History and development of construction kits including a special study of Mobilo and Reo Click

RESEARCH

Eric Parkinson

Canterbury Christ Church College

In line with the CLEAPSS* (1993) definitions, for the purposes of this article, the term 'kit' is seen to refer to all components of a specific type of construction materials whereas 'set' is reserved for a particular collection of components from a kit.

Abstract

This research is aimed at providing a background to the development of construction kits. It examines the various stages of official recognition of the place and purpose of construction kits in the primary curriculum in England and Wales. A brief review of some of the issues surrounding construction activities in the early years is offered. This compares and contrasts building styles which employ commercially available kits with those that utilise reclaimed materials. From this background, two well established kits are considered in detail from a small scale pilot study in a school. Research evidence in this school was gained in controlled conditions and yielded quantitative data about the ways that children interact with Reo-Click and Mobilo in open-choice building situations.

Introduction

Construction kits have been seen as part of the early years educational scene for many years. Most supply catalogues for the primary years will contain a rich diversity of kits. This may suggest both a considerable period of evolution and a marketplace eager and ready to accept new ideas. The size of the educational marketplace must be considerable. Catalogue sales account for a significant proportion of sales – indeed, many construction sets are only available through catalogue-based suppliers. One of the larger catalogue based suppliers in the market, NES-Arnold (1996), lists no fewer than 34 kits in the technology section of its 1996 'master catalogue'; that is, 34 different *types* of kit as defined within the CLEAPSS (1993) terms of reference. These include many sets, such as 'bulk' packs or specialised sets for themes, which vary (typically in terms of numbers of components) to meet different market demands.

Traditionally kits seem to have held a niche as a play activity in early years education, however the introduction of a National Curriculum in UK has perhaps given construction kits a formal place and new sense of purpose in teaching and learning design and technology.

Historical context

Meccano seems to have pride of place as the longest-established construction kit. Frank Hornby (1863-1936) devised the Meccano construction concept. This was originally known as Mechanics Made Easy and was the basis for the company Meccano Ltd, set up in 1901. Meccano began to diversify into model trains in 1920. Today the name Hornby lives on in the trade name Hornby Hobbies Limited of Margate, Kent. The association with construction kits has been lost, but model railways still play a fundamental part in the company's activities.

The early Meccano and Hornby model trains were primarily based on sheet metal manufacture, but by the late 1940s the plastics revolution was on its way. In 1947, the Danish LEGO company acquired a plastics injection moulding machine. This enlarged the range of toys under production. In 1949, Automatic Binding Bricks – a forerunner of the LEGO bricks we see today – were produced for the local Danish market. Expansion into the global market began with sales into Sweden in 1955 and to Germany in 1956. The now characteristic stud-and-tube coupling idea was patented in 1958 and an application to patent a bigger version of LEGO for smaller fingers, the DUPLO series, was made in 1967.

Construction kits are not, of course, purely an educational resource. Engineering grade slotted steel angle such as Dexion and Handy Angle have had a special place in industrial settings for many years. With these resources experimental production layouts, for example, can be tried and tested in small scale situations and adjustments made easily. Both products also offer great flexibility for storage systems with racks and shelving.

In some cases there has been an interesting overlap between the use of construction kits for industrial applications and their use in schools. One such crossover is identified by Bryan and Parkinson (1985) where slotted steel angle has been used in a primary school for a variety of uses from wind turbine base to child-sized land yacht.

Place and purpose of construction sets

What are construction kits used for? Clearly, there is much that children can learn from modelling the real world around them. This point is identified by CLEAPSS (1993) with the condition that whilst children may gain an awareness as to how things are constructed in the real world, this is not as straightforward as it seems, since very often our made surroundings are characterised by permanence of construction using adhesives, cement bolts and rivets. Construction kits, on the other hand, are "...held rather tenuously by the components gripping each other, with only friction and gravity preventing them from falling apart" [p.1]

The development of the National Curriculum in England and Wales has offered a consistently more refined view on the role of construction kits in technology. The DES/WO (1988) proposals implied the notion of construction kits with phrases such as:

> "...They [the children] should be involved in constructional activities that enable them to make things move...explore a variety of mechanisms including toys and equipment, and use simple devices such as wheels and rollers...They should be given the opportunity to explore levers, cranks, gears and pulleys..." [p. 80]

