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The place of blocks in the early childhood curriculum: Do we need a new set of free wooden blocks?

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WHY BLOCKS?

The central place of blocks as important and valuable materials in Western early childhood settings is well established. Literature includes statements that comment on both the value of block play for individual children, and the central place of blocks within group settings. Fry (1992) has noted "the quality of the child absorbed in self initiated block play activity, and the warm satisfied smiles of achievement and recognition" (p. 3), and Stritzel (1995) has posited that the "block center can be the most exciting place in the early childhood classroom" (p. 42). Blocks have been considered "the most useful and versatile ...toy or product ...in an early childhood program" (Karges-Bone, 1991, p. 5). In particular, multiple unit blocks[1] have been noted as the most important (Starks, 1960), the most useful and the most used equipment (Kinsman & Berk, 1979, cited in Fry, 1992), as well as being accepted in varied settings internationally as "one of the finest learning tools available to children" (Cartwright, 1988, p. 44).

In this paper I argue that there is a case for a new set of free wooden blocks for infants, toddlers and young children. I have chosen the term *free wooden blocks* to indicate pieces of wood which can be freely placed together. This paper provides a brief outline of literature relating to such blocks and discusses the place of blocks in the current curriculum context of Te Whāriki. The place of blocks as a traditional play material within Te Whāriki is exemplified through an exploration of the strand of *well-being*. A conceptual design of a new set of free wooden blocks is then proposed.

A HISTORICAL NOTE

Early reference within Western literature to children playing with blocks prior to the time of Froebel is very scant (Provenzo & Brett, 1983; Read, 1992), and when blocks are referred to, it is difficult to tell if they were in fact made of wood. In discussing

[1] Caroline Pratt's multiple unit blocks are widely available in Kindergartens and Playcentres as well as many other early childhood services in Aotearoa-New Zealand. They often have units measuring 13 x 6.5 x 3.25 cm and other blocks which are multiples and fractions of this size.

how to create "perfect citizens", Plato (Laws) argued for the need of early training and education aimed at virtue. Plato illustrated good training when he wrote “the future builder must play at building” (1953, 643). In commenting on this phrase Read (1992) suggested that blocks were used by children in Plato’s time. However, while one could contend that some children – perhaps builders’ sons – played with blocks, the connection between building structures and virtuous citizens would not appear to make explicit the place of play with blocks in Plato’s world. Additionally, it is unlikely that children played with wooden blocks in Greece nearly 2500 years ago, as builders were working with materials such as fired mud bricks, stone and marble.

Similarly, the substance from which blocks may have been made 500 years ago is unclear. In one corner of an oil painting by Pieter Bruegel the Elder, titled *Children’s games* and dated 1550, rectangular blocks lie scattered on the ground. The idea of playing with wooden blocks outdoors is one that does not feature in literature until early in the 20th century with Pratt’s yard blocks which Johnson (1924) says were created by securing six slats of wood to create hollow prisms.

More typical blocks are those made from solid wood and these are generally used indoors. In 1692 John Locke wrote of children playing with cubes which were in fact dice that had letters pasted on them (cited in Provenzo & Brett, 1983; cited in Read, 1992). The emphasis here was on aiding children to learn the alphabet and reading (Locke, 1902).

The idea of playing with cubes was developed further by Friedrich Froebel during the early 19th century. He provided children at early kindergartens with a wooden cube, sphere and cylinder as the focus of his 2nd Gift. For some subsequent gifts he divided wooden cubes into smaller components – small cubes, and rectangular and triangular prisms (Brosterman, 1997; Froebel, 1912; Goldammer, 1895).

A piece of equipment which is sometimes seen to epitomise the materials developed by Maria Montessori is the pink tower. This consists of ten cubes each varying from the next by 1 cm. Montessori also created blocks of other shapes - prisms, cylinders and other geometric solids such as pyramids and curved forms (Montessori, 1965).

Two more recent significant pieces of writing focus almost exclusively on multiple unit blocks (see figure 2, p. 15). These are an American publication called *The block book* (Hirsch, 1984), and *Exploring learning: Young children and blockplay* (Gura, 1992) which resulted from the work of the Froebel Blockplay Project in England. Hirsch's *The block book* addresses block play as it relates to children's learning of science, mathematics, social studies, and dramatic play. It also acknowledges the history of blocks, practical considerations for block play and the value of block play for older children. The Froebel Blockplay Project also investigated the issue of older children's use of blocks by including primary teachers, together with nursery nurses, in their research group. These teachers worked to use block play as a medium to explore the wider curriculum. Many different aspects of block play were explored in some depth through this collaborative work, especially in the areas of working with mathematics, science and problem solving. Issues of communication also featured, and there is an extensive reference list provided in this book. A work which looks broadly at a wide range of blocks is Provenzo and Brett's *The complete block book* (1983).

Other work focuses more specifically on given aspects of children's potential learning from their activity with blocks. For example: art has been addressed by Gelfer and Perkins (1987, 1988; Gelfer, 1990); Rogers (1985, 1987) studied social development; Pepler and Ross (1981) and Liedtke (1982) explored problem solving; Reifel's (1982, 1984) interest has been with representation; and closely aligned with this has been work on symbolic development (Trawick-Smith, 1990; Zervigon-Hakes, 1984) and literacy (Stroud, 1995). Some authors have taken up a particular issue which impacts on children's experience of curriculum and these have been explored in relation to blocks. Examples of such issues include gender (Christeller, 1995; Farrell, 1957; Meade & Staden, 1985; Varma, 1980); cognitive styles (Saracho, 1994, 1995); the importance of children being physically active in their learning (Stone, 1987; Williams & Kamii, 1986); and the space (Nash, 1981) and lengths of time children have available for play (Christie & Wardle, 1992; Tegano & Burdette, 1991). A further key approach in literature has been to look at a particular aspect of blocks. Examples of this include Hulson's (1930) analysis of individual 4-year-old children's block choices and resulting constructions; Goetz and Baer's (1973) experimentation to increase block form diversity; and Lambert's (1992) exploration of *within stage* development of block play.

The majority of the above work has been carried out overseas. The most significant piece of block play research in Aotearoa New Zealand was Meade and Staden's (1985) *Once upon a time, amongst blocks and car cases.* This focused on gender issues in block play. There is a great deal of scope for research into how the ideas presented in materials such as those mentioned above, can be applied and developed within the context of the early childhood services in this country. Another key area that could be explored here, is how children's play with blocks can be seen in the light of the early childhood curriculum in Aotearoa New Zealand - *Te Whāriki* (Ministry of Education, 1996).

