Learning through making in the early years

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Abstract
Fifty four five-year-old children in three London Primary Schools were tested using the British Ability Scales. Every 'product' of the children's construction work for the term was photographed. Three intervention groups were withdrawn from their classroom for one hour per week for focused instruction. 'Access only' groups were also withdrawn but were not provided with instruction. The children in the second control group received no additional experience of making beyond that normally provided in the classroom. A total of 450 products were constructed by the children during the intervention phase and each has been categorised from an analysis of the photographs and according to principles of structures and mechanisms. The evidence suggests that while the intervention group constructions became increasingly complex, the performance of the 'access only' group actually deteriorated in terms of both quantity and quality. No significant improvement in BAS scores between the pre-test and post-test was found yet the evidence did suggest that learning had taken place, and that children in the intervention groups produced more elaborate constructions than any of those in the control groups.

The benefits of 'Learning through Making' has been accepted since the inception of the kindergarten movement. Comenius, Pestalozzi and Froebel all extolled the virtues of industry and encouraged educators to provide opportunities for children to make things. Froebel's proposals for the Volkserziehungsonstalt at Helba in 1829 included the suggestion that children should spend each afternoon in crafts that included the making of wooden kitchen utensils, weaving, the use of pasteboard to make stars, wheels, boxes, napkin rings and lampshades. He also suggested that children might be encouraged to whittle boats, windmills and waterwheels, model with clay and flexible wire. For Froebel, education in manual skills served to develop the whole child, it was much more than merely a vocational concern. Froebel believed that craft provided a means of expression, and also a powerful means to develop habits of success, and a sense of power and mastery. The *Esmée Fairbairn Trust* provided us with the funding to test these assumptions.

Design and technology education is an area of the National Curriculum that remains under resourced and only partially applied in most early infant classrooms; a curriculum 'intervention' was therefore prepared. The research model adopted was designed to provide a programme evaluation. Both quantitative and qualitative methods were employed and the use of construction kits was agreed as the central focus with each of the schools involved. It was felt that construction kits offered a more 'clinical' and easily controlled context for the study of making than other media and that given their widespread use in infant classrooms (and homes) the findings might be more easily applied. Lego (UK) Ltd. supported the project by donating three DACTA™ kits to be used in the schools throughout the study.

Children from three classrooms in two London schools were tested using the British Ability Scales (BAS). The schools were selected to offer broadly typical and similar early years practice. The Block Building Scale was applied to measure the children's capability in copying a design with wooden blocks. Performance of this scale requires motor skills and visual-perceptual encoding. The Picture Similarities Scale was also applied to give an indication of non-verbal reasoning. Here the children were required to recognise a relationship based on some common concept or element that was shared between pictures selected from a series. The Matrices Scale provided an additional non-verbal measure of the children's fluid reasoning ability. Scales providing data on the children's Naming Vocabulary and Digit Recall were also applied to complete the profile and provide a Composite Ability Score (CAS) that was used in the initial grouping process.

The children were assigned to three equivalent ability groups of six in each class. A total of 18 children (one group in each of three classes) were thus placed in the intervention group, another 18 children were given 'access only' to the materials and another 18 made up a second control group who were denied access to the materials during the study period. The 'access only' group was formed in an effort to match the most common practices identified in previous research. Brown (1990) has referred to this common practice where the construction materials are 'seen principally as toys for the children to use in undirected play'. In Brown's study teachers were often unaware of the fact that children who were expected to be participating in this undirected play often left the task and chose a different activity entirely:

> "In an extreme case a pupil regularly opting to read or draw at this time might have had no engagement with them [the construction kits] at all" (Brown, 1990:35)

At the end of the intervention phase the BAS was conducted a second time to provide post-test data. Interviews were also conducted during the study and repertory grids compiled to provide a profile of the intervention and access group children's current knowledge and understandings of a selection of appropriate construction components (Siraj-Blatchford, 1995). Every 'product' of the children's construction work for the term was photographed and parents were also interviewed to identify the extent of the children's related work carried out at home.