As the technology curriculum began to crystallise out of the perhaps uncomfortable melt it had previously shared with science, the role of construction kits was further recognised in the National Curriculum Non-Statutory Guidance (1990) as part of existing good practice:

> "Aspects of good technology already exist in most primary schools through early experience of using construction toys, blocks, junk, plasticine, paper, card and wood." [B3, D and T April 1990]

Further reshaping of the National Curriculum now means that descriptions within Programmes of Study for both Key Stages 1 and 2 mention construction kits. At Key Stage 1, for example, it is suggested that "Pupils should be given opportunities to: work with a range of materials and components...items that can be assembled to make products, e.g. *reclaimed material*, textiles, food and construction kits." [p. 58]

Working with construction sets can offer a parallel and complementary experience with so-called 'junk modelling'. This is perhaps a rather unfortunate name for this important basis for constructional activity within design and technology. Certainly, the name was reinforced within the Non-Statutory Guidance (1990) quoted earlier. The use of the term 'junk' suggests not only that is scrap material used in the building of artefacts, but that the building procedures and the outcomes might be viewed as 'junk' as well. Within the context of this paper a more appropriate term, 'free' building, is proposed.

It is worth making a brief comparison of some of the strands of experience that free building and construction sets have to offer.

Construction sets	Free building
Rapid results	Takes time to get results
Limited skill dependence	Dependent on range of skills
No pupil choice of materials	Pupil choice of range of materials other than those in kit.

A brief overview of some research avenues

Some glimpses of the ways in which children interact with construction kits are provided by Claire (1992) who notes that:

> " ...the girls' models were less well made and less sophisticated than the boys', which had proper joints and articulation. The girls tended to make horizontal patterns with their bricks, or to pile bricks on one another to make the wall for their house, and not to interlock them. The boys made a rocket with could be carried around without falling apart, and boats whose pieces locked together" [p. 29]

The work by Claire is predominantly a piece of social study with special emphasis on the disadvantage that girls may be seen to be working under in mixed circumstances. Part of her conclusions reveal this when she suggests:

> "It does not seem to me to be right for girls to be at the mercy of machismo and condescension as part of the teacher's effort to encourage a collaborative classroom" [p. 29]

This trend towards social, gender-driven research is similarly evident in work by Ross and Browne (1993) in which they focus on constructional play, including kits, in early years classrooms to address their concerns in connection with "....the extent of girls' involvement in this area and developing practical strategies to promote equal opportunities". Ross and Browne point clearly towards the preferred engagement with constructional activity by boys rather than girls. With particular reference to construction sets, they highlight the general preference by girls for constructing 'passive' structures such as houses whereas boys engage in 'active' structures, often with an emphasis on motion.

Beat, writing in Browne (1991) points to the notion of the free play use of construction kits in perpetuating gender inequality. She notes that within free-choice situations children do not actually have a 'choice' since they may have already developed a strong gender identity about appropriate activities for boys and girls. Further, she suggests that teachers too apply their own set of a values from gender-stereotyped past experience and thus further channel the child's play.

In broader terms, there has been concern about the underachievement of girls in scientific and technical subjects for some time. White (1986), writing on the Girls into Science and Technology (GIST) project, highlights a range of possible causes for girls' underachievement. These include the perceived difficulty of physics, the absence of science studies which have social or human implications and, significantly, girls' relatively lesser experience with scientific toys and games. The GIST project ended in 1984, although a successor, Women into Science and Engineering (WISE), continues the spirit of this work.

Finding out what children are thinking

The latter part of this article sets out to examine the role of construction kits from the perspective of the child and to examine what they actually think they are doing when constructing. In other words, what are *their* purposes in using construction kits in free-choice situations?

If we start with what children think this may begin to inform our own view on the purposes of construction kits and therefore make us more aware of the possibilities that these materials offer in enabling learning.

Some key questions that define the parameters of this study are therefore:

- In what measurable ways do children choose to interact with construction sets?
- What do they choose to build?
- What starting points for modelling do they use?

