



The Enquiring Teacher:

Improving Student Engagement in Mathematics using

Physical Education

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Aim, focus and purpose

The aim of this research project is to critically analyse whether student engagement can be improved through the integration of physical education and mathematics. I have chosen this area of enquiry because the class I am teaching have a diverse range of additional learning needs which can pose a challenge when attempting to plan effective focus tasks. It was recognised that, the children in the classroom generally engage more during physically active, experiential learning-based activities.

In addition to this, I believe that my subject knowledge and confidence in teaching physical education and mathematics is very limited due to negative personal experiences. Therefore, I hope that by integrating and analysing the teaching of these subjects it will enable me to alter my perception and ultimately gain experience in teaching them and the confidence to teach them well.

Research Context

The research question was decided following a discussion between my partner and I. We identified that the children in our classes responded well to physically engaging lessons and that both classes lacked engagement during mathematics lessons. On further investigation, we also identified that these classes displayed poor maths skills in similar areas of development. We concluded that this could be a reflection of their lack of motivation, therefore made the decision to combine physical education and mathematics. Thus, our aim is to identify whether student engagement can be improved through the integration of physical education and mathematics.

The context of lesson study one was a small rural primary school in the county of Powys. In order to maintain anonymity, I will refer to this school as school A throughout this report. The class in school A was a year one and two mixed class with twenty-four children in total.

Lesson study two was conducted in a large urban primary school situated in Swansea City. This school will be referred to as school B throughout this report in order to maintain anonymity. The participants in lesson study two were a group of thirty-one children from a mixed ability year two class.

Both lesson studies were planned according to the age and stage of the children, making it appropriate and accessible to all learners. Both lesson studies were planned against the Literacy and Numeracy Framework (LNF) as well as the Physical Development (PD) area of learning within the Foundation Phase curriculum. It is important to note that the classes remained within their usual maths groups throughout the lesson to ensure that results were an accurate reflection of student engagement.

Review of Literature

The concept of cross-curricular learning has been the topic of debate in many countries throughout the years. The current curriculum in Wales is known as the Foundation Phase Framework. The curriculum was introduced in September 2010 and boasted to offer the best possible physical and mental, social and emotional health provisions for all children (Welsh Government, 2015). It aimed to provide children with the opportunity to practice and consolidate their learning, play with ideas, experiment, take risks, solve problems, and make decisions individually, in small and in large groups (Welsh Government, 2015). However, with no specific guidelines given to schools and professionals regarding the underpinning pedagogy, schools began to implement elements of the curriculum in ways in which they saw fit. Unfortunately, by September 2011, Estyn was reporting their frustrations regarding the disappointing outcome of this 'learning by doing' curriculum.

"We have repeatedly made clear that the Foundation Phase's concept of learning by 'doing' should not in any way lead to a relaxation in standards, especially in literacy and numeracy." (BBC News; Welsh Government Spokesman, 2011)

The Foundation Phase curriculum focussed on play and experiential learning across the curriculum, but it was not explicit that literacy and numeracy was also expected to be taught across the curriculum. In 2016, the Welsh Government officially announced that it is every teacher's responsibility to teach literacy and numeracy as cross curricular subjects.

Haydn-Davies et al (2014) state that mathematics and physical education are two subjects that we do not immediately associate with one another. Traditionally, these subjects are not seen as having common ground, however, research has shown that there are some clear fundamental links that underpin these two areas of learning (Haydn-Davies et al, 2014). Interestingly, recent research suggests that when combined, the uniqueness of both subjects can be extremely powerful in offering children a holistic learning experience that can also aid understanding in both areas (Rose, 2008).

On the contrary, it is believed that throughout recent years the teaching of maths has been neglected due to the prevailing primary ethos placing great emphasis on active learning. As Haylock (2006) believes, using and applying mathematics must always be at the heart of learning the subject. Therefore, when considering cross-curricular teaching in Wales and analysing the recent research which suggests that integrating these two subjects has a positive impact, it is possible that an innovative teaching opportunity has been under our noses for a significant amount of time.

