

Module Title: The Enquiring Teacher

Module Code: ECPP7001

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Title: An Investigation into the Effect the Integration of Physical Activity within Mathematics Lessons has on Pupil Engagement

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Introduction

The aim of this research project is to critically analyse the effect physical activity integrated within mathematics lessons has on pupil engagement. The reason for electing this area of research was that the classes my research partner and I are placed within have a quantity of pupils who lack engagement, particularly in mathematics. A subsequent reason was that the class have minimal opportunities to engage within structured physical activity outside of their weekly Physical Education (PE) lessons which is essential to support the reduction in obesity levels in Wales. The 2016/17 Child Measurement Programme identified that 27.1% of children in Wales are overweight or obese which emphasises the necessity for revolution (Public Health Wales, 2019). Donaldson's (2015) education reform aims to "construct capable, healthy, well-rounded individuals who can thrive in the face of unknown future challenges" which supports the area of research through increasing pupils' physical activity levels.

Research context

The study was conducted in divergent Primary Schools in Wales. Lesson Study one was employed in School 1 a small rural school in Mid Wales. The class was a mixed Year 1 and Year 2 class with 24 pupils (8 females; 9 males in Year 1 and 4 females; 3 males in Year 2) however one male Year 1 pupil was absent on the day of the Lesson Study. Lesson Study two was conducted in School 2 a large urban school in South Wales. The class was a Year 2

class with 32 pupils (16 females; 16 males) however on administration of the lesson four pupils missed the introduction and commencement of the main activity due to prior commitments with another teacher. The study investigates the effect physical activity integrated within mathematics lessons has on pupil engagement as this was a field of interest for the researchers which will impact future practice. Research conducted by teachers where they effectively become apprentices of their individual teaching has the ultimate impact on pupils learning and achievement (Hattie, 2009). The amalgamation of physical activity within a mathematics lesson necessitates pupils to engage in active learning. A constructivist learning theory where pupils 'make meaning' of their learning and develop their existing knowledge and understanding to succeed advanced levels of understanding. Furthermore, in view of the new curriculum which accentuates that to fully engage with their learning pupils require opportunities to collaborate actively with their peers (Donaldson, 2015).

Literature Review

There is limited research available on the effect physical activity in mathematics lessons has on pupil engagement which further strengthened our election as a beneficial area of research. Gardner's theory of multiple intelligences (1999) emphasises the correlation between different intelligences. Although kinaesthetic learning is apparent within classrooms through simple practises of throwing a ball to pupils to answer, more objective physical activity is absent. Egan (1991) considers pupils' necessitate excitement and enthusiasm known as ecstatic responses to support brain functions of learning and memory to construct effective teaching and learning. Boredom and disillusionment negate learning

whereas enthusiastic and exciting learning heightens pupil engagement and subject interest (Elliot, 1999). Howe (1999) believes engagement is fundamental to mastery of a subject.

Literature outlines that pupil engagement is complex to characterise, measure and recognise, but is progressively correlated with pupil achievement and perseverance (Baron and Corbin, 2012 et al). Research conducted in New Zealand found that pupils who were taught maths through physical education achieved significantly higher test scores in maths (Phillips and Marttinen, 2013). It is noted that the curriculum in Wales is significantly different to other countries as it already places emphasis on learning through play, however with the recent curriculum reform which places a greater emphasis on cross-curricular teaching, this area of research could inform teaching. The new curriculum promotes the development of transferable life skills, this area of research can be beneficial as it conforms to new curriculum demands. Phillips and Marttinen (2013) also suggests that the integration of subjects can be a useful tool to manage time and reinforce learning in real-life situations.

One of the limited programmes available is that of Math n Movement which is designed for children from Kindergarten to Year 6. The programme comprises of lesson plans uniting Mathematics and Physical Education with curriculum links to the United Kingdom, Australia and the United States of America. The programme aims to deliver a Maths and Physical Education enriching curriculum while developing fundamental Science, Technology, Engineering and Mathematics (STEM) skills of collaboration, resilience and leadership. The programme facilitates children to be active participants and not passive recipients in the lessons. With the increasing amount of time children are spending partaking in stationary

activities watching television and playing computer games. The programme affords children to learn, develop and rehearse maths skills while partaking in physical activity such as skipping, hopping and throwing. The programme aims to increase pupil engagement, mathematics and physical activity skills through the combination of STEM Maths activities and physical activity.

