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Young Children's Mathematical Patterning

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The Importance of Mathematical Patterning

The importance of pattern in mathematics and its essential role in the development of mathematical knowledge, concepts, and processes has been acknowledged by educators and mathematicians. Steen (1990), in fact argued that "Mathematics is the science and language of pattern" (p. 5).

Patterning can be defined as something that remains constant within a group of numbers, shapes or attributes of mathematical symbols or concepts. The arrangement of the group possesses some kind of clear regularity through the use of repetition. Charlesworth (2000) proposed that patterning is a process of "discovering auditory, visual, and motor regularities" (p. 190). Whilst there are three forms of patterns (repeating, growing and relationship), repeating patterns are the earliest form of pattern explored (Burns, 2000).

The Study

This study employed a multi-site case study (Yin, 2003) to investigate the nature of patterning in the pre-compulsory years of schooling. The study was conducted in both a preschool and preparatory year setting because these sites are typical examples of Queensland children's learning environments in the year prior to the commencement of compulsory schooling. The two sites were located in inner city Brisbane and were geographically close (two kilometres apart); they shared similar socio-economic clientele. Both classroom settings were arranged into interest areas such as block corner, home corner, collage table, and sand and water areas. The teachers' daily programs incorporated both teacher-directed times and free play opportunities. Each setting had 13 female and 12 male children and was staffed by a 4-year trained early childhood teacher. Typical of case study, multiple sources of data were collected. These data comprised semi-structured interviews with each teacher, copies of their daily programs and video-taped observations of the classes.

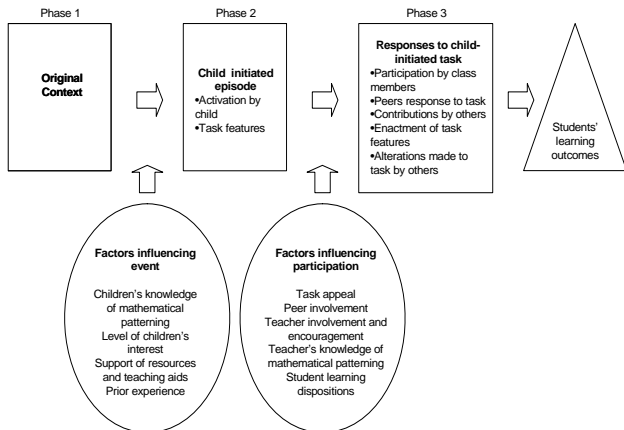
The Study Results

Analysis of a total of approx. 80 hours of video observations collected in the 2 classrooms revealed ten mathematical patterning episodes. An episode is defined as an occurrence containing some aspect of mathematical patterning behaviour. Conceptual frameworks (informed by Stein et al., 1996) were used to guide the examination of how children and teachers generate, engage in and direct mathematical patterning activities. The analysis of video data revealed 10 episodes of mathematical patterning. The episodes were characterised as teacher-planned, teacher-intervention, child-intervention and teacher-intervention. Highlighted in the findings is the powerful nature of child-intervention episodes and the potential that teacher-intervention episodes have to facilitate worthwhile mathematical patterning experience.

CHILD-INITIATED EPISODES

The category, child-initiated episodes, identifies events that incorporate a concept or process of mathematical patterning. These events that the child initiated can be explicit (clearly articulated) or implicit (implied but not clearly expressed).

In the preschool setting, a child named Chelsea was sitting at an inside table independently interacting with manipulative equipment called 'tap tap' (a hammer and nails construction kit). This construction material had been placed on a table for the children's use. No instructions for its use were provided by the teacher (*original context*). Chelsea initiated an episode (phase 2) by tapping shapes onto the cork board and described it to other children at the table. "It is a necklace with diamonds – diamond, funny shape, diamond, funny shape, diamond, funny shape". A second child, Emma, joined the table and created a necklace utilising an ABBA pattern (*response to child-initiated task*-phase 3). Chelsea's explicit interest in mathematical patterning (*factors influencing event*) seemed to provide the stimulus for other children to join her in creating patterns. Three children participated in this episode enthusiastically and the episode provided exposure to mathematical patterning concepts in a play-based experience.



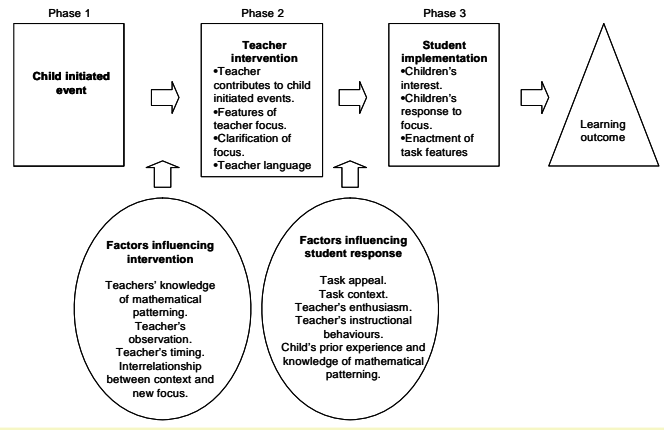
Findings

- child-initiated episodes containing mathematical patterning are productive learning experiences
- during unstructured play times children initiated activities that explored repeating patterns, pattern language, and the elements of linear patterns
- child-initiated episodes were rich opportunities where children shared, refined and developed their knowledge of patterns
- children chose to interact with concrete resources and integrate their knowledge of mathematical patterning into their play times

TEACHER-INTERVENTION EPISODES

Teachers may also intervene in child-initiated episodes thereby creating an extension or a chain of further developments. The intervention by the teacher contributes to the mathematical patterning component of the activity instigated by the child. The teacher's intervention tactics make explicit the patterning features of the activity – if the child has not previously done so. Intervention by the teacher may contribute to the children's knowledge or extend their thinking.

The teacher-intervention episode extended upon the child-initiated event involving Chelsea who independently created a diamond necklace using 'tap tap' equipment. This necklace featured an AB pattern, which she described as "diamond, funny shape, diamond, funny shape," (phase 1, *child-initiated event*). The teacher wandered past this table where Chelsea and three other girls were interacting. The teacher joined the conversation (phase 2, *teacher intervention*) and said "Can you tell me about your pattern Chelsea?" Chelsea described her necklace by the shapes. The teacher asked if there was any other way to describe her pattern. Chelsea didn't reply and the teacher continued "What about 1, 2, 1, 2?" Chelsea said "1, 1, 1, 1" and pointed to the shapes. The teacher departed and Chelsea said that she was going to record her pattern.



Findings

- teacher interjection in child-initiated episode highlighted to surrounding children the mathematical patterning focus
- the interjection had the potential to extend the children's knowledge, engage other children and provide scaffolding to the episode
- further findings in this study suggest there could be significant weaknesses in teachers' knowledge of patterning concepts and processes, and that their teaching competencies could be diminished as a result of their limited knowledge
- teachers need to have knowledge of mathematical patterning, patterning language and pattern form
- teacher-intervention episodes potentially have characteristics that can promote high quality mathematical patterning

Implications and Recommendations for Future Research

- future studies could contribute to the void of knowledge surrounding pattern development and enhance teacher knowledge
- future studies could include research pertaining to the sequential nature of patterning, ways to support the development of patterning in young children and teacher understanding about patterning
- future studies could assist in creating 'pattern aware' teachers who can make informed programming decisions about patterning activities and facilitate worthwhile patterning learning experiences

