Is maths alive for the child "under 5"?

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Do we need to acknowledge mathematics in the early childhood environment? Is there any mathematics to be acknowledged within an early childhood environment? The answer to both of these questions is an undeniable 'yes', and this paper addresses these questions through the relevant curriculum documents, issues relating to the learning and the corresponding issues for the teacher.

Mathematics is an integral part of a child's holistic learning experience starting in the early years of their life. It is one of the essential learning areas in early childhood education, as it aims to provide students with skills, concepts, understandings and attitudes to provide them with abilities to cope with everyday life. When a child has a birthday they are gaining knowledge of number, when they see how a tree or plant has grown over a period of time they are exploring measurement. The beginnings of algebra are evident in the many repeated patterns within the environment and the geometry of the world, including the world of the early childhood centre, is evident through familiarity with the surrounding shapes. From a very early age, children's concepts of statistics emerge through their decisions on the sorting of their playthings, bits and pieces and clothing. These are just a few examples of mathematics evident within an early childhood environment.

Mathematical concepts are very much a part of life and accordingly require recognition, and the earlier the better. They need to be acknowledged and developed otherwise they will remain unknown by the children. Imagine the difficulty a five year old would have if they were introduced to shapes for the first time when attending school.

Curriculum

These concepts are listed in the mathematics curriculum document called "Mathematics in the New Zealand Curriculum" (Ministry of Education, 1992). There are five content strands in this document being number, statistics, algebra, geometry and measurement. The document also discusses three mathematical processes which

we believe undergird the content strands. They are problem solving, developing logic and reasoning, and communicating mathematical ideas. These processes enable the children to gain understanding of the content strands. The document states "Mathematical education aims to develop in students the skills, concepts, understandings and attitudes which will enable them to cope confidently with the mathematics of everyday life" (Ministry of Education, 1992:8). The curriculum not only gives us as teachers an insight into what we can begin to promote, but also clear guidelines on how to teach the concepts.

However early childhood education is of a holistic nature, with children's learning in the essential learning areas of the *New Zealand Curriculum Framework* (Ministry of Education, 1993) integrated into the Early Childhood Curriculum, *Te Whaariki* (Ministry of Education, 1996). *Te Whaariki* provides a model for learning that weaves together "…. intricate patterns of linked experiences and meaning rather than emphasising the acquisition of discrete skills." (Ministry of Education, 1996:41). As early childhood educators we believe that aspects from both curriculums relate to one another. Through constructivist and co-constructivist learning, elements from the mathematics curriculum can be identified and addressed, bearing in mind that, as at school, at early childhood level children develop at different rates and this should be taken into consideration when assessing the meeting of achievement objectives.

Two major links between the curriculums are problem solving and language as these can be related to all essential learning areas. Language is a key aspect in the mathematics curriculum as negotiating and talking encourages children to express their ideas verbally. This can be related to Communication, Goal 2 of *Te Whaariki* (Ministry of Education, 1996) as it states there that children develop language skills in problem solving contexts in both real life and play situations. Children formulate ideas which can be linked to mathematics and through exploring, questioning, observing and interacting they gain a wide knowledge of mathematical skills and concepts which are continuously increasing. (Hawthorne, 1992). Play experiences are essential for children so that they can experience mathematics through they play as they observe, represent and investigate patterns and relationships between social and physical phenomena (Australian Education Council, 1991). A quote from class was "I hear and I forget, I see and I remember, I do and I understand."

The early childhood curriculum document *Te Whaariki*, has links between its strands and the essential learning areas. For example the link between the strand of Exploration and mathematics is "Children develop and use mathematical concepts when they collect, organise, compare, and interpret different objects and materials." (Ministry of Education, 1996:98). Children are constantly exploring the environment and it is through constant experimentation that they begin to make sense of previously unknown concepts. We can encourage children's learning within mathematics by drawing out concepts and discussing these with the children. This will not only happen during 'curriculum' type activities, but also throughout daily routines and occurrences. (Ministry of Education, 1996).

Meaningful Context

Within the early childhood environment, there are many different areas that a child will be exploring and many activities and experiences that they will be engaging in. But no matter what a child is doing, there will be mathematics involved. Whether they are reading a story or building with blocks, the key for teachers is to see the mathematics potential in that situation and convey it to the child. Hill (1995:37) states "It is empowering to observe children in their play and be able to identify the broad (mathematics) strands, then gaining confidence, identify more specific concepts and have the language to communicate these to the children."

Within the early years of development, children are particularly influenced by their environment and it is important that children's self-initiated involvement should be valued. Take measurement, for example, observe a child playing in the sandpit and *how* they persevere with the question of how many blocks it will take to reach from one side of the road to the other. Discover how much their questioning and problem-solving of everyday, meaningful tasks with a purpose aids the development of specific mathematical concepts. In water play how many jugs of water can fill a hose? On the climbing structures there is a continual pattern of mathematical problem solving, such as how many steps I can climb now? What will happen if I move up the climbing frame sideways? It is at this time the child then retrieves from their schema (Meade and Cubey, 1995) the previously stored information which they then internalise and reconstruct in relation to whatever task they are doing at the time. We believe that this is a continual process. Gradually, the concepts of measurement are enlarged on and the child grasps a greater understanding.

These experiences have got to be meaningful for the child. "Students learn mathematical thinking most effectively through applying concepts and skills in interesting and realistic contexts which are personally meaningful to them. Thus, mathematics is best taught by helping students to solve problems drawn from their own experience." (Ministry of Education, 1992:11). This statement taken from the mathematics curriculum epitomises our view of how mathematics should be taught. This is in contrast to 'maths time', currently appearing in some centres, where teaching mathematics means children completing worksheets at a set period of the day.