While it is apparent that there is scope for diverse explorations into many facets of blocks and block play in Aotearoa New Zealand, I believe that a central concern is the particular choice of which set of blocks to make available to children. It seems to me that the choice of blocks has a direct impact on the possible range of potential learning experiences to which children are exposed.

The contrasts between cubes, multiple unit blocks and large blocks provide an example of this. Children who are solely supplied with cubes are both supported and constrained by the intrinsic qualities of cubes. An inherent constraint within a set of cubes is that cubes do not overlap as fully as brick-shaped blocks when constructing a wall or similar structure (see figure 1, p. 5). Consequently, the structure is less stable than if it were built with longer brick-shaped blocks. This could result in limiting building of an extensive nature.

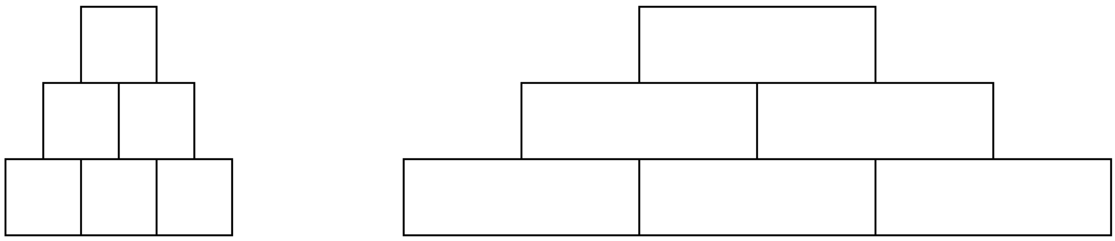

Figure 1. Contrasting stability of cubes and bricks

On the other hand, there can be valuable qualities inherent in a particular set of blocks. For example, with multiple unit blocks almost all dimensions of every block relate to the dimensions of the next. This allows the multiple unit blocks to be fitted together very readily and offers children many opportunities to create complex structures, as well as thinking through connections between proportions which introduce fractions, multiples and pattern repetition. However, multiple unit block sets do not include cubes, so children who play only with multiple unit blocks are not exposed to the qualities of cubes. The faces, corners and edges of cubes are exactly the same as one another, and this can result in building with cubes being less stable. If children are to build extensively with cubes, they will need to refine their building skills to achieve the effects they desire. Thus, an apparent limitation of cubes also has a potential benefit.

Providing both multiple unit blocks and cubes might seem a good strategy to capitalise on the possibilities of both types of blocks. This was done in the United States of America in the 1920s and 30s with a box of coloured 1 in. cubes supplied as part of the multiple unit block set (Johnson, 1933). However the size of the 1 in. cubes bore no relation to the sizes of the rest of the blocks in the set which were multiples of 2.75 in. This anomaly could disrupt complex building as a child could not extend their building in a regular fashion by adding, for example, a stack of three cubes (3 in.) to the end of a 2.75 in. block and have a stable base on which to continue building. Starks (1960) has noted that when small coloured blocks are available alongside multiple unit blocks, they are most often used by children to decorate the structures they have built with the rest of the blocks. I would suggest that, due to the contrast in dimensions, smaller blocks have been useful for little else.

Another anomaly with multiple unit blocks is that because they were originally created as multiples of imperial measurements, they do not relate readily to the metric sizes with which children in Aotearoa New Zealand need to become familiar as they engage with the mathematics curriculum. A further interesting factor when one is considering whether multiple unit blocks can satisfy children's potential learning with blocks, was highlighted in a study of differential gender involvement with two different sets of blocks in Aotearoa New Zealand (Christeller, 1995). This study compared how children used multiple unit blocks in contrast to a set of bigger blocks. It found that girls played 49% more readily with the bigger blocks. Christeller largely credited this to the fact that the favoured blocks were big enough for the children to create structures to play in, and thus enabled them to engage in sociodramatic play.

The glimpse given above of the anomalies within even a few of the existing sets of blocks suggests that it may be possible for children of the future to engage in play with a set of blocks that results in richer, more diverse learning experiences. This new set of blocks may broaden the types of experiences of block play available, while incorporating many of the valuable qualities of the sets of blocks which children have used.

THE CONTEXT OF MY STUDY

My study grew out of my reflections on my work as a teacher with infants, toddlers and young children in a variety of settings. Working in Kindergarten, childcare, Playcentre, Montessori centres, and a family home, I have observed and worked with children using a variety of sets of wooden building blocks. Reflection on my experiences has led me to believe that children's potential learning is influenced by the types and quantities of blocks available, together with their teachers' knowledge, attitudes and skills in supporting children in their potential learning. For example, most children attending childcare centres, Kindergartens and Playcentres in Aotearoa New Zealand have access to multiple unit blocks. This aesthetically pleasing, mathematically interesting equipment provides the potential for social, creative, cognitive and physical learning. However, this learning is often limited by constraints such as the quantity of blocks and accessories provided, the time and space available for block play, the level of teacher involvement in this play and differential gender involvement. By way of contrast, all children attending Montessori centres in Aotearoa New Zealand are introduced to sensorial materials which include specific sets of blocks to develop coordination, visual and muscular perception of dimension, and mathematical perception and language. Challenges within these settings include consistent provision of opportunities for creative endeavours, especially of a large cooperative nature as is sometimes seen with multiple unit blocks.

From these reflections I have come to the view that one comprehensive set of blocks could draw together many of the valuable qualities of various sets children have used and are using currently.

The aim of developing a conceptual design of a new set of blocks is for children to use blocks that, through their design, maximise children's potential learning. This aim arises from the broader context of my philosophy and experiences, influencing the way I view children, the curriculum and the various blocks I have explored, and thus impacting on this study. The underlying philosophical foundation of all my work with infants, toddlers and young children is that with respect for all children, they may each have every opportunity to fully develop their own unique potential. Within this, I value learning being enjoyable and appropriate, with a diverse range of experiences freely available both indoors and outdoors, over extended periods of time, with changes having their basis in analysis of observations. Existing sets of blocks have highlighted the potential learning from blocks as including their propensity to be explored as pieces of wood, their ability to be used in representation, as well as for abstract pattern creation, and the presentation of mathematical concepts. Skills which children can develop as they use blocks include fine visual discrimination and hand-eye coordination, and also the coordination and strength to manoeuvre large blocks. As children negotiate and build structures together, opportunities arise for developing extensive social interactions, as well as the verbal and non-verbal communication skills to support these interactions. Complex thought processes can be engaged as children variously plan, build, play with, play on or in, modify, record, reconstruct, and reflect on their constructions.

