Aim of Research

The aim of this task is to engage in educational research exploring the perceptions and engagement of year 6 pupils using Game-Based Learning (GBL) in mathematics. Mathematical skills are important for academic achievement and future educational opportunities (Kiwanuka et al., 2020); however pupils attitudes towards maths can affect their confidence and engagement (Goldin et al., 2016). The purpose of this research is to find out how the use of GBL in maths supports year 6 pupils' engagement. This will help in understanding how this learning strategy can support pupil motivation and engagement in learning maths and improve their overall experience. GBL in maths is an interesting area of research with much scope for exploration due to the variety of resources available to educators. In addition, Initial Teacher Education emphasises the importance of trainee teachers like myself engaging in educational research (Welsh Government, 2023), this provides the opportunity to explore a topic of interest, engage in research activities that encourage experimenting with and evaluating a new learning approach; supporting my own professional teaching practice and knowledge.

The research was conducted in a primary school located in one of the most deprived areas in the Swansea Local Authority, according to data from the Welsh Index of Multiple Deprivation (Swansea Council, 2019). The schools Estyn (2019) report mentions that pupils who start school have numeracy skills lower than expected of pupils at a similar age. Estyn (2019) also recognised teachers provided pupils with learning opportunities which enabled them to practise skills in a fun way and positively impact on their attitudes towards learning. The educational research was conducted in a Year 6 classroom, which had a total of 27 pupils placed in mixed ability groups.

Research question: **'What are the perceptions and engagement of year 6 pupils on the use of game-based learning in mathematics?'**

Literature Review

Duncan et al. (2007) and Kiwanuka et al. (2020) recognised maths skills are vital to pupil's learning, success within school and future academic opportunities. However, Goldin et al. (2016) highlighted that pupils attitudes towards maths can impact their confidence and engagement, affecting their motivation to learn. Ashby (2009) and Davadas and Lay (2017) both agreed with this statement and suggested that pupils personal experiences shape their attitudes and outlook on the subject. Studies from Aiken Jr, 1970, Ashby, 2009 and Hwang and Son, 2021 have shown how pupil's attitudes can have a positive or negative impact on their learning and achievements. The reason for these negative attitudes are varied and complex, influenced by factors such as lack of self-belief, misunderstanding of concepts, failure to see the real-life value of maths, and negative influences from adults and home environment. These factors/attitudes can be damaging to pupils engagement and motivation to improve their maths skills (Morsanyi et al., 2017; Grootenboer and Marshman, 2016).

A study by Syyeda (2016) found that pupils with negative attitudes towards maths are less likely to pursue the subject further, while those with positive attitudes are more engaged in lessons and motivated to pursue the subject in further education. This study provides insight into how attitudes influence motivation to learn maths. But, it only focuses on secondary school pupils aged 11 to 15, older than the primary focus of this research. However, a study by Larkin and Jorgensen (2015: 936) focused on year 6 pupils and found that those with negative attitudes often felt "hatred, boredom, and frustration" towards maths, it was also highlighted that these feelings were influenced by past learning experiences and teaching practices used to teach the subject. This recognises the importance of educators using a teaching and learning approach that provides a positive outlook on the subject. National Numeracy (2020) emphasises that to improve pupils attitudes towards maths, educational settings must create learning experiences that focus on building confidence and positivity towards maths. Anthony and Walshaw (2009) also suggest that using certain learning experiences can boost pupil's motivation, highlighting the importance of pupils participation in various fun and interactive learning activities like GBL to help them create positive experiences involving maths.

In 21st-century education and classrooms, there's a shift towards pupil-centred learning which focuses on encouraging pupils to taking ownership of their own learning (Alias and Luaran, 2017). The National Curriculum for Wales was first introduced in 1988, with

ongoing changes in the world of work, technology, and society, there's need to adapt teaching and learning approaches (Welsh Government, no date). The introduction and implementation of the Curriculum for Wales in 2022 aims to provide pupils with creative and interconnected experiences to develop fundamental skills needed to adapt and thrive in a changing world (Welsh Government, 2017). This change in Welsh education provides an opportunity to introduce new teaching approaches to support pupil's academic growth and progression. Koh (2015) suggests that implementing new approaches into teaching and learning can enhance pupil engagement and motivation.