Research suggests that due to the abstract nature of some mathematical concepts, many children find learning in this subject difficult (McCann, 2016). Many educators and researchers believe that giving children the opportunity to visualise and practically apply mathematical concepts, such as shape, space, distance and volume supports understanding. In addition to this, Chanai (2009) argues that physical education can help increase student self-concept in maths as well as improve their understanding of mathematical concepts. In addition to this, Reed (2010) conducted a study which integrated physical activity and maths. The study found that children who were involved in the integration of both subjects over a period of three months achieved significantly higher overall test scores in maths, science, and literacy.

In 2014, Professor Graham Donaldson was asked by the Welsh Government to conduct a review of the Welsh curriculum, in 2015 Donaldson published a full report of his findings and included recommendations for a new curriculum. Donaldson (2015) reported that teachers would like to have more power to make decisions about how to teach and what to teach within the curriculum. Donaldson (2015) also took into consideration pupil voice. Upon asking children and young people what they want from their education, Donaldson discovered that children want a greater emphasis on life skills, personal confidence, basic skills, work skills, career advice and health and well-being. They also want lessons to be fun and interesting (Donaldson, 2015).

The emphasis placed on the importance of pupil voice stems from Article 12 of the United Nations Convention on the Rights of the Child (UNCRC) 1989 which states that children have a right to

express their views and have them taken seriously. Additionally, several articles within in the UNCRC (1989) concern children's right to access to good food and highest attainable standard of health (The World Health Organisation, 2017). This means that the government and education providers are legally obligated to ensure that there are appropriate provisions available for the enjoyment of health for all children and young people.

On the contrary, Public Health Wales (2018) reported that obesity among children and young people in Wales is rising, as it is globally, and the healthcare costs associated with treating obesity are high and are continuing to soar. Public Health Wales (2018) found that 27.1% of reception aged children in Wales are overweight or obese. Furthermore, the National Assembly for Wales (2017) stated that children in Wales are much below the recommended amount of daily activity, as research found that 91% of children in the UK aged 2-4 years are not meeting the guidelines of 3 hours of activity a day.

Figure one shows a comparison of results gathered by The Programme for International Student Assessment (PISA) between Australia and Wales. These statistics clearly display that the children of Wales simply do not have the skills to apply what they learn in school to real-life situations (PISA, 2015).

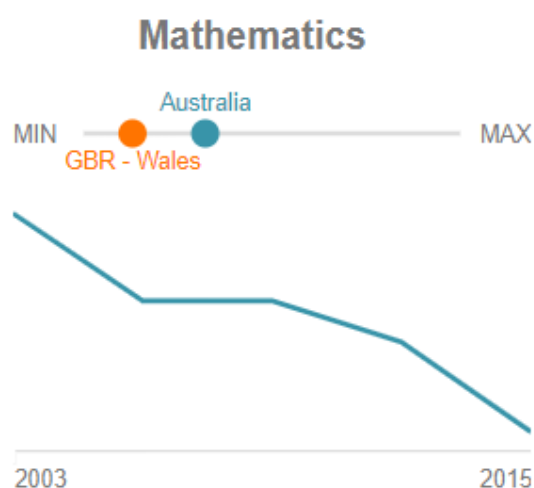


Figure 1.

In 2014, the Australian Department of Education identified that the most effective method of reducing childhood obesity in their country was to increase the mandated amount of time students need to engage in physical activity from 120 to 150 minutes per day (NSW Department of Education, 2015). Shockingly, the current mandated amount of daily physical activity for children and young people aged between 5-18 years in Wales is 60 minutes. The National Assembly for Wales (2017) reported that being inactive is perceived as normal by a large proportion of people living in Britain in the 21st Century. This passive attitude towards levels of activity, where movement and exercise are viewed as simply a personal choice is not sustainable in Wales and is an issue that urgently needs to be addressed (National Assembly for Wales, 2017).

Following the increase of mandated exercise time per day for Australian children and young people, teachers immediately began to wonder how they were going to incorporate this additional 30 minutes of physical activity into their overcrowded timetable and still meet the time requirements for all their other curricula (McCann, 2016).

