What are the effects of outdoor learning on young children's mathematical development.

Abstract

This research project will explore what the effects outdoor learning has on young children's mathematical development from two different schools here in South Wales. Other research will be explored, and their findings will be analysed to discover what the benefits are and to get a more in-depth understanding of the subject. Through purposive sampling the participants chosen will be part of a small sample size consisting of ten children, the class teacher and teaching assistant. Ethnographic research will be conducted using a mixed method approach of observations of the young children whilst they learn mathematics outdoors and interviews with the teaching staff to understand their perspective on the topic. Triangulation will be implemented to ensure the validity and trustworthiness of the research project. Following this the research findings will be analysed to determine what the effects outdoor learning has on young children's mathematical development are.

Throughout the planning of and when conducting the research project ethical considerations will be put in place outlined by British Educational Research Association (BERA) (2018) and Ethical Research Involving Children (ERIC) (2020) with regards to gaining consent/assent from participants, providing information sheets with full rationale of the research topic being carried out and what will be required of them, ensuring the researcher is transparent and gains voluntary informed consent. Furthermore, the participants will be reassured that the data will be collected and stored safely in accordance with the Data Protection Act 2018, to protect their confidentiality.

Literature Review

The rationale for this research project is to explore what the effect outdoor learning has on young children's mathematical development and discover what the benefits may be. According to Dillon, Rickinson and Teamey (2016) outdoor learning is organized learning that takes place in the outdoors. Knight (2013) states that outdoor learning is active learning where children within the early years learn through what they do, experience and discover. The children are given the opportunity to learn

about the outdoors, whilst also learning new skills and developing personally and socially (Knight, 2013).

According to Wainwright (2021) much research has been carried out on the effects outdoor learning has on children's well-being and motor development, however, the effects outdoor learning has on children's mathematical development is not so widely researched in Wales. Therefore, in order to gain a more in-depth understanding this research project will focus on children's mathematical development in the outdoors in South Wales.

Edwards *et al.* (2016) highlights the significance of outdoor learning, stating it can be more motivating and have a greater impact on the children. Furthermore, it has the power to become a stimulating source of fascination, personal development and breakthroughs in learning (Edwards *et al.* 2016).

According to the research carried out by Linder, Powers-Costello, and Stegelin (2011) on mathematics in early childhood, they researched curricular methods inspired by the Reggio Emilia approach. Through observations, they stated that although the children reflected positively on the experience, the research highlighted the significance of the teacher's involvement with the children and ensuring they are providing enriched and engaging learning experiences for them.

The research carried out by Waite, Bolling and Bentsen (2015) on comparing outdoor learning mathematics in an English forest school and a school in Denmark had similar findings to the research carried out by Linder, Powers-Costello and Stegelin, where the children reflected positively. Waite, Bolling and Bentsen (2015) focused on the aims, purposes, pedagogy, outcomes and barriers faced in the two different schools. They found that although the two schools have different national education and cultures, they both share commonalities in the pedagogy's used and their findings. Waite, Bolling and Bentsen (2015) concluded that outdoor learning had a positive effect on the children's confidence, communication, social skills, knowledge and understanding and the children demonstrated a positive attitude towards learning.

According to Ihmeideh and Al-Qaryouti (2016) and Waite (2009) outdoor learning offers opportunities to develop large movements linked to gross motor skills which are the platform for fine motor skills needed for children's hand-eye coordination.

Edwards *et al.* (2016) agrees and states that outdoor learning is crucial in enriching children's learning experiences and contributes to their holistic development.

Theorist Maria Montessori believed that the outdoors is a natural extension of the classroom (Marshall, 2017). Marshall (2017) continues to state that outdoor learning encourages children to build on their knowledge learnt in the classroom through sensory experiences of nature and contact with the outdoor environment and the different seasons. Similarly, theorist Froebel also backed outdoor learning and believed that exposing children to simple, open-ended materials encouraged them to represent their ideas, experiences and feelings (Bruce, 2012).