In my view children's learning with blocks will be maximised if the blocks they use are a comprehensive set in which every block is related to another in simple proportions. These proportions can apply either across the whole range of blocks, or within a sub-set of the range. The inter-related quality of the proposed new set of blocks will cover an extensive variation of sizes, with both gross and fine differentiations between various blocks. The metric system will be reflected in the blocks, both in their sizes and in the quantities provided. The metric system utilises millimetre and centimetre measurements, and is based on having multiples of groups of 10. The blocks will measure between 1 and 200 cm and the smallest variation between blocks will be 5 mm. In many instances 10 (or multiples of 10) of each size block will be provided. In choosing the particular range of shapes for this set of free wooden blocks, consideration has been given to providing blocks which will expose children to a wide range of shapes, and yet also allow children to create forms for themselves.

BLOCK PLAY - ITS PLACE IN *TE WHĀRIKI*

It would seem that in recent years the emphasis of curriculum discussion has shifted away from a focus on the physical play materials provided in early childhood settings. This is evident, for example, in the early childhood curriculum document for Aotearoa New Zealand - *Te Whāriki* (Ministry of Education, 1996). In *Te Whāriki* blocks are mentioned specifically only twice in the entire 99 pages, and then minimally - as possible examples of materials through which to fulfil the *communication* strand of the curriculum.

This raises the question of whether blocks are being relegated to an insignificant position in the current curriculum context. Are blocks no longer relevant to children in early childhood education settings in Aotearoa New Zealand?

Cuffaro (1995) suggested that the materials young children use are equivalent to the textbooks used by their older peers. Drawing on this analogy, it is possible to argue that for older children, their curriculum is far broader and deeper than a set of textbooks. Nonetheless, text books do provide some insight into other children's curriculum. Similarly:

> In the hands of children, the materials we offer become tools with which they give form to and express their understanding of the complex world in which they live …they author their own texts, create meanings, and make sense of the often mysterious and complex world of which they are a part. (Cuffaro, 1995, pp. 36-37)

So considering materials such as blocks as textbooks of the early childhood curriculum raises the possibility of traditional play materials continuing to have a role as children engage with their curriculum. The place of such "textbooks" as blocks within *Te Whāriki* (Ministry of Education, 1996) is perhaps best expressed in the explanation of the principle of relationships. This states that children "learn through responsive and reciprocal relationships with people, places, and things" (p. 14).

Whereas in the past, materials such as blocks have been considered to have a central place within the curriculum in their own right[2], in more recent years the emphasis has shifted to the active interplay between adults and children working in relationship with one another, and with *things,* such as blocks. *Te Whāriki* brings into focus the social and cultural contexts of learning:

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[2] Examples of literature where blocks are considered centrally within curriculum include Beaty's (1996) *Preschool appropriate practices* and Hohmann, Banet and Weikart's (1979) *Young children in action: A manual for preschool educators*. In Aotearoa New Zealand, an example that demonstrates the centrality of blocks is Meade's (1985) listing of blocks as one of the activities available in the centres she studied in the early 1980s.

> This curriculum emphasises the critical role of socially and culturally mediated learning and of reciprocal and responsive relationships for children with people, places, and things. Children learn through collaboration with adults and peers, through guided participation and observation of others, as well as through individual exploration and reflection. (Ministry of Education, 1996, p. 9)

It is interesting to note that this emphasis is in harmony with views expressed by some of the most significant contributors to literature about blocks. Irvine (1982, cited in Meade & Staden, 1985) has cautioned that "un-adult-erated play borders on professional negligence" (p. 28), and Bruce (1992) stated that rich "blockplay does not just occur. It develops when the adult acts as a powerful catalyst working hard to enable it. This needs to develop in a sustained way" (p. 26). In a similar vein, Fry (1992) indicated that "a passive attitude of waiting for the right children - usually boys - to discover the blocks and make the block corner come alive severely limits the potential of what might be occurring all the time" (p. 6).

BUILDING - WELL BEING

To further illustrate the relevance of traditional curriculum materials such as blocks in the current curriculum context, I now want to consider blocks in relation to a strand of *Te Whāriki* (Ministry of Education, 1996). Every strand is worthy of consideration, but for the purpose of this paper I have chosen to explicitly focus on only one - the first, which is *well-being*.

Well-being refers to the "health and well-being of the child [being] protected and nurtured" (Ministry of Education, 1996, p. 46). For this strand the three goals are that "children experience an environment where: their health is promoted; their emotional well-being is nurtured; [and] they are kept safe from harm" (p. 46).

Some facets of well-being which readily relate to free wooden blocks are hygiene and safety, together with rules for their use, and children's emotional development.

Safety and hygiene are particularly important issues, especially with regard to infants and toddlers. The blocks provided for these age groups must be large enough not to be swallowed, and cleaned frequently so that infants and toddlers can safely explore them with their mouths. Maintenance of blocks is also necessary for safety - for example, sanding any rough edges is necessary to minimise the risk of splinters. Outdoor blocks can be painted to protect them from the elements (Starks, 1960), and a choice must be made between oiling[3] or keeping the natural quality of the plain wood for blocks used indoors. Safe storage of blocks requires consideration of how they are placed in relation to one another. For example, it is better for large, heavy blocks to be positioned on low shelves (Fry, 1992; Starks, 1960) so they do not have to be lifted up high, and do not fall far if they are not well-stowed or if there is an earthquake.

