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Maths and Physical Education in Primary Education – 'More than just counting beanbags'?

Introduction

Owen: "I love maths – I can add big numbers!"
Meredith: "Well, I love PE, I like running around and using the beanbags!"
Owen: "You don't need a brain to play with beanbags"
Meredith: "Well, adding is boring, beanbags are fun!"

Mathematics and Physical Education can be two subjects that children do not immediately associate as having common ground and yet there are some clear fundamental links that underpin these two areas of learning. When presented alongside each other, the uniqueness of both subjects can be very powerful in offering children a holistic learning experience that can also aid understanding in both areas. The dialogue above between two children highlights some common misunderstandings and misdirection about the benefits of these subjects and what influence they can have on a child's overall educational experience. No mathematics educator would claim that maths is just about adding and taking away. Similarly, no physical educator would claim that physical education is merely about throwing beanbags. Both subjects can provide children with a wealth of challenge, engagement and fulfilment whilst also not forgetting the more serious nature of what both disciplines set out to achieve; core fundamental skills that every child will need throughout their life.

The concept of cross-curricular learning has been much debated with the recent review of the primary curriculum (Rose, 2010). The inherent value of the curriculum, and 'subjects verses thematic work' have often been positioned as polar opposites. Deeper examination of conceptual learning through the subjects is sometimes missed within this debate. Although cross-curricular learning can be a valuable and worthwhile learning experience for children, it should not be at the detriment of meeting individual subject areas aims. It is about **respecting** subject specific knowledge, skills and understanding while at the same time recognising and **valuing** the contributions between the different subjects. The curriculum review has perhaps raised again the importance of learning to learn and developing children's learning power as a goal of lifelong learning, alongside the specific applications of learning that the subjects themselves can offer (Claxton, 2007). Links between subjects therefore, should not be forced or contrived. This article therefore, serves as an illustration point for how learning through mathematics and physical education can support learning in the primary curriculum and considers the following:

- Learning about mathematics through physical education
- Learning about physical education through mathematics

- Learning through mathematics and physical education
- Broader learning in mathematics and physical education

Learning about mathematics through physical education

Due to the abstract nature of some concepts in mathematics, many children find learning in this subject difficult. Being able to visualise shape, space, distance and volume and then apply these concepts into practical situations can support understanding. As we are aware, many children benefit from concrete experiences; being able to see these concepts brought to life in a context where they can experience, experiment and explore their thinking. This not only gives a sense of purpose to their work but provides teachers with a variety of ways to engage children in learning. Children still need however to engage with and explore the fundamental mathematical concepts with time to consolidate their learning otherwise they carry through misconceptions. Physical education can provide children with another dimension to learn about, explore and apply key mathematical concepts and language.

Many teachers approach the following mathematical concepts through physical exploration: length, distance, area, mass, angle, time, space, analysis and problem solving. Children need to explore these concepts regularly and practically in order to reinforce learning. This can of course be achieved within the classroom setting but what about outside the classroom in a more physical environment?

Consider the following:

- A physical education lesson focusing on children learning how to vary their throwing technique in order to hit different targets from varying distances. How could you use this learning activity to develop the children's understanding of space, angle, direction, length and measurement?

- A physical education lesson focusing on exploring the dynamics of balance. The children investigate using different bases of support to see what provides them with more balance or less stability. How could you use this learning activity to develop the children's understanding of area and shape in the context of providing a stable or unstable base?

- A physical education lesson focusing on children responding creatively to a musical or artistic stimulus. The children must design a movement sequence based on fundamental movement skills. How could you use this learning activity to develop the children's understanding of timing, shape, pathways, angles and direction to make this movement sequence more creative?

- A physical education lesson focusing on children planning a team orienteering challenge. How could you use this learning activity to develop the children's understanding of area, speed and estimating distance?

Physical education can provide children with 'real life' opportunities to explore, develop and apply their mathematical skills and understanding which support curiosity and questioning. It is also a valuable way to illustrate to children that learning can be taken beyond the classroom and into a physical context where the context promotes an atmosphere of enquiry.

Learning about physical education through mathematics

The primary goal of physical education is to enable children to value and participate in regular and habitual physical activity throughout their lives. This requires the development of physical, social, emotional and cognitive skills as well as knowledge, understanding and attitudes. In addition to this, physical education contributes to dispositions that encourage lifelong learning through encouraging reflection on the choices that contribute to health and well-being.

Physical education provides a range of opportunities for mathematical learning. One illustration is the meaning and use of data. How can data can be collected, analysed, processed and operationalised within a mathematical arena? Such examples can include timetabling of sporting events, scoring of activities, comparisons of team results through the use of league tables (how many goals scored for, against what is the total number of points scored?) as well as identifying trends and patterns in any of the data that has been collected. More complex examples would include using larger sporting events as a theme for statistical enquiry (such as intra/inter school competitions or experiencing complex problem solving in off-site activities and residential experiences.