According to Garon-Carrier *et al.* (2018) learning mathematics is vital for young children as it provides them with important life skills. Mathematics can help the children measure, problem solve and develop spatial awareness and how to recognise shapes even in the early years (Garon-Carrier *et al.* 2018). Welsh Government (2022) state in the foundation phase curriculum ways in which mathematics can be taught within the early years. This could include using objects such as blocks, stones or sticks to help with counting skills. Songs or rhymes can be beneficial in helping children learn how to count also (Welsh Government, 2022). The foundation phase curriculum supports children's play and states that it is an important part of children's development including their mathematical development (Welsh Government, 2022). Hands-on learning can help young children concentrate on a task for longer periods of time (Garon-Carrier *et al.* 2018).

Robertson (2017) believes that the whole world is a mathematical place. Children are naturally curious therefor they will automatically use mathematical thinking and develop their math skills as part of their outdoor experience (Robertson, 2017). Bilton (2010) agrees and suggests that learning mathematics outdoors allows young children to explore shapes, count, measure and develop their mathematical ideas through creative play and their imagination. Learning math outdoors will simply extend the children's learning from indoors, allowing them to explore their senses, including sound, touch and smell. These finding as shown in research carried out by Robertson (2017).

Dancer (2021) suggests that in order to develop successful outdoor learning, one must reflect upon the math experiences provided indoors and think of ways to

expand them outdoors. Furthermore, Tucker (2014) believes that mathematics is not just a cognitive process for young children, it is also a physical, emotional and social experience. Supporting children's mathematical learning outdoors can sometimes look like providing them with mathematical opportunities that are far noisier, messier and bigger within an enriched natural environment than if they were to learn math in a classroom (Tucker, 2014).

Methodology

According to Mukherji and Albon (2015) it is important to have a sample when conducting a research project as a sample of participants is far more manageable to collect data from than it would be from the whole population. Mukherji and Albon (2015) states that a sample is a group of people taken from a larger population for measurement, employing techniques to produce a sample that is representative of the whole population. Therefore, generalizations can be made from the findings.

The chosen sample type for this research project is purposive sampling which is a non-probability sampling technique that is best used to gather qualitative responses, with the expectation that the participants will provide rich and unique information valuable to this research project, allowing the researcher to attain a better insight and more precise research results (Palinkas *et al*. 2015). Etikan, Musa and Alkassim (2015) believe that purposive sampling is more cost effective for the researcher and will also save them time as they are choosing the participants that best suit the purpose of the study only.

Through purposive sampling, the participants chosen for this project are young children aged four and five in reception classes across two different schools that provide outdoor learning mathematics in South Wales. The sample sizes will be ten children per session to ensure that the sample is kept small in order to gain a more in-depth understanding. Cohen, Manion and Morrison (2018) suggest that too large a sample may be overwhelming and may emphasize the statistical differences that are not completely relevant. However, Cohen, Manion and Morrison (2018) continue to state that too small a sample may hinder the results from being extrapolated.

The sample will also include the reception teaching staff to better understand their perceptions of the effects outdoor learning has on young children's mathematical development. The reasoning behind choosing this sample of participants is at the

age of four and five the young children are naturally curious and love to explore and are developing their mathematical skills everyday (Keenan, Evans and Crowley, 2016). The choice to choose participants from two different schools was with the hope of attaining qualitative results from a broader area, making the research fair compared to only carrying out research in one school. The research will be carried out in the two different schools in their outdoor learning area to ensure the young children are in their natural learning environment and ensure they are comfortable in order to attain more reliable results (Boyd and Bee, 2013).

In order to attain more reliable results this research project will take place over a period of four months, allowing the researcher to be present in both schools and let the children familiarise themselves with them for them to feel more comfortable. With the hope that when the chosen methods of research are carried out the children and teaching staff will act how they would normally in everyday outdoor learning. Dowling (2014) suggests that feeling safe and comfortable is vital to a young child's healthy development. Keenan, Evans and Crowley (2016) agree and believe that in a supportive environment with staff the child is comfortable with will encourage the child to engage and they are more likely to explore.

This research project will be conducted using ethnographic research which is a qualitative method for collecting data, often used for researching behavioural and social sciences (Sangasubana, 2011). Data is collected using observations and interviews usually on-site or in a naturalistic setting which requires the researcher to fully immerse themselves in the day to day lives or culture of those under study (Sangasubana, 2011). Similarly, Hammersley (2014) states that this process is holistic, inductive and requires a long-term commitment from the researcher.