Rebecca Johnston (2015) conducted a research project into the benefits of physically active learning in Mathematics trialled over a ten week period. To measure the variations in her pupils' mathematical ability Johnston implemented a 62 question test which was applied pre and post-employment of the trial. For the subsequent ten weeks Johnston expended Maths n Movement alongside brain breaks to engage pupils within daily moderate to vigorous physical activity. The trial established a considerable positive impact on pupils' mathematical ability with an improvement in test scores for 20 out of the 21 pupils from the class. Pupils' scores were improved by up to 50% with the majority of scores improving by 25%. The study found the higher performing pupils and the lower performing pupils permitted the smallest gain but the remaining pupils' scores exceeded expectations. The utmost finding noted from the research was the transformation in pupils' attitudes towards their mathematical learning. The study was found to positively improve pupils' mathematical confidence with 62 unhappy responses for specific mathematical concepts pre study compared to only 3 unhappy responses post study.

The National Health Service (NHS) advises children aged 5 to 18 years old should complete at least sixty minutes of physical activity every day to maintain a basic level of health (NHS,

2019). This recommended physical activity is essential for strengthening muscles and bones, maintaining a healthy weight and improves health and fitness. Furthermore physical activity improves concentration and learning and builds confidence and social skills which emphasises the importance of physical activity within the curriculum. Although pupils have on average up to 1 hour 20 minutes play time during a school day it doesn't necessarily mean pupils are engaging in physical activity. Research conducted by John Moores University Liverpool (2009) found girls play less energetically than boys owing to the fact they favour engaging in conversation with their friends. The research found girls participate in 6% less energetic playtime activity than boys.

Although within a schools weekly timetable there are usually two Physical Education (PE) lessons where pupils will be required to partake in different forms of physical activity this is still significantly less than the NHS recommendations. An increasing number of schools have introduced the Daily Mile which is an inclusive and enjoyable initiative which aims to improve children's well-being and physical and mental health. In support of the NHS guidelines that children should partake in sixty minutes of exercise daily, schools have an increased responsibility to seize opportunities to embrace physical activity across the curriculum. Gray (2012) states children who are fit and healthy have an enhanced capability to multitask and accomplish challenging mental tasks. Owing to these findings schools have an increased requisite to incorporate physical activity across the curriculum to not only support future generations learning but their health and well-being. Physical activity based lessons not only support pupils' health and well-being but increase pupils' learning and retention. Dale's (1969) cone of experience condition pupils learn most by doing, with 90%

of what pupils do generally retained. The implementation of physical activity has been found to have distinctive effects on pupils' cognitive, participation, engagement as well as their academic attainment. A study conducted by Castelli et al (2007) identified a distinct correlation between pupils' fitness levels and their attainment. Specifically pupils' with Autism find common classroom practicalities difficult, such as collaborative work and employment of appropriate classroom behaviours. Furthermore Pan (2008) recognised pupils with Autism spent an increased amount of time inactive during break and lunch periods.

Explanation of lesson study

The methodology used to conduct the research was that of Peter Dudley's Lesson Study Model which is an explicit classroom action research model that originated in Japan in the 1870's. Japan have an excellent education system and have been ranked within the top eight countries in the latest PISA results (PISA, 2015). The Lesson Study requires a minimum of two education practitioners to work collectively to identify an area of research.

Participating in collective research that aims to progress teaching and learning is the solitary utmost influential exploit an educational practitioner can undertake to improve educational outcomes for pupils (Robinson et al, 2009). Consuming current literature, practitioners collaboratively research, plan, teach and observe lessons, using reflection, observation and pupil feedback to modify approaches for the subsequent lesson. Lesson Study is consumed to develop and enhance teaching, learning and teachers practice. Lesson Study has had an influential effect on education in the United Kingdom (UK) improving pupil progress and teaching practice within the core subjects in both primary and secondary schools.

Furthermore Lesson Study has been consumed to support the development of comprehensive pedagogic methodologies, for instance assessment for learning (AfL).