Unless we make their experiences meaningful and create a learning environment that will encourage the child to revisit a particular concept of mathematics in the future, they will choose not to learn from these experiences, possibly devaluing the worth of the experience. Thus the pattern of the child's learning and perception of mathematics has already been set, and the effects may be devastating for that child's future learning.

Cultural Context

With a little effort and imagination, we can learn to present mathematics in a way that does not exclude children because of their ethnicity, culture, age or gender, and that can be appropriate to each individual child. The earliest manifestations of the development of mathematical concepts can be seen in infancy as the baby discovers the permanence of objects, spatial continuity and the effect of her own actions on the objects and people around her. It is our belief that Maori children can become aware in the early stages of infancy of patterns that are present in their own cultural surroundings, such as on the walls and ceilings of the marae such as tukutuku panelling and the carvings on the walls and ceilings.

Even the photos of tupuna that are placed on the wall are allowing the child to immerse herself in mathematical concepts of measurement. In particular, this can be by listening to the generations being orally recited to those on the marae. Counting the generations of those relatives who have passed on helps with grouping and storing for later development. These are all forms of mathematics and they can stimulate the child to firstly recognise patterns, numbers, and statistics, leading to categorising of the types of patterns, to the number of generations there are in the photos on the walls. As children are exposed to different cultural experiences and values, they will have a variety of experiences in their schema which can relate to maths. It is our firm belief

as childhood educators that we must be aware of these cultural perspectives, and where appropriate relate these to mathematics and teach children with those resources that are pertinent to their culture.

Teacher Role

The main aspect of learning and teaching in early childhood education is that knowledge and understandings are constructed through social interactions with others, as Vygotsky details in relation to his co-constructivist theory for learning and teaching. The learning and teaching of mathematics is no different. Pateman and Johnson (1990) affirm this view that "Mathematics is a social construction, not an externally determined body of objective knowledge." In light of this, the majority of mathematical experiences and activities should involve interactions between children and peers, and also between children and teacher. As teachers are powerful models for children, through interaction, and engagement in their own mathematical activity, they must portray enthusiasm and enjoyment of mathematics, and learning in general. This impresses the notion that learning, and learning of mathematics, is a rewarding, enjoyable and worthwhile event or experience. As Hill (1995) writes "…. children sense what is important to the adults around them."

By focusing on the 'emergent curriculum' and running a child initiated programme, teachers should plan for, and engage children in, experiences that will be relevant to the children involved. Teachers need confidence in their own mathematical knowledge in order to influence, and be influenced themselves, through interaction with the children. It is through these experiences of interaction that a child uses and stores information for future reference. Children will benefit from the support of a teacher who has the ability to see where the child is heading mathematically, then support and guide those experiences in a mathematical direction. Using the correct mathematical language when working with, or alongside, children helps to support that learning. Some examples, for instance, of geometric language are: along, beside, under, on top of, straight, circular, square, sloping… Algebraic examples are: the same as, different from, patterns, what comes next?… and in measurement: how tall? how long? bigger than, small, short, heavy, huge ……

Teachers need to add stimulation to a child's surroundings to allow the child to develop to their full mathematical potential. The environment should contain resources which cater to children's needs. Appropriate resources should be readily available for children to use. These resources should assist children to make

decisions, and to solve problems, by allowing them to choose appropriate materials for themselves. Haynes (1997) writes "Choice includes thinking about things; questioning the appropriateness of something; being allowed to be wrong, yet to have another go; making decisions and to feeling good about the achievements made." These issues relate to essential components of the mathematical processes, valued in our New Zealand curriculum as essential ingredients of mathematical learning.

Teachers can facilitate children's learning by asking questions such as "Do you think….?", and "What would happen if….?" These sorts of questions are open-ended and allow children to gain a sense of empowerment through their responses. It is also important to affirm children's expressed ideas and explain why we agree or disagree with them. Disputes over mathematical actions and knowledge will "feed the (mathematical) process by modelling the process of checking" (Schwartz & Brown, 1995).

As teachers we need to gain confidence in mathematising the environment. Confident early childhood teachers are able to support children's mathematical learning through scaffolding and facilitating children's learning, by providing new and exciting challenges and by valuing the children's investigations and explorations (Hawthorne, 1992). We recognise the importance of a pre-service teacher education programme which provides teachers with knowledge of mathematics for themselves, to enable them to then provide a mathematical learning environment of a high professional standard.

We have a great deal of responsibility in the attitudes we use to portray mathematics to the children. Hill (1995) states "Only when adults find mathematics empowering will it be truly empowering for children." Our enthusiasm for mathematics is as important as our carefully planned learning experiences. This, combined with a genuine understanding of the importance of mathematics and an ability to facilitate effective learning in a secure environment, will provide children with a productive start in their mathematics education.

In conclusion, mathematics is an integral part of early childhood education. Many may say that mathematical learning does not occur until children start primary school but this is not the case. Children in early childhood are capable learners of mathematics and, if supported, can engage in learning beyond what is typically thought they are able to do. Perry and Conroy (1994:4) write "Children are able to construct mathematical ideas well beyond those which are expected of them at certain

ages." By effectively planning for, and implementing, rich mathematical experiences using current learning theory, assessment procedures and curriculum documents, we can maximise children's learning within Early Childhood Education, and therefore enhance children's learning in the future. By developing mathematical understandings in the early childhood years, children are gaining a 'head-start', or advantage, for the rest of their education.

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(Council, 1991; Education, 1992; Education, 1993; Education, 1996; Hawthorne, 1992; Haynes, 1997; Hill, 1995; Meade & Cubey, 1995; Pateman & Johnson, 1990; Perry & Conroy, 1994; Schwartz & Brown, 1995)