GBL is an approach that uses games to engage pupils in their learning (Ke teal., 2019). It combines classroom and pupil-centred learning through the use of educational materials/ games; making learning fun while introducing pupils to new learning concepts and supporting them in achieving their academic goals (Trybus, 2015). It is recognised as a major learning trend in the 21st century (Pho and Dinscore, 2015)**,** Zou (2020) recognises a growing interest in this approach, as there has been an increase in research studies since 2019. Liu et al. (2021) highlights how GBL can increase pupils motivation by providing them with a fun and creative way to learn and helps them to develop problem-solving and collaboration skills. This study highlights the benefits of GBL but solely focuses on digital-GBL, Wong and Osman (2018) suggest that GBL can involve digital and non-digital games. However, research by Hui and Mahmud (2023) investigated both digital and non-digital GBL and their positive impact on pupils learning maths. Their findings showed GBL simplifies maths by actively engaging pupils in hands-on/interactive learning, which helps them to practise skills, receive instant feedback and learn new concepts or reinforce previous learning in an enjoyable manner, helping to boost their motivation towards the subject.

There is a growing body of research into GBL and highlights the benefits it brings to engaging pupils in maths. However, studies mainly focus on pupil's attitudes and emotions towards learning the subject, neglecting their perceptions of it. By addressing this research gap, we can understand why pupils enjoy this learning approach, providing valuable insights into their engagement levels. Also, gathering pupil's thoughts on future maths lessons using this approach can promote pupil-centred learning, helping to inform future lesson planning. I will further explore research from Hui and Mahmud (2023) as the lesson will involve the use of both digital and non-digital games to assess pupil's engagement and perceptions of maths.

Explanation of Case Study

Hamilton (2011) states that case studies are a research method involving use of various data collection techniques and gathering perspectives from the participants, helping to develop an understanding of a topic. Bartlett and Vavrus (2018) state case studies are widely used in educational research and Thomas (2011) explains the purpose of this method is to provide the researcher with the tools to explore diverse views within a specific situation and develop a deeper understanding. Tight (2017) recognises there are numerous definitions of case studies because each piece of research has it's own unique focus/purpose, meaning that it varies based on the approach to the study. However, Tight (2017) and Priya (2021) both highlight key elements of case studies. Case studies are a form of qualitative research that use a holistic approach, offering flexibility in data collection and examine various subjects such as individuals, families and communities within their natural real-life contexts. Yin (2009, as cited in Baskarada, 2014) mentions that case studies can be exploratory, descriptive, or explanatory, and the preferred research method when seeking answers related to 'how', 'what', and 'why' questions.

Thomas (2015) stresses the importance of identifying the appropriate case study method, this means considering factors such as research question, purpose, design, and audience. This involves choosing the type of case study (Thomas, 2015) and between a single-case study, focusing on one situation, or multiple-case study, covering a broader range of situations (Gustafsson, 2017). In this study, an exploratory single-case study approach is adopted because it focuses on one situation, exploring the perceptions and engagement of pupils in GBL when learning maths. The case study approach has many advantages, single-case studies are more affordable and less time consuming compared to multiple-case studies (Gustafsson, 2017). Hamilton and Corbett-Whittier (2013) also state case studies in educational research enable researchers to focus deeply on specific topics, offering practical insights and flexibility within real life contexts. Additionally, case studies allow for the examination of unique cases, potentially offering valuable perspectives for other researchers in the field.

However, Lee and Saunders (2017) comment on the limitations of case studies, and that findings may be difficult to generalise because it focuses on one situation. Sonderman and Dolles (2013) raise concerns about the validity and reliability of research findings because there is no comparison with other cases. Ferreira et al. (2020) suggest triangulation to help

address these concerns and improve the validity of study findings. This involves using various data collection methods instead of relying on one. This can help strengthen the credibility of findings and provide a more thorough understanding of the topic. This factor was considered during my research, which influenced my decision to use observations and group interviews for data collection.

