WHOLE CLASS WORKING MEMORY INTERVENTIONS:
AN EVALUATION AND COMPARISON OF THE IMPLEMENTATION OF COMPUTERISED TRAINING
AND A PRACTICAL, CLASS BASED PROGRAMME

A thesis submitted to the University of Manchester for the degree of Doctorate in Educational
and Child Psychology in the Faculty of Humanities

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<td>AWMA</td>
<td>Automated Working Memory Assessment</td>
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Abstract

Whole class working memory interventions: An evaluation and comparison of the implementation of computerised training and a practical, class based programme

Background: Working memory (WM) refers to a system responsible for temporarily storing and manipulating information. It is recognised as having a key role in supporting children’s learning. Research has suggested that targeted interventions can lead to improvements in children’s WM capacity or strategies to increase its efficiency. Some interventions, largely computer-based but also practical, claim to address the needs of whole classes. There is relatively little research concerned with the implementation of such programmes as whole class interventions.

Participants: Two Year 5 classes from separate schools received two WM interventions, MeeMo and Memory Booster. Six students from each class were selected to create two focus groups. Both class teachers also participated in the research.

Methods: A mixed methods design was utilised, with an emphasis on qualitative data. Each class received a randomly allocated six week intervention implemented by the class teacher. Fidelity and dosage were monitored through the use of structured observations and an implementation diary completed by the class teachers. Two student focus groups and two semi-structured teacher interviews were conducted. The in-built monitoring provisions of each intervention were also investigated.

Analysis/Findings: All qualitative data were transcribed verbatim and analysed using thematic analysis. Findings were presented as thematic maps, exploring the facilitators and barriers for implementation of each intervention. Quantitative data gathered through each interventions monitoring provision were analysed using descriptive statistics to inform discussion around the perceived outcomes.

Conclusion/Implications: The study extends understanding of the context-specific implementation factors involved in using MeeMo and Memory Booster as whole class interventions and explores the utility of the monitoring provision of each intervention. A framework for effective implementation was developed and specific recommendations for both programme developers and school staff are provided.

Keywords: Working memory, Memory Booster, MeeMo, whole class intervention, programme implementation
Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for any other degree or qualification of this or any other university or institute of learning.

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I would like to thank all of the staff associated with the University of Manchester Educational and Child Psychology Doctoral course for their approachability, support and guidance over the past three years. Particular thanks go to Dr. Caroline Bond, who has supervised my research over a long and at times undoubtedly painful process, while maintaining a positive and encouraging demeanour. The approach taken by Caroline has helped to keep me on track and maintain the focus of the research, at different stages providing optimism that the word count was not insurmountable and helping me to take a step back and remove the unnecessary drivel.

I would like to extend my gratitude to work colleagues and placement supervisors who have been extremely supportive and have helped me to develop as a psychologist.

I would like to offer huge thanks and congratulations to the other trainees who have gone through this and have emerged safely onto the other side. You’ve made the last three years a pleasure, or at least slightly more bearable!

I am grateful to my family and friends for their unwavering support and helping me to remember that there is life outside of the course and this research. Having something to look forward to on a regular basis has helped me to stay positive. I would particularly like to thank my Mum, Dad and Grandma for their constant encouragement and helping me to achieve the things I have so far.

Finally, I would like to thank Suzanne, who moved in with me at the start of the Doctorate and is still there despite it! Thanks for your endless patience, your support when I’ve not been productive and most of all for the constant supply of tea. Let’s hope that doesn’t change just because I’ve finished writing this thesis.
1. **Introduction**

1.1. **Overview of Introduction**

This chapter considers the context in which the research was conducted and provides information on the rationale behind the research. It also includes an outline of the structure and overview of the remaining chapters.

1.2. **Research context and rationale**

> “If working memory training can demonstrate its efficacy at the population level, and this leads to the prevention of academic underachievement, then a major advance in children’s education could be achieved.”

(Skelton, 2012, p. 196)

The research presented forms part of the professional doctoral training to qualify as an Educational Psychologist. It has been conducted by a Trainee Educational Psychologist (TEP). The researcher (hereafter referred to interchangeably as the TEP) is currently undertaking a unique fieldwork placement in the North West, with a cluster of seven local schools (six Primary and one Secondary) (Morewood & Rumble, 2013). During the fieldwork placement the researcher frequently worked with children and young people (CYP) who experienced difficulties with working memory (WM) which appeared to contribute to difficulties in accessing the national curriculum and achieving their full potential. Through consultation with parents/carers and teaching staff it became apparent that interventions for these students would be valued, but staff generally felt that more students in the class could benefit from improving their WM. Several computerised interventions and programmes are commercially available and many claim to cater to large groups or whole classes as well as to individual students. Recent research from Skelton (2012) developed a practical WM intervention designed specifically for whole class implementation and questioned the utility of the computerised programmes for whole class implementation, leading to the key focus of the present research. This is the implementation of computerised and practical WM interventions, namely Memory Booster (Leedale, Singleton & Thomas, 2004) and MeeMo (Skelton, 2012). Although a more experimental outcome evaluation was considered there was already some evidence for effectiveness but no exploration of implementation, which can often be more important (Snow & Juel, 2005). Two research questions (RQs) were developed to inform the present research:

**RQ1:** What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory?
RQ2: What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions?

1.3. Thesis structure

Chapter 2 provides a review of the literature, locating the research within the broad topic areas of WM and programme implementation before narrowing the focus onto literature closely related to the present research. This highlights the existing gap in the literature and leads to a rationale for the present research.

Chapter 3 details the methodology and research design applied during the research. This includes the philosophical considerations which shaped the research, the research design applied, information about the participants and data access. The methods for data gathering and data analysis are then presented before a critique of the methodology and ethical considerations are explored.

Chapter 4 provides the results of the present research. For both Memory Booster and MeeMo a summary of participant information is provided for contextual information before the implementation is considered. The results for each intervention are then presented broadly in two distinct parts; quantitative and qualitative. The chapter concludes with a summary of the results in which a comparison is drawn between the two interventions.

Chapter 5 presents the discussion of the findings by RQ. A framework for effective implementation is developed in line with RQ2. The extent to which the RQs are answered and the contribution to knowledge is explored before the limitations of the research are outlined. Finally, the implications for professional practice, programme developers and further research are considered and a conclusion is offered.
2. Literature Review

2.1. Aim and Overview of the Literature Review

The aim of the literature review is twofold. Firstly, to locate the research within the broad topic areas; working memory and programme implementation. Secondly, to narrow the focus onto literature which is closely related to the current research. This literature will be critically evaluated before a rationale for the present research is offered.

The literature review will begin by outlining the review strategy used followed by an evaluation of the literature found. An overview of the literature review will be provided, with key pieces of research being critically evaluated. This will start with an introduction to WM followed by theories of WM and an insight into each component involved in the multi-component model of WM memory. Assessment of WM will then be considered briefly before the implications of WM difficulties are outlined. A summary of research regarding WM training and interventions will be explored before focussing on the evidence base of programmes to be utilised in this research, Memory Booster and MeeMo. Implementation science and programme diffusion will be considered in a general sense, before considering their importance in school-based interventions. This will be followed by a short section regarding the role of the EP in relation to WM, relevant interventions and programme implementation. Finally, an evaluative summary of the literature will be offered before a rationale and research questions for the research is discussed. This will include the aims of the current research and how it builds on and extends the existing knowledge base.

2.2. Literature Review Strategy

The review of the literature draws on theory, research and guidance from a range of sources, including journal articles, books and ‘grey’ literature such as doctoral theses. The researcher acknowledges the differing degrees of academic rigour and status associated with the various sources, but it was felt that this was mediated by the possibility of extending and broadening the literature search. The literature was accessed via a number of methods, including a systematic search of electronic databases including PsycINFO, Pubmed, Web of Science, Sage Full Text Collection, ScienceDirect and Education Resource Information Centre (ERIC). The British Library Electronic Theses Online Service (EThOS) was also used to search for recent and relevant academic research which may not yet have been published.
The following search terms were included in various combinations and in conjunction with truncation and Boolean operators such as ‘AND’, ‘OR’ and ‘*’: ‘Working memory’; ‘intervention’; ‘training’; ‘programme’; ‘whole class’; ‘effectiveness’; ‘outcomes’; and ‘implementation’.

Searches were carried out within specific journals such as Educational Psychology in Practice. A search was made on ‘Google Scholar’ and on the University of Manchester library catalogue using the same terms. Hard copies of theses available in the Manchester Institute of Education (MIE), University of Manchester were also used when recommended by the researcher’s supervisor. The searches outlined above were initially made from the earliest dates available through to July 2013. Subsequent searches were periodically conducted throughout the research to ensure the most recent developments and research in WM and implementation science were acknowledged and included in the literature review. This comprehensive search provided a wide range of literature and key texts upon which the literature review is based. Each paper’s title and abstract were visually appraised to identify its potential value and relevance to the current research.

In summary, the literature search was used to locate and review papers primarily on i) working memory theory and evidence, ii) development of working memory in children, iii) implications of working memory for skills development, iv) working memory training and interventions, v) implementation, and vi) whole class interventions.

2.3. **Introduction to Working Memory**

Working memory (WM) plays a key role in supporting children’s learning throughout school and into adulthood. It is a term used to refer to a system which is responsible for temporarily storing and manipulating information (Alloway, 2006) in the performance of complex cognitive tasks (Hulme & Mackenzie, 1992). This information could be drawn from short-term memory (STM) or long-term memory (LTM). WM’s primary functions include encoding, effortful retrieval from LTM, enactment of strategic processes, control of attentional processes and executive management of memory systems (Dehn, 2010). It has been analagised as a mental workspace or jotting pad used to store important information during everyday life, and summarised as the ability to hold and manipulate information in the mind over short periods of time (Gathercole & Alloway, 2008). Essentially, WM is conceptualised as the processing of information while trying to retain the same or different information (Dehn, 2010). The main distinction between WM and the other two global systems (LTM and STM) is that it involves conscious ‘processing.’

WM can be considered an ‘executive skill’, something that helps us to regulate our behaviour (Dawson & Guare, 2004). Meltzer (2007) and Synder, Maruff, Pietrzak, Cromer and Synder (2007) are in agreement that WM would come under the umbrella term of executive function, which is about the effort that is made in situations where
several cognitive processes are needed simultaneously. Meltzer (2007) suggests that definitions of executive function often include the following five elements:

- Goal setting and planning
- Organisation of behaviours over time
- Flexibility
- Attention and memory systems that guide these processes (e.g. working memory)
- Self-regulatory processes such as self-monitoring.

Dawson and Guare (2009) explored and delineated the umbrella term of executive functioning, suggesting that there are a total of 11 executive functions, of which WM is typically the second to emerge. The order of emergence of executive skills in thought to be:

- Response inhibition
- Working memory
- Emotional control
- Sustained attention
- Task initiation
- Planning or prioritisation
- Organisation
- Time management
- Goal-directed persistence
- Flexibility
- Metacognition

(Dawson & Guare, 2009, pp. 16-17).

From a broad perspective, WM is a central cognitive process which is involved with the active processing of information. It appears to be fundamental, a capacity which underlies both complex and elementary cognitive processes (Lepine, Barrouillet & Camos, 2005). A meta-analysis of WM training states that it “is one of the most influential theoretical constructs in cognitive psychology” (Melby-Lervåg and Hulme, 2013, p. 270). This influence derives from links between measurement of WM capacity and a wide variety of real world skills (Cohen & Conway, 2008) and applications to issues in cognitive development and developmental disorders (Gathercole & Alloway,
WM is thought to be one of the main cognitive processes underlying thinking and learning. By utilising the contents of various memory storage systems, WM enables individuals to learn and piece together thoughts and ideas (Dehn, 2010).

2.4. Theories of Working Memory

There are several theoretical models of WM which vary in regards to the structure and function of the WM system (e.g. Barrett, Tugade & Engle, 2004; Cowan, 1995, 2005; Ericsson & Kinstch, 1995). The term “working memory” was initially used by Miller, Gallanter and Pribam (1960, cited in Apter, 2012) as a theoretical supposition intended to clarify how the most rapid and short-term memory functions could be compartmentalised. It was described topographically by Atkinson and Shiffrin (1968) and Cowan (1995; 2005) proposed that WM is not a separate system, but part of short-term and long-term memory. The Cowan model of WM is organised into two embedded levels: long-term memory representations that are activated and; the focus of attention, regarded as having a limited capacity and able to hold up to four of the activated representations. Oberauer (2002) extended this model by adding a third component, a narrower focus of attention able to hold just one section of information at a time within the four-element focus, effectively selecting a piece of information for processing before shifting the attentional focus to the next piece of information until all have been processed. Baddeley and Hitch (1974) challenged the model initially proposed by Atkinson and Shiffrin (1968) and developed an alternative which conceived of WM as being distinct from short-term memory and comprising three separate components; a visuo-spatial scratchpad, a phonological loop and a central executive. This was later revised to include a fourth component, the episodic buffer (Baddeley, 2000).