The observations will be carried out on the ten children and the teacher's involvement during an outdoor learning session of mathematics. Letters of consent with be sent out to the participating children's parents prior to the research being carried out, following that verbal assent will be attained from the children themselves. This will be discussed in-depth in the next section of this portfolio.

Mukherji and Albon (2018) believe that observations allow the researcher to observe participants in their most natural settings. Furthermore, it will allow the researcher to witness the participants react to situations and make certain choices first hand

opposed to taking their word for it in an interview alone. Newby (2014) believes that in order for the research to be reliable, it must take place on a regular basis, this way the researcher will have a better insight into how the children are developing. The observations will take place every day over a four-week period in each of the schools. This will allow the additional two months prior to be solely for the researcher to spend time with the children and the teachers in the settings, ensuring the children and teachers familiarise themselves with the researcher (Mukherji and Albon, 2015).

The researcher will be present during the sessions of learning mathematics outdoors and will conduct field notes on what they observe about the children's actions, behaviours, expressions and interaction. The researcher will take guidance from the foundation phase curriculum in Wales as to where developmentally the children of this age should be and what type of mathematics they will be learning. For instance, Welsh Government (2022) suggest that children aged four and five should be able to recognize numerals up to 20, count using their fingers and recognise and be able to draw symmetrical shapes. All of these activities can be learnt outdoors, with most of them using natural objects like leaves or stones for counting.

Following the session, the researcher will expand on their notes, therefore gaining an in-depth understanding of what they have observed. Field notes are a qualitative approach often used in ethnographic research (Sangasubana, 2011). Field notes are a written form of observations in which the researcher will record during or immediately after they have observed the participants (Newby, 2014).

Following the sessions outdoors, the researcher will conduct a separate semi-structured interview with the teacher and the teaching assistant, allowing the researcher to understand their perception and see if they match the observations made. Data will be gathered via note taking and a voice recording of the conversation. According to Galleta (2013) semi-structured interviewing is a method usually consisting of a dialogue between researcher and participant, guided by a flexible interview style. Set questions will be prepared, however this method allows the researcher to attain open-ended answers, allowing the researcher to ask further questions based off the responses they receive (Lambert, 2019). The choice to use open-ended questions will allow the researcher to explore what the teacher thinks

the effect outdoor learning has on children's mathematical development and to understand their feelings towards it and whether they notice any benefits or not.

During the planning of this project other forms of gathering data were considered like questionnaires for example, however, the decision was not to use them. Mayer (2015) believes that questionnaires often look at gathering quantitative data using methods like the likert scale which looks at gathering numerical data opposed to focussing on words and meanings. Some questionnaires can include qualitative questions, however, Wyse, *et al.* (2017) suggests that participants will often want to communicate more verbally than they will be willing to write down on paper.

Having taken both qualitative and quantitative data collection into consideration, it is evident that from this mixed method approach that qualitative data is what is required. Qualitative data focuses on gaining an in depth understanding of a chosen subject through asking open-ended questions and conversational communication focussing on words and meanings, whereas quantitative research would be collecting and analysing numerical data (Mayer, 2015).

Coe *et al.* (2021) suggests that there may be some limitations to one researcher carrying out observations, such as children's actions or body language might be missed during observations. The child might be experiencing an 'off day' or feeling upset resulting in them not wanting to engage in the activity like they would normally, this would affect the research results. Kumar (2019) agrees and states another limitation may be observer bias. This may happen when the observer is aware of the aims of the research and has expectations or opinions that may influence what they perceive or record during the study (Kumar, 2019).

Another factor to consider is the Hawthorne effect. This is when participants in research may modify their behaviour in response to them knowing they are being observed (Mostafazadeh-Bora, 2020). Therefore, unintentionally the research findings may be distorted (Newby, 2014). The halo effect is also a limitation to consider during conducting interviews in research. Nicolau, Mellinas and Martin-Fuentes (2020) states that the halo effect is a form of cognitive bias, where a researcher's impression of a person may influence how they think and feel about their character. This could be wanting to interview the head teacher as the

researcher believes they must be knowledgeable as they have a powerful role, this may impact the evaluations of that person's role.