The methods of data collection expended within the research were observations, reflections and interviews which encompassed the aim of the research that concentrated on pupil engagement. The observational notes documented during the lessons were recorded by a non participant observer. Using the purposeful sampling method three target pupils' within each class were elected to be the focus of the observations. The target pupils' were specifically selected from the different attainment groups in attempt to certify utmost contrast. An ethical consideration in relation to the observer scribing notes during the lesson was that pupils' were introduced using the Pupil Information Sheet (Appendix C) to the observer to ensure they were aware of her presence and the reason. The observational notes were used to support the categorisation of the target pupils' within the Leuven Scale of Engagement. In compliance with the GDPR no more data than is required for the purpose of the study was noted during the observations. The data will be stored on an encrypted USB device which is password protected to ensure only the designated personnel gain access to the data stored on the device. Paper copies will be securely stored during the application of the data within the study and in accordance with GDPR will be kept for no longer than required for the purpose.

The Leuven Scale of Engagement (Appendix D) established at the Leuven University in Belgium provides practitioners with a method to assess pupils' engagement. The five point scale includes a brief description to support the categorisation of pupils' engagement within

a given lesson. The scale was elected as the researchers felt the scale met the requirements for assessing the engagement of the pupils within the study. The scale provided the practitioners with distinct behaviours and characteristics to evaluate which concluded with a scale categorisation. A Leuven Scale tick sheet (Appendix E) was expended to record the individual target pupils' engagement scale categorisation.

On completion of each lesson my research partner and I completed a reflection using the Gibb's (1988) reflective model. The model comprises of six stages beginning with an initial description of the lesson and finalising with a conclusion and action plan. Engagement with reflective practice is essential for educational practitioners to evaluate their own practices. Dewey (1933) compared reflective practice and teaching routine as an equal attribute within education that all teachers should engage with to evaluate their practice. Hattie (2012) supports Dewey's theory by accentuating a lesson is not complete until it has been evaluated. The conclusion and action plan from Lesson Study 1 were imperative to identifying the lesson alterations for the subsequent lesson. Gibb's reflective model was elected because it provided the researchers with a systematic approach to evaluate the experience using the distinct stages. Gibb's model also facilitates the interpretation of events objectively where their impact can be critically analysed. A limitation of the model is that owing to the distinct stages within the model the reflection can become restricted as the researcher doesn't evaluate beyond these stages.

Parental consent (Appendix A) was obtained from all pupils who participated within the Lesson Study. Children whose parents who did not give consent still participated within the

lesson however no observation notes were permitted to be recorded either by myself or by my research partner. Furthermore pupils provided assent to partake by indicating using a smiley face (Appendix B) if they were willing to be included within the study. Participants were reminded on numerous occasions that they had the right to withdraw at any point during the study. Pupils were informed that if they would like to withdraw they simply had to inform myself or the observer.

A focus group interview, a form of qualitative research comprising of the three target pupils for each school was expended to obtain pupils attitudes, feelings and views in relation to the associated lesson. The interview comprised of a small number of open ended questions (Appendix F) which allowed pupils to include more information and provided the researcher with more valuable and contextual responses. The employment of open ended questioning additionally reduces the likelihood of participants contributing answers which they perceive the researchers desire to receive. Owing to the age of the participants it is possible that they might find the interview situation overwhelming and refuse to participate or not wholly contribute. The group structure for the interview conducted in familiar surroundings will support pupils in feeling at ease within the interview therefore increasing the chances of validity within their responses.

However there are limitations associated with focus group interviews. Although previously stated implementing open ended questions allowed for increased detail it can result in a depth of information that proves challenging to analyse. Auto recording of the interviews was made to ensure the accurate recording and analysis of pupil responses. The audio recording will be stored and used in accordance of General Data Protection Regulations

(GDPR) and BERA. The findings and responses from the interview on completion of Lesson Study one will be consumed to modify the subsequent lesson within the study. Permitting pupils to have a view and contribute to decision making associated with their education support Article 12 of the United Nations Convention on the Rights of the Child (UNCRC). Furthermore the Welsh Government (2011) desire all children and young people to be given prospects to dynamically contribute to decision making surrounding their education.