The model which will be utilised and referred to during this proposal when WM is discussed is the multicomponent model of working memory (Baddeley, 1986, 1992, 1998b, 2000, 2001, 2003b, 2010; Baddeley & Hitch, 1974). This is considered to be the most influential (Logie & Della Salla, 2001; Skelton, 2012) and is used in research relevant to this thesis (St Clair Thompson et al., 2010; Skelton, 2012). This model (Figure 2.1) represents WM as a system made up of four connected but functionally distinct components (Baddeley, 2000). At the core of working memory is a central executive system, a domain-general system of limited capacity often likened to a mechanism of attentional control (Kane & Engle, 2003). The central executive is supported by two domain-specific storage components: the phonological loop, responsible for the maintenance of auditory information; and the visuo-spatial sketchpad, responsible for visual and spatial information (St Clair-Thompson et al., 2010). Baddeley (2000)
identified the episodic buffer as the fourth subcomponent of WM. This is responsible for the integration of information from the WM subcomponents and long-term memory.

![Diagram of the Multicomponent Model of Working Memory](image)

**Figure 2.1 Multicomponent model of working memory (Baddeley, 2010: 138)**

The four components of WM have been shown to be dissociable in both children and adults (Chase, Clark, Sahakian, Bullmore & Robbins, 2008; Marsolek & Burgund, 2008; Postle & D’esposito, 1999; Postle, Idzikowski, Sala, Logie & Baddeley, 2006). Research utilising lesioning and functional neuroimaging has also indicated that they are served by relatively distinct neural circuitry (Ravizza, Delgado, Chein, Becker & Fiez, 2004). The following subsections will briefly outline the neurological location and function of each component.

**2.4.1. Central executive.**

The functioning of core WM processes, specifically executive processes, is thought to reside in the prefrontal cortex. It is strongly associated with a number of regions within the frontal lobes (Chase et al., 2008; Ravizza et al., 2004) such as the dorsolateral prefrontal cortex (Brodmann’s Area (BA) 9/46), inferior frontal cortex (BA 6/44) and the parietal cortex (BA 7/44) (Braver et al., 1997; Collete & Van Der Linden, 2002; Henson, 2002).

The central executive is the component of WM that has overall attentional control of the WM system. It is thought to be involved whenever an individual is required to simultaneously store and process information. Tasks which introduce interference or a secondary processing task while requiring the retention of information will necessitate the involvement of the central executive (Dehn, 2010). It is not regarded as having any capacity for storage, and as such is considered to be a pure processing system responsible for higher level cognitive processes (Baddeley, 1996, 1998a). The central executive could be considered to have five core roles in allocating attention within the WM.
system: Divided attention; Switching attention; Selective attention and inhibition; Updating, and; Storing and manipulating information to and from LTM (Baddeley, 1996, 1998a, 1998b, 2007; Fournier, Larigauderie & Gaonac’h, 2008; Miyake et al., 2000)

It is analogous to an executive board that controls attention, selects strategies and integrates information from several different sources. It is modality or domain free, acting as a link between subsystems that are dependent on auditory or visual processing (Dehn, 2010).

### 2.4.2. Visuospatial sketchpad.

The visuospatial sketchpad is primarily localised within the right hemisphere (Osaka, Logie & D’esposito, 2007; Smith, Jonides & Koeppe, 1996), particularly areas in the supramarginal gyrus (BA 40), premotor cortex (BA 6) and inferior frontal cortex (BA 47) (D’esposito, 2007).

The visuospatial sketchpad is a ‘slave’ storage system with no capacity for controlling attention or decision making (Henry, 2011). It is responsible for holding visual and spatial information for short periods of time so that it can be utilised during thinking, remembering and processing tasks (Logie, 1995). It supports remembering visual features of an object such as form and colour, and also spatial information such as where in space an object was located. The information stored is susceptible to rapid trace decay and it is assumed that some form of rehearsal takes place to refresh and maintain information. However, the details regarding this are currently unclear (Henry, 2011).

### 2.4.3. Phonological loop.

The phonological loop is implicated with left hemisphere activation (Baddeley, 2003b). It is primarily associated with functioning in the left temporoparietal region (Hautzel et al., 2009; Strand et al., 2008; Vallar & Papagno, 2002), more specifically in the parietal cortex (BA 40) and the pre-motor region within Broca’s area (BA 6/44) (Awh et al., 1996; Paulesu, Frith & Frackowiak, 1993; Smith & Jonides, 1997).

The phonological loop is proposed as a specialised storage system for speech-based and acoustic information. As with the visuospatial sketchpad, it is a ‘slave’ system. It requires an interaction between two linked components, the phonological store and the articulatory rehearsal mechanism, in order to enable representations of verbal information to be kept in an active state (Baddeley, 1983, 1986). The phonological store is passive and time-limited, with speech material known as the ‘memory trace’ fading rapidly and decaying. Approximately two seconds’ worth of speech-based material can be held. The articulatory rehearsal mechanism is used to recite the information in the phonological store in order to prevent the aforementioned rapid decay. The recitation of the material, known as
articulatory or verbal rehearsal re-enters it into the phonological store, where it begins to decay again. This is usually done internally by adults but involves some form of internal speech. The articulatory rehearsal mechanism also has a second function, converting visual information into speech. This is known as phonological/verbal coding (Henry, 2011).

2.4.4. Episodic buffer.

To explain the interface between long-term memory and WM, Baddeley (2000, 2006) added a fourth component, the episodic buffer, to his model. The episodic buffer is described as a multimodal temporary store, meaning it does not just store information in one modality, but deals with information from different modalities such as auditory, visual, spatial and kinaesthetic. A further characteristic is that it is thought to bind together information from different sources within the WM system (Henry, 2011). It is considered to be a consciously accessible, limited capacity component that interfaces with long-term episodic and semantic memory to construct integrated representations based on new information (Dehn, 2010). Baddeley described the episodic buffer as ‘a temporary storage system that is able to combine information from the loop, the sketchpad, long-term memory, or indeed from perceptual input, into a coherent episode’ (2007:148).

Baddeley originally hypothesised that the episodic buffer would be located in the hippocampus; however recent studies with an amnesic individual with severe hippocampal damage are reported to show that tasks requiring the episodic buffer were unimpaired. He now states that we are unlikely to find a single location responsible for the episodic buffer, and believes it might be an emerging property of a number of different brain areas working together which give rise to the episodic buffer (Baddeley, 2001; Baddeley, 2013).

2.5. Development of Working Memory

The proficiency of WM develops considerably from preschool through adolescence. Research suggests that there is a linear increase in WM performance between four and 12 years, reaching a plateau towards 15 years (Conklin et al., 2007; Gathercole et al., 2004; Luciana et al., 2005; Pickering & Gathercole, 2001). Dawson & Guare (2009) suggest that of 11 executive functions, WM is the second to emerge in typically developing children.

The capacity of the phonological loop increases consistently from early childhood to adolescence, generally increasing from two or three items at four years of age to six or seven items in early adulthood (Hulme et al., 1984). Children aged four years of age show sensitivity to the phonological similarity of auditorily presented items on a list, suggesting the phonological store is in place by this age (Hulme & Tordoff, 1989). However, an essential
strategy of using rehearsal processes to refresh decaying phonological representations is not intrinsic in young children, and typically emerges when children reach approximately seven years of age (Gathercole, Adams & Hitch, 1994; Oxley & Norris, 2000). When this strategy has emerged children do not tend to show overt signs of rehearsal such as lip movement and explicit repetition, and do not exhibit a word list effect when recalling list items (Flavell, Beach & Chinsky, 1996). The word length effect describes the finding that short words are better recalled than lists of long words, a finding considered important as it provides evidence for time-based decay and led to the theoretical development of WM and the phonological loop (Jalbert, Neath, Bireta & Surprenant, 2011) Children as young as five can be trained to use rehearsal strategies although in these children word length effects are subsequently demonstrated (Johnson, Johnson & Gray, 1987).

There is a significant degree of individual variability in WM abilities. Indeed, Alloway & Gathercole (2006) state that in an average class of 30 children, they would expect to see WM capacity differences correspond to five years of normal development between the three highest and three lowest scoring individuals. To extend this example, a typical class of nine year old children would be likely to include individuals whose capacities vary from that of the average performance of seven to 12 year olds (Gathercole et al., 2004).

Vuontela, Steenari, Carlson, Koivisto, Fjallberg and Aronen (2003) found that both auditory and visual working memory performance in school-aged children improves with age, indicating a functional maturation of the underlying cognitive processes and brain structures. This study also indicated that the development of the performance of WM tasks varies in girls and boys, suggesting a larger degree of maturity in the female rather than the male executive systems in children aged between 6 and 10 years. Vuontela et al. (2003) also found differences in mastering auditory and visual WM tasks, which indicated that visual WM reaches functional maturity earlier than the corresponding auditory system.

2.6. Assessment of Working Memory

In an experimental setting, an individual’s WM capacity is reliably assessed by tasks in which the individual is required to process and store increasing amounts of information until recall errors are made (Alloway 2006). An example of such a task is reading span, which requires the participant to make judgements about the semantic properties of sentences while remembering the last word of each sentence in sequence (Daneman & Carpenter, 1980). An individual’s WM capacity is often assessed using WM span measures which require participants to engage in active processing whilst maintaining information for later recall (St Clair Thompson, 2010). In contrast,
assessment of STM could be described as ‘storage-only tasks’ and place menial demands on processing (Alloway, 2006).

WM assessment is an integral aspect of most standardised cognitive assessments (e.g. WISC-IV UK, BAS3, NEPSY-II) and therefore can be considered an integral element of most EPs’ professional practice (Farrell et al., 2006; Scottish Executive, 2002). The WISC-IV UK has three subtests which can be used to gain a WM index score; digit span, letter-number sequencing and sequencing arithmetic. The BAS3 includes a recall of digits backwards subtest and the NEPSY-II includes word list interference.

In addition to the WM assessments which are an important component of standardised cognitive tests, there are also currently two standardised test batteries designed specifically to assess children’s working memory capacities; the Automated Working Memory Assessment (AWMA) (Alloway, 2007a) and the Working Memory Test Battery for Children (WMTB-C) (Pickering & Gathercole, 2001). Both provide several assessments of the different aspects of STM and WM and provide age norms, allowing for identification of children who have poor WM for their age (Holmes et al., 2010). An investigation into the AWMA’s theoretical structure suggested that it fits with a four component model and can be used to assess verbal STM, verbal WM, visuospatial STM and visuospatial WM (Alloway, Gathercole & Pickering, 2006). The WMTB-C is based on a three component model and includes tests of verbal STM, visuospatial STM and verbal WM (Gathercole & Alloway, 2008).

As the name indicates, the AWMA is conducted using a computer. It is thought that the automated aspect of the AWMA will assist the researcher in ensuring efficient, standardised administration and scoring of the assessments, while also removing any potential researcher bias and subsequently increasing reliability (Bergman Nutley et al., 2011; Holmes et al., 2009; Holmes et al., 2010; Van Der Molen et al., 2010).

2.7. Working Memory Implications

WM is said to be essential to be able remember our plans and others’ instructions, consider alternatives and make mental calculations, multi-task, and relate to the present, future or past. It also directly links with longer-term memory systems to acquire permanent knowledge (Gathercole & Alloway, 2008; Dehn, 2010; Skelton, 2012). As a result, it is of significant importance to children’s capacity to learn (Alloway et al., 2009a). WM has been implicated in a wide range of developmental and academic skills, including: acquisition of language and vocabulary (Alt, 2011; Baddeley, Gathercole & Papagno, 1998; Morra & Camba, 2009; Sasaki, 2008); reading (Alloway, 2007b; Savage, Lavers & Pillay, 2006; Swanson & Jerman, 2007); reading comprehension (Cain, Oakhill & Bryant, 2004); spelling (Service & Turpeinen, 2001); mathematics (Alloway, 2007b; Berg, 2008); behavioural inhibition (Mcauley & White,
Some of the key implications for WM and academic progress are explored below.

### 2.7.1. General academic achievement and attainment.

There is considerable evidence of a causal relationship between children’s WM abilities and their attainment in school. As stated above, WM is fundamental to achievement in a range of key academic and developmental domains, and WM has been found to be a useful prospective indicator of performance on national curriculum assessments at the ages of seven, 11 and 14 (Alloway & Alloway, 2010; Alloway et al., 2005; Alloway, Gathercole & Elliott, 2010; St Clair-Thompson & Gathercole, 2006). Holmes, Gathercole & Dunning (2009) estimated that 10-15% of school children experience some level of WM difficulty. These children are at risk of making poor academic progress and of educational underachievement (Alloway et al., 2009b; Gathercole, Lamont & Alloway, 2008). Over 75% of children with WM difficulties score within the bottom 10\textsuperscript{th} percentile in both reading and mathematics (Gathercole & Alloway, 2008). It has recently been suggested that deficits in WM might be a cognitive phenotype for children who make slow progress at school, but who do not have general learning difficulties (Gathercole, 2010, cited in Holmes, Gathercole & Dunning, 2010).

In addition to the above implications, WM impairments are associated with a wide range of developmental disorders of learning, including attention-deficit hyperactivity disorder (ADHD), dyslexia, specific language impairment (SLI), Down syndrome, reading and mathematical difficulties (Alloway, 2006; Holmes, Gathercole & Dunning, 2010).

One suggestion as to why WM can constrain and impact on learning is because it provides a resource for the individual to integrate knowledge from long-term memory with information in temporary storage (Swanson & Saez, 2003; Swanson & Beebe-Frankenburger, 2004). Alloway (2006) discusses that children with weak WM capacities are limited in their ability to perform such operations in important classroom-based activities. Gathercole (2004) furthers this argument by suggesting that poor WM skills result in ongoing learning difficulties because the system acts as a bottleneck for learning in many individual learning episodes, disrupting the incremental process of acquiring skills and knowledge over school years.