Observation of children working in free play situations with construction sets is one way of gaining information. This may seem an objective, non-interventionist way to acquire data on how children interact with construction kits. However, this approach does leave some gaps. For example, children may be observed to have made a particular artefact. Some fragments of conversation may have been recorded as children tell peers about their achievements. But a flaw in this approach is apparent if we, the observers, may make up our own minds about what we think children have constructed. We decide what the evidence actually represents. For example, is the winged artefact that the child holds aloft with accompanying buzzing sounds an aeroplane, a bee or even a hummingbird?

Asking children what they have made, or what their creation represents, is a way of gaining access to their inner thoughts and in

this respect, science education research can offer a valuable perspective regarding the ideas that children may hold. The term 'constructivism' has been used by researchers such as Driver et al (1985) for the approach in which individuals internalise some degree of their experiences in their own way and construct their own meanings. As a consequence, as teachers we may be better placed to assist learning if we understand what ideas children already hold in their heads. This in itself is not a new idea. Ausobel (1968) had recognised this notion as a general principle of effective learning and this can be summarised in *teachers finding out what the learner already knows and teaching accordingly.*

Constructivism as a set of beliefs is noted for the ways in which it appears that children's ideas are personal, stable and may seem at odds with accepted truths. Within the constructivist approach to promoting learning a number of stages can be recognised. These stages may expose misconceptions, challenge them and enable the learner to assemble or adjust a mental framework in which more accurate ideas are accommodated.

The first phase of this is termed 'elicitation'. Ollerenshaw and Ritchie (1993) note that this stage concerns supporting children as they discover what it may be they already think. The *process* of elicitation is important within this focus on Reo Click and Mobilo. It is a way in which research evidence on the beliefs of children can be gained – and that all- important flying object mentioned earlier can be assigned to the animal, mineral or vegetable classes!

Towards a classification of construction kits

Construction kits can sometimes seem a bewildering array of small parts – particularly those destined for the upper years of Key Stage 2 and Key Stage 3 . In this article there is not sufficient scope for offering a quantification of the degree of complexity of various construction sets. No doubt in the future the development of a Construction Complexity Index may offer assistance both as a research tool and to enable teachers to begin to plan a classroom application framework for purposes of recognising progression and continuity.

For the purposes of this paper, a simple view has been taken on a mode of classifying kits by their appearance and mode of use. The two fundamental criteria employed are:

- How the kit fills space
- How the individual parts join together

Reo Click and Mobilo

These are two popular construction kits – constructed of high quality plastic extrusions – which claim to be appropriate for education in the early years. Both are of continental origin and seem to have made their way into the UK education market around the early 1980s. For example, the E. J. Arnold Supplies catalogue for 1983 describes Mobilo.

The kits fill space in different ways. Mobilo is based predominantly on cube lattices with some straight and cranked ladder-like pieces. The parts are joined with two types of special polythene link. These either clip onto individual lattice members or press-fit into the square spaces of a cube lattice or ladder section. Wheels are available as clip-on pairs.

Reo Click is based on tubular members and clip-on sheets. Link pieces act essentially as inserts to the ends of pipes so one may be connected to the other. Wheels are available in two sizes and need to be held in place with pipe inserts acting as end-stops.

Observations of use of Mobilo and Reo Click in a controlled environment

Before describing the findings from a limited range of activities with children, it is worth reflecting on some data gained from their teachers about the range and uses of construction sets in classrooms. A pilot study was conducted with the co-operation of the headteacher and staff in a large infants' school in Kent**.

From this small study, it was noted that the average number of kits that teachers could name from their classrooms was eight. Overall, a surprising 23 different types of kit were mentioned from data gathering questionnaires. The most frequently named were Lego, Duplo and wooden building blocks. Some kits were only represented in single classrooms and this accounted for over half of the kits. Among the kits mentioned by more than one teacher were Reo Click and Mobilo.

As part of a pilot investigation for a larger inquiry, 24 Year 1 children were selected (average age 5 years and 4 months). In an attempt to avoid some of the social distractions that may occur in an unlimited choice free-play situation, the children were not simply observed in a free-play classroom setting, but seated in groups of four. Each child was offered a tray of Mobilo or Reo Click pieces and asked to make anything they chose. The aim of this pilot study was simply to note four things: Firstly, the time children took to make something; second, the number of parts they used; third, what the children said they had constructed; and fourth, on brief questioning afterwards, some indication of what made them think of building their particular artefact.