Andrade (2020) mentions that research/case studies use samples because studying the entire population is impractical and findings from the sample are intended to apply to the population as a whole. Therefore, researchers must employ proper sampling methods to create a representative sample, ensuring accurate findings that are applicable to the larger population (Andrade, 2020). For my research, participants were chosen through simple random sampling. Random sampling involves selecting participants using random number tables/generator or a 'pick a name out of a hat' approach (Newcastle University, 2024). Daniel (2012) states random sampling is cost-effective, easy to implement and ensures every individual has an equal chance of being chosen. This can reduce results bias and ensure the sample is more representative and accurately reflects the whole population. However, Sharma (2017) highlights the limitations in random sampling, there is a risk of sampling errors, leading to under-representation of certain groups and inaccurate conclusions about the population. Good and Hardwin (2012) state to overcome potential errors, implementing sampling procedures that clearly state the target population and developing a method such as using a digital generator or random selection from lists. This can help to increases the randomness during the selecting process, enhancing the validity and generalisability of research findings (Good and Hardwin, 2012). This is something I considered in my research, the 4-5 pupils chosen were randomly selected from the classroom register after obtaining parental consent.

Research methods

This research used qualitative research methods, including observations and group interviews with 4-5 pupils. These methods were used to explore and generate data about the pupil's thoughts, opinions and experiences with GBL in a maths lesson and how it influenced their understanding and enjoyment. A maths lesson was planned (See Appendix A) that involved pupils engaging in 3 tasks that supported their learning about probability, it involved digital and non-digital games that were practical and interactive. Random sampling was used to ensure a diverse group of students with varied academic ability were chosen, reflecting the school's mixed-ability classes.

Observation:

This involved observing the established group of 4-5 pupils during the probability lesson. The observation's focus was studying pupil engagement levels using the Leuven Scale of Active Engagement in Learning (See Appendix B), information about each level will be included on the observation form, aiding with assessing pupil engagement during the lesson. Pupils were observed for 5 minutes in each activity, their comments, body language and attitudes were noted and each pupil given a score of 1 to 5 based on the Leuven Scale of Involvement in Learning (Laevers and Heylen, 2003). This scale and 5-minute intervals were used to allow time for note taking and observation of all participants during the lesson. During the observation, pupils may change their behaviour and act differently due to social desirability bias or self-consciousness (Christensen and James, 2017). Therefore, the observation was held in a familiar environment and trust was established with pupils prior to the research. This can help to minimise bias and other influences, leading to deeper insights and enhancing the credibility of research findings (Creswell, 2014).

Observations are a method that gathers data by watching and recording what is happening in a real life situation, this can help to develop an understanding of people's behaviours and interactions, including non-verbal cues such as gestures in different areas of study (Newcastle University, 2024a). They provide valuable and immediate data which can enhance credibility and support the understanding of pupil's behaviour and engagement (Johnson, 2017). Sapsford and Jupp (2006) believe observations can work alongside other research methods and help to develop a deeper insight into a complex topic. However, they can be time-consuming and raise ethical concerns about privacy and consent, especially with vulnerable people (Queiros et al., 2017). Resnik (2020) stresses the importance of careful planning and ethical considerations, this helps to create a responsible study that prevents harm, maintains participant privacy, follows professional standards and ensures the credibility of research findings. Also, Engel and Schutt (2016) share concerns about selective observation, the researcher may unintentionally focus on certain factors and overlook others, leading to biased or incomplete data, affecting the reliability of the research findings. However, Thomas and Hodge (2010) recommend researchers preparing clear aims/criteria on what to observe, this can help them to remain focused and ensure the data collected is relevant to the research question, helping to enhance the validity and quality of findings (Thomas, 2017). I took this into consideration

during my research planning, leading to my decision to use the Leuven Scale of Involvement in Learning.

The Leuven Scale of Involvement in Learning is an observation-based tool which aims to measure a child's engagement during a task (Laevers and Heylen, 2003). It can help with understanding how children become involved during activities, there are five levels within the scale which range from extremely low: bored or extremely high: greatly involved (Woods, 2016). Ktoridou et al. (2020) states the Leuven Scale of Involvement in Learning provides structured measurement for assessment and clear criteria for each level which can help to identify patterns of engagement and gain insight into pupils learning. It can also help to enhance research validity because it provides a consistent and reliable method for assessing pupils engagement (Ince and Kitto, 2019). However, MacRae and Jones (2023) mention the scale has limitations, it focuses on what pupils do and may miss other valuable information such as their interests, motivation and cognitive engagement. Coe et al. (2021) highlights to overcome this, researchers can use additional research methods such as interviews to help them gain more information and understanding of pupils engagement, supporting the findings of the scale.