Instead of hiding from this issue, one school in Australia began a trial to test the benefits of physically active learning in Mathematics. This approach is referred to as hierarchal cross-curricular teaching where one subject is used to support learning in another (Barnes, 2015). The Australian study found that combining mathematics with physical education increased the amount of time students engage in physical education lessons and lead to significant improvements in student's mathematical ability and overall confidence within the subject (Johnston, 2015).

Ultimately, owing to the findings of this research and Australia's high PISA test results, the research question was developed in an attempt to replicate its positive impact on student engagement.

Study Design

For the purpose of this research project, I have used a teaching improvement method that originates from Japan. This methodology is known as Lesson Study (LS). Lesson study is a form of classroom-based action research which focuses on the development of teacher practice knowledge (Dudley, 2014). It involves groups of teaching professionals working in collaboration to plan, teach, observe and analyse teaching and learning in research lessons. The concept is that teaching, and learning is reflected upon over a cycle of research lessons in order to inform and improve future teaching and learning. Lesson Study was identified as the most appropriate method for this research project because it directly relates to teaching and learning, it was also chosen because of its high success rate within the United Kingdom. According to Dudley (2014) LS has been found to improve teaching techniques and pupil progress in core subjects within both secondary and primary schools for a number of years.

Buchard and Daniel (2017) reported that when LS group members observe pupils, they focus more on their skills and thinking strategies in the lower primary school setting, whereas in the upper primary school setting, LS groups grant more importance to the knowledge of the object taught rather than their competences. Upon reading this, we recognised that in order to use this methodology correctly, we needed to ensure that we focussed on the relationship between teaching and learning rather than on developing teaching.

Action research is an ongoing, formative, proactive and evolutionary process. Sharp (2009) states that action research allows teachers to clearly reflect upon current practice critically and analytically in order to consider the most appropriate course of action. Sharp (2009) argues that action research allows teachers to monitor, change and evaluate the effectiveness of their lessons throughout a cycle of research lessons. However, Howe (2002) believes that while action research is useful for small-scale studies, it is time-consuming. Nonetheless, the value of this methodology outweighed it's

disadvantages on this occasion because it provides a powerful means of improving and enhancing practice.

Dudley (2014) states that the amount of information that is generated by 30 or more learners engaged in activities over the course of an hour or so is vast that it is extremely difficult for a teacher to recognise and examine each aspect of learning to inform future practice. Therefore, lesson study has come to play a crucial part in the development of professional teaching practice. The presence of another professional allows the teacher to focus on the teaching as the observer is able to make notes on and evaluate the quality of the learning that is taking place (Dudley, 2014).

Structured non-participant observations, focus groups and reflection models were chosen as the schedule for our research project. The agenda for our structured observations was developed using Leuven's Scale of Involvement (LSI). The LSI indicates the quality of the learning taking place at the time of observation (Leavers, 2003). The tool was adapted to suit this research project but still consists of a rating scale of 1-to-5 (Appendix 4). It was chosen because it is quick and easy to use but provides immediate feedback regarding the level of engagement of the focus group during the lesson (Appendix 1 and 4).

Non-participant observation refers to the role my partner and I will assume during the structured lesson observations. It means that we will remain detached from the observation and take the 'fly on the wall approach'. This will allow us to obtain a true representation of the children and their learning. Sharp (2009) states that non-participant observation is more reliable and, in many ways, less demanding. On the contrary, Thompson (2016) believes that non-participant observations have the potential to lack validity because the researchers are less able to ask why participants are acting in a particular way. Nonetheless, after much debate, my partner and I decided that structured non-participant observations were the most suitable schedule for our research project.

For reflection purposes we agreed to use a reflective model. Upon discussion we found that the most effective approach would be to use Gibbs Reflective Cycle (1988) within the self-reflection

section of Brookfield's Lenses (1998). Brookfield's Lenses was chosen because it allows the opportunity to make reliable judgments of the teaching and learning that took place during the lesson. The use of Gibbs will be used within the first of Brookfield's four lenses which focuses on personal reflection (Appendix 3).

