Developing Early Maths Concepts through Play

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Young students are active participants in their learning, particularly when engaged in play contexts, but how do we best use play to teach mathematical concepts and ensure deep understanding? This article will explore strategies for play-based mathematics learning suitable for young students. A simple planning structure that follows a sequence of small group play-based activities and whole class discussions is used to develop intended mathematical concepts and proficiencies.

Important characteristics of young learners

Provision of appropriate learning experiences for young students must take account of their characteristics. Young learners commonly learn by observing, examining and interacting with their environment. They are generally resilient and are capable of making and acting on choices, expressing their opinions and describing their understanding in a variety of verbal and non-verbal ways.

Young students learn best when they are actively involved in exploring, manipulating and constructing their environment in a way that is meaningful to themselves. They use a scientific approach to make inferences, then experiment and test their ideas, using their observations to develop broader and deeper understanding of their world.

Play and Learning in Mathematics

A connectionist approach to learning mathematics can be used to structure mathematical learning experiences that begin with students engaging in free play with materials or within contexts purposefully selected by the teacher. The teacher's role is to extend this play to focus on the intended learning using challenging questions and problems to draw out student ideas and solutions. Focused questioning and explicit teaching of the intended concept and proficiencies follow with the goal of promoting problem solving and extending student thinking. Finally, the teacher assists students to make links with other materials, contexts and concepts. See Appendix 1 for an example unit plan that is described below.

Learning Intent

When planning a unit of work, the teacher first needs to consider the concept that is to be the learning focus along with the mathematical proficiencies to be developed. Clarity regarding intentions assists the teacher to choose appropriate contexts for the learning and provide opportunities for the development of deep understanding of a concept by avoiding broad but superficial attention to too many topics.

Specifically planning for the development of mathematical proficiencies provides a focus for interactions between teacher and students. Using this focus, the teacher is able to encourage students to develop dispositions necessary for becoming effective users of mathematics. Teachers model focus dispositions and mathematical proficiencies, encouraging students to adopt them through their reactions to what students do and say.

Vocabulary

Young learners are continually expanding their vocabulary and this includes words and phrases with mathematical meaning. The planning process, therefore, requires focused attention on the vocabulary to be developed throughout the unit. Through discussion with the

teacher, students become familiar with mathematical terms and descriptions and begin using them within the context of the play and during subsequent learning activities.

Step 1: Child Initiated, Spontaneous Play

The teacher's role here is to choose materials or a play context that will provide opportunities to focus students' attention on the chosen learning intentions. Materials that are flexible and engaging will encourage students to play and to interact with other students in a way that is meaningful to them. As the students play, the teacher observes and asks questions that focus their attention on the intended mathematical concept e.g. What did you use? How many did you use? What do you have most of?

Step 2: Teacher Initiated, Planned Play

During subsequent play activities, the teacher further encourages the development of the intended concept by asking questions and encouraging students to wonder about something related to it e.g. Can you make soup with only two ingredients? I wonder which ingredient you have more of? How could you be sure? Observation of student responses will help identify the extent of student understanding and design questions that will extend and challenge them.

Step 3: Challenge

Challenging problem-solving questions need to be unfamiliar and require students to think about mathematical ideas that are not routine or haven't been taught yet e.g. I have __ objects in my collection (choose a number larger than theirs). Do you have more or less than I have? Can you make your collection have the same number as mine? What did you do? For extra challenge, add and/or take away from your collection and note whether the student can adjust theirs to take account of the change.

Step 4: Explain and Practise

During this phase, students share their strategies and listen to other students' explanations. Focused teaching occurs when the teacher re-explains the strategies that students used, simplifying and clarifying the ideas and modelling the intended vocabulary. Students are then encouraged to solve similar problems in order to practise choosing and using strategies they have learned.

Step 5: Connect and Generalise

Opportunities to extend the mathematical thinking are then sought to help students make links with other concepts and contexts. More structured materials like ten frames, counters or cubes can be introduced at this point and questions asked that will extend and deepen students' understanding of the concept e.g. I have four blue counters on my ten frame. I want to have nine. How could I make it into nine using these yellow, green or red counters? Provide less than five of each colour if you want to encourage more two partitions.

References

Fluckiger, B, Dunn, J & Wheeley, E. (2015). Age-appropriate Pedagogies for the Early Years of Schooling: Foundation Paper. *Prepared for the Department of Education and Training, Qld by Griffith University*

Appendix 1: Example unit plan

Learning intention/s:

Concepts: making and comparing quantities, making groups the same (add/take away), partitioning of numbers to 10
Proficiency: communicate mathematically using materials and verbal descriptions, finding more than one solution to a problem.
Mathematical vocabulary: more, less, the same, equal, add some more, take some away, number names

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<td>1. Child Initiated – Spontaneous
Materials or context:
Students will be given a box with ‘junk’ materials to play with. Materials include straws, milk bottle lids, coloured sticks of various sizes, small bowls, plastic cups, beads, glass stones, coloured tongue depressors and other similar objects.
Focus question/s: Tell me about what you have made. How many _____ have you used? What do you have more/most of?
Proficiency: remember to wait until students respond. Respond positively to descriptions and reflect them back using mathematical vocabulary.</td>
<td>2. Teacher Initiated – Planned
During the free play time many students were making ‘soup’ with the materials.
Task: Challenge the students to make ‘soup’ using two types of ‘ingredients’ from the junk materials box. Allow a short time to choose (count to 20)
Questions:
I wonder which of the two ingredients you have more of. How can you tell?
I wonder what you could do to make sure that you have the same (equal) number of each ingredient.
What did you do to make them equal?</td>
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<td>3. Challenge
Focus on particular quantities and using number names to describe them. Change their collection to make it the same as a given quantity. This will vary depending on student need.
Example:
Get me six blocks
I have some blocks. Do you have more or less than me?
Can you make your collection have the same number? How did you do it?
I am going to take some of my blocks away. Can you make yours the same now? How did you do it?
Extension questions: vary the quantity that is asked for and compared to. Put my collection in an opaque container and ask students to follow the count while you add, take away or do both to my collection.</td>
<td>4. Explain and Practise
Group time: Review examples of the challenge questions. Students draw or explain their thinking for others. Re-explain using materials and mathematical language.
Practice: Students work on similar questions
Making and adjusting amounts on ten frames
Barrier games – one student describs quantities and changes to quantities while the other replicates the description.
Game – work in pairs. One student drops blocks into a container and then changes the quantity. The other student has to say how many there are now.</td>
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<td colspan="2">5. Connect and Generalise
Making connections: Ask similar question when students are using other materials or engaging in other play e.g. how many leaves do you have? What you have to do to make it that you have 8 leaves in your collection? How many leaves will you have if I give you two more? … if you give one to Sarah?
Manipulation questions: I have some blue counters on my ten frame (4). I want to have nine counters on it. How could I use yellow, red and green counters to make it into nine?
Ask students to compare their answers with other students and work out how they are the same/different.
Extension: Find three more ways to make nine. Make nine but you must use three colours. …but you must have more blue counters than any other colour.</td>
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