Historically, and unlike many other cognitive abilities, WM was thought to be highly heritable (Kremen et al., 2007). Recent research and improved understanding of WM has demonstrated an increasing influence of environmental experiences affecting WM, for example the indication that childhood poverty is predictive of WM impairments in adults (Evans & Schamberg, 2009).
2.7.2. Language development.

WM is theoretically implicated in several areas of language development and research is increasingly supportive of this stance. There is evidence for a direct relationship between WM performance and vocabulary knowledge in children (Gathercole & Baddeley, 1993; Jarrold, Baddeley, Hewes, Leeke & Phillips, 2004). It is thought that the early acquisition of vocabulary is influenced by both verbal STM (Leclerq & Majerus, 2010; Majerus et al., 2006) and verbal WM abilities (Alt, 2011; Sasaki, 2008). The phonological loop is proposed to have evolved to facilitate the acquisition of language (Baddeley, Gathercole & Papagno, 1998) and it is thought that disrupting the phonological loop through the use of articulatory suppression, manipulating phonological similarity and word length adversely affects the acquisition of new language vocabulary (Papagno & Vallar, 1992). Further research has suggested that the phonological loop is particularly integral to learning novel vocabulary (Baddeley & Wilson, 1988; Gathercole & Baddeley, 1990).

It has been proposed that verbal STM and WM each provide a fundamental capacity which enables higher order language skills to develop through the learning of sound structures of novel words (Baddeley, 2003a; Papagno & Vallar, 1992).

2.7.3. Literacy development.

WM is thought to impact on the development of reading and writing skills and measures of WM have been shown to be good predictors of achievement in these areas independent of verbal STM measures (Oakhill & Kyle, 2000; Swanson & Sachse-Lee, 2001). It has been argued that verbal WM in particular is integral for the development of reading (Baddeley & Wilson, 1993; De Jong, 1998) and writing skills (Kellogg, 2001). WM is implicated in the development of phonological awareness skills, which are central to children’s reading development (Bone, Cirino, Morris & Morris, 2002, Oakhill & Kyle, 2000). Children with severe and persistent difficulties with reading, such as those with dyslexia often score poorly on verbal and visuo-spatial WM assessments (Jeffries & Everatt, 2004; Smith-Spark & Fisk, 2007). These difficulties may be compounded by difficulties in language development as highlighted in Section 2.7.2.

Reading comprehension is also thought to be heavily impacted upon by WM ability (McVay & Kane, 2012). Children’s verbal WM abilities can be used to explore and explain unique variance in reading comprehension above that of verbal STM, word reading and vocabulary knowledge (Swanson & O’Connor, 2009b; Waters & Caplan, 1996). This is perhaps unsurprising when considering that successful reading comprehension relies on the ability to store and process information in an attempt to simultaneously read the sentences, hold the information in mind,
ask pertinent questions and integrate the information with LTM knowledge to interpret meaning (Ranganath, Cohen & Brozinsky, 2005).

In regard to written skills, the process of writing as a whole is extremely complex and requires a good level of WM ability (Berninger et al., 2010a; Kellogg, 2001). Skelton (2012) considers it understandable that poor WM will result in difficulties in simultaneously trying to switch between: i) rehearsing and answer in the articulatory loop, ii) applying rules regarding the segmenting of the individual words into its constituent phonemes, iii) applying rules regarding letter formation and, iv) focussing attention on motor control in the physical act of writing. This may result in children being observed to be able to achieve some, but not all of these processes consistently on one occasion. Skelton (2012) suggested that this may emerge in some children proving their ability to think of answers or to write while being dictated to, but not do both as the WM load is too high to cognitively handle.

2.7.4. Numeracy development.

The impact of WM is perhaps most often demonstrated with the use of mathematical skills, particularly mental arithmetic. Skelton (2012) gives the example that it is used to support storage of digits whilst simultaneously retrieving and processing rules of multiplication and number facts from LTM. WM is considered to be a foundational ability on which fluency can be achieved in numerical concepts (Geary, Hoard, Byrd-Craven & Desoto, 2004) and mathematical calculations or operations (Krajewski & Schneider, 2009).

Children with specific and pronounced mathematical difficulties such as dyscalculia tend to display considerable issues with both STM and WM abilities (Kyttala, Aunio & Hautamaki, 2010; Rotzer et al., 2009). The use of dual-task procedures to deliberately impair the operation of specific components of WM during arithmetic calculations provides evidence for the central executive’s involvement in mental addition (Imbo, Vandierendonck & De Rammelaere, 2007) and for the phonological loop’s contribution to information storage (Furst & Hutch, 2000).

2.7.5. Social, emotional and behavioural development.

Social and emotional development is impacted upon by WM, particularly in the areas of Theory of Mind (Gokcen et al., 2009; Mutter, Alcorn & Welsh, 2006) and emotional control (Mikels et al., 2008; Schmeicel & Demaree, 2010). It has been estimated that over a third of children identified as having poor WM have a clinically significant comorbid difficulty with emotional control and regulation (Alloway et al., 2009a; 2009b).

WM capacity is also thought to impact on the development of a range of executive skills including inhibition (Gamboz, Borella & Brandimonte, 2009; McNab et al., 2008), the ability to self-regulate (Alloway et al., 2009b;
Barratt et al., 2004, Holmes et al., 2010,) and to maintain focussed attention (Kane et al., 2007). This can lead to children with low WM displaying high levels of distractible and inattentive behaviours at school (Lui & Tannock, 2007). In line with this, limited WM capacity is considered a primary difficulty for children with Attention Deficit Hyperactivity Disorder (ADHD) and a determining factor for definition its behavioural characteristics (Burgess et al., 2010; Rapport et al., 2009). It has been posited that inattentive symptoms occur because WM becomes quickly overloaded, enabling interference from less relevant information which disrupts goal-directed behaviour and attention (Gathercole et al., 2006b; Holmes et al., 2010a).

Early recognition of WM difficulties and the provision of appropriate and effective educational support and targeted intervention are considered paramount to improving long-term outcomes for a large number and wide range of children (Holmes, Gathercole & Dunning, 2010).

2.8. Working Memory Training and Interventions

Until relatively recently, interventions for poor WM have centred around the use of accommodations and adjustments to the environment that can help to avoid or reduce these difficulties (Dehn, 2008; Gathercole et al., 2006b, Holmes, Gathercole & Dunning, 2010). An example of this is Alloway (2006), who suggests that the learning process of children with poor WM skills can be improved dramatically by reducing WM demands in the classroom. She suggested ways, via effective classroom management to reduce the memory-related failures frequently experienced by children with WM impairments through strategies to reduce processing demands and development of effective strategies to improve the efficiency of WM, such as rehearsal, chunking, and visual imagery (Holmes, Gathercole & Dunning, 2010; St Clair-Thompson, 2010).

A growing body of literature has indicated that targeted WM training can lead to improvements in children’s WM capacity (Morrison & Chein, 2011). This research has coincided with an increase in the use and availability of adaptive, computerised WM training packages such as Cogmed (Cogmed, 2006), Jungle Memory (Memosyne, 2011) and Memory Booster (Leedale, Singleton & Thomas, 2004). The term ‘adaptive’ describes computer programmes that utilise training tasks that are automatically adjusted in difficulty according to a continual reassessment of an individual’s WM capacity (Apter, 2012). Such computerised programmes tend to specifically target, employ and challenge an individual’s WM capacity through the mechanisms of repeated practice on demanding activities (Skelton, 2012).

Computerised training packages appear to be the most direct, useful and well-validated method for improving poor WM and learning in children. Holmes, Gathercole and Dunning (2010) summarise that recent research into such
computerised training has identified “dramatic gains in working memory [...] in typically developing children and adults, adults following a stroke, children with developmental disorders such as ADHD and [...] children with poor working memory.” (2010:33). In addition to a range of clinical populations, computerised training has also been shown to increase WM in typically developing preschool children (Thorell et al., 2009) and adolescents (Løhaugen et al., 2011). It has been demonstrated that such improvements in WM can generalise to non-trained WM tasks and persist at follow up assessment 4-6 months post training (Holmes et al., 2010; Klingberg et al., 2005; Thorell et al., 2009). Homes, Gathercole and Dunning (2010) highlight that the gains made in children with poor WM are sustained over six months, then transfer into gains in learning. The programmes are likely to prove effective through mechanisms related to increases in the relative capacity of WM (Cowan, 2005) or increased ability of cognitive control mechanisms which support WM (Hasher, Lustig & Zacks, 2008).

There is further recent research which suggests that WM improvements induced by training may have a secondary impact on additional areas, such as improving reading comprehension ability (Dahlin, 2010), LTM (Van Der Molen et al., 2010), performance on tasks on fluid intelligence (Jaeggi et al., 2008) and inhibitory control (Klingberg et al., 2005). However, this is a more contentious area of research, with Shipstead, Redick and Engle (2010) concluding that the case for adaptive WM training successfully generalising has not yet been proven. The claims of additional benefits have been further questioned by recent reviews (Apter, 2012; Shipstead, Redick & Engle, 2012) and a meta-analysis (Melby-Lurvåg & Hulme, 2013).

Recent reviews (Apter, 2012; Shipstead, Redick & Engle, 2012) and meta-analyses of the literature (Melby-Lurvåg & Hulme, 2013) offer a more critical consideration of the relevant research. Apter (2012) questioned the claimed benefits of WM training on the basis that the research methodologies were flawed. Amongst other critiques, he highlighted small sample size and/or inadequately specified control (Alloway, 2009; Holmes et al., 2009; Klingberg et al., 2002) and inadequate control of other cognitive processes affected by test conditions particularly the way in which stress and fatigue during test procedures affect attentional processes (Klingberg et al., 2002). Shipstead, Redick & Engle (2012) stated that there was a need to directly demonstrate that WM capacity does increase in response to training, arguing that the transfer of training of WM must be demonstrated using a wider variety of tasks, eliminating the possibility that results can be explained by task specific learning. Melby-Lurvåg & Hulme (2013) state that while current training programmes yield reliable, short-term improvements on both verbal and non-verbal WM tasks, the short-term near transfer effects for verbal WM were not found to be sustained after a delay of nine months, although for visuospatial WM there is some suggestion of training effects five months after training. Apter (2012) concluded by stating that many of the research difficulties have arisen because both the
WM model (Baddeley & Hitch, 1974) and the augmented version (Baddeley, 2000) are under-specified for the purpose of the research he reviewed and were not intended for use as a training paradigm.

There is a need for critical scrutiny of any training or intervention, particularly if they are commercially marketed to schools or to parents and make claims to improve something as fundamental as WM. The recent surge of critical articles should therefore be welcomed by those who may use or advocate the use of such programmes, as they raise awareness of any potential failings of research and provide a rigorous perspective through which the evidence base can be viewed. However, it is important not to simply accept or take these reviews or meta-analyses at face value. They deserve equal scrutiny and critical evaluation when considering their findings, as they too can be flawed in their methodology and display limitations. When considering the Melby-Lurvåg and Hulme (2013) article for example, there are considerable limitations such as the authors’ apparent grouping of diverse sample populations, with no consideration given to specific subgroups. The sample populations evaluated in the meta-analysis were heterogeneous, with participants ranging from Primary school aged to over 51 years old. Effect sizes from diverse clinical groups including typically developing children, adolescents, adults, children with ADHD, children with dyslexia, children with low WM and children with low IQ were also combined. Those with severe WM difficulties and those with typical WM abilities were also grouped together (Cogmed, 2013). While it is useful to consider training programmes’ effectiveness for a diverse population, a more useful analysis may have considered specific subgroups and how they may or may not have been differentially impacted by training. An additional criticism of the meta-analysis is that the concept of ‘working memory training’ did not appear to be adequately specified and was taken to include a variety of training programmes and protocols, such as simple and complex span training (Klingberg et al., 2002; 2005).

Publication bias is a further limitation of the Melby-Lurvåg and Hulme (2013) article, as only published articles were utilised. However, as it is likely that only articles which find an effect and display a positive result would be published, it is likely that the true effects of the WM training programmes are likely to be even smaller than those estimated (Cuijpers et al., 2010).

There is a great deal of research supporting the use and effectiveness of WM training. However, it is generally concluded that further methodologically sound research is required to improve the knowledge base, particularly with regards to claims made about improvements in secondary areas such as curriculum or improvements in fluid intelligence. In response to the question of whether WM training works, Morrison & Chein (2011) give a “tentative yes” (2011:57) as their answer.
2.8.1. Memory Booster.