The intervention groups

Each intervention group was withdrawn from their classroom for one hour per week and for this period 'making things' was given the same sort of priority normally given to the literacy and numeracy curriculum. When children are taught to read we normally read to them - we therefore (at times) 'made' things for (and with) individuals in the intervention group. When we prioritise reading we normally hear the children read individually - so we systematically monitored the children's making and intervened when necessary to support them. In the teaching of reading we normally break down words and teach phonics - and in the same way we broke down various constructions and showed the children how they were made up from different mechanisms and structures. We discussed with the children their plans for making, and carefully matched supporting materials to their needs, they were given constant encouragement and every completed construction was praised and photographed for analysis. From week five the children were encouraged to draw pictures of what they intended to make before embarking upon the construction.

The 'access only' groups

During the first session the children were invited to look carefully at the bricks and components available in the DACTA™ box. They discussed the things that could be made with the Lego. They were given a free choice of what to make and it was explained that a photographic record of all their constructions would be kept. As soon as they made something they were encourage to continue and make something new. If they lost interest they were allowed to return to their classroom. In subsequent sessions the bricks were simply tipped out onto the floor and the children invited to make anything they wanted. No help was offered and the researcher tried to look busy making notes to avoid them asking for any. Help was therefore given only when directly asked for and where it would have been unfair not to do so. Often rather than providing direct assistance when requested, the children were directed to watch others. As soon as they were available the children were shown their photos individually but these were never shown to the whole group.

During session seven, to keep the children's interest in one group it was necessary to introduce a theme which individuals could contribute to. They chose a town theme and worked together to make various things. At this stage, in all of the groups there were some children who were making no progress and they were beginning to get bored. By the end of this phase most of the children in the 'access only' groups were making little visible progress in their construction work.

The second control groups

The children in the second control group received no additional experience of making beyond that normally provided in the classroom. Any related constructional (e.g. modelling with 'recycled' materials) were conducted at times when the other groups were able to share the same experience.

In the final phase of the research all of the pupils were interviewed and tested with the BAS again and their repertory grids were also compiled for a second time. Apart from identifying a great deal of data concerning the specific benefits to be gained from making activities in the early years a broad range of early evaluative constructs are also being identified. These may be of particular value to other research projects concerned with the design and technology education of girls and other underachieving groups. It is envisaged that this data will be analysed further over the coming months and that this data will be included in the final research report.

Contamination and confounds

As far as could be assessed minimal contamination was caused by the children of different groups working together in relevant constructional contexts. The parents of each child in the intervention group was questioned to identify any school friends that they might have been playing with after school. The project groupings were only applied for the purposes of the study and we therefore feel confident that there were no consistent differences in the treatment of the children in the different groups apart from that defined in the intervention above.

Attrition

Attrition was minimal, where one child left a group at an early stage it proved possible to substitute an alternative but equivalent child from the same class. Where children were absent from a particular session this has been recorded and allowed for in the calculation of statistics.

The findings

During the ten weeks of the intervention phase a total of 450 products were constructed by the children. The children's products were placed in a series of categories that were developed from an analysis of the photographs (Brown, 1990). This categorisation was also informed by an analysis of the guidance currently available to teachers concerned with teaching principles of structures and mechanisms. In this paper only D and F categories will be discussed. D categories relate to structures and environments, F categories to mechanism and moving parts. D1s and F1s represent very simple constructions while D8s and F8s more complex. It should be noted that it proved impossible to photograph every single individual construction, a few were broken while they were being played with and others were altered several times during sessions. It was also difficult to make generalisations about the capabilities of some individual children from the categories alone. Child 45, for example, produced very few F categories compared to D's. This was not because she was incapable of using moving parts, it was simply because she had a preference for constructing models involving people and intricate gardens and most of our efforts to encourage mechanisms failed. When she was asked in session 9 to make something different she easily made a truck. By contrast, child 25 clearly produced very few F's because she found it particularly difficult and on the one occasion she did produce a model with moving parts (an F4) it is likely that she received some assistance from another child.