Ethical considerations

There are ethical considerations associated with conducting research in a classroom environment to safeguard the pupils, staff and researchers. The initial consideration was the approval from the University of Wales Trinity Saint David (UWTSD) Ethics Committee to conduct the research as rationalised within the submitted ethics form. During the completion of the research the researchers had to adhere to the University of Wales Trinity Saint David Research Ethics and Integrity Code of Practice (UWTSD), British Education Research Association (BERA) and the Education Workforce Council. In accordance with the BERA the identity of the children and any personal information will remain confidential throughout the study. Children will be referred to as Child A, B and C in all aspects of the study. The identity of the school will remain confidential and the schools will be referred to as School 1 and School 2. Anonymity is not being offered during the study due to the nature of the research. The researcher will know their participants prior to the observation taking place because the Lesson Study is taking place within their placement school.

Although parental consent was obtained, where parental consent was not been granted for pupils to partake within the study, the pupil still participated within the lesson however no observations or information was permitted to be recorded. Even though pupils had granted their assent throughout the study they were reminded they had the right to withdraw at any point during the study and that it would have no detrimental effect on their education in accordance with the BERA (2018) which state participants might chose to withdraw their consent at any time and for any motive. Prior to the commencement of the lesson I introduced my research partner, the observer to the class and explained to the class using the Pupil Information Sheet (Appendix C). In accordance with the Education Workforce Code of Professional Conduct and Practice I ensured all rational precautions to safeguard all pupils' within my care.

Lesson Study 1 results and analysis

Lesson study one was conducted with a focus on the effect physical activity integrated within a mathematics lesson has on pupils' engagement. On commencement of the lesson Target Child A was distracted by the presence of the observer. Child A was preoccupied with what the observer was writing rather than listening to instructions which resulted in Child A missing the initial instructions. The subsequent instruction required pupils to make a rectangle shape using their bodies as a group. Child A was reluctant to contribute to the group discussion despite her mathematical ability. Child A was more than capable of using her understanding of the shapes properties to accomplish this task however demonstrated resistance to participate with their group. However Child A was willing to follow the

instructions of pupils within their group to create the shape. The following activity required pupils to match a shape property to the relevant shape, owing to Child A's ability they were given a more complex property of a shape with 0 corners. Upon clarification Child A hastily moved to the relevant shape, a sphere which was located on the opposite side of the Muga court on the playground. Owing to Child A's engagement within this aspect of the lesson Child A was able to independently accomplish this aspect of the lesson without any peer support.

Using the Leuven Scale for Engagement it was ascertained that Child A's levels of engagement remained the same at a moderate level during the physical activity mathematics lesson compared to a traditional maths lesson. Child A found the concept of the lesson conducted outside and the presence of the observer distracting effecting her engagement within the lesson.

Target Child B demonstrated reluctance to go outside when lining up and demonstrated negative facial expression and body language stood at the back of the line. As I was leading the class to the playground Child B hung back at the rear of the line and appeared reluctant to follow her peers for the commencement of the lesson. During the introduction I implemented a range of questioning techniques to activate prior learning however Child B remained at the back and showed no interaction or engagement. On commencement of the first activity which involved pupils to move like a particular animal in relation to their topic for this term Child B instantly became engaged within the activity. Child B demonstrated that they had listened appropriately to my instructions as was able to accomplish the instruction immediately with no peer support. I instructed the class to work in their groups

to use their bodies to make a shape. A child within Child B's group took the lead and instructed their peers to stand in particular places to create a triangle shape. Child B willingly followed their peers' instructions and was able to verbally exchange properties of a triangle with their group. The following instruction required pupils to locate a particular shape, Child B demonstrated effective listening and understanding as they located the required shape. Child B was the only child at this shape which demonstrated they had engaged with the instruction and was confident within their understanding.

In employment of the Leuven Scale for Engagement Child B was judged to have high levels of engagement during the lesson in comparison to low levels of engagement within a traditional maths lesson. Although Child B demonstrated negative behaviour on commencement of the lesson however, once they had received the initial activities instructions their engagement transformed.

Child C exhibited excitable behaviour when initially moving outside onto the playground for the commencement of the lesson. On several occasions Child C had to be reminded to walk to the Muga but owing to their excitement persisted to run and skip and speak loudly to their peers. Child C lacked engagement during the introduction which included the instructions for the foremost activity. Owing to the lack of engagement Child C was unaware of the exact instructions and followed their peers primarily. I brought the class back together to give them the next set of instructions, Child C attempted to distract their peers by raising their coat above their head and counted in welsh. Child C showed no concept to use their body to create a rectangle shape with their peers. However when questioned by

myself of the properties of a rectangle Child C was able to identify several properties which I encouraged the group to use to create the shape.

