Does an outdoor classroom support children's development in maths?

Hoxton Garden Primary School, EYFS

Abstract

The purpose of this study was to examine the effectiveness of implementing an outdoor maths classroom and to find out if this had an impact on pupil progress. Using a focus group model, the study followed the impact of maths lessons outdoors. For ten weeks a focus group participated in outdoors maths using the natural environment to develop key skills. The class teachers carefully planned sequences of lessons to ensure that mathematical learning opportunities were challenging, appropriate and adaptive to the needs of all learners. Although the lessons were adult led, children were encouraged to develop their knowledge further through independent play.

Introduction

Hoxton Garden Primary School is a multi-cultural primary school situated in Hackney, London. The proportion of pupils who are eligible for the pupil premium is higher than average and a significant number of pupils enter Nursery and Reception below the expected level for their age across a number of areas of learning. The proportion of pupils from a minority ethnic group and those who speak English as an additional language are also higher than the national average.

One of the specific areas of learning within the EYFS curriculum is mathematics. Children's development is assessed from birth. This does not happen in isolation and relies on influential adults such as parents and carers as key teachers, providing feedback and modelling appropriate mathematical skills. Mathematics is an important part of learning for all children in the early years and receiving a good grounding is an essential life skill. As well as numeric fluency, it helps skills such as problem solving, understanding and using shapes and measure to develop their own spatial awareness.

In order for a child to meet their early leaning goal by the end of Reception, children need to be able to count reliably, place numbers in order, use quantities and objects

to add and subtract and count forwards and backwards. It is important to recognise how complex this may be to a child who has not been exposed to mathematical thinking and language before entering an educational setting. Children need the support of adults to help them to understand these complex and often challenging areas. *"The language a child speaks affects the rate at which they learn numbers and hear numbers in natural conversation not just in counting routines. Language is a critical part of learning the meaning of numbers."* (Science Daily, 2013). Therefore, when pupils have not been exposed to this type of language they may struggle with the early concepts of maths.

It had been discussed across Early Years Foundation Stage that some children lacked interest in maths activities throughout the provision. Some were below expected in their early development. They were unable to access games or activities independently and often became disinterested when they were faced with any offer of independent mathematical challenge. They were unable to apply simple maths vocabulary, often noticed to be using mathematical language incorrectly and needing adult intervention.

While children make good progress from their starting points in their maths development by the end of EYFS, the group of children were identified as not making as much progress as their peers became a clear focus for intervention. Some had entered Reception at 'expected' and sustained 'expected' throughout the first term rather than reaching 'above expected' when accelerated progress could have been achieved. Children who entered Reception at 'below expected' were also achieving 'below expected' by the end of the first term and gaps had not been closed.

Hauser (2005) describes that innovative approaches to early mathematics should not only be developmentally adequate and effective, but also compatible with the kindergarten pedagogy. As kindergarten children are highly motivated to learn, but not in a formal, instructional way, play can be regarded as a powerful vehicle for learning. Play can be defined as activities that *"are fun, voluntary, flexible, involve active engagement, have no extrinsic goals, involve active engagement of the child, and often have an element of make-believe."* (Weisberg, Hirsh-Pasek, and Golinkoff 2016, 105).

In order to investigate this, the group of focus children were tracked across ten weeks participating in regular maths lessons outdoors where lessons were based on the idea of play as the powerful tool. Data analysis was identified to review the effectiveness of the sessions through tracking starting points and end points against Development Matters bands. It was expected that regular lessons outdoors would engage children more by expanding their learning space and allowing for a more imaginative play environment which would then in turn develop their confidence in learning the key skills needed to progress in maths.

Research Process

The process was co-ordinated by the phase leader and delivered by two classroom teachers and two Nursery Education Officers. A group of 9 children were involved in the study, 3 children from Nursery and 6 children from Reception Classes. The focus children identified were chosen by the class teachers as individuals who showed a disengagement in independent maths and through the analysis of data were not making progress or below expected attainment. After discussions with the class teachers a common thread seemed to be identified with the focus children.