After week seven the intervention group were sometimes discouraged from using moving parts by the particular design problems set. The situation up to that point suggests that while the intervention groups constructions were becoming increasingly complex, the performance of the 'access only' group was actually deteriorating in terms of both quantity and quality. This suggests that the teacher's

Scale	Pre-test Chi-Square	Significance	Post-test Chi-Square	Significance
Block Design	0.01	0.99	0.63	0.73
Picture Sim'	0.24	0.89	0.07	0.97
Matricies	2.06	0.36	2.22	0.33
Vocabulary	0.03	0.98	0.89	0.64
Digit Recall	1.28	0.53	0.40	0.82
CAS	0.34	0.98	0.37	0.83

(Kruskal-Wallis One-way ANOVA)

Table 1

role in encouraging learning is crucial and that the practice of simply relying on access to the materials and 'discovery' may actually be counterproductive.

Interestingly, early analysis of the photographs also suggests that no correlation is to be found between the product categories and any of the BAS sub-test scores. But correlations were found between these categories and gender. Both the complexity (Sig. .0018) and quantity (Sig. .0006) of F categories (mechanisms) produced were strongly correlated with 'Boys'. The quantity of D categories (environments) produced were also correlated strongly with 'Girls' (Sig. .0018) (Mann-Whitney). The above Table 1 provides an indication of the difference between groups in terms of BAS pre-test and post-test performance

As can be seen the groups were constructed to show no significant differences in scores at Pretest. The Table also shows that the groups remained equivalent and the samples were well controlled.

When we looked for possible changes in each group's performance between pretest and posttest the statistics shown in Table 2 were obtained.

We thus found that there were no significant improvements in scores between the pretest and posttest. On the face of it, this suggests a general lack of progress and improvement in ability despite the tuition. More realistically three interpretative possibilities should be considered:

1 That neither the intervention and/or the access to materials had any significant cognitive effect upon the children.
2 That the intervention did improve the children's performance but that the BAS was insensitive to the specific capabilities that were developed.
3 That the results were compromised by some unknown errors or effects.

While the latter possibility may only be satisfactorily dismissed following replication, the photographs and the personal construct

	Chi-Square	Significance
Block Design	1.89	0.39
Picture Similarity	0.65	0.72
Matricies	0.02	1.00
Vocabulary	2.67	0.26
Digit Recall	1.39	0.50
CAS	1.24	0.54

(Kruskal-Wallis One-way ANOVA)

Table 2

interviews do provide a basis for making a judgement regarding possibility 1) and 2).

The identification of improvements in design and problem solving capability

Early analysis of the evidence does suggest that some learning has taken place, that children in the intervention group produced more elaborate constructions than any of those in the control groups. This is reflected in the analysis of the categories and in qualitative terms. It was the intervention group alone that elaborated their constructions with other found materials and it was only in the intervention group that some of the children used integral chassis in their vehicles.

Improvements in perseverance and quality

The total number of bricks used in each construction was recorded although the number of bricks employed should not be taken to indicate relative complexity. Often children were seen to construct more intricate designs using fewer bricks. That said, the data did provide a crude indication of the amount of work involved in construction and might therefore be taken as an indicator of perseverance in making. But again there is a danger of reading too much into this. For example, child 1 was generally more productive than child 47 and this may well be an indication of his demotivation in the face of the difficulties he experienced in realising his designs - but it might equally have been the result of his greater inclination to engage in fantasy play with the things that he did make. This inevitably left him with less construction time.

We have gained some evidence to suggest that Dweck and Leggett (1988) are correct in associating performance goals (as opposed to learning goals) with learned helplessness and low self-esteem. This is particularly relevant to pupil self-concepts in key subject areas such as mathematics, science and design and technology. Careful scaffolding may thus be considered crucial.

References

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