Quite a variety of rules have been suggested with regard to block play which relate to keeping children safe from harm. Hitting with blocks (Banta, 1980), and throwing (Banta, 1980; Cartwright, 1988, 1995; Hirsch, 1984; Karges-Bone, 1991), swinging and dropping them (Cartwright 1988, 1995) are generally deemed unacceptable. Cartwright (1988) also disapproves of "stepping, sitting, lying, or rolling on unit blocks" (p. 47) except in special, controlled circumstances. The advice to be flexible in "special circumstances" features in a number of sets of rules, including those which also disapprove of walking on blocks (Fry, 1992; Hirsch, 1984). There is also advice on restricting the height of buildings made from blocks, with Fry (1992) suggesting building only to a child's shoulder height. Rules regarding the dismantling of structures vary from Froebel's "nothing must be destroyed, but that each new figure should, as far as possible, grow out of its predecessor by slight alterations" (Goldammer, 1895, p. 52), through taking down buildings (Banta, 1980) rather than crashing (Cartwright 1988, 1995), knocking, pushing or kicking (Hirsch, 1984), to not demolishing other children's structures (Fry, 1992; Karges-Bone,

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[3] Fry (1992) recommends the following process to oil blocks: lightly sand, wash, dry and coat with 65% raw linseed oil, 10% turps, 25% Johnsons Traffic Wax. Leave to absorb coating (with spaces in between) and then wipe off excess.

1991). These rules can be seen to provide for children's physical and emotional safety. However, one could wonder at how readily many of these rules support children in developing their perception of what is possible with blocks.

It seems that there may well be a conflict between issues of care for the blocks themselves and children becoming fluent in their play with blocks through attempting more risky endeavours. Johnson (cited in Bruce, 1992) coined the term *stunt-building* to refer to some of the more adventurous play with blocks. A solution to this dilemma could well lie in the curriculum itself. Such is the interwoven nature of *Te Whāriki* (Ministry of Education, 1996) that rules also feature as part of the belonging strand with the goal that "children and their families experience an environment where they know the limits and boundaries of acceptable behaviour" (p. 62). The general tone of the supporting material for this goal suggests that rules are not to be seen as a wholly rigid body of that which must be adhered to without question, but rather they are to be discussed, understood and where appropriate, debated and negotiated between the adults and children themselves.

Where blocks are well maintained, and play with them is supported by appropriate rules, children can experience blocks as things with which they feel safe and comfortable. This is because, as Cartwright (1988) has pointed out, blocks are clean and consistent in form, and to some extent predictable and non-threatening. Indeed, there is no wrong way to build (Karges-Bone, 1991) and in the process of creating, children can satisfy and also develop many aspects of their emotional well-being. Blocks can be made into anything at all (Fry, 1992), and thus fulfil creative initiatives (Cartwright, 1988). In building three-dimensional forms children can experience a great sense of stature and power (Cartwright, 1988), and the completion of the structure may fill them with a sense of satisfaction and pride in the achievement (Fry, 1992). As children become increasingly involved in their creations and strive to incorporate particular ideas, they will meet with varying degrees of frustration as well as joy in the discovery of design, use, and mastery of blocks as a medium for their play and learning (Cartwright, 1988; Fry, 1992). Features of emotional development such as learning to cope with frustration and the experiences of joy, satisfaction and pride, are achieved all the more fully with increasing skill in block building enhanced by persistence and patience in attending to the matter in hand (Cartwright, 1988). In turn, this enhances concentration (Bruner, 1980). Obviously, block play is not always a solitary activity, and as building evolves to include one's peers so too does the range of challenges in nurturing children's emotional well-being. This is because with co-operation comes negotiation, redevelopment and sometimes, compromise, as well as the possibility of creating something jointly which could not be achieved alone. A delightful example of this was cited by Bruce (1992), who described an adult attempting to reproduce a block construction created by two girls, and when she failed "the girls explained 'You need a friend'. They gave a demonstration. One held the block while her friend arranged the other blocks against it so that they would balance as a whole" (p. 17).

Starks (1960) advocated that evolving processes, such as those mentioned above, are best supported by adults who demonstrate a sympathetic, alert interest in the children and their actions and processes. She suggested that this is well supported by observation skills which enable teachers to discover the emotional patterns of the children with whom they work, so that they can develop increasingly skilful strategies for supporting each child. Such support should not, in Stephens' (1995) view, include empty or manipulative praise, but rather should be comments that reflect children's specific ideas. He recommended:

> engag[ing] WITH children … What better way to pay children a compliment than to show them their ideas are so motivating and intriguing that you will set aside some of your time to become part of their make-believe world? (pp. 51-52)

A further strategy adults can use to support children's emotional well-being is to take photographs and video footage of children's processes and products. Fry (1992) commented that playing back a video of block play can provide the builder with "a wonderful 'me!' experience" (p.14). Such material can extend into record keeping and assessment work with the development of, for example, learning stories which feature children's play with blocks.

In my view, issues relating to health and safety, along with rules for block play, will be fairly consistent across a range of different sets of blocks. However, in terms of the potential for children to learn through their play with blocks – across emotional well-being, as well as physical, cognitive and spiritual domains – a comprehensive set of blocks appears to offer enhanced opportunities for learning.

AND SO ... A NEW SET OF FREE WOODEN BLOCKS

The blocks for which I give the conceptual design in this paper span hollow and solid blocks as well as organically shaped forms. The blocks are based in the metric system and vary from one another in multiples of 0.5, 1 and 10 cm, in ways that highlight their fractional and multiple qualities. The blocks are of a diverse range of sizes from 1 to 200 cm in length and each bears relationships to others either as part of the whole set or as a subset within the whole set.

A hole in the middle: hollow blocks

A hollow block is one that is made by fixing together wooden boards to form a prism with a hollow centre. Where only four boards are used to make a rectangular prism the block creates a window effect and when five boards are used a nesting box is the result (see figure 2).

Dividing hollows

The initial 10 six-sided hollow units measure 40 x 20 x 10 cm and almost all of the other blocks relate to this as either a fraction or a multiple of this size. For example, 20 of each half unit are created by dividing units in four ways - by length (40 cm x 10 cm^2); by width (20 cm^2 x 10 cm); diagonally through length (40 x 20cm and 10cm deep) and diagonally through depth (40 x 10 cm and 20 cm deep) creating pillars,

square-based prisms and two forms of right-angled scalene triangular-based prisms or wedges. Four types of 40 quarter units are created in a similar fashion, resulting in short pillars and three types of triangular-based prisms (20 cm x 10 cm$^{2;}$ 20 x 20 cm and 10 cm deep; 20 x 10 cm and 20 cm deep; and 40 x 10 cm and 10 cm deep) (see figure 3). Five 4- and five 5- sided unit blocks will complete this subset of blocks. When an empty four-sided block is placed on its side or on its end it is possible to see through the block, and thus it can represent empty space (as seen next to the ladder in figure 2) such as a doorway or window. Reifel and Greenfields (1982) note that a door is "a structure embedded within another structure" (p. 224). Given the complexity of representing a door or similar part-whole relation, it would be interesting to test if some four- and five-sided blocks within a much broader set of blocks will provide a support for children to discover other ways of working with the ideas of representing and creating empty spaces with six-sided hollow blocks and solid blocks. So that children are encouraged to experiment with creating spaces, it may be necessary for there to be only a small number of four- and five- sided blocks. These few blocks could suggest to children the possibility of building with spaces, and prompt them to develop formations with other blocks which create open spaces, once their supply of ready-made four- and five- sided blocks is exhausted.