The data collection method chosen was focus group interviews. We chose to interview the participants chosen for observation from school A and school B. Focus group interviews were most appropriate as they designed to be pieced together from the transcripts (Sharp, 2009). One of the main problems with focus group interviews is that people may not feel comfortable airing their views in public. This may be made worse both if they do not know the other participants and, paradoxically, if they do. For example, if one participant is senior to another in the same organisation, the more junior person may feel unable to express different views, but greater trust between participants usually leads to more openness (Hammersley, 2008).

In public, people often express the views that they feel that they ought to have, rather than their real views. This is known as social pressure and may mean that the focus group's views are different than that of the whole class (Hammersley, 2008).

Field notes are descriptive accounts of events and situations that have been observed during fieldwork. Field notes were used as a method of recording during both lesson study one and two because it was agreed that they were the most appropriate method of recording (Biesta, 2007). Although dated, Sanjek (1990) suggests that scratch notes need to be transformed into well-written notes, as soon as possible while impressions are still vivid to ensure they are accurate. This limitation did not impact our results because we discussed key incidents of each lesson study immediately after the lesson in the form of a post observation reflection meeting.

Audio recordings were also used as form of data collection for the research project. This data collection method provided an accurate transcript of all questions and answers given within each focus group interview. This was useful as it allowed us to accurately gather the information, we

required in order to produce our results. Nevertheless, when analysing the recordings to produce a transcript for our results we were aware that this record was not the event itself, but a representation of it (Bucholtz, 2000).

Lesson Study One

Lesson study one carried out in a playground with twenty-four children present within school A. At the beginning of the lesson study Child A was distracted by the presence of myself (the observer). Child A seemed curious about what I was writing which meant she missed the first set of instructions given. Upon realising this, she looked to her peers for support and was able to copy them and join in.

In the next part of the lesson, Child A was asked to make a rectangle shape using her body with a group of peers. She seemed reluctant to contribute to the group and did not participate in the problem-solving discussion that her peers were engaged in. Child A was being led by peers and did not object to being told where to stand, however, it appeared that Child A did not understand the concept of making with her body. However, Child A is one of the higher ability children in the group and can name 2D and 3D shapes and list their properties. This suggests that Child A simply might not have understood the instruction.

Following this the children were asked to find a shape that related to a property given to them on a card. Child A's card required her to look for a shape with no corners, upon receiving this card she looked to an adult and asked them to read it aloud. Child A immediately made her way to a sphere which was located at the opposite end of the muga. Child A did not rely on her peers for this aspect of the lesson as she was one of the first children to locate the matching shape.

During the observation, Child B was initially very distracted and displayed excitable behaviour. When instructed by the trainee to line up at the door to go outside for the lesson, Child B stood towards the back of the line and showed negative facial expressions and body language. The children began to leave the classroom – following the trainee – at which point, Child B held back from the rest of the group and was reluctant to follow her peers.

On arrival to the muga, the trainee began to give some initial instructions, however, Child B stood behind the rest of the class and offered no input despite the trainee using a range of differentiated

questioning techniques. The trainee gave a command, for example, hop like a frog and blew the whistle which meant that the children needed to start. Child B listened and followed these instructions very well. This fast reaction and independence suggested that she listened and understood the instructions given. This is evident because Child B was not interacting with peers at this time but was able to start immediately without looking to her peers for support.

As the lesson progressed the trainee gathered the children together and asked them to work in teams to use their bodies to make shapes. Child B was immediately engaged in this activity and was keen to work with a peer to form a triangle shape, however, the group was reminded that they needed to make a triangle as a team. Child B decided to ignore this instruction and continued to make a triangle with just one peer. Finally, a member of the group took the lead and instructed the children to stand in a particular order to form a triangle shape, at which point, Child B was happy to follow in the direction of her peer. However, when quizzed about the shape her group had made, she volunteered and was able to give a property of a triangle.

The next instruction given was to locate a particular 3D shape. The trainee asked the class to go to a cylinder, Child B immediately made her way to a cylinder which no other child had gone to. Despite being the only one there, Child A was confident enough to remain with her decision and was able to give an explanation as to how she knew it was a cylinder.