Memory Booster is one of the two programmes which will be utilised during this research. Lucid Research Ltd were keen to have the product independently evaluated and supplied it for the purpose of the present research. Further rationale for using Memory Booster will be explored below. Memory Booster (Leedale, Singleton & Thomas, 2004) is a computerised adventure game for children that teaches and encourages the use of rehearsal, visual imagery, creating stories and grouping with a view to improving WM (St Clair-Thompson et al., 2010). It is commercially available to both schools and parents, and claims to teach children strategies to learn more effectively and remember more easily, leading to a beneficial effect on all types of memory problems (Lucid Research Ltd, 2012a). There is currently a limited, but positive evidence base supporting its efficacy. Two previous studies with children aged six to seven years, claimed that Memory Booster resulted in significant improvements on measures of WM (St Clair-Thompson & Holmes, 2008). A more recent study assessed 254 children on measures of the phonological loop, visuo-spatial sketchpad and central executive components of WM. Specifically, the digit recall, block recall and listening recall tasks were taken from the WMTB-C. Subgroups were also tested on tasks of following instructions and mental arithmetic in the classroom, and standardised tests of reading, arithmetic and mathematics. Half of the sample then used Memory Booster over six to eight weeks. All the children were then retested on the memory and ability measures and the standardised tests were administered five months later. The results revealed that WM strategy training using Memory Booster resulted in significant improvements in tasks assessing the phonological loop and central executive components of WM, and also in following instructions and mental arithmetic in the classroom. Within the memory measures the intervention group showed a significantly greater improvement than the control group on tests of digit recall, listening recall, but not block recall. There were also significantly greater improvements on the classroom performance, specifically following instructions and mental arithmetic, for the intervention group. However, there was no significant improvement in any of the standardised tests, whether immediately or at follow up (St Clair-Thompson et al., 2010). This is largely in line with the findings of the recent meta-analysis (Melby-Lurvåg & Hulme, 2013) and critical reviews (Apter, 2012; Shipstead, Redick & Engle, 2012), and suggests that Memory Booster is useful in supporting children to improve their WM, but not in directly improving abilities in numeracy or literacy.

The limited research available for Memory Booster is very positive with regards to improvements in WM, however some of the available research has been conducted by researchers who are affiliated with Lucid Research Ltd. There is a need for further objective evaluation of this product, and to the claims of the publisher that it is effective for all children. There is also a need to consider the implementation of the programme, and whether fidelity is
possible in ‘real world settings’, or whether adaptation will affect the outcomes of the programme. No research was found to focus in detail on the implementation of computer based WM programmes such as Memory Booster. Although not specific to Memory Booster, there are criticisms of the practical use of computer based programs likely to restrict their applicability and uptake within schools (Ertmer, 2005; Hermans et al., 2008). They include factors such as teachers feeling they do not have the appropriate skills to use them (Michael & Chen, 2006; Prensky, 2010) and that teachers can feel disempowered leading to reduced efficacy belief (Holden & Rada, 2011). Skelton (2012) argues that computerised WM training is limited by considerable practical implications. He states that the reliance on technology limits the accessibility in the classroom, effectively restricting the use of computerised WM training to individual children who experience the most pronounced difficulties. No literature was found which looked at the implementation of computer programmes as a whole class WM intervention. Skelton (2012) also argues that the use of a computerised format for both the presentation of information and for responses is likely to entail a focus on visuospatial WM development over verbal WM.

2.8.2. MeeMo

In response to the above criticisms of computerised WM training, Skelton (2012) developed and evaluated a practical, whole-class WM training programme. Within the evaluation Skelton aimed to investigate the effectiveness and although he also attempted to consider implementation factors this was not a primary focus. This programme, MeeMo, involves pairs of children engaging in a series of five card based working memory activities, with three levels of difficulty for each. The research involved two distinct phases: programme development, in which a theoretically effective and practically usable WM training programme was developed and; programme evaluation, which trialled the programme in the classroom to investigate the extent that it increased children’s WM capacity and whether it was considered to be practical and sustainable by the children and class teacher. The second evaluative phase sought to provide an evaluation of outcomes and a practical evaluation using a mixed methods approach (Skelton, 2012).

Using the AWMA, Skelton (2012) utilised one assessment from each domain of verbal STM (Digit Recall), verbal WM (Listening Recall), visuospatial STM (Dot Matrix) and visuospatial WM (Spatial Recall). It demonstrated that the children involved made significant gains in their working memory, and their verbal short-term memory both immediately after the programme and at a two month follow up. He claims that MeeMo has advantages over computerised training programmes as it is a contextually embedded programme that is employed in the naturalistic classroom setting shortly before and after other WM demanding activities. He hypothesised that
MeeMo holds promise as potentially demonstrating more direct and transferable benefits into daily classroom practice. However these claims are subjective and have not been objectively considered.

As a result of its promise and effectiveness, Skelton is currently in contact with publishers and is pursuing the possibility of rolling the MeeMo training package out into schools (personal email correspondence, 2012). However, before it is widely used in schools, it is important to further assess and evaluate its effectiveness in different settings and with wider populations. It is particularly important for it to be independently replicated and objectively evaluated, as the only current research into it is the thesis in which it was developed and then evaluated by Skelton (2012). The researcher is not aware of any alternative practical whole class WM interventions.

Although the research demonstrated the potential for MeeMo to be practical and effective, there are considerable limitations of the research methodology. One such limitation is the subjective nature of some of the data gathering methods, such as interviews. It is possible that as the teacher and students were active participants, their opinions may reflect expectations created by receiving the programme, rather than actual changes resulting from the programme (Allinder, 1994). As alluded to above, there is also the potential researcher bias, which may be exacerbated due to the participants’ knowledge that the researcher had created and was then evaluating the programme. A further limitation is the small sample size (n=24), which consisted of a single classroom in a school in which the researcher also worked. This affects the generalisability of the study in terms of the effectiveness and outcomes, but also with regards to the implementation. It is difficult to identify the specific factors which may present as either a barrier or facilitator to its use in practice. As Skelton (2012) made claims about the ‘usability’ of MeeMo compared to computerised training, it is important to investigate this with regards to implementation science. Indeed, Skelton (2012) recognises that although the children and teacher found the programme and resources easy to use and found it difficult to identify areas where improvements could be made, the methodology employed was primarily concerned with their experiences. This meant data regarding potential issues and improvements were not targeted. It is important at this stage to consider the implementation factors and whether MeeMo is truly feasible as a whole class intervention.

2.9. Implementation Science and Programme Diffusion

Developing an effective programme or intervention and building an evidence base are only the first steps towards supporting CYP, regardless of the area of support (Durlak & DuPre, 2008; Kay, 2012). Transferring effective programmes from research settings into more complex, real-life settings with a range of extraneous variables, while ensuring their maintenance can be a complicated and difficult process which is dependent on a range of
factors (Kay, 2012). These factors, or ‘phases’ of programme diffusion include: how well information about a programme and its value is shared with communities (dissemination); whether an organisation or group opts to try the new programme (adoption); how well the programme is conducted during a trial period (implementation); and whether the programme is and can be maintained over time (sustainability). As a whole, this process known as diffusion can refer to the spread of new ideas, technologies, products and evidence-based promotion, prevention or treatment programmes (Rogers 2003). It is thought that if the maximum possible number of people are to benefit, diffusion must be successful in multiple communities and at each stage of the process. Previous research indicates that the diffusion of effective interventions typically yields diminishing returns as the process continues. This is said to be for numerous reasons such as information for effective interventions not being adequately disseminated to the appropriate communities or if innovations are adopted and trialled, they often encounter implementation problems that diminish a programme’s impact (Durlak & DuPre, 2008; Rogers, 2003). Beard et al. (2005) concurred that the impact of interventions usually decreases over time.

2.9.1. Programme implementation.

The research in this study is primarily concerned with the implementation phase of the diffusion of the interventions utilised; MeeMo and Memory Booster. Implementation refers to the process by which an intervention is put into practice (Lendrum & Humphrey, 2012). Research studies across several disciplines have demonstrated that interventions are rarely implemented as designed and the variability in implementation is related to the variability in the achievement of expected outcomes (Durlak, 1998; Wilson et al., 2003). It is vital to carefully consider implementation issues if legitimately useful conclusions are to be drawn from the outcomes of an intervention or programme (Durlak & DuPre, 2008; Kay, 2012; Petipas, Cornelius, Van Raalte & Jones, 2005). This is because accurate interpretation of outcomes depends on incorporating knowledge with regards to which aspects of an intervention were delivered and how well they were implemented. Snow and Juel (2005, p. 514) argued that “the quality of the implementation of the program turns out to be much more important in explaining the outcomes than the nature of the program”. Data from over 500 quantitative studies evaluated in five meta-analyses offered considerable empirical support that the level of implementation affects the outcomes obtained in promotion and prevention programs (Durlak & DuPre, 2008).

In total, there are eight common aspects of implementation that can be assessed, with five of these being generally accepted in the implementation literature as ways of measuring fidelity (Dane & Schneider, 1998; Domitrovich &
Greenberg, 2000; Dusenbury et al., 2003; Cross et al.; 2010; Ennett et al.; Lendrum & Humphrey, 2012). Dane and Schneider (1998), describe the five commonly assessed aspects of implementation as being:

1) Programme adherence (also referred to as fidelity): This refers to the extent to which the delivered programme corresponds to the originally intended programme.
2) Programme dosage: This refers to how much of the original programme has been delivered.
3) Programme quality: This refers to how well the programme has been delivered.
4) Participant responsiveness: This refers to how well the programme stimulates the participants.
5) Programme differentiation: This refers to the extent to which the programme’s theory and practice can be distinguished from other programmes.

In addition to the five aspects of implementation outlined above, Durlak and DuPre (2008) highlighted a further three:

6) Monitoring of control/comparison conditions: This refers to any services received by these groups.
7) Programme reach: This refers to the rate of involvement and representativeness of programme participants.
8) Adaptation: This refers to changes made to the original programme during implementation.

Recent school based interventions such as the social and emotional aspects of learning (SEAL) programme have emphasised a bottom-up approach to implementation which encourages flexibility, experimentation and local ownership, as opposed to more prescribed, ‘top-down’ approaches which is embodied in many US based interventions utilising randomised controlled trials (RCTs) (Weare, 2010; Lendrum & Humphrey, 2012). This is thought to be in response to practitioner demands for greater flexibility (Office for Standards in Education (OFSTED), 2007; Smith et al., 2007; Keating et al., 2009; Lendrum, 2010 cited in Lendrum & Humphrey, 2012; OFSTED, 2010).

Lendrum & Humphrey (2012) argue there is a need for more research that focuses specifically on the examination of implementation in school settings, and called for an increased emphasis on the this aspect of evaluation research in UK journals.

It can be argued that there is limited utility in an ‘evidence-base’ that does not take the context of implementation or the perspective of the implementers into account, particularly as implementation variability is thought to be
inevitable in real-world settings (Lendrum & Humphrey, 2012). Therefore, it is considered important that this research is focussed on the implementation of the interventions

Implementation fidelity is defined by Dusenbury et al. (2003: 240) as ‘the degree to which teachers and other programme providers implement programme as intended by the programme developers’. Lendrum and Humphrey (2012) state that fidelity is a primary concern for numerous programme designers and is informed by the assumption that interventions which demonstrate high levels of impact at the efficacy stage will produce similarly positive results if replicated faithfully by practitioners in the ‘real-world’. There are arguments that without high levels of fidelity to the original programme, positive results are not as likely to be repeated (Greenberg et al., 2005). However, it is thought likely that local adaptations are inevitable and could even be of benefit to those receiving the programme. A full consideration of the debate regarding fidelity and adaptation is beyond the scope of this thesis but appears to have moved on from whether or not adaptation is acceptable to a more useful consideration regarding which approaches to adaptation are acceptable and which may undermine the effectiveness of a programme (O’Connor, Small & Cooney, 2007).

As suggested in Lendrum and Humphrey (2012), recent school-based interventions in the United Kingdom have emphasised a ‘bottom-up’ approach to implementation. This is a relevant and interesting point, and appears to respond to research and studies which indicate that programme deliverers frequently modify programmes during their implementation (Berman & McLaughlin, 1976; Rogers, 2003; Ringwalt et al., 2003) and that such adaptations made by programme deliverers can in fact improve programme outcomes (Durlak & DuPre, 2008). Despite this research it appears that the current government highly regards RCTs and is more aligned with the US model of evaluation. The National Foundation for Educational Research (NfER) is encouraging schools to engage in research using RCTs (NfER, 2014).

Durlak and DuPre (2008) have suggested that programme deliverers who are knowledgeable about their communities should be able to adapt a programme to make it more effective in a specific context, as long as the implementation proceedings are carefully measured. Additionally, it has been argued that interventions are more likely to be adopted, implemented and have positive results if there is greater flexibility for modifications to be made to interventions by the programme deliverers (Berman & McLaughlin, 1979).

2.9.2. A framework or model for successful programme implementation.

Following their review of the implementation literature, Durlak and DuPre (2008) reported that there are at least 23 contextual factors which can influence implementation. Durlak and DuPre (2008, p. 335, see Figure 2.2)
developed a framework for successful implementation in which it was hypothesised that implementation is influenced by variables present in five categories: innovations, providers, communities, the prevention delivery system (features related to organisational capacity) and the support system (training and technical assistance). This multilevel ecological perspective is thought to be necessary for understanding successful implementation (Altschuld et al., 1999; Riley, Taylor & Elliott, 2001; Wandersman, 2003). The bidirectional arrows in the outer circles indicate that variables in these categories can interact with each other and with the delivery system and support systems to affect implementation. Durlak and DuPre (2008) proposed that under favourable circumstances, variables in all five categories interact and lead to effective implementation.

![Figure 2.2 Framework for effective implementation (Durlak & DuPre, 2008, p. 335)](image)

Based on Durlak and DuPre’s (2008) framework, Kay (2012, p. 179) developed a tentative model of effective programme implementation incorporating two additional categories at the outer levels; environmental factors and participant characteristics (Figure 2.3).
Despite this model being devised to inform a specific school on the implementation of a specific intervention (the WhyTry Program, Moore, 2001) Kay (2012) posits that some factors are general implementation factors which could apply to many programmes. The revised model for effective programme implementation (Kay, 2012, p. 179) provides some useful insight into programme implementation which may be of relevance to the current research.