Child C was categorised as having low levels of engagement during the lesson which exhibited a negative effect on their engagement in contrast to a traditional lesson where they would commonly be categorised as possessing high levels.

On reflection the observer and I identified that the lesson would have increased effectiveness if conducted in a hall rather than outside. The reason for identifying that the lesson would be better conducted in a hall was that pupils were very excitable about completing a Maths lesson outside. This excitement had a significant influence on particular pupils' levels of engagement during the lesson. Interestingly during the interview Child C asked why the lesson was not conducted in the school hall similar to PE lessons. In accordance with Article 12 of the UNCRC which states children have the right to express an opinion and have that view considered when choices are being formulated relating to them, the subsequent lesson was conducted within the hall. Child A acknowledged that a number of her peers were very excitable about conducting a mathematics lesson outside and thought that if physical activity became an increasingly regular event pupils would find it less exciting. The researcher and I agreed conducting the lesson in the school would reduce pupil excitement and therefore increase the validity of the results.

The observation methods used to document and evaluate the Lesson Study provided the adequate level of detail and accuracy in recording the findings from the lesson to evaluate the effect the integration physical activity within a mathematics lesson has on pupil engagement. The Leuven Scale for Engagement proved particularly effective as it afforded

an accurate and valid method to categorise the target pupils' levels of engagement within the lesson.

Lesson Study 2 results and analysis

During the trainee's introduction Child A lacked engagement and subsequently surveyed down towards the kitchen area at the far end of the hall where staff were preparing lunch. Child A continually swayed and twisted their body with the occasional glance at the trainee. When Child A's concentration was conveyed back to the trainee they gazed at the trainee in a daze with no facial expression or movement before becoming distracted by their surrounding once again. On introduction to the main activity of the lesson Child A sat on their knees with relaxed body language and dropped shoulders. Child A was looking on occasions towards the trainee although spent considerable time looking at the surrounding within the hall. Once the activity had begun Child A chose to stand at the rear of the group where they couldn't see and waited for their peers to move forward during the activity before they could see. During this time Child A continuously twiddled his hands, swung their arms and generally demonstrated the inability to remain still for more than a few seconds. For the completion of the activity the pupils were required to work in their groups to identify shape properties, Child A positioned themselves slightly out of the group and looked round towards the other group. A peer joined the lesson late and Child A was asked to explain to their peer what they were doing, Child A was capable of providing a detailed explanation of the activity.

In accordance with the Leuven Scale of Engagement Child A was categorised as low levels of engagement which is an improvement compared to a traditional maths lesson where they would be considered as consuming extremely low levels.

Throughout the introduction of the lesson Child B demonstrated some engagement and listened at irregular intervals, looking around the hall and seemed to be trying to gain attention from their peer. On commencement of the introductory activity Child B showed minimal engagement and stood with minimal enthusiasm. When asked what number their pair were Child B showed they had listened as was able to promptly tell the trainee the number. Child B indicated their engagement with the activity as they stood with posed legs and arms once the trainee gave the instruction the activity was about to start. Once Child B and their partner had completed the activity Child B lacked any engagement with their peers who were still completing the activity. During the trainees instructions for the subsequent activity Child B listened intermittently but was easily distracted when their peers spoke to them. Child B positioned themselves near the back of the line when split into their groups ready to begin the activity. During the final aspect of the lesson where the groups were required to identify the properties of different shapes, Child B positioned themselves at the back. Child B sat at the rear and showed no engagement with the group and let the group complete the activity. Child B did however agree the properties of a cuboid which demonstrated they understood the activity.

On conclusion of the observation Child B was categorised as exhibiting moderate levels of engagement which showed the physical activity had a negative impact on Child B's engagement would be categorised at extremely high during a traditional maths lesson.