Group Interview:

This involved interviewing the 4-5 pupils using a pre-planned list of open-ended questions (See Appendix C), pupils shared their perspectives, thoughts and opinions towards the lesson and how they thought it helped to stay engaged. Interviews were planned to take place as soon as possible after the lesson to ensure the accuracy of the pupils perceptions, thoughts and opinions (Cohen, Manion & Morrison, 2017). Pupil responses will be recorded by taking written notes completed during or straight after the interview. Because interviews may raise pupil's anxiety (King and Horrocks, 2010), the interview was held in a neutral and safe space familiar to them. In group interviews, the interaction between participants such as dominance, silent participants, peer influence and social pressures can influence the discussion and viewpoints shared (Vogl et al., 2023); therefore before the interview, pupils received clear instructions on how to behave during the interview, this included equal participation, being respectful, and taking turns when speaking. This helped to promote a standardised and ethical environment which can help to reduce behaviour variability, while also ensuring respect, consistency and inclusivity is maintained, enhancing the reliability and credibility of research findings (Krueger and Casey, 2015).

Group interviews is a method that involves planned discussions with a small group led by the researcher, this can help to gather varied perceptions and data from a group interaction (Krueger and Casey, 2015). They are time-efficient and using open-ended questions can provide insights into perceptions and interactions in the group (Kamberelis, and Dimitriadis, 2013). This method enables the researcher to explore participants diverse responses, enhancing the researchers understanding within the study (Barbour, 2018). Group interviews can also create a supportive environment for sharing, encouraging collaboration and open discussion, helping to enhance data collected and validate findings through direct engagement between researcher and participants (Cyr, 2019). However, these methods have limitations, Bell and Waters (2018) highlight there is limited control over the discussion and data collected, also participates can respond without constraints to open-ended questions. This can lead to vague or wide ranging answers, impacting the depth of data collected, making it difficult to analyse (Weller et al., 2018). Flick (2021) recommends using a structured approach to address these challenges, it can help to provide clear instructions and guide participants toward relevant information, preventing participant fatigue and simplifying the data analysis process.

Ethical Considerations

In educational research it is vital to follow ethical practice. Robson (2002) describes ethics as adherence to a set of principles or codes of conduct. As a student representing the University of Wales Trinity Saint David (UWTSD), it is important to follow the ethical considerations outlined in their Research Ethics and Integrity Code of Practice. This emphasises the expectation of maintaining high ethical standards during the research process, ensuring it follows ethical, legal and professional framework (UWTSD, 2022). Data protection requirements, including those outlined in UWTSD's Research Data Management guidelines (2022), General Data Protection Regulations, and British Educational Research Association (BERA) guidelines, must also be considered regarding data purpose, retention, and storage. All participant data must be handled with care and remain confidential (UK Data Service, 2021: BERA, 2018), aligning with article 16 of the UN Convention on the Rights of the Child: right to privacy (Welsh Government, 2021). To ensure anonymity, any identifying details about participants will be removed, and they will be assigned unique identifiers (e.g., Child A, B, C). The results from the study will be stored securely in a locked filing cabinet or the University’s encrypted Office 365 system and data will be destroyed after the assessment is marked.

Also, it is essential to gain pupils assent and consent from parents or carers, this involves making participants fully aware of their involvement within the study and understand their right to withdraw at anytime (Brooks et al., 2014). However, gaining pupils' assent can be challenging due to school environments that emphasise conformity, making it difficult for pupils to express their thoughts and feelings freely (Kirby, 2020). Pupils may also seek approval from their teachers, potentially influencing the relationship with the researcher and introduce social desirability bias into the educational research (Christensen and James, 2017: O'Reilly et al., 2013). To ensure authentic assent, pupils must be fully informed about the study and its requirements, as outlined in the UWTSD (2022) and BERA (2018) guidelines. Ethical considerations are outlined in the ethics form (see Appendix D). Parental consent will be obtained through a consent form (see Appendix E). Also Pupils age, maturity and psychological capability was taken into account prior to seeking their assent. Pupils participating in this study are aged 10-11 years, The British Psychological Society (2019) state pupils this age can participate in the assent process, using a simplified assent form. Gaining Assent involved having a discussion with the pupils about the study and their involvement, then having them complete a simplified assent form (see Appendix F) to show their permission to participate.