The attitudes and behaviours of the focus group were measured through baseline, interim and data and these were used to identify the progress made throughout the research process as well as qualitative data in the form of pupil interviews and teacher interviews. The phase leader led training to support class teachers and Nursery Education Officers in leading a maths session outdoors as well as supporting them in observing developmental fundamentals in mathematical skills.

The class teachers introduced adult led maths learning outdoors in the first week. It was important to establish that children understood the purposes of these lessons and gained an insight as to what they were about before beginning a whole session. During the next nine weeks, teachers delivered maths outdoor sessions three times a week for fifteen to twenty minutes. These lessons included counting bugs, sharing stones and making shapes using twigs.

Weekly phase meetings provided an opportunity for dialogue between the professionals who were undertaking the research project. This provided essential discussions to take place and allowed time to share and discuss methods that were

successful and those that were not as successful. The dialogues gave the professionals further support in developing ways to ensure children were beginning to use the strategies taught independently and how to implement this successfully.

Findings

The children responded very well to the outdoor classroom, they showed enthusiasm and good engagement in the activities. The results from the children's interviews and discussions with class teachers showed the implementation of lessons outdoors were a success. Children were able to recall the key skills that they had been taught and were able to use mathematical language when explaining what they had learnt. There were a number of very quick noticeable differences in ways that children developed their imaginative play in the outdoor area. Class teachers noticed that the focus children incorporated various maths skills in their play throughout the indoor and outdoor provision and were able to confidently model how to use concrete objects to their peers.

The progression of statements within number, shape, space and measure were visited throughout each meeting and the evidence discussed for consistency in judgements. Rapid progress was evident in children's ability to use concrete objects to add and subtract. Figure 1 is used to identify the statements that were discussed within regular meetings to ensure consistency of judgements (highlighted in red).

Fig.1

Number

40- 60 months	**ELG**
Recognise some numerals of personal significance. Recognises numerals 1 to 5. Counts up to three or four objects by saying one number name for each item. Counts actions or objects which cannot be moved. Counts objects to 10, and beginning to count beyond 10. Counts out up to six objects from a larger group. Selects the correct numeral to represent 1 to 5, then 1 to 10 objects. Counts an irregular arrangement of up to ten objects. Estimates how many objects they can see and checks by counting them. Uses the language of 'more' and 'fewer' to compare two sets of objects. Finds the total number of items in two groups by counting all of them. Says the number that is one more than a given number. Finds one more or one less	Children count reliably with numbers from one to 20, place them in order and say which number is one more or one less than a given number. Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer. They solve problems, including doubling, halving and sharing.

from a group of up to five objects, then ten objects. In practical activities and discussion, beginning to use the vocabulary involved in adding and subtracting. Records, using marks that they can interpret and explain. Begins to identify own mathematical problems based on own interests and fascinations.	

Shape, space and measure

40-60 months	ELG
Beginning to use mathematical names for 'solid' 3D shapes and 'flat' 2D shapes, and mathematical terms to describe shapes. Selects a particular named shape. Can describe their relative position such as 'behind' or 'next to'. Orders two or three items by length or height. Orders two items by weight or capacity. Uses familiar objects and common shapes to create and recreate patterns and build models. Uses everyday language related to time. Beginning to use everyday language related to money. Orders and sequences familiar events. Measures short periods of time in simple ways.	Children use everyday language to talk about size, weight, capacity, position, distance, time and money to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them.

It became more evident that children had fostered a desire to incorporate mathematical thinking in play-based activities. They were becoming confident in speaking about numbers in the environment and building on prior knowledge throughout independent play. It was apparent that children had developed a mathematical way of thinking that allowed them to recognise opportunities in the environment and use the strategies that were taught throughout the independent learning. Many pupils were able to reflect on their learning and discuss the skills they learnt using the correct terminology. As the weeks continued there became a greater need to provide opportunities to challenge this further by developing the skills needed to problem solve and provide children with right set of skills to use maths in various contexts. Ensuring fluency in certain skills with the expectation that pupils would transfer the knowledge and skills they have learnt to deal with more complex situations. Figure two identifies the statements that were later discussed within regular meetings to ensure consistency of judgements (highlighted in green).