On commencement of the introduction Child C was evidently listening attentively to the trainee as they maintained eye contact with the trainee throughout. At the start of the initial activity Child C was ready; stood with posed legs and arms ready to run. Child C's facial expression exhibited their full engagement with this activity as they were evidently listening and watching the trainee's every instruction and movement. As soon as the trainee gave the command for their pair to begin, Child C started immediately. Even when Child C had completed the activity they intently watched all their peers throughout the activity. Following instructions for the main activity of the lesson Child C positioned themselves near the front of their groups' line. When lined up ready to start Child C took a step out of the line to ensure they could directly see the trainee giving the final instructions. After Child C had participated within the activity they remained engaged and watched their peers until the completion of the activity. The final aspect of the lesson required pupils to work as a group to identify properties of shapes. Child C took the lead for completing the task but ensured they involved their peers within the activity. Child C was subsequently chosen by their group to be the scribe and took pride in their groups' compilation of the shape properties.

Using the Leuven Scale of Engagement Child C was judged as possessing extremely high levels of engagement which is consistent with their levels of engagement during a traditional maths lesson.

Upon reflection of Lesson Study 2 it was evident that the pupils within the second lesson found the maths lesson considerably less exciting in comparison to Lesson Study 1. The paramount reason for the minimal excitement during Lesson Study 2 was that it was

executed within the school hall which ensued a reduction in hype due to the continuity of the hall. The study will support future practice where I will increase the inclusion of physical activity within mathematics lessons to specifically to support pupils' who have low mathematical ability and for those with low levels of confidence and self-esteem.

Discussion of research findings

The research findings presented variable results on the effect physical activity integrated within a mathematics lesson has on pupil engagement. The lessons were shown to have a positive effect on some of the target pupils, however had a detrimental effect on other target pupils' levels of engagement. A significant influence on the results from Lesson Study 1 using the Leuven Scale for Engagement was that pupils evidently found the lesson overly exciting for the reason that it was conducted outside. The lesson had a significant effect on Child B's level of engagement; using the Leuven Scale for Engagement Child B was determined to have high levels of engagement. Generally in a traditional mathematics lesson Child B would be considered to have low levels of engagement. Child B is a lower ability pupil within mathematics and will often become distressed when faced with difficulty. Similarly to the research conducted by Johnson (2015) the lower ability demonstrated the upmost benefit from the physical activity mathematics lesson. Furthermore, Child B lacks confidence to contribute during traditional maths lesson. Throughout the physical activity mathematics lesson Child B displayed confidence, this was evident when she was the only child at a particular shape and hadn't followed her peers to a shape. Child B's perception of maths may be transformed through the implementation of physical activity lesson as documented by Johnson (2015) who found pupils thoughts of

maths were transformed after completing a trial of Maths n Movement. Within Lesson Study 2 Child A's engagement was improved from consuming extremely low levels of engagement during a traditional maths levels compared to low levels during the integrated physical activity lesson. Child A is a lower ability who requires motivation and support to accomplish different activities across the curriculum. Child A is easily distracted during lessons however due to the innovative lesson demonstrated increased listening and attentiveness resulting in improved engagement levels. Howe (1999) believes engagement is fundamental to mastery of a subject.

However, the inclusion of physical activity into a mathematics lesson had a detrimental effect on Lesson Study 1 Child C's levels of engagement. Child C evidently found the concept of the mathematics lesson taking place outside too exhilarating which significantly impacted their levels of engagement. Although it is noted to have a negative effect on Child C's engagement, for the future it could potentially have a positive impact in support of Egan (1991) who considers pupils' necessitate excitement and enthusiasm to support brain functions of learning and memory to construct effective teaching and learning. Child C would be classified as having high levels of engagement within a traditional mathematics lesson however, during the physical activity lesson was considered to be low. Findings identified the physical activity mathematics additionally had a negative effect on Lesson Study 2 Child B's engagement levels. Child B's engagement levels declined from extremely high to moderate. Child B did not seem content with having to participate within physical activity owing to personal dislike of physical activity. An additional intelligence as to Child B's lack of engagement was that as they are a higher ability pupil may have required an

increased level of mathematical content in accordance with the Foundation Phase Framework. The physical activity mathematics lesson was established to have no impact on the subsequent target pupils' levels of engagement however it should be noted Child C within Lesson Study 2 was judged at having extremely high levels of engagement in a traditional maths lesson therefore there was no higher level of engagement that could be achieved.