Learning through Mathematics and Physical Education

Although the curriculum for mathematics and physical education is not necessarily constructed separately, it is important to be aware that in order for children to succeed within physical education they need a sound understanding of some core mathematical concepts. Graham, Holt, Hale and Parker (2007) describe core concepts for learning in physical education as how skills are performed e.g. the use of levels, pathways, direction, speed, relationship of the body with objects, space and effort etc. Without this understanding children will find it difficult to apply the technical skills they are developing in a creative way.

Children also need to understand the relationships between numbers (such as more than, less than and equal to) as well as basic operations and problem solving techniques. Without these fundamental skills, they will find it difficult to engage fully in physical education lessons and quickly become disengaged with the cognitive challenges that the subject can offer. The danger in this happening is that learning in physical education becomes merely about the physical, thereby creating a ceiling level in their learning. Wider mathematical concepts beyond number e.g. working effectively in space and applying tactics and compositional approaches, are characteristic to learning in physical education and should feature as part of high quality physical education experience.

This requires some consideration of the principles that underpin planning and assessment so the curriculum experienced is not restricted to a one dimensional view of the subject. Within the time constraints placed upon a primary school timetable, deeper conceptual

links between the subject areas need to be explored wherever possible. Perhaps too, children need to have these links made explicit to them through diligent and careful planning, so that they can transfer conceptual learning into situations beyond the classroom and school environment.

Broader learning in mathematics and physical education

Below are some examples showing how learning in mathematics and physical education can be integrated. Within the proposals for the new primary curriculum (Rose, 2010) there is also a wider remit for physical education in relation to contributing towards the area of understanding 'personal development, health and well-being'.

Learning Activities	Mathematics within Mathematical Understanding	Physical Education within Understanding Physical Development, Health and Wellbeing
Small teams have to move beanbags from the home hoop to other selected hoops. Children complete the maths task through variety of travelling techniques and challenges.	E1 to estimate the number of objects and count them, recognising conservation of number	E1 to work and play independently and in groups
Each child investigates time to complete specified distance through variety of travelling techniques. Alternatively, the measuring of variety of throwing techniques and objects to investigate the most effective and efficient methods.	L3 to explore number patterns and properties, and represent them using graphs, simple formulae and ICT	E3 to identify and talk about their own and others' strengths and how to improve
Engage children in completing travelling challenges in small groups. This involves children completing a set number of laps with each member of the group contributing to the overall total. Alternatively, throwing challenges that require children to mentally work out basic number formulas.	M9 to select from a range of mental strategies for the addition and subtraction of numbers with two significant figures	M2 to listen to, reflect on and respect other people's views and feelings
Children in groups complete challenges that require the whole group from travelling from A to B using equipment such as hoops. Set out boundaries that require mathematical solutions and problem solving techniques	L6 to use proportional reasoning to compare numbers and quantities and solve problems	L1 to take the lead, prioritise actions and work independently and collaboratively towards goals
Provide variety of travelling challenges that involve object control if required. Setting challenges that require to complete set tasks within specific times, such as, completing set distance in specific time, where children has to demonstrate understanding of time. This can be completed individually or in teams.	L19 for solve problems involving time and time intervals, including time represented by 24-hour clock	M4 to recognise their own and others' strengths and weaknesses and how to improve
Follow a trail/treasure hunt to answer questions at each checkpoint, while navigating round objects. The information is then collated and analysed to show a mathematical word	E15 to generate and explore questions that require the collection and analysis of information	L8 how to respond to challenges, including recognising, taking and managing risks

problem. The children write the problem down and then solve it.		
Allow children to use conclusions from previous lessons to improve their performances.	E17 to interpret and draw conclusions from information they have collected	L4 to self-assess, set goals, prioritise and manage time and resources, understanding how this will help their future actions

Final thoughts

The connections between mathematics and physical education are not limited to children's learning. There are also questions raised about the development of teachers' confidence to deliver these connections effectively and the pedagogical principles that underpin practice for both subjects (Hodgen and Askew, 2007; Morgan and Bourke, 2008). In both subjects teachers often feel less confident due to their own personal educational experience and perceptions of their own competence to 'do' the subject.

In relation to these concerns there are also similar misconceptions about teaching approaches that are employed. In many instances a more teacher-led approach is used based on the preconception that there is only one 'right' answer to a sum or one way to perform a physical skill. This view needs to be balanced with a more problem solving or discovery approach, where the process is highlighted as more important than the outcome.

In conclusion, there are many effective and creative ways to work within both mathematics and physical education to promote meaningful learning. Actively challenging misconceptions about what each subject can offer and what type of learning can occur within them is one way to move towards improved overall attainment. Perhaps this returns us to where we started in terms of the importance of reflecting on our broader goals to look beyond the particular subjects to develop a meaningful curriculum and develop childrens' capacity to learn.

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