.

- Teacher. How do you know?

- Albin: For to. One two. One two.

- Albin points on the scales and the cubes while he explains with words.
Albin teaches conjecturing to Anna

- The game prompts Albin to form conjectures about what will make the weights in the scale pans the same.

- Initially Anna is hesitant and follows Albin’s lead.

- Her actions suggest that she also considers that the cubes need to be arranged on the pan so they resemble the groupings on Albin’s pan. This conjecture turned out to be false.
Teacher: Do you believe it?

Albin: Mmmm

Anna: Otherwise, we can do so here. For one to take of it.

Anna removes yellow 4 group of cubes.

Anna: So he takes it.

Anna points to the scale pan on Albin's side.

Anna: So he takes it off (the entire contents of the pan on Albin's side of the balance) and then he takes it from me.

Teacher: Does it work?

Albin pulls down a yellow 2x3 group of cubes and pulls up yellow 4 cube lying on the bottom on Anna's side.

Anna and Albin watch the centre of the scales. It becomes green.

Albin: Yessssssssss!

Teacher: Ooooohhhhh (make a delighted cry). It says you have succeeded!
Learning for an uncertain future

- The children determine for themselves how to think about what to do.

- They act (ir)rationally not because others expect it of them but because it makes sense to them in the circumstances.
The problem

- Anna: We have the same weight.
- Teacher: Do you have the same weight?
- Albin: Mhm.
- Teacher: It looks a bit strange on the scale. Emil's side is far lower than yours.
- The balance shows that Alan's side is heavier, but there is an equal number of cubes on each side.
- Albin moves on yellow 2x3 group and then the balance moves.
- Albin: It's just because it was stuck there.
- When Albin explains he shows simultaneously which yellow 2x3 cube group he means.
- Teacher: Yesss. But what happens now?
- Albin points to the point, which is not yet green.
- The scale is still not showing equilibrium. There are as many cubes on each side scale.
- Albin: Mhmhmhm.
- Albin puts his fingers in his mouth.
The teacher: how do you solve this? Albin's side is still heavier.

Anna pulls up a red 4 cube. Anna's side now weighs more. Albin drags a yellow 4 cube. Albin's side becomes heavier.

Teacher: Nämnen!

Anna takes yellow 2x3 cube group from Albin's side and put in her scale pan. Anna's side is heavier. Albin draws up a yellow 2x3 cube group. Anna points to Albin's pan. Albin's side now weighs more.

Anna looks at Albin's side where there are no cubes left on floor. Anna pulls up a yellow 3 cube group from his side to his pan and happens to have with him a yellow 2x3 cube group down.

Anna: It was on.

T: Solved it?

Anna: Yes.

Balance flashed green.

Balance now shows Albin's side is heavier
♦ When Albin removes a yellow 2x3 cube group, the balance point flickers green briefly. Albin puts yellow 2x3 cube group at the foot of the balance. Now the balance point shines green with a slow pulse.

♦ Teacher: (draws breath as the tension) Look, how was this?

♦ Anna: He took some cubes.

♦ Teacher: How many cubes have you Albin, how is your part?

♦ Albin counting cubes on his side, he points to the cubes.

♦ Albin: 1 2 3 4 5 6 7 8 9 10 - 10!

♦ Teacher: And how many has Anna?

♦ Anna points to the cubes as she counts them.

♦ Anna: 1 2 3 4 5 6 7 8 9 10 11 12 16

♦ Teacher: Were there 16? Albin help us and count.

♦ Albin: 13! (Albin hops, claps his hands.)

♦ Teacher: Is it?

♦ Albin: Mmm

♦ The teacher: 13 ... And you were 10 and balance shows the same.

♦ Albin looks at the teacher and claps his hands together.

♦ Teacher: How could this happen now?

♦ Albin change games.
What aspects of the game/table appear to contribute to this learning?

- Possibilities to interact
- Flexibility of actions but with a restricted choice of actions
- Possibilities for teacher to ask leading questions.
- Surprising results
What aspects of the game/table appear to hinder this learning?

- Green light provides the “expert” who determines whether or not the balance has the same “weight” on both sides.
- No recording of results for discussion later
- Cannot break up or put together the cubes.
- Different kinds of challenges (e.g. cubes of different colours could consistently in one game have the same weight so that the relationship between the cubes could be the problem to be solved)