Clambering into cubes and piling up prisms

Two series of other hollow blocks up to 2 m in length are designed as nesting box cubes and long rectangular prisms. The five-sided cubes nest into one another and measure 1 m^3, 90 cm^3, 80 cm^3 and so on through to 10 cm^3. Five-sided nesting boxes offer ease of storage and variety in play. They can be placed inside one another and also so that the open side faces any direction. If a cube is placed so that the open side faces the ground, then it will appear to be like any other block, and children could climb up onto it, perhaps with the aid of ladders, cleated boards or other blocks. If a cube were placed the opposite way up then children could climb into it. It will also be possible to enter an open cube if it is placed so that the open side faces outwards, creating a cave-like space. Six-sided prisms all measure 2 m in length, and vary like the cubes from 1 m^2 through to 10 cm^2. All of the hollow blocks will need to be strong enough to safely hold children's weight, so the largest cubes and prisms will need some form of reinforcement such as a wooden diagonal between opposite corners of the internal walls, or steel brackets inlaid into internal corners. Where children climb up onto these blocks they will need to be used on a safety surface. Most often, the hollow blocks are likely to be used outdoors. Consequently, these blocks will need to be treated in some way to protect them in outdoor weather conditions. Painting the blocks in a natural tone, varnishing or waxing them could all be considered.

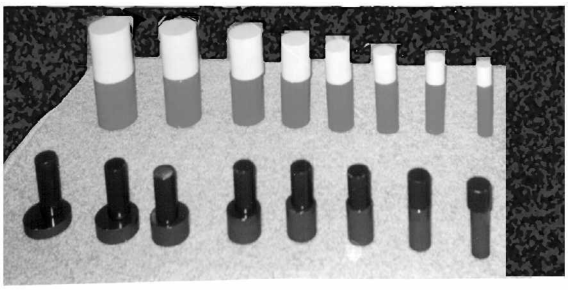
Figure 4. Six of the green knobless cylinders

Figure 5. Montessori knobless cylinders

Multiplying Montessori materials

The idea of a sequence of cubes is continued with ten sets of solid cubes measuring 10 cm^3, 9 cm^3 through to 1 cm^3. Square-based prisms and four different series of cylinders will be provided in parallel with the cubes, all drawn from Montessori's sensorial materials and completing one subset within this set of blocks.

Many of the Montessori sensorial materials have the potential to be used in creative ways including representation; however, I believe that this is inhibited by the fact that in most instances, there is only one block of each size provided. An example of this is illustrated in figure 4 where the child is building a car, yet he does not have access to four cylinders of the same size to represent wheels. Within the new set of blocks there will be 10 of each size of the square-based rectangular prisms measuring 10 cm^2 x 20 cm, 9 cm^2 x 20 cm, 8 cm^2 x 20 cm, and so on through to 1 cm^2 x 20 cm. The measurements for 10 of each of the cylinders are given with the diameter of the circular face listed first, followed by the height. The first series varies from big to small: 5.5 x 5.5 cm, 5 x 5 cm, decreasing in half centimetre diminutions to 1 x 1 cm. (see the third tower in figure 5). The second series varies only in diameter: 5.5 x 5.5 cm, 5 x 5.5 cm, through to 1 x 5.5 cm (see the tower on the right of figure 5). The third series of cylinders maintain a diameter of 2.5 cm and vary in height from 5.5 to 1 cm. Changes in opposing directions are used for the set of cylinders with measurements from 5.5 x 1 cm, through 5 x 1.5 cm and 4.5 x 2 cm to 1 x 5.5 cm (see row across the bottom of figure 6).



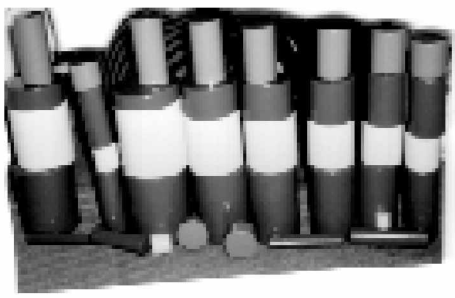


Figure 6. Knobless cylinders combined

Pyramids, prisms and things that roll away: geometric solids

Also drawn from Montessori materials (as well as Eton geometric solids), are other block shapes - square- and triangular- based prisms and pyramids, cones, spheres, ellipsoids and ovoids. Ten blocks of each shape will be provided and these will equate in size to the largest solid wood square-based rectangular prism. The square- and triangular- based prisms and pyramids will measure 10 cm along the edges of their square or equilateral-triangular faces, and they will be 20 cm tall. The circular faces of the cones will measure 10 cm in diameter and they too will be 20 cm tall. Spheres will be 10 cm in diameter, and ellipsoids and ovoids will be 10 cm wide and 20 cm tall. Storage of blocks which have no flat sides may be problematic. Square stands which have pieces hollowed out for the curves to sit in could be made, or three baskets could be provided. The rationale for providing curved solids is the desire to expose children to the characteristics of a diverse range of forms as they play.

A multiplicity of fractions

Returning to the idea of a unit block, the hollow fractional unit blocks described above are parallelled by smaller solid fractional units: the 40 units measure 20 x 10 x 5 cm, and half and quarter unit blocks are derived from this in the same way as for the hollow blocks. These are effectively enlarged multiple unit blocks, conceptualised as fractional blocks because each of the smaller pieces are simple fractions of the unit (see figure 7).