Data Presentation and Analyse Methods

Data analysis involves obtaining and converting raw data into meaningful information for research purposes (More et al., 2019). By analysing data through chosen research methods, researchers are able to interpret findings and identify patterns relevant to their research aim (Awang, 2013; Bergin, 2018). Holmes (2020) states student researchers engaging in educational research must acknowledge their postionality. Rowe (2014) and Johnston et al. (2020) both highlight how a researcher's personal background and beliefs can impact data analysis in various way, including biased interpretations, selection of research method, data collection and interpretation of findings and also impact ethical considerations. Holmes (2020) states that acknowledging positionality promotes transparency and minimises bias. However, Bell and Waters (2018) highlight that no research is perfect and researchers must recognise their role and understand they cannot be entirely impartial. But, Amoureux and Steele (2016) recognise that researchers who acknowledge their positionality and engage in reflexivity can help to identify the strengths and weaknesses of their research. This encourages openness to influences and prompts questioning of assumptions during the research process, leading to bias awareness,

continuous reflection and transparency. I considered this and incorporated reflection and assumption questioning into my research to ensure the credibility and quality of my work.

Gibbs (2018) states there are different ways to analyse qualitative data, this research used a Thematic Analysis (TA) approach for data analysis. Javadi and Zarea (2016) highlight TA is a common approach used in qualitative research, Braun and Clarke (2006: 79) defines TA as: 'a method for identifying, analysing and reporting patterns within data' and it has a 6-step process: Familiarisation, Coding, Generating themes, Reviewing themes, Defining themes and Reporting. TA has numerous strengths, it is a flexible and accessible approach and can be applied across various research types (Nowell et al., 2017). Braun and Clarke (2022) also mention TA is simple to learn and apply, making it suitable for researchers of all experiences. However, Jason and Glenwick (2016) state there are numerous ways to interpret themes, making it a challenging and time-consuming process. Terry and Hayfield (2021) suggest organising the data carefully and using tools to simplify this process, reducing time and stress. TA also enables the researcher to gain/provide detailed interpretations of data, helping to better understand perceptions and develop insights about the topic (Terry and Hayfield, 2021).

Moravcsik (2019) stresses the importance of transparency within research, this includes documenting research processes, data collection method and challenges, this can help to enhance the trustworthiness and reliability of findings. Silverman (2020) also suggests assessing credibility by observing participant behaviour and interaction because they change how they act to conform with expectations, therefore researchers must try and reduce these influences to ensure they provide insight that is authentic. I took this into consideration and provided participants with clear guidelines on how to conduct themselves during the observation and group interview (e.g. being respectful and turn-taking) to ensure respect and inclusivity. I also used triangulation in my research, as Ferreira et al. (2020) suggests. It can help to compare data and show consistencies, helping to strengthen the findings credibility, providing more understanding of the topic.

Discussion and Results

Five pupils were included in this study, however one pupil was absent on the day the research was conducted, therefore results are based on 4 pupils. Based on the analysis and results using the Leuven scale observation and group interviews, there were 3 over-

arching themes: 1) Pupil's High Engagement Levels, 2) Pupil's Preference for Activities and 3) Positive language used to describe the lesson (Fun/Like).

1) <u>Pupil's High Engagement Levels:</u>

All pupils showed high levels of engagement across the various activities during the probability lesson, as evidenced by their scores of Level 4 or 5. The high level of engagement suggests that the digital and non-digital activities provided were stimulating and interesting which helped engage and motivate them during the probability lesson. This relates to Liu et al. (2021) who highlighted how GBL can help to boost pupil's engagement/ motivation to learn maths in a fun way. The lesson provided opportunities for the pupils to problem solve, collaborate and explore, helping them to remain focused and have meaningful and positive learning experiences, progress and achieve. This supports the findings of Hui and Mahmud (2023) demonstrating the use of both digital and non-digital GBL can allow pupils to learn in an enjoyable manner while boosting their motivation towards the subject. The high levels of engagement observed across the different activities suggests the pupils found the activities interesting, stimulating and enjoyable. This recognises the importance of pupil's engagement and attitudes within their own learning as recognised by Goldin et al. (2016) who stated that attitudes influence confidence and engagement, making pupils more likely to participate and be invested in their learning.

