
Engaging children and parents in Physically Active Maths sessions

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Abstract

Recognising the potential positive effects of physical activity in children, and the importance of motivation and engagement in mathematics, the social enterprise Numberfit and researchers from UCL have designed a programme that combines physically active games with mathematics learning. We present the design principles of a platform that enables children (and their parents) to undertake parts of this programme remotely. The platform has been designed taking into account the particular constraints of the 'lockdown' during the COVID-19 pandemic. In particular, we aim to keep children physically active during the lockdown and encourage parental engagement while leaving some space for parents to attend their other duties during these challenging times.

Author Keywords

Physically Active Learning; Maths; parental engagement

Introduction

At least 1.38 billion children and young people have been affected by school closures worldwide due to the COVID-19 pandemic [5]. Moreover, the international message is asking all society to "stay at home", which has an important impact in children, especially in areas with a strict lockdown or those living in small spaces [5].

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Design principles

Parental involvement: Importance or parental involvement in children's education.

Autonomous play: Parents need space/time to attend other responsibilities.

Physical activity, motivation and learning: Physical Activity encourages motivation and learning.

Game based learning: Get the "playful" component of learning.

Social component of learning: Children like to know that other children are playing/learning, as a community of learning.

Support children from different socioeconomic backgrounds: Need to attend those with different socioeconomic backgrounds.

Evidence suggests that when children return to school after a period of closure (such as summer holidays or weekends), they are displaying accelerated weight gain partly due to the lack of daily structure and loss of cardio-respiratory fitness activity [11, 13]. In addition, prior research suggests that summer holidays have a detrimental effect particularly in mathematics computation and spelling, probably due to the lack of opportunities for practicing and reinforcing procedural knowledge [6].

In this context, we have developed a platform and associated resources that provide structure and encourage children's physical activity but also opportunities to engage in practicing mathematics in a playful way.

This platform has different sections to allow children to use it independently, but also to get parents involved. A first option is for an autonomous playing session where after choosing a topic, videos are displayed that guide children through games that combine body movement (star jumps, open the arms, bend down or running) with a mathematical activity. For example, one of the games requires children to mirror some physical actions, depending on the result of a mathematical operation. In another game, physical activity is alternated with some maths questions. The children are encouraged to self-monitor the correctness of their answers and input their scores that then appear in a shared leaderboard with all the scores of their friends (see Figure 1).

Another section of the platform offers to the families resources and the possibility of playing additional games. This section does not require the use of videos and digital technology but demands a higher parental involvement.

In what follows we describe the design principles we have identified in this context, and how they are addressed through the proposed platform.

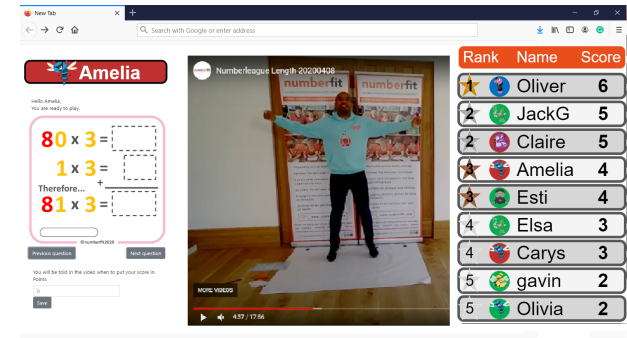


Figure 1: Children follow a video (center) that guides them to engage in physical activity and solve maths questions (left). Children's score appears on the leaderboard (right).
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Design principles

The principles presented here were obtained either by previous related research in the field, or our own reflection from previous work preceding this platform and feedback from the first design iterations.

Encourage parental involvement

The influence of parental involvement in the school success of young children is well researched [4, 8]. Considering maths achievement in particular, a review of intervention studies identified specific parental involvement activities (communication with the school, providing support for learning, and celebrations for accomplishments) as essential to supporting mathematics outcomes [9]. Following this design principle, one of the functionalities of the platform offers parents the possibility of playing games with their children. In addition, we encourage parents to engage in reflective discussions with the children by attending to their answers to the questions vis-a-vis their leader board score.

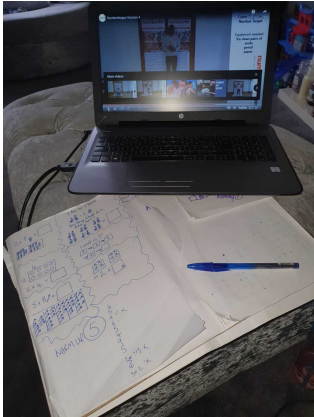


Figure 2: A child is using the platform on the screen to follow a video session. The maths exercises have been copied by hand in a piece of paper.
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Autonomous play

On the other hand, the lockdown is creating a stressful situation for many parents and carers [3, 5], as many work from home, care for other members of the family, in addition to having their children at home. Following early feedback from parents pointing this, the platform has a mode of autonomous playing with minimal parental intervention, by means of a video that guide the learners autonomous learning and recap, and encouraging some reflection.

Physical activity, motivation and learning

Some works in the literature demonstrate significant interaction between physical activity, cognitive functions and academic attainment [12, 7]. In mathematics in particular, research indicates that teaching mathematics through physical activity (PA) is a promising alternative [10]. Moreover, physical activity and games help motivation. Many studies have found a positive association between intrinsic motivation for mathematics and achievement [1]. The proposed technology proposes a structured session of physical activity based games and maths exercises.

Gamification and learning

Constructive competition may be reflected in enjoying the competition, wanting to participate, and interacting positively with competitors. Use of the social learning environment changes the relationship between learners and learners themselves [2]. Social component of learning is achieved through designing the games as a constructive friendly competition. With the leaderboard acting as a tool that gives the position of each child's avatar, the players influence a change in behaviour.

Learning as a social activity

Given the effort to address the lockdown, we wanted to replicate the feeling of belonging to a community (e.g., a class) which learns at the same time. As such, we allow

children to create their own profile, get scores and be part of a leaderboard, where they can see their own learning and that of their friends.

Support children from different socioeconomic backgrounds

Schools are the way to make education a universal right. However, school closures may be increasing the disparity for children and families with a lower socioeconomic status. In particular, some households may not afford one device per child. Some families can have pay as you go internet for downloading some resources or game instructions, they may not be able to stream video. In other cases, the difference may be having a printer at home or not. In response to this fact, we offer both sessions delivered by video, and physically active game instructions which can be played offline or questions which can be either printed or copied by hand (see Figure 2). The overall goal of the platform is to provide opportunities for children to be physically active, despite their circumstances.

Conclusion and future work

We present an innovative pedagogy delivered through a platform that encourages interaction of children and parental engagement in learning maths through physical activity. Our goal is to evaluate this technology with children and families. We would like to investigate whether it helps families to maintain physical activity levels and whether it helps parental engagement in home schooling as an alternative or even as a break from school-based online routine. Our early prototypes suggest that children can engage in autonomous physical activity and mathematics recap. Moreover, we would like to research further the interaction of remote groups of children even in an asynchronous mode.

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