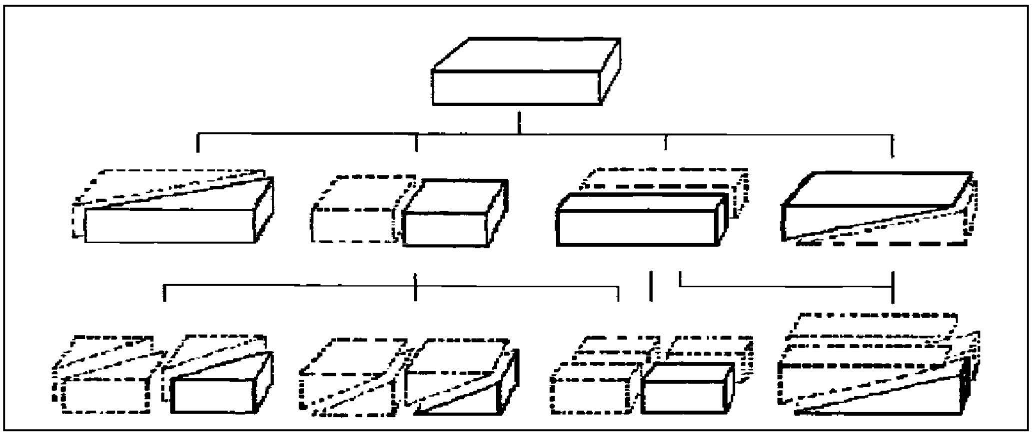


Figure 7. Solid fractional unit blocks showing derivation of half units and quarter units from a unit measuring 20 x 10 x 5 cm

Multiple units within this new set of blocks are created by multiplying the length of the unit block. These will measure 30 x 10 x 5 cm, 40 x 10 x 5 cm, 50 x 10 x 5 cm, 60 x 10 x 5cm, 70 x 10 x 5 cm, 80 x 10 x 5 cm, 90 x 10 x 5 cm and 100 x 10 x 5 cm (see figure 8).

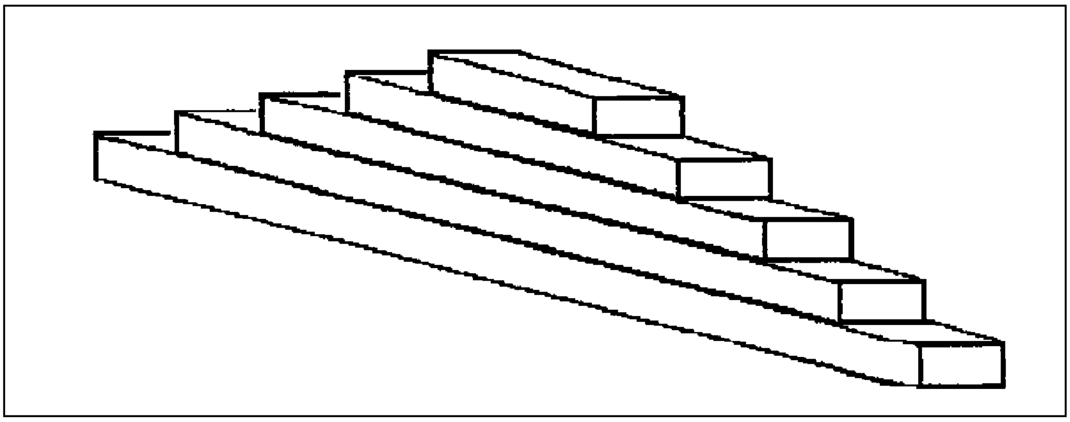


Figure 8. A stack of five solid multiple unit blocks. The uppermost blocks is a unit measuring 20 x 10 x 5 cm, and the quintuple unit is 1 m long.

Around the bend: curves, bridges and other variations

Curves, arches, and circular and elliptical cylinders, complement the linear blocks. There will be 10 half unit cylinders made up of 3 solid half unit cylinders, 8 solid half unit semi-circles and 12 solid half unit quarter-circles. All of these blocks will be 5 cm deep, and each complete circle will have a diameter of 10 cm (see top left of figure 9). There will be 10 unit ellipse-based cylinders measuring 20 x 10 cm, and 5 cm deep. As with the circular cylinders, some of these ellipses will be divided into smaller portions. There will be 3 solid unit ellipse cylinders, 4 solid unit semi-ellipses with the straight side measuring 20 cm, 4 solid unit semi-ellipses with the straight side measuring 10 cm, and 12 solid unit quarter-ellipses. Quarter- and semi-circle curves, and quarter and semi- ellipse curves will fit around the solid forms detailed above. There will be six semi-circular curves measuring 30 cm across at the widest point. They will be 10 cm wide along the breadth of the curve, and 5 cm deep. Eight quarter-circle curves will match the semi-circles exactly, but be only half as long. Similarly, five elliptical rings will be divided so that there are two semi-elliptical curves which measure 40 cm across at the widest point and from the mid-point between these widest points the nearest outer edge is 15 cm away. Another two semi-elliptical curves divide the full ellipse in half between the closest outer edges which are 30 cm from one another. From the mid-point between these, the furthest outer edge is 20 cm away. Twelve quarter-elliptical curves complete this set of five elliptical rings which are all 5 cm deep.