Conclusion

The necessity to engage within research is apparent within the New Professional Standards which state the requisite to participate within professional development to support the continuing development to teaching practices in concurrence with the advances within the curriculum. The study conducted into the effect of the integration of physical activity within mathematics lesson has on pupil engagement necessitated numerous outcomes which will significantly influence future practice. Although the findings from the study presented inconsistent results the study was found to have significant impact on the engagement of lower ability pupils who would generally lack the confidence within the subject. These pupils' demonstrated increased confidence to participate within the lesson which will support their mathematical skills development. Furthermore, there is a significant need for schools to support the reduction in childhood obesity which are continuing to rise yearly. Although schools can educate pupils on the importance of healthy eating and the

significance of regular exercise, schools essentially can't ensure pupils achieve this during a normal school routine. An increased presence of physical activity mathematics would increase pupils' opportunities to partake within physical activity as part of the Foundation Phase curriculum.

Although the study obtained some beneficial findings into the effect of physical activity integrated within mathematics lesson has on pupil engagement the study consumed some limitations. The significant limitation of the study was the limited number of lessons the Lesson Study was conducted within. As was evident especially within Lesson Study 1 the pupils found it extremely exciting that their mathematics lesson was to be conducted outside. Owing to the overly enthusiastic behaviour pupils displayed the results obtained were not an accurate representation of the effect physical activity within a mathematics lesson has on pupil engagement. To effectively critically analyse the effect physical activity within mathematics lesson has on pupil engagement the study necessitates to be conducted over a series of lessons. Conducting the research over series of lessons would reduce the excitement within pupils that negatively impacted results of this study and therefore increase validity of the results.

The methodology exhausted within the study provided the researchers with the appropriate level of detail and findings to critically analyse the research aim. Gibb's reflective model supported the researchers to critically analyse the lesson using the structured stages. The model facilitated the researchers to identify lesson improvements and modifications which will further support the validation of the findings. Consuming the Leuven Level of

Engagement within the study provided an effective method to assess the engagement of pupils during the Lesson Study. The scale afforded the researchers with a single indicator to directly compare the difference within pupils' engagement within a physical activity based lesson in comparison to a traditional lesson. Pupil voice through the focused group interviews were indispensable in obtaining pupils' opinions on the lesson and played an imperative role in modifying the lesson for future practice.

During the subsequent school placement I would embrace within my planning mathematics lessons which incorporate physical activity. These lessons don't necessarily require the whole lesson to incorporate physical activity but can incorporate physical activity within the introduction or plenary of a lesson. The study found that the physical activity elevated pupils' confidence and engagement which would prove highly effective for those pupils' lacking self-esteem and confidence and those with lower mathematical ability. The research aim also supports Donaldson's Successful Futures (2015) purpose that all children and young people will be healthy, confident individuals, ready to lead fulfilling lives as valued members of society. Through the mathematics lessons that incorporate physical activity children will be engaging in supplementary physical activity when their traditional mathematics lessons would necessitate being stationary within their classroom. In addition the physical activity within mathematics lessons assists children in achieving the recommended sixty minutes of daily exercise as advocated by the NHS. Increased physical activity will support the reduction of overweight and obesity levels of children in Wales which are currently at their highest level of 27.1% (Public Health Wales, 2019).

As Grigg's (2015) states action research can be consumed to study and strive to develop an area within classroom practice. After engaging with research into the effect physical activity incorporated within mathematics lesson has on pupil engagement it is an area of classroom practice which I would like to develop further. Ensuring the consumption of the latest classroom practice is essential in enduring as an effective teacher. An effective teacher will have a powerful and lifelong influence on an individual's education and life which supports the four main purposes of the curriculum as outlined in Successful Futures (Donaldson, 2015). Hill (2013) affirms the solitary approach to raise standards of attainment in Wales to advance the quality of teaching and learning in schools which is dependent on the quality teaching. Teachers necessitate a compelling understanding of the why, what and the how of teaching to achieve teaching excellence (Donaldson, 2015).