Child C displayed excitable behaviour when told that the lesson was going to be a physical maths lesson outside. Child C could not control his excitement while moving to the muga and was asked to calm down on several occasions by the trainee. It was evident that Child C lacked engagement during the first set of instructions for the lesson because he needed to look to his peers to find out what he needed to do for the first activity.

Following this, the trainee brought the children together for a new set of instructions. While this was happening Child C appeared disengaged and attempted to distract a peer by holding his coat above his head and counting in Welsh while the trainee was talking.

Child C's group was then asked to make a rectangle shape using their bodies, Child C displayed no interest in participating in his group and it appeared he had no concept of how to create a rectangle using his body. However, when quizzed by the trainee about what properties a rectangle has, he was able to list several properties of the shape.

On reflection, the trainee and I agreed that adaptations needed to be made to this lesson to improve future teaching and learning. We decided that we would conduct lesson study two indoors as opposed to outdoors (Appendix 2). This is because it was evident that the children were easily distracted by their surroundings while on the playground. The focus children seemed to associate this environment with 'play time' and struggled to remain focussed. During this time, my partner and I discussed the effectiveness of the research methods we had used. We concluded that we were happy to continue to use these tools and agreed to keep them the same for lesson study two.

Lesson Study Two

Lesson study two was carried out in a large hall within school B, with 33 children present. During my lesson introduction Child A appeared to be day dreaming as he continuously stared at the kitchen area for a considerable amount of time.

For the warm up activity, the children were split into two large groups and asked to stand in two lines opposite each other. The class were given a number that they shared with their opponent standing opposite them. Child A was given the number four but did not remember it. He asked a peer what number he was given. The class began the activity and when number four was called, Child A responded immediately and ran to the cone. This suggests that Child A was somewhat engaged during the lesson introduction as he was able to respond quickly to a specific instruction.

On introduction to the main activity Child A was observed fidgeting while I was giving the instructions but offered the occasional glance in my direction which suggested that he was listening intermittently. Child A sat slouched, on his knees with dropped shoulders which implied that he lacked motivation and interest.

Child A positioned himself towards the back of the line on commencement of the main activity, presumably to ensure he did not have to run first. While his group were racing, Child A stood in the queue and offered no support to his peers while they were racing. He was observed standing closely behind a peer, which suggested that he lacked confidence.

The last aspect of the lesson involved the children making a list of properties for 3D shapes they had collected. Child A positioned himself slightly out of his team and looked around towards the opposing team. He did not contribute to the group discussion, but half way through the activity noticed that his peers had grouped their shapes according to their properties. Child A nudged a peer, reached out and grabbed a shape from one of the piles, presumably to create a reaction. The rest of the group were still engaged in the activity and had not realised what Child A had done. Appearing

disappointed that he did not gain the reaction he had presumably hoped for, Child A returned the shape and sat, gazing across the hall to the other team. Interestingly, when a child joined the lesson late, it was observed that Child A was able to explain in detail what we had been doing in the lesson and what his team were trying to achieve.

On commencement of the lesson introduction, Child B appeared to be listening intently to my instructions. At the start of the warm up activity Child B stood in a starting position which indicated that he was ready to run. Child B's facial expression was serious and exhibited competitiveness. As soon as I gave the command for his pair to begin, Child B began to race. After he raced, he intently watched his peers and offered an abundance of support and encouragement to his team members.

During the next set of instructions Child B positioned himself near the front of his group, presumably to ensure he could see and hear me clearly. The final aspect of the lesson required pupils to work as a group to make a list of properties of the 3D shapes they had collected. Child B took the lead in listing the properties and made some effort to involve his peers and listen to their opinions and ideas. This displayed his confidence and ability to lead the group and independently list properties of 3D shapes, however it also suggests the he can sometimes lack empathy and consideration for his team members.

During the introduction of the lesson Child C appeared to be listening at irregular intervals. She was looking around the hall and seemed to be trying to gain attention from a peer. On commencement of the warm up activity Child C showed minimal engagement and interest. She stood in a starting position while waiting for me to call her number, when I did, she reacted immediately and was able to beat her opponent in the race, this suggests that Child C was motivated and was confident in her ability to win. After competing in the race, she appeared to lack interest in her team's success and stood talking to a peer.