<u>2) Pupil's Preference for Activities:</u>

The results from the observation indicate that each pupil had different preferences for activities based on their scores. Child A and Child C favoured the practical game as they scored the highest in this and the dice investigation game, while Child B showed greatest interest in the practical game, scoring highest in this area. Child D seemed to have an equal interest in all three activities as indicated by their Level 4 scores across the board. During the interview, all pupils expressed their interest in more interactive games in the future. All pupils mentioned they would like more 'Hands-on games' while Child A further commented 'Games that we can do in the tuff tray'. All pupils mentioned they would like more digital games during their maths lessons involving the use of laptops or iPads because they believe it makes the lesson more 'Fun'. This recognises the importance of pupil feedback, this can help educational staff and settings to provide a variety of learning opportunities involving digital and practical/non-digital games that promote positivity and boost pupil's confidence which relates to National Numeracy (2020) and the statement by

Anthony and Walshaw (2009) that these experiences can help to improve pupil's participation, motivation and learning outcomes when learning maths.

3) Positive language used to describe the lesson (Fun/Like).

All pupils used positive language throughout the interview and expressed their enjoyment of the lesson. They believed it was enjoyable and commented 'It was fun' and 'I liked it' while showing positive facial expressions that reflected their enjoyment and excitement for the lesson. Other comments such as 'It was exciting' (Child C), 'Made maths easier to learn' (Child A & Child D) and 'Good and enjoyable' (Child B) were also made during the interview. These comments indicate that this experience enabled them to think positively about learning maths, helping them to feel confident and motivated to explore and further develop their maths skills. This recognises the importance of positive learning experiences which can be influenced by pupil's personal experiences towards maths as highlighted in Ashby (2009) and David's and Lay (2017) statements. Also this can influence pupil's mindsets towards maths and can influence their motivation and confidence in their abilities and how they face mathematical challenges and studies in the future which relates to Syyeda (2016) and Larkin and Jorgensen (2015) study of pupil's mindsets and motivation.

Conclusion and Recommendation

The purpose of this assignment was to engage in educational research that studied year 6 pupils perceptions and engagement with GBL use in mathematics. A single-case exploratory study was conducted in a primary school using the qualitative research methods of observations and group interviews. It is important to recognise that research cannot be absolutely perfect, therefore researchers need to reflect on the process to recognise strengths and areas for improvement, promoting transparency and trustworthiness. This was a short scale piece of research conducted in a short space of time and provided a small amount of data; observations and group interviews were chosen to provide an understanding of pupil engagement and perceptions. The use of the Leuven Scale of Involvement in Learning during the observation allowed for a structured assessment of pupil engagement, while group interviews provided an opportunity for in-depth exploration of pupil perspectives. However, it is important to acknowledge the limitations of these methods, such as potential bias and the difficulty in generalising findings beyond the specific context of the study. Although, there is no end point to educational research, the findings did provide an insight into pupil experiences and engagement with GBL when learning maths. A recommendation would be to conduct

further research on a larger scale, this could explore the long term effects of GBL on pupils engagement and learning and investigate the effectiveness of different GBL approaches in diverse educational settings which can inform teaching and learning practice.

Additionally, implementing alternative methods such as questionaries can help to gain perceptions from a larger number of participants. Standardised questions could be designed/used to gather specific data while ensuring consistency in data collection across different participants and educational settings. Also, due to participant responses being anonymised, they may feel more comfortable in providing honest responses, leading to more accurate and authentic data. This opportunity has taught me the process of implementing educational research and supported my future professional practice. This experience has enabled me to try a new teaching approach within the classroom, develop my teaching approaches and evaluate and share the impact with others which relates to the teaching standard ‘Evaluating the impact of changes in practice’. This experience will be documented in my Professional Learning Profile by creating a Professional Experience Template. I believe this will help me to feel more prepared to engage in my own future research or assist others with their own, helping to reach the research goals.

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