2.9.3. Implementation factors: Potential facilitators and barriers.

There is a great deal of literature related to the successful implementation of various programmes and interventions, however the potential facilitators and barriers are variable due to the wide range of interventions and the inevitable difference in contexts. Kay (2012) highlighted four main barriers to implementation in her research: ‘language’; ‘lates’; ‘threats to privacy’ and; ‘contextual demands’. As this was focussed on WhyTry (Moore, 2001), an intervention designed to build resilience some of the barriers are likely to be specific to this type of intervention. For example, although ‘language’, ‘lates’ and ‘contextual demands’ could foreseeably impact on
the implementation of WM interventions it is unlikely that ‘threats to privacy’ would be considered a potential barrier as the intervention would not engage in activities which engaged private thoughts, feelings or experiences.

Langley, Nadeem, Kataoka, Stein and Jaycox (2010) explored factors that affect the implementation of a cognitive behavioural intervention in schools in the US. They suggested four main barriers to implementation which appear to be relatively universal; competing responsibilities of the programme deliverers, lack of parental engagement, logistical barriers and a lack of support from school administrators and teachers.

It is thought to be particularly important to develop sufficient capacity for implementation in order to support local providers in successful programme implementation. An increasing body of literature indicates that well planned implementation and effective support are crucial elements for the success of any intervention (Beard et al., 2005; Corboy & McDonald, 2007). Ultimately, Durlak and DuPre (2008) claim that the success of a programme is dependent upon the interaction of numerous ecological factors specific to the local context. The 23 implementation factors incorporated into the five categories highlighted in Figure 2.2 (Durlak & DuPre, 2008, p. 335) could be considered facilitative factors if they occurred or were sympathetic to the intervention in question. Conversely, if the factor did not occur, was not present or was opposed then it could be considered a barrier to implementation. The factors outlined by Durlak and DuPre (2008, pp. 337-338) are provided in Figure 2.4 below.

<table>
<thead>
<tr>
<th>I. Community Level Factors</th>
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<tbody>
<tr>
<td>A. Prevention Theory and Research</td>
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<tr>
<td>B. Politics</td>
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<tr>
<td>C. Funding</td>
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<tr>
<td>D. Policy</td>
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<tr>
<td>II. Provider Characteristics</td>
</tr>
<tr>
<td>A. Perceived Need for Innovation</td>
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<tr>
<td>Extent to which the proposed innovation is relevant to local needs</td>
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<tr>
<td>B. Perceived Benefits of Innovation</td>
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<tr>
<td>Extent to which the innovation will achieve benefits desired at the local level</td>
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<tr>
<td>C. Self-efficacy</td>
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<tr>
<td>Extent to which providers feel they are will be able to do what is expected</td>
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<tr>
<td>D. Skill Proficiency</td>
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<tr>
<td>Possession of the skills necessary for implementation</td>
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<tr>
<td>III. Characteristics of the Innovation</td>
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<tr>
<td>A. Compatibility (contextual appropriateness, fit, congruence, match)</td>
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<tr>
<td>Extent to which the intervention fits with an organization’s mission, priorities, and values.</td>
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<tr>
<td>B. Adaptability (program modification, reinvention)</td>
</tr>
<tr>
<td>The extent to which the proposed program can be modified to fit provider preferences, organisational practices, and community needs, values, and cultural norms</td>
</tr>
<tr>
<td>IV. Factors Relevant to the Prevention Delivery System: Organizational Capacity</td>
</tr>
<tr>
<td>A. General Organizational Factors</td>
</tr>
<tr>
<td>1. Positive Work Climate</td>
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Climate may be assessed by sampling employees’ views about morale, trust, collegiality, and methods of resolving disagreements.

2. Organizational norms regarding change (a.k.a., openness to change, innovativeness, risk-taking)
   This refers to the collective reputation and norms held by an organization in relation to its willingness to try new approaches as opposed to maintaining the status quo.

3. Integration of new programming
   This refers to the extent to which an organization can incorporate an innovation into its existing practices and routines.

4. Shared vision (shared mission, consensus, commitment, staff buy-in)
   This refers to the extent to which organizational members are united regarding the value and purpose of the innovation.

B. Specific Practices and Processes

1. Shared decision-making (local input, community participation or involvement, local ownership, collaboration)
   The extent to which relevant parties (e.g., providers, administrators, researchers, and community members) collaborate in determining what will be implemented and how.

2. Coordination with other agencies (partnerships, networking, intersector alliances, multidisciplinary linkages)
   The extent to which there is cooperation and collaboration among local agencies that can bring different perspectives, skills, and resources to bear on program implementation.

3. Communication
   Effective mechanisms encouraging frequent and open communication.

4. Formulation of tasks (workgroups, teams, formalization, internal functioning, effective human resource management)
   Procedures that enhance strategic planning and contain clear roles and responsibilities relative to task accomplishments.

C. Specific Staffing Considerations

1. Leadership
   Leadership is important in many respects, for example, in terms of setting priorities, establishing consensus, offering incentives, and managing the overall process of implementation.

2. Program champion (internal advocate)
   An individual who is trusted and respected by staff and administrators, and who can rally and maintain support for the innovation, and negotiate solutions to problems that develop.

3. Managerial/supervisory/administrative support
   Extent to which top management and immediate supervisors clearly support and encourage providers during implementation.

V. Factors Related to the Prevention Support System

A. Training
   Approaches to ensure provider proficiencies in the skills necessary to conduct the intervention and to enhance providers’ sense of self efficacy.

B. Technical Assistance
   This refers to the combination of resources offered to providers once implementation begins, and may include retraining in certain skills, training of new staff, emotional support, and mechanisms to promote local problem solving efforts.

Figure 2.4 Factors affecting the implementation process (Durlak & DuPre, 2008, pp. 337-338)
2.10. The Role of the Educational Psychologist

The literature suggests that there are five key functions within an EPs role (consultation, assessment, intervention, research and training), which should be conducted at three levels (organisational, group and individual) across different settings (Fallon, Woods & Rooney, 2010; Farrell et al., 2006; Scottish Executive, 2002). This research is broadly concerned with the following topics: working memory and the implementation and outcomes of whole class interventions. All aspects of this can be considered to be part of the role of the EP.

2.10.1. Educational Psychologists and working memory.

As discussed previously, WM assessment is an integral aspect of most standardised cognitive assessments (e.g. WISC-IV\textsuperscript{uk}, BAS3, NEPSY-II) and therefore can be considered an important element of most EPs’ professional practice (Farrell et al., 2006; Scottish Executive, 2002). As a result of working with and assessing CYP who may experience difficulties with WM, EPs are likely to be expected to have knowledge and awareness of appropriate strategies or interventions to support this.

2.10.2. Educational Psychologists and programme implementation.

Evaluating outcomes is considered to be a key aspect of the EP role and a requirement of ethical and accountable practice (Frederickson, 2002). EPs have the required skill set and knowledge in research design, implementation and analysis in order to evaluate interventions (Grieg, 2001; Frederickson, 2002). Cline (2012) argued that it is essential for EPs to look at implementation by taking investigation into interventions beneath the surface of the observable inputs and outputs and look at underlying causal mechanisms and key contextual factors that may influence outcomes separately and in combination. EPs are experienced in working within school systems and as such are well placed to have a key role in developing implementation models to support effective programme implementation in addition to undertaking programme evaluation (Bond, Cole, Fletcher, Noble & O’Connell, 2011).

The school improvement and programme implementation literature (Fullan, 2001; Greenberg et al., 2005) provides a background which can assist EPs in identifying key factors which need to be attended to for successful development and implementation of school programmes.

Lane and Corrie (2006) conceptualised the EP role as that of scientist-practitioner, which involves EPs making use of scientific principles and methods within the context of EP practice to extend the knowledge base of the profession. These principles will be applied within this research to investigate the implementation and outcomes of two different WM training programmes, with a view to extending the knowledge base of EPs, teachers and other educational professionals.
2.11. Summary of Literature and Rationale

To summarise, there is an extensive body of research and literature which has provided practitioners and researchers with a greater understanding of the importance of WM in underpinning children’s learning potential. It has also led to a greater insight into the multifaceted mechanisms by which it operates and an awareness that it appears to be possible to increase or improve children’s WM. This research has led to the development and subsequently the evaluation of explicit training and interventions for WM, the majority of which are computer based programmes, such as Cogmed (Cogmed, 2006), Jungle Memory (Memosyne, 2011) and Memory Booster (Leedale, Singleton & Thomas, 2004). While evaluations of such training and interventions generally report positive effects, there are questions and criticisms levelled at the methodologies used, and the objectivity of the researchers involved. In comparison to the other training programmes, Memory Booster is under-researched and would benefit from further independent and objective evaluation. Criticisms of the utility of such computerised programmes and their limitations led to the development of MeeMo; a practical, classroom based training programme (Skelton, 2012). The initial evaluation suggests positive effects on children’s WM and verbal STM; however this was conducted by the researcher who developed the programme and has not yet been repeated by objective researchers.

There is relatively little research concerned with the implementation of such programmes, particularly for use as whole class interventions. The identification of possible barriers at this relatively early stage potentially allows for the development of strategies to overcome them prior to the broad dissemination (Lendrum & Humphreys, 2012). With regards to the current literature, there are no studies concerned with implementation and outcomes comparing computerised WM programmes with more ‘hands-on’ WM programmes generally, or Memory Booster and MeeMo specifically. For the purpose of the current research eight common aspects of implementation which are measurable (Cross et al., 2010; Dane & Schneider, 1998; Domitrovich & Greenberg, 2000; Durlak & DuPre, 2008; Dusenbury et al., 2003; Ennett et al., 2011; Lendrum & Humphrey, 2012) will be considered to monitor the implementation of the two interventions. The five which are generally accepted will be explored in greater detail, in line with existing research and recommendations made in the implementation literature. The framework for effective programme implementation (Durlak & DuPre, 2008) will be used as a framework to inform discussion around key implementation factors for both Memory Booster and MeeMo.
2.12. Expected Contribution to Knowledge and Current Research Aims and Objectives

The main objective of this research is to provide an objective comparison of a practical, activity based working memory training programme and a computerised training programme. The focus is largely on implementation and ecological validity, although outcomes will also be considered in terms of programme data, student and teacher views. Initially, the objective was to focus on the effectiveness of each intervention however this was not possible for a variety of reasons discussed subsequently.

This research aims to investigate and compare two different working memory training programmes, one practical (MeeMo) and one computerised (Memory Booster), over a six week period of intervention. It will investigate the implementation, usability and outcomes of each in a Primary school setting. Each of the interventions will be independently evaluated in terms of the implementation, ease of use and outcomes as a whole-class intervention, and then a comparison will be drawn between the two. The research questions (RQ) are outlined below:

RQ1. What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory?

RQ2. What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions?

Using the RQs outlined above as an impetus for this research, it is expected that the data gathered will provide the researcher with an objective evaluation and comparison of the implementation and outcomes of both MeeMo and Lucid Memory Booster as whole class WM interventions with Year 5 children. The expected contribution to knowledge is a greater understanding of the ease and success of implementation of activity-based and computerised intervention programmes for WM when used as a whole-class intervention. The impact of this knowledge will be to provide EPs, schools and researchers with a greater understanding of the implementation, practicalities and outcomes related to using MeeMo and Memory Booster as whole class interventions to improve WM.
3. **Methodology**

The literature review around working memory interventions in general, and around Memory Booster and MeeMo specifically, revealed a need for research which evaluates the implementation of the interventions and focuses on whole class programme implementation in a UK context. Therefore, within this piece of research the researcher aimed to evaluate both the implementation and the outcomes gained through the implementation of MeeMo and Memory Booster in a UK context. It is acknowledged that the data set is too small to utilise inferential statistics and to consider generalisability of findings of this study to the wider population. As a result, the focus of this research is the study of implementation factors pertaining to the Memory Booster and MeeMo interventions and the outcomes, rather than effectiveness per se, of each intervention. In this research, outcomes refer to the perceived impact of the interventions on the participants and any progress made as measured through each interventions monitoring provision. As the programmes differ theoretically and in delivery, evaluation of participant response to the mode of delivery and the teacher’s perception of the fit with their teaching philosophy was also considered to be important. The study is restricted to the investigation of these aims within two Year 5 classes in two separate focus schools.

It is hoped that this research will inform schools who are considering the use of either a computerised or a practical whole class working memory intervention of the specific nature of each intervention and the specific facilitators and barriers experiencing in implementation. It is also hoped that the research will inform the programme developers of any potential implementation issues in specific contexts so that they may be taken into account.

To achieve these research aims, the researcher aimed to answer the following research questions (RQs):

- **RQ1.** What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory?

- **RQ2.** What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions?

### 3.1. **Overview of Methodology**

This chapter aims to describe the methodology and research design applied during the research. It will begin by outlining the rationale for the design used, specifically the philosophical considerations which shaped the research. This includes an exploration of the ontological, epistemological and axiological positions which influenced the researcher. The selection of a mixed-methods approach will then be explored and explained. The data access
(Section 3.5) will clarify the research setting, participant demographic and the participant recruitment process. The data gathering methods will then be outlined before the subsequent data analysis methods are discussed. A summary of the methodology will offer a chronological overview of the process of the research. The researcher will then present a critique of the described research methodology. Finally, ethical considerations will be acknowledged and explored.