At the end of the lesson the teams were asked to make a list of properties for the 3D shapes they had collected. The complexity of this aspect meant that the teams needed to devise a strategy that

allowed them to list as many properties as possible. Throughout this part of the lesson, Child C did not engage with her peer and was happy to let the rest of her team members create a list without her input. On one occasion, Child C agreed that one of the properties of a cuboid were missing which demonstrated her understanding and ability to complete the activity. Child C's lack of engagement in this part of the activity suggests that she lacks confidence when working in large groups.

The outcome of lesson study one was met because the children were able to compete in large teams to find and sort the properties of 3D shapes. Upon reflection, it was noted that the level of engagement, according to the Leuven Involvement Scale, had increased in comparison with the results from lesson study one, which may have been the result of conducting the lesson indoors (Appendix 1).

Ethical Considerations

In accordance with British Education Research Association (2018) ethical guidelines were considered and followed throughout the planning, preparation and execution of this research project.

Before requesting consent from parents, I explained the purpose of the research project to the children and explained how it would be conducted in an appropriate manner. As Sharp (2009) states, that when studying education, you should openly discuss what you intend to do and why with participants before proceeding to gain consent. The whole class were informed that participation was voluntary, and it would affect their education if they wished to not participate at all or withdraw from the study. During the planning of the project it was recognised that Article 12 of the United Nations Convention on the Rights of the Child (1989) states that children should have a say in matters that affect them. This means that it was important to give children the opportunity to give assent as well as gaining parental consent. It was also noted that assent needed to be obtained in a manner that was suitable for the children to understand so they could make an informed decision. It is important to note that parents were also given the opportunity to ask further questions regarding the research before they made a decision (UWTSD, 2017).

In accordance with BERA (2018) guidelines, all information about the children and their identities have remained confidential throughout this research project. Due to the nature of this research, it is not possible to maintain anonymity because investigators will know their participants prior to carrying out the observations. In addition to this, the identities and exact locations of the partnership schools have also remained anonymous in order to further safeguard students and staff.

Finally, all raw data gathered throughout this research project has been stored within a password protected university "Cloud" storage system. No digital documents were saved directly onto a private laptop and all hard copies of observations will be destroyed following the completion of this research project. This is in accordance with the General Data Protection Regulations (2018).

Discussion

To our knowledge, this is the first study conducted within Wales that explores the impact on teaching and learning when mathematics and physical education are combined. Several barriers and facilitators to hierarchical cross-curricular teaching have been identified by other studies in this field, however, the most relevant studies have been conducted in New Zealand, Australia, Canada and some parts of the United States. This was considered throughout the literature review as there are many obvious differences between the Welsh curriculum and that of larger countries.

Some studies have found that there is a connection between the mind and the body, therefore integrating lessons has the potential to improve learner outcomes (Thompson and Robertson, 2015). Results have also suggested that students enjoyed integrated experiences and felt that it contributed to the enjoyment of using various maths concepts in the classroom setting (Thompson and Robertson, 2015).

The research conducted aimed to identify whether student engagement could be improved through the use of physical education in mathematics lessons. The results of the study show that five out of six participants within the focus group displayed behaviours to suggest that their engagement was higher than during a traditional mathematics lesson (Appendix 1). These results show that there is a strong correlation between student engagement and the use of physical activity within maths a lesson. Similarly, Johnston's study (2015) revealed a significant positive impact on class arithmetic performance which increased from 32.9 to 47 out of 62, over a ten-week period.

Nonetheless, it is important to note that these studies differ from the point of view of study design, sample size and time conducted. There are many other obvious differences between the two studies that need to be taken into consideration when comparing their validity and reliability, such as culture, curriculum and teacher styles. However, when taken at face value, the evidence suggests that this hypothesis has the potential to positively impact teaching and learning, as well as contribute to the health and well-being of children in Wales.