Triangulation will be applied in this research project. Triangulation can be used as a qualitative research strategy to test the validity or trustworthiness of the information gathered through different sources (Carter *et al.* 2014). Similarly, Roulston (2018) agrees and states that triangulation is when several methods or data sources are used in qualitative research to develop an understanding of the subject. The use of both observations and interviews in this project ensures that triangulation is being applied to help reduce research bias that may come from a single method approach. It can also help enhance the validity of the research by approaching the same topic with different tools (Carter *et al.* 2014).

Ethical Considerations

According to Miller (2012) research ethics are the moral principles that decide how an individual will carry out their research. These moral principles help to guide researchers to conduct their work without knowingly or unknowingly deceiving or causing harm to participants or members of society (Palaiologou, 2012). Miller (2012) continues to state that these moral principles are used by university governing bodies and governments to shape the research regulations which must be followed by researchers when completing their work.

According to Bertram *et al.* (2016) researchers should be aware of the risk and potential of causing harm to young children during the research and ensure that adequate protection is put in place, not only to protect the child but the researcher and their organisations also. BERA (2018) state that educational researchers when undertaking research should operate within an ethical respect of any participants involved. The participants involved should be treated fairly, with dignity and with respect and freedom from prejudice (BERA, 2018).

According to ERIC (2020) when planning to conduct a research project it is vital to obtain consent from the participants and their organisation including parents or carers if there are children involved. This is important to the research relationship and is a signal of respect for the participants dignity and ensures they have the right to share their views and the right to have them heard in matters that affect them (ERIC, 2020).

The first step in gaining consent for this research project will be to contact both school's head teachers to discuss if they would like to be involved in this study. Following this a meeting will be arranged with the head teachers to discuss in detail what this research project will consist of and the reasoning behind it, including methods used and data protection. Following discussion and providing the schools are happy to be involved then letters of consent will be sent out to the teaching staff and the parents of the children that may be involved inline with the guidelines outlined by BERA (2018). In person visits will also be arranged with the possible participants and the children's parents to discuss consent and any ethical issues in accordance with BERA (2018) and ERIC (2020).

It is worth noting that once consent has been given by the children's parents then verbal assent will be required from the children themselves (Harcourt, Perry and Waller, 2011). According to BERA (2018) the difference between consent and assent is adults over the age of eighteen can give consent, where as assent is the agreement given by a young person under the age of eighteen who are not legally empowered to give consent. It is important that the researcher provides the young child with information that matches their capacity when gaining assent (Palaiologou, 2012).

National Society for the Prevention of Cruelty to Children (NSPCC) (2020) suggest providing information sheets for the participants outlining all aspects of the research project and what will be required from them ensuring the researcher is completely transparent. The information sheet will disclose all aspects of the research being conducted to avoid deception or not informing the participants about what is going on. According to University of Wales Trinity St David (UWTSD) (2022) is it also vital that the participants be made aware that they have the right to withdraw from the research at any time, even if they have already consented to be a part of it. This will be outlined in the information sheet and also during the research the researcher will be reminding all involved that they have to right to withdraw at any stage and ensure all are happy to continue each time the research is being carried out. This way the researcher will know if an individual no longer wants to participate.

Once these sheets are provided to the participants and the researcher has verbally informed them of all aspects outlined, ensuring that the participant does not feel

pressured or swayed into participating then voluntary informed consent can be obtained (Mauthner *et al.* 2002) and (BERA, 2018). Voluntary informed consent is one of the main principles for research ethics (UWTSD, 2022). The intention is that participants can enter research freely and fully informed of what it means for them to take part, and that they are consenting to before taking part (BERA, 2018).

During the research the children will be continually informed of why the researcher is there and they will be informed that they have the right to dissent if they wish too. Dissent is when a participant, usually a young child, wishes to refuse participation in the research (Walker and Solvason, 2014). The children will be given this option at any point during the research.