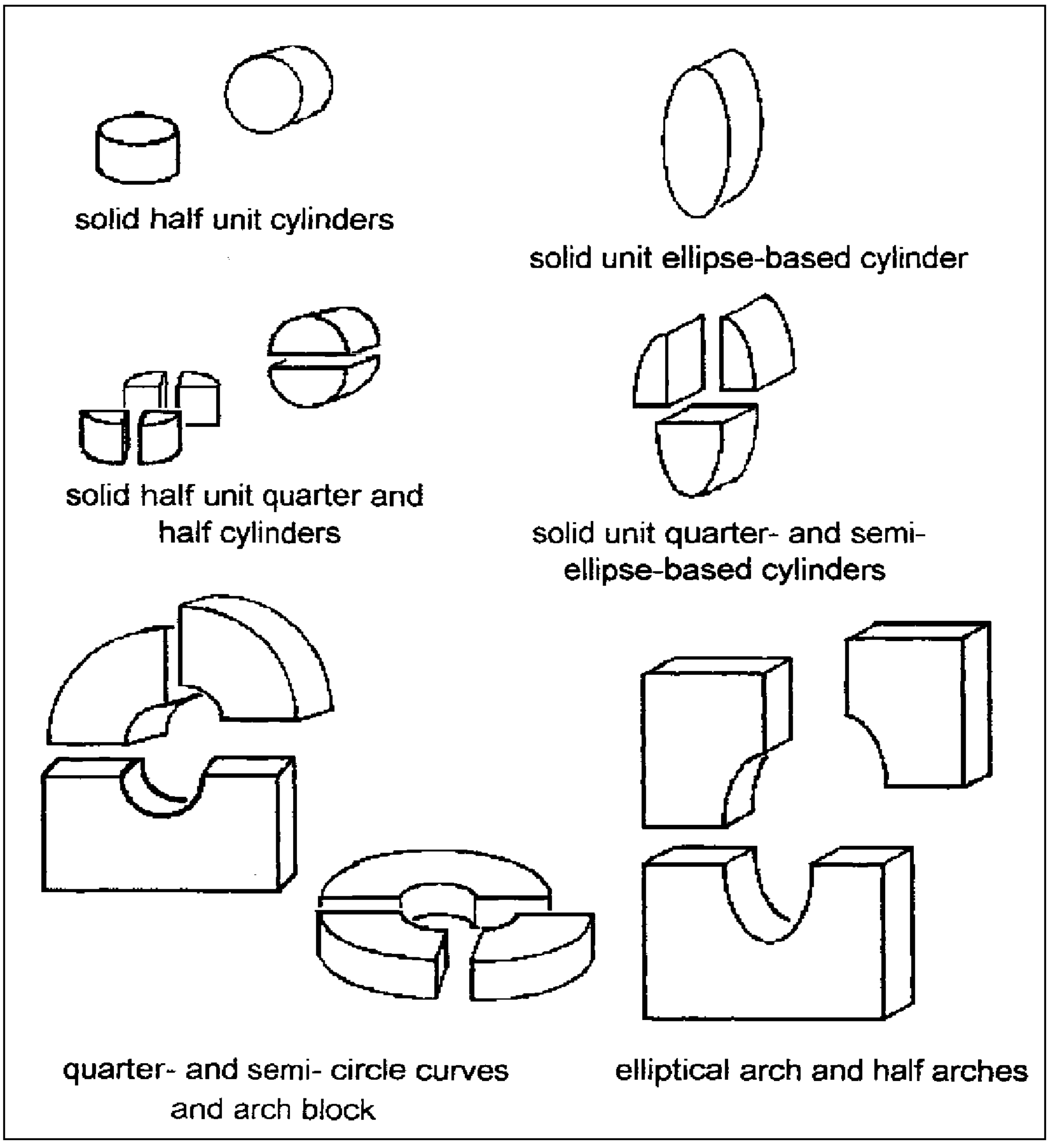


Figure 9. Some solid circular and elliptical cylinders, curves and arches. Solid half unit cylinders measure 10 cm across and the solid unit ellipse-based cylinder measures 10 x 20 cm. The furthermost points on a semi-circle curve are 30 cm from one another. Each block is 5 cm deep

With the arches, the inner curve will match those of the curves detailed above, but rather than each outer curve maintaining a breadth of 10 cm, the outer edges will form a right-angle so that, in the case of an arch, the effect will be a block which is a rectangular prism with a curve hollowed out of its longest side so that it resembles a bridge with a tunnel underneath. For the circular arches, six blocks will be 30 cm long, 15 cm wide and 5 cm deep, with a semi-circle with a 5 cm radius cut from the middle of the 30 cm side. Eight half arch blocks will each have two 15 cm sides, a depth of 5 cm and quarter-circles cut from one corner. The elliptical arches have two blocks that are 40 cm long, 15 cm wide and 5 cm deep, with a 20 cm long semi-ellipse hollowed from each. Two arches are 30 cm long, 20 cm wide and 5 cm deep, this time with a 10 x 10 cm semi-ellipse taken from each. Twelve half arches are blocks 20 x 15 cm with a quarter-ellipse (10 x 5 cm) hollowed from one corner of them.

Going another way: switches

A switch is a single block which combines straight and curved aspects to form a shape such as T, X or Y. There is an issue of whether or not to include switches within this set, given that they combine forms which are already provided. However, switches do facilitate the movement of accessories (e.g., wooden cars) along blocks in more than two directions, and if they are used in building a structure or pattern, switches can support diversity within the design. The issue is that for the most part, the effects created by switches can be duplicated with other blocks, so providing ready-made combinations may undermine children's discoveries of their own combinations. Thus their efforts to solve design issues may be prematurely resolved by the provision of these more complex forms. However, there are some switches which do need to be considered, such as the four-way X-switch. This can be approximated by placing two quarter-circle curves together so that their longest sides touch one another. But, with a four-way X-switch, accessories such as wooden cars can traverse the block without getting stuck in the gap which widens out from between the point of contact of the two quarter-circle curves. Another benefit of providing switches over the component parts is that switches hold their shape when they are placed on the vertical. That is to say, if a child balances a Y-switch on its end, the two far ends point up providing an effect on which they can build, which could not be achieved in any other way.

In an effort to balance these two sides of the issue, I have chosen to include a minimal selection of switches within this conceptual design. These are the T-, Y- and X- switches (see figure 10). Given that the key benefit of providing switches is that they facilitate changes in direction for both accessories and patterns made with blocks, the rationale for selecting these particular switches is based on their directionality.

The actual details of these switches will be as follows: five T-switches: rectangular prisms 15 x 20 x 5 cm with two 5 cm solid quarter-circles hollowed out of each end of one 20 cm side of each prism (see left of Figure10); five Y-switches: these measure 30 cm across the top of the Y with a 10 x 5 cm semi-circle hollowed from this. At the base of the 15 cm curve a 5 cm piece extends down to complete the base of the Y. Both the curve and this piece are 10 cm wide and 5 cm deep (see right of figure 10); five X-switches: 20 cm square-based prisms, 5 cm deep, with 5 cm quarter-circle curves hollowed from each corner (see middle of figure 10).