Fig 2:

Number

40- 60 months	ELG
Recognise some numerals of personal significance. Recognises numerals 1 to 5. Counts up to three or four objects by saying one number name for each item. Counts actions or objects which cannot be moved. Counts objects to 10, and beginning to count beyond 10. Counts out up to six objects from a larger group. Selects the correct numeral to represent 1 to 5, then 1 to 10 objects. Counts an irregular arrangement of up to ten objects. Estimates how many objects they can see and checks by counting them. Uses the language of 'more' and 'fewer' to compare two sets of objects. Finds the total number of items in two groups by counting all of them. Says the number that is one more than a given number. Finds one more or one less from a group of up to five objects, then ten objects. In practical activities and discussion, beginning to use the vocabulary involved in adding and subtracting. Records, using marks that they can interpret and explain. Begins to identify own mathematical problems based on own interests and fascinations.	Children count reliably with numbers from one to 20, place them in order and say which number is one more or one less than a given number. Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer. They solve problems, including doubling, halving and sharing.

Shape, space and measure

40-60 months	ELG
Beginning to use mathematical names for 'solid' 3D shapes and 'flat' 2D shapes, and mathematical terms to describe shapes. Selects a particular named shape. Can describe their relative position such as 'behind' or 'next to'. Orders two or three items by length or height. Orders two items by weight or capacity. Uses familiar objects and common shapes to create and recreate patterns and build models. Uses everyday language related to time. Beginning to use everyday language related to money. Orders and sequences familiar events. Measures short periods of time in simple ways.	Children use everyday language to talk about size, weight, capacity, position, distance, time and money to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them.

The data that was collected throughout three collection points throughout the academic years showed good progress for all 9 children as a result of the sessions and strategies taught.

Numbers			
	Baseline	**Interim**	**End of term**
Child A	30-50 S	40-60 E	ELG
Child B	30-50 D	40-60 D	40-60 S
Child C	30-50 D	40-60 E	ELG
Child E	30-50 S	40-60 D	ELG
Child F	30-50E	40-60 E	ELG
Child G	30-50 S	40-60 D	ELG
Child H	30-50 S	40-60 E	ELG
Child I	30-50 D	30-50 S	40-60 D
Child J	30-50 S	30-50 S	40-60 S

Shape, Space and Measure			
	Baseline	Interim	End of term
Child A	30-50 S	40-60 D	ELG
Child B	30-50 S	40-60 E	40-60 S
Child C	30-50 S	40-60 D	ELG
Child D	30-50 S	40-60 S	ELG
Child E	30-50 D	40-60 E	ELG
Child F	30-50 S	40-60 D	ELG
Child G	30-50 S	40-60 D	ELG
Child H	30-50 D	30-50 S	40-60 E
Child I	30-50 S	40-60 E	40-60 S
Child J	30-50 S	40-60 E	ELG

Key:	E = emerging	D = developing	S =secure	ELG = Early learning Goal

Impact and conclusion

Evidence concludes that the impact of implementing lessons outdoors were positive. Only 3 out of the 9 focus children did not meet their Early Learning Goal however the data shows that they made good progress from their starting points. The evidence through the pupil questionnaires identifies the positive impact that outdoor learning had on the overall progress of the participants and these lessons have given pupils

strategies to use throughout independent play. Lessons based on children's interests were a powerful catalyst for mathematical enquiry and provided a strong starting point to support and extend their mathematical thinking. Opportunities for problem solving, reasoning, critical thinking and reflection were vital for children to make the most of their emergent understanding of mathematics.

Teacher motivation and the thought behind the sequence of lessons was a powerful motivational tool, which enhanced the outcomes of this research project. Teachers noted that the results were noticeable from the very start, which gave them the inspiration to continue. The way in which children were able to develop their knowledge through play based activities were influential.

The findings that have been identified within this project support the idea of the importance of play based learning within the early years. If outdoor lessons are planned for effectively it seems evident that it could change the attitudes of learning, self-esteem and gaps in learning within pupils.

As a result of this research project, it is clear to see that the outdoor classroom had a positive impact on the pupils identified and it supported with the progress of pupils. If it is successfully implemented, the impact on other pupils may show the same achievement and progress as identified.

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