In addition to this, Johnston (2015) found that the combination of these two subjects had a positive impact pupil attainment. Another limitation of this study regards time constraints as we were unable to test this theory over a long period of time. If this study was longitudinal, it would have been possible to produce results for and comment on its potential to improve pupil attainment.

On analysis of the transcript, when asked if they would like to have more physically active maths lessons, the focus group expressed that they would like this approach to be adopted by their class teacher for future maths lessons. One member of the focus group stated that they found it difficult to work in large teams, but without prompt expressed that with more practice this skill would develop over time. Another member of the focus group identified that learning maths in this way includes lots of other skills such as collaboration and perseverance.

One of the main limitations of this research project and most discernible difference to similar research studies, involves the use of focus group as a data collection method. This is because focus groups are not projectable in the same way that quantitative studies can be, ultimately meaning that a judgement cannot be made with regards to the whole class' opinion on the enjoyment or level of engagement during the lesson studies conducted.

Another limitation that was brought to light when assessing how well we used the Lesson Study methodology.

Conclusion

This study showed that the integration of mathematics and physical education can be beneficial for student engagement. These results are intended to assist future research in discovering new methods of teaching with regards to subject integration. The concept of subject integration has the potential to pose as an area of further research because of its relevance to the new curriculum that is currently being developed within Wales.

With Donaldson (2015) becoming seminal in the development of the new curriculum in Wales, it is possible that in the near future teachers could have the power to make decisions about how to teach and what to teach within the curriculum. This means that they will need to make informed decisions that can be justified with valid research and pedagogy.

Prior to conducting our research, my partner and I did not integrate mathematics into our P.E. lessons which means that our results reflect an isolated experience. As a result of this, it is difficult to determine the learning within the lesson. However, if similar research were conducted longitudinally, there is potential for more comprehensive results to be produced.

Following the positive feedback from our focus group and improvement of student engagement within the Foundation Phase setting, I am interested in continuing to work in collaboration with teachers in my future career to discover alternate methods of integration.

Upon reflection of the positive outcome, it is important to note that elements will impact my future teaching. The driving force behind the study was to measure whether students would learn core curriculum more efficiently through physically active lessons. This idea came forth following a discussion regarding the nature of the children in our classes. We identified that both classes preferred to be physically active and lacked skills in mathematical concepts. Thus, we decided to integrate the two and analyse the outcome.

If given the opportunity within our future practice, my partner and I would like to apply these teaching methods across year groups throughout the Foundation Phase and Key Stage 2 setting, however, we understand that the development and success of integrated lessons is a process that will have to be applied over time.

I strongly believe that the integration of physical education and mathematics will encourage the development of mathematical concepts in ways that children can apply to everyday life. The main benefit of this includes children becoming more competent in the work place, not just mathematically but in areas such as team work, collaboration, problem solving and time management. It could be suggested that teaching the same content in multiple settings, increases the chances of accommodating for all learners.

In addition to this, the integration of these subjects has the potential to combat soaring levels of childhood obesity within Wales. Its potential goes beyond the curriculum as it will enable us to teach the younger generation the importance of physical activity, which is a lifelong skill to be desired.

Recommendations

To begin with, in order to produce more reliable findings regarding the integration of mathematics and physical education, it is recommended that a longitudinal, quantitative study be conducted before the hypothesis is considered for implementation across schools in Wales. However, this study shows that there is potential to mould and shape the way in which teachers choose to teach these subjects in the future. If I were to carry out this research again in the future, I would ensure that all children in the class were involved in the study and that a control group was used as part of the research project.

Moving forward, it is recommended that teachers and school administrators seek out ways to incorporate physical activity with their academic lessons in order to meet the recommended exercise time for children and young people. This concept could be pioneered within schools in Wales on a large scale to prove its effectiveness. There are programmes available such as 'Move for Thought' and 'Math and Movement' which provide extensive activity ideas as well as curriculum links. Such programmes do not require extensive training and are adaptable for different subject areas and year groups. These programmes offer an effective means of increasing academic performance and student engagement as well as contributing to the nationwide battle of childhood obesity.

Further research in this field should focus on student attainment as well as engagement. This concept derives from the findings of many other research studies which have produced quantitative results regarding improvements in student attainment.

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