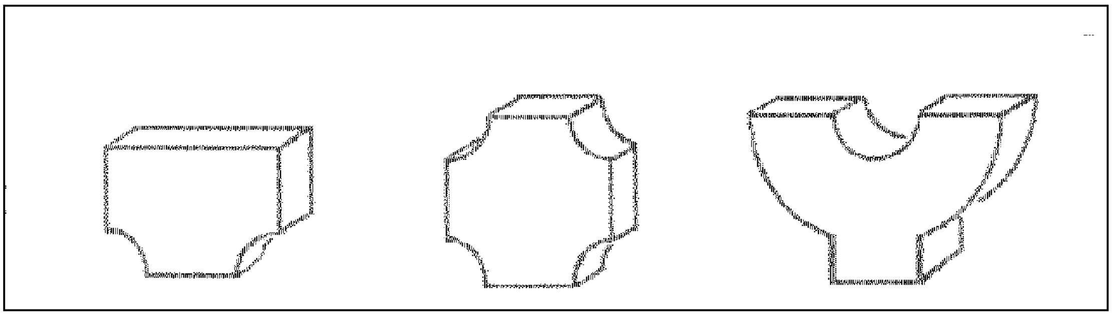


Figure 10. Solid switches. The T-switch is 15 cm tall and the X- and Y- switches are 20 cm tall. Each switch is 5 cm deep

The Roman arch

In addition to the curves and arches detailed above, there will be blocks with which children can build Roman arches. These are effectively a modified form of an enlarged Roman arch from the Montessori materials (see figure 11). The new set of free wooden blocks will include sufficient materials to build three arches, with the intention of adding more of these blocks if they prove popular. For three Roman arches there will be 27 trapezium-based prisms, with the small end of the trapezium being 1.75 cm long, and with 10 cm sides separating out to the far edge of the trapezium which will be 5.25 cm long. Each prism will be 5 cm deep. To hold the blocks which form the arches in place it is necessary to have pairs of irregular quadrilateral-based prisms. For three arches there will be six of each of the following prisms, which will all be 5 cm deep: six prisms each with a base of 4.9 cm and top of 5.9 cm which are in parallel, and separated from one another by a height of 5.2 cm; also in parallel, a base of 5.9 cm and a top 8.5 cm on six prisms measuring 4.5 cm in height; prisms with a 8.5 and 12.5 cm parallel base and top respectively, separated by a 3.4 cm height; and six five-sided prisms each with a parallel base of 12.5 cm and top of 17.5 cm, a height of 6.9 cm, in parallel with the 6.9 cm side and at a right-angle to the 17.5 cm top the fourth side measures 5 cm, and with the fifth side on an angle joining the fourth side of the shorter (12.5 cm) base. Additionally, there will be three rectangular-prisms measuring 5.25 x 5 cm and these too will be 5 cm deep. A further three pieces are necessary to facilitate the building of the arch. These are 20 cm long rods each 5 cm^2 at one end. Ten centimetres from the far end they fall away gradually down to 2 x 5 cm. One rod is needed to assist the construction of each Roman arch. This piece is set in place under a solid half unit semi-circle to create a base on which the Roman arch can be constructed. On completion of the arch, the rod can be gently withdrawn from the structure so that the semi-circular block drops down and can be removed from the arch it has been supporting.

Figure 11. The Roman arch

An ecological angle: organically shaped forms

This conceptual design of a new set of free wooden blocks includes a series of organically shaped forms such as branches from trees as suggested by Jaffke (1988) and driftwood. These are unlike the other blocks in the set in that they do not have regular shapes or sizes and, like some of the geometric solids detailed above, many will have no plane sides.

Tree stumps, branches and driftwood comprise this aspect of the set of blocks, and these could be selected with children. The sizes of many of these forms will be given in the piece of wood that is found, but others, particularly branches, could be sawn into a variety of sizes - from about 0.5 cm discs through to lengths of approximately 1 m or more, and rough edges sanded so that the children can handle them safely.

The process of selecting and preparing these blocks for use, together with the contrast between these and the blocks of regular forms, could provide the foundation for discussions with children about wood as a sustainable resource. One of my concerns about providing wooden blocks for young children is the hidden messages which lie behind blocks. It seems to me that blocks suggest that humans have power over natural resources, and children's play with blocks reinforces a sense that it is appropriate for humans to build structures at will, having cut down trees and processed them for their timber, with little regard for the impact of this on the environment. While I struggle with the morality of developing a new set of blocks which reinforces this aspect of the hidden curriculum, I recognise that it is also possible to awaken children's sense of ecological awareness. While the ecological dimension of human development is not overtly acknowledged as part of the curriculum - Te Whāriki (Ministry of Education, 1996) - it seems that respect for the environment is woven into the fabric of Te Whāriki through the emphasis placed on spiritual development and honouring Te Tiriti o Waitangi. In the belonging strand, for example, note is made that "a respect for papatuanuku [sic] should be promoted" (p. 54). It seems to me, that in honouring Papatuanuku (Mother Earth) and her children (e.g., Tane - the God of the Forest), it may be possible to engage in critical discussions with children which start to redress this concerning aspect of block play, and this could lead to positive actions such as tree planting.

BUILDING INTO THE FUTURE

This conceptual design of a new set of free wooden blocks is not considered to be wholly definitive and complete. I expect that once this new set of free wooden blocks is made available to children, many further insights will emerge on how it may be improved. I have noted some instances where observation of children will be needed to guide decisions of which blocks need to be selected or added. For example, I noted that the numbers of blocks listed in the section about the Roman arch were sufficient for three arches to be built. I envisage that more subsets of the Roman arch blocks could be added if it were found that more of these blocks were needed. In most other instances I have recommended 10 blocks, or multiples of 10 blocks. If observation shows that the quantities of some blocks are insufficient then the addition of more of these blocks in groups of 10, will need to be considered. However, adding more blocks is not necessarily the best solution in all situations where the supply is deemed lacking. I have given an example of this in the rationale for providing a limited number of four-sided hollow blocks. With a four-sided hollow block children can readily build a space (e.g., a window) into their creation. If only a small number of four-sided hollow blocks are provided, the supply of these blocks could be quickly exhausted. In such cases, children wishing to create the effect of a ready-made form, could be prompted to engage in more complex building strategies with other blocks to create the same effect. The discussion about the provision of different shaped blocks follows the same principle. In this instance, the appropriateness of providing switches of different shapes was a consideration. The concern was to provide enough materials to support children in changing directions, both with accessories and in making patterns with blocks, yet not to pre-empt every diverse form children might wish to create. Just as some decisions will be needed regarding additions to this set of blocks, so too there will need to be considerations of modifications to some blocks and the elimination of others.

Once this new set of blocks is made available to children, it will be possible to consider whether or not children are engaging in the types of learning outlined above. Observation will also reveal which modifications to the set of blocks are necessary. The development of the conceptual design of this new set of blocks is really only the first step in a much longer process. Once the blocks have been made, there will be a need to research how they are used in early childhood settings. The observation of how the children, teachers and other adults interact with, and through, one of the *things* of curriculum could provide the basis for further refinement of these free wooden blocks.

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