Construction time and the number of parts used are extremely crude indicators of construction performance, but quantitative nonetheless. Beyond this study, this data will be used in situations where older and younger children will be compared. It will also be used for comparison with children who have never encountered construction kits – for example in developing countries. For example, do older children build with more parts over a longer time? How do children in developing countries react to construction kits when these may never have played any historic role in their education system?

Within the controlled setting of this pilot study it was found that the average construction time for an artefact was six minutes for Reo Click and four and a half minutes for Mobilo. Despite the longer construction time for Reo Click, the average number of parts used was only 9 whereas 12.25 pieces were used for Mobilo artefacts.

The issue of starting points for free-choice building was illuminating. Only one child was unable to recall what it was that she had made. Wheeled vehicles accounted for one third of all artefacts, and most of these were called cars, although one child referred to his as a 'wheeler'. Out of the wheel associated group, there was only a slight bias to this class of construction by boys. Some of the motivation to make cars seems to have been infectious and had arisen from the limited discussions which took place in the small groupings of four children. The one gun that was represented was made by a girl. Animate objects accounted for only an eighth of all constructions. Two boys made dinosaurs and a girl made a bird.

Just under half the children questioned were not able to say what had made them think of building their artefact. Three children said that they "Just had it in my head". Of the remainder a couple of children made reference to TV programmes as a source idea and two more actually referred to the construction kit as the source of inspiration since wheels and particular shaped pieces from the kits themselves suggested some particular starting point for an artefact.

Other sources of inspiration were objects encountered around or beyond the school. The school flagpole provided one such starting point, as did climbing frames used in out-of-school activities.

A number of responses did not point clearly to any direct external source of motivation. When one child was asked what made her think of building a ladder she replied "You can climb up it". Another who built a car said "Because it's got wheels on it"

Evidence suggests that there may have been some interplay between external sources of motivation and the perceived capabilities of the construction kits. Flagpole and climbing frame construction, for example, was undertaken with the tubular based Reo Click. A flag and a key were also made from Reo Click since this offered both tubular and flat plate constructional members.

The research on Mobilo and Reo Click continues. Beyond this pilot survey, data for older children will be collected and a parallel programme of research initiated in primary schools in Jamaica. Outcomes to this research, especially regarding the times taken for children to produce artefacts, may have implications for the ways in which we set construction kit related tasks in classrooms.

References

Ausubel, D (1968) *Educational Psychology: a cognitive view*, New York: Holt Rinehart and Winston

Beat, K 'Design it, build it, use it. Girls and construction kits' in Browne, N, (Ed) (1991) *Science and technology in the early years*, Milton Keynes: OUP

Bryan, D and Parkinson, E (1985) 'School Notice Board', *Journal of the Association for Design and Technology in Education*, Volume One, Summer 1985, 22-23

Claire, H (1992) 'Interaction between girls and boys: working with construction apparatus in first school classrooms' in *Design and Technology Teaching*, Vol 24, Number 2

CLEAPSS (1993) *School Science Service, Construction Kits L173*, revised May 1993

DES/WO (1988) *Science for Ages 5-16*, London, HMSO

DES/WO (1990) *Non-Statutory Guidance: Design and Technology*, National Curriculum Council

DfE (1995) *Key Stages 1 and 2 of the National Curriculum*, London: HMSO

NES-Arnold (1996) *NES Arnold 96*, Nottingham: NES

Driver, R, Guesne, E and Tiberghien, A (Eds.) (1985) *Children's ideas in Science*, Milton Keynes: OUP.

Ollerenshaw, C and Ritchie, R (1993) *Primary Science – making it work*, London: David Fulton Publishers.

Ross, C and Browne, N (1993) *Girls as Constructors in the Early Years*, Stoke-on-Trent: Trentham Books Ltd.

Whyte, J. (1986) *Girls into Science and Technology: the story of a project*, London: Routledge and Kegan Paul.

* CLEAPSS – Consortium of Local Education Authorities for the Provision of Science Services

**The assistance of the headteacher and staff of St Margaret's Infant School, Rainham, is gratefully acknowledged.