3.2. Philosophical Considerations

The choice of research methodology for a research study is guided by the research paradigm and philosophical considerations; therefore it is important for researchers to clarify their philosophical position (Denscombe, 2010). Guba and Lincoln (1994) suggest that the research paradigm should be explored prior to the consideration of research methods. This is because a researcher’s views and beliefs they hold about the world will be defined by the paradigm in which they position themselves (Burrell & Morgan, 1979), which consequently influences the foundations of the research and shapes the nature of the study (Bryman & Bell, 2003; Denscombe, 2010). It can be argued that the philosophical considerations inform not only the choice of research topic and research questions, but also the methodology that is selected in order to explore them (Kay, 2012). As it has been suggested that most contemporary qualitative or mixed method research approaches are embedded in a consciously selected epistemology, ontology and axiology, these philosophical considerations are outlined below.

3.2.1. Ontological and epistemological position

Ontology is the philosophy of the world view of reality (Heron & Reason, 1997) and considers the perspective(s) from which the research is viewed. Epistemology can be explained as the theory of knowledge and how knowledge is constructed (Coolican, 2009).

The ontological and epistemological position assumed for this piece of research is one of critical realism, which admits an inherent subjectivity in the production of knowledge (Madill, Jordan, & Shirley, 2000) and therefore contends that ‘the way in which we perceive facts, particularly in the social realm, depends partly upon our beliefs and expectations’ (Bunge, 1993: 231). Critical realism has been found to be useful in a wide range of research in practice- and value-based professional contexts (Anastas, 1998). It represents an integration of positivist and relativist positions, and has been touted as of crucial importance to Trainee Educational Psychologists (TEPs) in explaining and understanding how educational psychology works and in helping to clarify and articulate the various processes underlying Educational Psychologists’ (EPs) values, concepts and practices in effecting change (Kelly, Woolfson & Boyle, 2008). As critical realism brings together elements of both positivist and relativist stances it is
important to consider each of these viewpoints. Positivism and relativism will be explored below before a critical realist stance is discussed in more detail.

### 3.2.1.1. Positivism.

Positivism has been termed the “standard view” of science (Robson, 2002, p. 19). It is a methodological belief that phenomena such as human experience and social behaviour are reducible to observable facts and the mathematical relationships between them. It includes the belief that the only phenomena which can be considered as relevant to science are those that can be directly experienced, observed and measured (Coolican, 2009). Positivism assumes that science is based on data gathered through quantitative methodologies, which are used to test hypotheses and establish cause and effect relationships (Robson, 2002).

Positivism can be criticised with regards to its underlying philosophy as well as its application to social research (Kay, 2012). Based on the definitions of positivism above (Coolican, 2009; Robson, 2002) it is apparent that the positivist view does not take into account the fact any observation is influenced by the characteristics, perspectives and biases of the observer. Subsequently positivism would not accept that two different observers could observe the same phenomena in different ways and reach differing conclusions regarding the knowledge and facts about the same phenomena. In terms of its application to social research, positivism regards participants as objects from which the researcher must remain distant and removed in order to maintain objectivity. This is not practical in the present research where it is important to understand the context and acknowledge the participants in order to fully comprehend the implementation factors for each intervention. As Sarantanos (1998) highlighted, participants hold valuable knowledge about the context and by treating them as objects, such information cannot be obtained. Thus, the adoption of a positivist approach is not feasible for this research as it may result in the omission of important information from the data gathered.

### 3.2.1.2. Relativism

Relativism is a theory of knowledge which posits that objective facts are an illusion and that knowledge is constructed by each individual through a unique personal framework (Coolican, 2009). Relativism maintains that there is no reality separate from the conceptual systems employed by people (Trigg, 1989) and views the world as being seen through subjective experience. Therefore it assumes that there is no objective reality and, as such, can be considered at the other end of the philosophical spectrum to positivism. In contrast to positivism, relativist approaches view the research process as generating working hypotheses rather than empirical facts and places an emphasis on viewing the meaning of experience and behaviour in context (Robson, 2002). The role of language is
emphasised in relativist approaches, both as an object of study and as the central instrument used to construct and represent the world. Consequently, it follows that qualitative methodologies are used by researchers who take a relativist stance (Robson, 2002).

Criticisms of relativism include the argument that accounts gathered using a relativist perspective cannot be considered as true, but rather an invitation to view things from a particular perspective (Robson, 2002). In addition to this, as relativism in its pure form assumes that reality is dependent on the views or perspectives of an individual, it follows that relativism deems it possible for multiple realities to exist (Kay, 2012). This is a notion and a possibility which the researcher does not accept, meaning that ‘pure’ relativism is not a stance which can be ascribed to the current research.

### 3.2.1.3. Critical realism

It is the researcher’s opinion that neither a purely positivist nor a purely relativist approach would provide suitable and appropriate ontological and epistemological positions for this piece of research. A more balanced and integrative stance was therefore sought; critical realism.

Critical realism involves using qualitative and quantitative approaches alongside each other to agree:

- On the role of values in enquiry
- On the theoretical nature of facts
- That reality is complex, multiple and constructed, and
- That any particular set of data is explicable by more than one theory.

(Kelly, Woolfson & Boyle, 2008, p. 25)

The epistemological stance of critical realism is particularly important in this piece of research as the researcher is concerned with what works in particular contexts, and why (Matthews, 2010). Critical realism allows the researcher to incorporate participant perspectives (Robson, 2002) and therefore will reveal local, tentative explanations of why things happen in the way that they do as opposed to creating grand, overarching theories (Kay, 2012).

The critical realist stance assumed by the researcher does influence the methodology. Robson (2002) highlights that for realist researchers there are social objects which can be studied scientifically, but the methods chosen must fit the subject matter. Therefore the choice of methodology can be viewed as a pragmatic approach, which
advocates the use of whatever methodological approach will work best to answer the research questions (Robson, 2002).

The focus of this research was to explore the implementation and outcomes of MeeMo and Memory Booster. This was completed largely by ascertaining the views of student and teacher participants regarding their experiences of MeeMo or Memory Booster within an epistemological and ontological stance of critical realism. The impact of this meant that although participant views were sought and represented as accurately and objectively as possible, the researcher’s own experiences will have some bearing on the research. It is acknowledged that an absolute truth cannot be defined within the context of the present research.

3.2.2. Axiological position

Axiology is concerned with the role of researcher’s values in research and considers how these values may influence and impact upon the research. The researcher’s values may influence a range of factors including the choice of topic, the way in which research is approached and the way findings are interpreted and reported. Therefore it is important for the researcher to be clear on the values and beliefs which have influenced and guided this research.

A primary belief of the researcher is that all students deserve opportunities and support which will enable them to develop, progress and work towards their potential and that, as long as it is done appropriately and sensitively, all children should be included in educational provision with their peers. Therefore, interventions which claimed to cater to and include the whole class were selected.

It is the researcher’s opinion that school staff are often best placed to support CYP and that they are most likely to effectively implement an intervention if they have a level of ownership and feel empowered to take control of it. These values meant that the research was designed to utilise and incorporate the contextual knowledge and skills of school staff in implementing interventions which have an emerging evidence-base but which require further investigation and can be investigated and shared by the researcher. The teaching staff were given control to implement the intervention as they would in their usual manner without being overly prescriptive; there was a focus on maintaining ecological validity (Lendrum & Humphrey, 2012).

A core value of the researcher is that CYP’s views and opinions are extremely important, and should be elicited and acknowledged in order to understand how they are feeling and how they can better be supported. The researcher adheres to the belief that all people are viewed as important and valuable, that positive change is always possible
and that each person has a valid contribution to make (Rees, 2008; Seligman, 2011). Therefore, the researcher sought to gather pupil participant views regarding the intervention through qualitative means to ensure they are represented and included.

3.3. Mixed Methods Design

The current research utilised both qualitative and quantitative data to enable the researcher to explore programme implementation and inform discussion regarding outcomes or effectiveness. This is referred to throughout the literature as a mixed methods approach or mixed methodology. Tashakkori and Teddlie (1998) provide a good historical overview of the philosophical debates associated with mixed methods research and outline the key positions of different authors during the “paradigm wars”. Mixed methods approaches in research have been steadily increasing in popularity since the 1960s (Leech and Onwuegbuzie, 2009). A full overview of the mixed methods approaches is beyond the scope of this thesis. For the purpose of this research Powell, Mihalas, Onwuegbuzie, Suldo and Daley’s (2008) suggestion that mixed methods research “should be used when the research question suggests that combining quantitative and qualitative approaches is likely to provide superior research findings” (p. 292) is fitting.

Mixed methods research involves gathering and analysing both qualitative and quantitative data in a single study. Quantitative research involves data which is in a numerical form and is traditionally favoured by researchers taking a positivist stance (Coolican, 2009). Qualitative research involves the gathering of non-numerical data to produce a rich picture. This is usually taken by researchers taking a relativist stance (Coolican, 2009).

Onwuegbuzie and Johnson (2004) suggest that approaches to research can be considered as being on a continuum. They suggest that the continuum would run from mono-method designs employing either quantitative or qualitative methods on one end, to fully mixed methods at the other end, with partially mixed methods placed in between. A fully mixed methods approach involves mixing quantitative and qualitative data gathering within one or more stages of the study. A partially mixed methods approach does not require the qualitative and quantitative data gathering to be mixed. Instead, the qualitative and quantitative data gathering occurs either concurrently (at the same time) or sequentially (at different time points) and then mixed during the analysis or interpretation stage (Leech & Onwuegbuzie, 2009). The qualitative and quantitative phases or elements of research within a partially mixed approach can be given differing degrees of emphasis, depending on the focus of the research and the methods utilised to investigate it. The differing degrees of emphasis are referred to as either ‘equal status’ or ‘dominant status’. Equal status refers to the qualitative and quantitative phases having approximately equal
emphasis with regards to answering the RQ(s). Dominant status refers to when one component may be given higher priority or be considered more important in answering the RQ(s). This typology of mixed approached to research is illustrated well by Leech and Onwueguzie (2009).

Based on Leech and Onwueguzie’s (2009) typology (Figure 3.1), the present research utilises a partially mixed concurrent dominant status design in an attempt to confirm, cross validate and corroborate findings within a single study (Greene, Caracelli & Graham, 1989; Morgan, 1998; Steckler, McLeory, Goodman, Bird & McCormick, 1992). The data is mixed at the interpretation stage. The dominant phase of this research involves qualitative rather than quantitative data for several reasons. It is considered by the researcher to be the most appropriate and useful when considering implementation issues and offers the richest data in the set. It can also be used to inform both research questions, whereas the quantitative data can only offer insight into the outcomes (RQ1). Also, the use of qualitative data gathering methods allowed some flexibility and the opportunity to be guided by the participants and their views, which corresponds with the critical realist stance taken by the researcher. In addition, the group of participants from which the quantitative data was gathered during the present research is not considered large enough to draw any conclusive findings.

The design of this research can also be referred to as QUAL-Quan, indicating an exploratory mixed methods design where the qualitative data are more heavily weighted. Similarly to Kay (2012), the purpose of combining the quantitative and qualitative data for this piece of research was to allow a more exploratory approach to emerge. It also lends more meaning to the quantitative data by including contextual data and adds a more objective and complementary quantitative layer to the qualitative data.

Powell, Mihalas, Onwueguzie, Suldo and Daley (2008) suggested that mixed methods research should be utilised when the research question indicates that combining qualitative and quantitative approaches is likely to provide superior research findings. In the case of the present research, this is certainly true of RQ1. In a review of methodology Mujis (2005) argues that the most appropriate method needs to be selected for each task in the research, for instance although it is more financially beneficial to use surveys to investigate teacher behaviour, observations are much more reliable. This belief has guided the researcher in selecting different methods to inform the different research questions.
Figure 3.1 Typology of mixed research (Leech & Onwuegbuzie, 2009:269)
Robson (2002) suggests that an advantage of using a mixed methods approach is the opportunity for triangulation, which is described as “a method of finding out where something is by getting a ‘fix’ on it from two or more places” (p. 371). Robson (2002) advocates using very different methods to gain a better estimate of the answer. For RQ1, which investigates implementation outcomes, the researcher sought to triangulate the quantitative data gathered through the monitoring provision of each intervention with the qualitative data gathered through interviews, focus groups, teacher implementation diary entries and observations. A further advantage of multiple methods is the ability to address different research questions. An overview of the research questions, data gathering and analysis methods is provided in Table 3.1 below:

<table>
<thead>
<tr>
<th>Research question (RQ)</th>
<th>Data gathering method(s)</th>
<th>Data analysis method</th>
</tr>
</thead>
</table>
| 1) What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory? | Monitoring through the provisions of both interventions (MeeMo and Memory Booster)  
- Semi structured teacher interviews  
- Pupil focus groups | Descriptive statistics (where possible) and qualitative description  
Thematic analysis |
| 2) What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions? | Teacher implementation diary  
- Observation of sessions in each group  
- Semi-structured teacher interviews  
- Pupil focus group | Documentary analysis  
Documentary analysis  
Thematic analysis |

Table 3.1 Research question, data gathering and data analysis methods
3.4. Methodological Process of the Study

This section attempts to delineate the methodological procedures followed by the researcher during this piece of research. Please refer to Figure 3.2 below for a visual representation of the process followed by the researcher, from participant recruitment to data analysis.