It is important to consider the rights of the child during research in accordance with The United Nations Convention on the Rights of the Child (UNCRC) to ensure the children and their well-being are protected (UNICEF, 2021). Article 3 of UNCRC states that any actions concerning children should have the child's best interest as the primary consideration (UNICEF, 2021). In terms of research, this means that the best interest of the child is top priority and the risk or harm to the child is minimised by putting adequate protection in place (BERA, 2018). It is also important to understand the ethical implications of excluding some children from research, or not taking into consideration their views in accordance with article 12 of UNCRC (UNICEF, 2021). This states that the child has the right to express their views freely in matters that affect them. To put these into practice, during the research the researcher will ensure that the child is central to all decisions made and that their views shall be listened too as advised by Christensen and James (2017). Christensen and James (2017) also state that children do not always feel pressure, although they are always keen to help, therefore it is important that they are made aware continuously of why the researcher is there and if they do not wish to take part then it can stop at any point.

Another ethical factor to consider is how to protect the confidentiality and anonymity of everyone involved. According to Petrova, Dewing and Camilleri (2016) there is a difference between the two, anonymity is when the researcher does not know who the participants are or has no information about them. Confidentiality means the researcher knows who the participants are, however, any identifying information will

be removed from the research report. ERIC (2020) suggests respecting the privacy and confidentiality of all participants including the children involves close consideration of many aspects, including privacy with regard to how much information the participant wants to share, and with who, ensuring that the information that is gathered and stored is done in a way that is confidential to those involved, and privacy to the participants so they are not identifiable in the publication findings. To protect confidentiality and anonymity during this research project the school names and the names of the participants will be kept confidential in the publication of findings in line with ERIC (2020).

It is important to disclose to the participants that all information will be kept confidential, however, there are limits to this for example if the researcher were to witness any harmful behaviour or sensitive information was disclosed to them then they would be obliged to break the confidentiality/anonymity and pass that information onto the appropriate person (BERA, 2018). In a school setting, it is likely they will have their own protocols on safeguarding, therefore the researcher could follow those guidelines when necessary.

All data collected in this project will be written notes and recordings of the interviews only. This data will be stored safely in a locked cabinet in a locked room, or on a university computer memory stick, which are password protected and encrypted ensuring the data is kept secure in line with the data protection act 2018 (UWTSD, 2022). The Data Protection Act 2018 is the UK's implementation of the General Data Protection Regulation (GDPR) 2018, which is in force to control how personal information is used by organisations and to protect an individual's right to confidentiality (BERA, 2018).

In line with the GDPR 2018, the participants will have the right to view all data gathered involving them and this should be made accessible to them should they wish to view it (UWTSD, 2022). When the research is completed, the findings will be shared with the participants and the parents of the children before being published to ensure all involved are satisfied and will be an opportunity to discuss the findings.

It is important to follow the GDPR 2018 guidelines on how and when to dispose of the data correctly (BERA, 2018). Upon completion of the research project, it is important to dispose of all participant contact information and data gathered

immediately by shredding and disposing in confidential waste available in the university and all interview recordings to be erased (UWTSD, 2022).

During this research project there could potentially be risk to those involved, therefore it is important to know how to reduce this. The potential risks to the participant could be feeling uneasy or experiencing emotional distress having a researcher present, causing disruption to the session. Nolan, Cartmel and Macfarlane (2013) suggest the researcher works with the teachers and children to choose a time and length of observation that best suits them. If the researcher notices any cues of withdrawal from the children, then the observation will stop. The researcher will use a non-intrusive approach as to not disrupt the outdoor learning (Bruce, 2012). There may be potential risk of physical harm to the participants considering the observations will take place outdoors, the researcher should follow the school's protocol and risk assessment in case physical harm was to occur (UWTSD, 2022).

Some risks to the researcher could be risk of physical harm when in the outdoors. Ensuring appropriate health and safety measures are in place can help reduce this. The researcher is also at risk of being accused of impropriety regarding the way they have interpreted the data, they may be viewed as being dishonest (Bertram *et al.* 2016). It is important for the researcher to be transparent and show everything and to be objective during research. There could be negative repercussions on the researcher and the university if they were to lose any data or recordings they have and risk breaking confidentiality as they are a UWTSD student. The researcher will follow the Data Protection Act 2018 as previously mentioned in this portfolio to ensure they store the data correctly.

Another risk to the university could be adverse publicity if the researcher fails to adhere to the school's policies or acts unprofessionally, this will have a negative effect on the university. To avoid this the researcher will discuss policies and procedures with the head teacher prior and ensure they are aware of best practice (UWTSD, 2022).