Recommendations

To improve the validity of the Lesson Study research, if conducted again I would perform a series of lessons which focus on the research aim. Conducting a series of comparable lessons would permit the researcher to analyse data to formulate an analysis founded on a larger data source. In support of Dudley's Lesson Study model I would consume observational notes and pupil voice to modify and evolve the subsequent lesson. The research was conducted in Year 1 and Year 2 classes within the Foundation Phase, to obtain a wider data source the Lesson Study could be conducted within Key Stage 2 to examine if physical activity within mathematical lessons has comparable results. An alternative recommendation to improve the validity of the study would be include a mathematics lesson which incorporated physical activity into the weekly planning before the study was

scheduled to commence. The introduction of regular mathematics lessons incorporating physical activity would become an ordinary event for pupils, causing less uncharacteristic behaviour for the Lesson Study.

The research conducted has influenced my future practise as I will incorporate an increased number of mathematical lessons which contain physical activity as the research was found to have a significant effect on the lower attaining pupils' engagement. Furthermore these lessons would be valuable to the pupils with low concentration and engagement levels in areas across the curriculum. Drawing on observation and participants' interview responses mathematical lesson introductions incorporating physical activity would increase pupil engagement. Implementing physical activity mathematics lessons would be specifically beneficial for groups of pupils who lack self-esteem and confidence. The study established, particularly in School 1 that pupil self-esteem and confidence was elevated compared to a traditional maths lesson. Incorporating physical activity within a mathematics activity will not exclusively develop pupils' mathematical and physical skills but can be implemented to progress pupils' collaborative skills which were identified as poor in School 1. Pupils would be fostering collaboration skills in an extensive range of subject across the curriculum.

Reference List

BERA- RSA (2014), *Research and the Teaching Profession: Building the capacity for a self-improving education system*

Calderhead, J. and Shorrock, S (1997) *Understanding Teacher Education*, London: Falmer Press

Child Measurement Programme for Wales, [Online] Available at: www.wales.nhs.uk, Accessed 26/01/19

Code of Professional Conduct and Practice for Registrants within the Education Workforce Council, [Online] Available at: www.ewc.wales, Accessed 27/02/19

Coe, R., Aloisi, C., Higgins, S. and Major, L.E. (2014) *What makes great teaching? Review of the underpinning research*. Durham University

Dewey, J. (1933) *How We Think. A restatement of the relation of reflective thinking to the educative process* (Revised edn.), Boston: D. C. Heath.

Donaldson, G (2015) *Successful Futures: Independent Review of Curriculum and Assessment Arrangements in Wales*

Estyn (2016) *Pupil participation: A best practice guide*, Estyn

Ethical Guidelines for Educational Research, [Online} Available at: www.bera.ac.uk, Accessed 23/01/19

Grigg R (2015) *Becoming an Outstanding Primary School Teacher*, Oxon: Routledge

Harbin, S. (2012) *The Effects of Physical Activity on Engagement in Young Children with Autism*, University of Washington

- Hattie, J. (2009) *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*, Routledge: London
- Haylock, D. (2006) *Mathematics Explained for Primary Teachers*, Sage: London.
- Hill, R. (2014) *The Future Delivery of Education in Wales*
- Johnston, R. (2015) *Dalby State School- Physical Activity Leadership Program- Active Maths*, iAIM
- Laevers, F. (2005) Well-being and Involvement in Care Settings. A Process-orientated Self-evaluation Instrument. Research centre for Experienced Education: Leuven University
- Phillips, S and Marttinen, R. (2013) *Physical and Education: The Perfect Couple*, Columbia University
- Physical activities guidelines for children and young people*, [Online] Available at: www.nhs.uk, Accessed 23/01/19
- PISA Results*, [Online] Available at: www.oecd.org, Accessed 20/02/19
- Pound, L and Lee, T. (2015). *Teaching Mathematics Creatively*, Oxon: Routledge
- Professional Standards for Teaching and Leadership*, [Online] Available at: www.learning.gov.wales, Accessed 02/02/19
- Robinson, V., Hohepa, M., & Lloyd, C. (2009). *School leadership and student outcomes: identifying what works and why best evidence synthesis*. Auckland: New Zealand Ministry of Education.
- Studies reveal lifelong gender difference in physical activity*, [Online] Available at: www.exeter.ac.uk, Accessed 23/01/19
- What is the daily mile?*, [Online] Available at: www.thedailymile.co.uk, Accessed 20/02/19