Figure 3.2 Methodological process of the study

3.5. Data Access

This section begins by providing information about the researcher’s role as a Trainee Educational Psychologist (TEP) and the cluster of schools with whom he works. It then outlines the sampling methods used to recruit participants and provides information regarding the schools in which the research was conducted and the participants who took part in the study. In order to maintain confidentiality and anonymity for participants, the schools will be
referred to either as School A and School B, or by association of the allocated intervention (Memory Booster or MeeMo).

As previously outlined, during the research the researcher was working with a cluster of schools (Morewood & Rumble, 2013). The research idea developed organically during fieldwork, when assessments of CYP frequently indicated difficulties with WM. Consultation with staff highlighted that interventions for these students would be valued, but staff generally felt that more students in the class could benefit from improving their WM. At a termly review the TEP suggested the current research to school representatives and all present indicated that they were interested in the research. The expected level of commitment was then explicitly outlined, and each representative was asked to independently email the TEP regarding their interest and whether they would realistically be able to commit to the six week intervention and associated data gathering. Participating schools were recruited based on the schools’ ability to commit fully to the research.

It was decided that Year 5 classes would be selected as the desired participants. This was because they can be considered to be within the optimum age range for the development of WM (four to 12 years). Additionally, they will usually have developed the use of some strategies and rehearsal processes which appear at approximately seven years of age. Year 6 was also considered, however due to additional demands such as SATs and forthcoming transition to secondary school it was considered unfair to conduct the research with this age group.

Selection criteria were developed for the eventuality of more than two schools being able to participate in the research. Consideration would be given to aspects such as attendance rates and how closely matched the two Year 5 classes may be. Three schools expressed an interest and said they were able to commit to the research. In response to this, two schools were selected and the third offered one of the interventions or some WM training at a later date. The third school also agreed to be a contingency school in case of any difficulties with the research. Of the participating schools, one class was randomly assigned to the Memory Booster intervention (school A) and one to the MeeMo intervention (school B).

The current research took place in two mainstream primary schools located in the same North West Local Authority. The two schools share a geographical similarity but are very different in terms of the demographics, particularly the gender ratio, pupils with English as an additional language and those eligible for free school meals (FSM) and the pupil premium. Table 3.2 below outlines and compares the key demographics based on information provided by the Department for Education (DfE) website. The following text offers further information from each school’s most recent Ofsted report.
<table>
<thead>
<tr>
<th></th>
<th>School A (Memory Booster)</th>
<th>School B (MeeMo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date DfE information updated</td>
<td>11 December 2013</td>
<td>11 December 2013</td>
</tr>
<tr>
<td>Age range</td>
<td>3-11</td>
<td>4-11</td>
</tr>
<tr>
<td>Gender of entry</td>
<td>Mixed</td>
<td>Mixed</td>
</tr>
<tr>
<td>School type</td>
<td>Community School</td>
<td>Community School</td>
</tr>
<tr>
<td>Total number of pupils on roll</td>
<td>228</td>
<td>346</td>
</tr>
<tr>
<td>Percentage (%) of boys on roll</td>
<td>56.6%</td>
<td>49.1%</td>
</tr>
<tr>
<td>% of girls on roll</td>
<td>43.4%</td>
<td>50.9%</td>
</tr>
<tr>
<td>% of pupils with SEN statement or on School Action Plus</td>
<td>7.5%</td>
<td>7.8%</td>
</tr>
<tr>
<td>% of pupils with English not as first language</td>
<td>66.3%</td>
<td>4.5%</td>
</tr>
<tr>
<td>% of pupils eligible for free school meals (FSM)</td>
<td>16.6%</td>
<td>4.9%</td>
</tr>
<tr>
<td>% of pupils eligible for free school meals at any time during the past 6 years</td>
<td>21.2%</td>
<td>7.8%</td>
</tr>
</tbody>
</table>
According to the most recent Ofsted inspection report School A (Memory Booster) (Ofsted, 2010a) was judged to be grade 1 (outstanding) in both ‘overall effectiveness’ and ‘the school’s capacity for sustained improvement’. In September 2012, it was reported that for the 2012-2013 academic year 27 children were eligible for the additional support provided by the school and funded through the pupil premium grant. For 2013-2014, the allocation has been made to all those pupils who have received FSM at any time during the last 6 years and have an allocation of 40 students (School 1, 2013). The Ofsted inspection report (Ofsted, 2010a) stated that three quarters of the pupils belong to minority ethnic groups, the majority of whom are of Pakistani origin. There are a high proportion of pupils who speak English as an additional language, some of whom are at an early stage of learning English.

According to the most recent Ofsted inspection report (Ofsted, 2010b) School B (MeeMo) was judged to be grade 1 (outstanding) in both ‘overall effectiveness’ and ‘the school’s capacity for sustained improvement’. The school website (School 2, 2013) highlights that for the 2012-2013 academic year 27 children were eligible for pupil premium funding. The information for 2013-2014 was not available at the time of writing. Most pupils are of White British heritage with around 10% having Asian or Caribbean backgrounds. A below average proportion of pupils have special educational needs and/or disabilities (Ofsted, 2010b).

Both schools were involved in the researcher’s TEP fieldwork placement as previously indicated. Therefore positive working relationships had already been forged between the researcher and key staff such as the headteacher and SENCo in each school. In School A, these key staff initially acted as a liaison between the researcher and the Year 5 class teacher, hereafter referred to as Teacher A. In School B, teaching in the Year 5 class was shared between two teachers. Teacher B was a newly qualified teacher (NQT) in her first year of post-qualification teaching while Teacher C was a very experienced teacher who was also the deputy head-teacher and Special Educational Needs Coordinator (SENCo). Although this clearly had benefits such as a familiarity of the context and existing working relationships, there were also ethical issues related to the dual-role of the researcher. This is examined subsequently in Section 3.9.

After identifying and allocating interventions to the two schools, informed consent from the teachers who would be involved in implementing the intervention was sought (see Appendices A and B for information sheet and consent form). All three class teachers were forward thinking and were happy to engage with the research as they were able to identify students in their class who they thought it would benefit.
After the schools had agreed and the class teachers had given informed consent, consent from the parents/carers of each child within each Year 5 class was also sought (see Appendices C and D for parent/carer information sheet and consent form) and a briefing was offered at each school, where parents were able to discuss the research with the researcher and ask any questions they may have. Finally, informed pupil assent was sought after the process had been explained to them and also prior to the AWMA assessment and their involvement in the focus group (see Appendix E for pupil assent form).

3.6. Data Gathering Methods

In this section each of the methods used to gather data will be explored in approximately the chronological order in which they were implemented.


The researcher utilised the Automated Working Memory Assessment (AWMA) (Alloway, 2007a) to assess the WM of each student in each class prior to the commencement of the intervention. The AWMA is a computerised assessment of STM and WM based on the multi-component model of WM (Alloway, 2007a). It comprises separate components which measure verbal WM and visuo-spatial WM, and also verbal STM and visuo-spatial STM. The AWMA has proven to be a useful outcome measurement within previous WM training evaluation studies (Alloway & Alloway, 2010). It was initially planned that the AWMA would be used at three separate time points to measure the effectiveness of each intervention; as a baseline, or pre-intervention measure, immediately after or post-intervention and at a follow up approximately two months after the intervention. However, due to the small sample size, and the subsequent impossibility of using inferential statistics, it was decided that the researcher would focus more on the implementation and outcomes from the perspective of those involved. It was then decided that the AWMA would provide useful contextual information to the researcher regarding the WM profile of each class. This contextual information could be utilised when considering the data gathered. The AWMA also served the additional purpose of screening each class to identify a sample of six children per intervention to potentially be included in the focus group. It was decided that in order to ensure the views of the focus group were varied, the sample of each group would consist of the two highest, the two lowest and the two in the middle of the AWMA scores. This was done in conjunction with the children in each class, ensuring that, if selected, the children wanted and were willing to participate. Each potential participant was fully informed and assent was gained before the sample of six was asked to engage in the focus group. If, for any reason one of these children was not able or
decided not to participate then the child with the next highest or lowest score were selected, and so on until a sample of six for each group was selected.

3.6.2. Implementation of the interventions and in-built monitoring provision.

Each intervention was implemented for six weeks, during one half-term. The interventions were introduced and explained to the teachers who were due to implement with enough time for them to consider how they could use them and whether there were any perceived difficulties which would need to be overcome. Support was offered to each in terms of the researcher’s time to discuss and troubleshoot any potential issues before the intervention began and also the relevant contact for each intervention in terms of usual support which would be offered if the intervention had been purchased.

In line with the researcher wanting to maintain ecological validity, but also wanting to conduct research which was as reliable and valid as possible, each teacher was informed that they were expected to attempt to use the intervention daily for the recommended time (15-20 minutes depending on the intervention) for a six week period. They were encouraged to follow the instructions but it was acknowledged that they may need to ensure the interventions could be implemented. Below is a brief outline of each intervention, the expectations for implementation and the in-built monitoring provision which was to be utilised.

3.6.2.1. MeeMo.

As outlined in the literature review, MeeMo is a practical, school based training programme, with the conception that it can be used to help every child in a class to improve their WM (Skelton, 2012). It involves the use of cards which display a question on the front and an answer on the back. There are five different colour-coded activities, allowing for one to be used each day of the week. The activities are called Mix Up, Order Order, Group Up, Location, and Spot The Difference. For each activity there are three difficulty levels (easy, medium and hard) which are also colour-coded. Children are expected to work in pairs, taking it in turns to be either the ‘Questioner’ who asks the questions and checks the answers, or the ‘Thinker’ who listens to the questions and provides an answer. MeeMo is designed to be used every day at a pre-specified time for approximately 15 minutes. During this session each child takes the role of either the Thinker or Questioner for 6 minutes, before the roles are reversed for another 6 minutes. Children have autonomy in selecting their own difficulty level and the Thinker receives feedback by collecting each card they get right. Their progress is tracked by visually drawing the number of correct responses in a personalised monitoring booklet.
The class teachers were given the programme and the researcher explained how to use it in line with instructions given. An instruction booklet was provided which offered explicit instructions and guidance. Skelton (2012) indicates in his own research that MeeMo proved simple to introduce, set-up and use on a daily basis in the classroom context.

The in-built monitoring provision for MeeMo is a personalised monitoring booklet which each student completes independently after each MeeMo session. There are no associated assessments or monitoring forms for the teachers to complete.

3.6.2.2. Memory Booster.
Memory Booster is a computerised programme which aims to help children improve their memory skills. It can be used individually or with a whole class, as long as each student has access to a computer and appropriate log-in details. Memory Booster is an adventure game set in the context of a castle, in which children play memory games to progress in the game and also to earn periodic rewards in the form of short cartoons. During the ‘mission’ the player is taught and encouraged to use different strategies, namely:

1) Rehearsal – simple repetition of verbal information
2) Visual imagery – creating pictures in the mind to represent the information that has to be remembered
3) Creating stories – generating a narrative that links together the information in the form of a story; if the story is amusing then it is more likely to be remembered.
4) Grouping – using higher-order conceptual categories (e.g. ‘living things’, ‘things we use in the home’) to group items together


The manual, or “Memory Booster Guide for Teachers, Parents and Professionals” (Leedale, Singleton & Thomas, 2004) explicitly outlines how to install and run Memory Booster, as well as providing details about the programme itself and how to track progress. Memory Booster automatically logs and tracks student progress, so there was no need for students or teachers to complete any additional assessments. It also provides an option for the teacher to monitor progress and provide feedback or certificates.

3.6.3. Observation schedule.
Many studies of school effectiveness and implementation emphasise the importance of observation as a tool for assessing programme fidelity and for triangulating subsequent data. An observation proforma was created
(Appendix F) based upon key elements of programme implementation. Although Durlak & DuPre (2008) identified eight common aspects of implementation that can be assessed, the five which are generally accepted in the literature as ways of measuring fidelity were used to guide the observations. These are adherence, dosage, quality of programme delivery, participant responsiveness and programme differentiation (Dane & Schneider, 1998; Domitrovich & Greenberg, 2000; Dusenbury et al., 2003; Cross et al., 2010; Ennet et al., 2011). The observation schedule was designed to be used by the researcher during each observation to ensure the observations were consistent, regardless of which intervention was being observed. The researcher utilised a naturalistic observation approach recording largely qualitative data which allowed for the capture of more detailed and contextually embedded information (Coolican, 2009). A more structured or systematic approach utilising quantitative coding was considered but it was felt that this may lead to data that was “reliable but not rich” (Coolican, 2009, p. 131).

Observation is an extremely useful tool which enabled the researcher to keep track of the fidelity and the implementation of each intervention, and also allowed for triangulation of data from the focus groups and interviews. However there are some issues which should be considered in terms of reliability and validity. Perhaps the most significant criticism of observation is that, despite the use of the schedule to structure it, the recording of information is based on the researcher’s perspective and as such may not necessarily be representative of if another observer had recorded information. The use of a largely qualitative recording system risks omission or distortion in the data (Coolican, 2009). This was demonstrated by Halliday and Leslie (1986), whose study measured inter-observer reliability and found that the observers agreed on 76.7% of occasions, indicating that they did not agree on nearly a quarter of occasions. There is also the possibility that the presence of the researcher observing would influence the behaviour or approach of the teacher implementing the programme or of the students engaged in the intervention (Coolican, 2009). It was hoped that the use of the implementation diary completed by the teachers would be utilised to triangulate the data gathered during observations and to try and investigate whether this was usual practice. Also, multiple observations were conducted, with a minimum of three observations occurring during the course of the observation. The researcher ensured both Teacher B and Teacher C were observed when implementing MeeMo. Observations were conducted at the start, during the middle and towards the end of the six week period.

3.6.4. Implementation diary.

The teaching staff who were responsible for implementing the interventions were asked to complete an implementation diary. They were asked to complete this every day during the six week period of intervention.
Teacher B and Teacher C agreed to share an implementation diary, with the relevant teacher completing the diary on the corresponding date. The implementation diary was used as one method for monitoring fidelity and dosage, as well as providing information such as whether the whole class was able to participate, whether additional support or differentiation was required and any facilitators or barriers to implementing the intervention. It was also used as triangulation for data gathered through other data gathering methods. It was designed to be quick to complete, with the majority of questions answerable by a tick or letter taken from a key. There was also space to expand and provide further information if necessary. Please see Appendix G for a blank implementation diary.

3.6.5. Semi-structured interviews.

One-to-one semi-structured interviews were conducted with those responsible for implementing the interventions. In both cases this was the class teacher. The semi structured interviews were conducted following the cessation of each whole class working memory intervention.

Interviews typically follow a format which involves the researcher questioning and receiving answers from the interviewee. Interviews are most commonly conducted on a one-to-one basis, as was the case in the current research. Separate interviews were conducted with each teacher as it was felt important to identify the characteristics and explore the implementation and outcomes of the individual interventions which had specifically been used. It was believed by the researcher that combining the interviews would have led to difficulties in understanding which data pertains to MeeMo and which to Memory Booster and would not have allowed for in-depth exploration of implementation issues of each.

Semi-structured interviews were selected for use during this research. Semi-structured interviews have predetermined questions but the researcher is allowed the freedom to alter the wording of the questions, give explanations and omit or include additional questions as appropriate (Robson, 2002). Robson (2002) suggested that semi-structured interview schedules may adhere to the following format:

- Introductory comments (probably a verbatim script);
- List of topic headings and possibly key questions to ask under these headings;
- Set of associated prompts;
- Closing comments.

(Robson, 2002, p.278)
The interviews were used to inform both RQ1 and RQ2. Both interviewees were asked to use their implementation diary (described above) as an aide memoire to help to recount their thoughts throughout the intervention. The ‘interview guide approach’ method of interview, as described by Patton (1980), was used by the researcher within the semi-structured format. This is characterised by the researcher specifying topics to be covered in advance, and then using this schedule as a guide during the interview. The order of the questions within the interview was dependent on the researcher at the time of the interview, and additional areas which were not initially specified were allowed to be investigated in response to the interviewee (please see Appendix H for an example interview schedule). This flexibility was a considerable advantage over other data gathering tools. Another advantage was the possibility for greater depth of data analysis than many other methods of data collection such as a questionnaire, due to the potential for interviews to provide a rich data set (Cohen, Manion & Morrison, 2007).

The interview schedule included questions related to both research questions, addressing both outcomes and programme implementation. This included: experience of the intervention; facilitators; barriers; adaptations; benefits; drawbacks; impact on individual students and on the whole class. It was intended that the interviews with the class teachers may inform future amendments to either of the interventions or adaptations to the school implementation to increase the relevance of the programme to the context in which it is delivered. All three teachers were invited to participate separately in a semi-structured interview. Due to time constraints and other commitments it was not possible for Teacher C to engage. To ensure her perspective was incorporated Teacher B liaised closely with Teacher C throughout the process. Each interview was recorded using a digital audio recorder, and the recordings stored only until the completion of the research.

3.6.6. Focus groups.

Two focus groups were conducted, one with each sample of six children, to inform both RQ1 and RQ2 and ensure the views of those using the interventions were represented. The focus groups were conducted following the cessation of the whole class working memory interventions. The sample of six students per intervention was selected based on the students’ willingness to engage in the focus group and their performance on the pre-intervention AWMA. The AWMA scores were analysed to identify the two highest scoring students, the two in the middle and the two lowest scoring students. This was to ensure a varied sample that was approximately representative of the range of the class’s WM ability.

Focus groups are a very popular method of data collection in applied social research (Robson, 2002). Kitzinger and Barbour (1999) suggest that any group discussion could be called a focus group as long as the researcher actively
engages in encouraging group interaction. Coolican (2009) identifies an advantage of focus groups as being that more data can be gathered in a session than in a 1:1 interview. Mujis (2005) argues that focus groups have the capacity to assist researchers in being open to unanticipated patterns rather than being reliant on their own theories. In depth interviews may be time consuming but enable greater understanding of the participants’ perspectives. Mujis (2005) concludes by arguing that the instruments and measures used should reflect the goals of the project rather than convenience to the researcher. An additional reason for gaining student views in addition to teacher views and observation data was Mujis’ (2005) suggestion that observer and student reports of teacher behaviour correlated more closely than teacher’s own reports and observer reports (Hook and Rosenshine, 1979).

Six participants is thought to be large enough to gain varied opinions, while small enough to allow individuals to fully express their opinions (Krueger & Casey, 2009). Individual interviews may be more intimidating for the children involved, and would also result in greater disruption to the class teacher. Coolican (2009) likened focus groups to ‘group interviews’ and indeed, a similar semi-structured, interview-guide approach was utilised, as outlined above for the 1:1 teacher interviews (see Appendix I for the focus group schedule). The focus group schedule included questions on both programme outcomes and aspects of implementation. Each focus group was recorded using a digital audio recorder and the recordings stored only until the completion of the research. The use of an audio recorder enabled the researcher to focus on guiding the group interview rather than taking notes.

In the present research, the focus groups provided an opportunity for an interactive discussion relating to the students’ experiences of participating and engaging in each intervention. It was important for the researcher, whilst facilitating the focus groups, to utilise effective communication and process skills to encourage a full and open discussion of views. Mack et al. (2005) suggested that building rapport between group members is important and suggests ideas to develop rapport, such as establishing ground rules at the start. This was done explicitly with pupil participants in each focus group. The ground rules for both groups included the need to let everybody speak, to talk one at a time, to respect each other’s views and to not interrupt.

The researcher was mindful of group dynamics and ensured each group member had an opportunity to express their views and that no one group member was dominant. A potential disadvantage to using focus groups is the phenomenon of groupthink. Due to the interactive nature of focus groups, participants can influence and be influenced within this environment and any uniqueness and independent responses may be lost in such an open forum (Kruger & Casey, 2000; MacDougall & Baum, 1997). The researcher was aware of this and attempted to ensure participants felt confident to voice their own opinion.
3.7. Data Analysis Methods

Data analysis is considered to be an important part of the research process, as “data do not just speak for themselves: selection and interpretation are required” (Gillham, 2000, p. 79.) The following section describes the methods used to analyse the data gathered during this research. The qualitative data analysis will be described first followed by a description of how the quantitative data were analysed.

3.7.1. Qualitative data analysis.

The data gathered from the focus groups and semi-structured interviews were transcribed by the researcher and then analysed using thematic analysis (Joffe & Yardley, 2004; Braun & Clarke, 2006; Fereday & Muir-Cochrane, 2006).

3.7.1.1. Transcription.

Transcription is important as the qualitative data gathered needs to be changed into a commonly used format so that it can be analysed (Coolican, 2009). The act of transcription can be viewed as an integral part of the research as it involves the researcher familiarising him or herself with their data (Reissman, 1993). Indeed, transcription is suggested as part of the first stage of thematic analysis; familiarisation with the data (Braun & Clarke, 2006). Bird (2005) claims that transcription should be seen as a key phase of analysis.

Although there is no specific way in which to conduct thematic analysis, Braun and Clarke (2006) suggest that it does not require the same level of detail as other forms of analysis, such as discourse analysis. Therefore, the researcher selected a form of transcription which involved recording only the verbal content without the non-linguistic features (Coolican, 2009).

Once transcription had been completed and checked, the digital audio recordings of each semi-structured interview and focus group were deleted in line with ethical considerations and information given at the time of gaining informed consent from participants.

3.7.1.2. Thematic analysis.

The transcriptions of the semi-structured interviews and focus groups were analysed using thematic analysis in line with the framework outlined by Braun and Clarke (2006). Thematic analysis is “a method for identifying, analysing and reporting patterns (themes) within the data” (Braun & Clarke, 2006:79), where the researcher engages in an active role identifying the themes. Braun and Clarke (2006) identify a number of considerations that need to be explicitly addressed both prior to and during the thematic analysis: what counts as a theme; how much of the data...
will be included; inductive versus theoretical thematic analysis; and whether the focus will be upon semantic or latent content. Each of these considerations will subsequently be addressed, before the process of thematic analysis is explored.

Firstly, it was decided by the researcher to categorise a theme as any piece of data that “captures something important in relation to the overall research question” (Braun & Clarke, 2006, p. 82). As suggested by Braun and Clarke (2006), ideally there will be a number of instances of a theme across the data set although the prevalence of a theme does not make it more crucial. Researcher judgement was necessary in determining what constitutes a theme. Secondly, the researcher decided to focus on a rich description of the data set, rather than a detailed account of one particular aspect. This is considered to be particularly useful when investigating an under-researched area or when working with participants whose views on the topic are not well known (Joffe & Yardley, 2004; Braun & Clarke, 2006). Thirdly, the researcher needed to consider the type of thematic analysis that would be used, specifically whether the themes or patterns within the data would be identified in an inductive or ‘bottom-up’ way (e.g. Frith and Gleeson, 2004) or in a theoretical, deductive or ‘top-down’ way (e.g. Boyatzis, 1998; Hayes, 1997). An inductive analysis involves identifying the themes from the data itself, whereas a theoretical approach tends to be driven by the researcher’s theoretical or analytic interest in the area (Braun & Clarke, 2006). Although Braun and Clarke seem to indicate that there is a dichotomy, the researcher considered the approach taken to contain elements of both theoretical and inductive approaches. The exploratory nature of the study requires inductive analysis, however the researcher was very aware that he had set out to answer specific research questions and that the analysis would be shaped by this and by prior knowledge and experience. This ‘hybrid’ approach has been endorsed as an effective method of analysing complex data (Joffe & Yardley, 2004; Fereday & Muir-Cochrane, 2006). Finally, it was decided that the current research would focus on identifying semantic, rather than latent themes. Semantic themes are identified within the explicit or surface meanings of the data, whereas latent themes require examination of the underlying ideas, assumptions and ideologies which are said to inform the content (Braun and Clarke, 2006). It was thought that identifying semantic themes was more appropriate to the topic area and focus of the research.

The researcher followed the six phases of thematic analysis as described in Braun and Clarke (2006:87), which are detailed in Figure 3.3 below.
Table 3.3 outlines the six phases of thematic analysis and describes the process engaged in by the researcher during each phase.

**Table 3.3 Process of each stage of thematic analysis**

<table>
<thead>
<tr>
<th>Phases of thematic analysis (Braun &amp; Clarke, 2006)</th>
<th>Description of process</th>
</tr>
</thead>
</table>
| **Phase one:**
Familiarising yourself with your data          | - Transcribed interviews and focus groups (data sets).
                                                | - Checked transcripts against voice recordings. |
                                                | - Re-read transcripts.                        |
                                                | - Created initial ideas and notes.            |
| **Phase two:**
Generating initial codes                     | - Systematically assigned initial codes across the entire data set by selecting extracts in NVivo and creating ‘nodes’. |
<pre><code>                                            | - Collated data relevant to each code.         |
                                            | - Engaged in inter-rater reliability checking by asking an independent rater to code a small section of each transcript and calculating the difference between matched and un-matched data (based on meaning rather than wording of codings). |
</code></pre>
<p>| <strong>Phase three:</strong>                               | - Sorted the codes into potential themes by grouping the ‘nodes’ |</p>
<table>
<thead>
<tr>
<th>Searching for themes</th>
<th>into clusters or themes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Some codes were included in more than one theme</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase four: Reviewing themes</th>
<th>Sought to refine the themes devised. The researcher attempted to ensure that data within each theme fitted together meaningfully whilst ensuring distinctions between themes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Checked data extracts corresponded with coded themes. Some themes were discarded based on the strengths and relevance.</td>
</tr>
<tr>
<td>-</td>
<td>Created a thematic map or network of potential themes. This was supported by information provided by Attride-Stirling (2001) and is explained further in section 3.7.1.2.1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase five: Defining and naming themes</th>
<th>Read the collated extracts within each theme to identify the ‘essence’ of each theme and what aspect of the data each theme captured.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Provided each theme with a concise name which immediately provides the reader with a sense of the theme.</td>
</tr>
<tr>
<td>-</td>
<td>Re-organised themes and data extracts where necessary.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase six: Producing the report</th>
<th>Final analysis of the themes to ensure the researcher is able to tell the complicated story of the data in a way which convinces the reader of the merit and validity of the analysis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Related the analysis to the research questions and the literature.</td>
</tr>
<tr>
<td>-</td>
<td>Wrote up the data analysis to be included within results section.</td>
</tr>
</tbody>
</table>

It was decided by the researcher to utilise NVivo software to assist in the management and analysis of the data. NVivo allows researchers to create a project that holds the data, the ideas about it and links between them. It allows for flexible coding that can incorporate initial ideas or codes through to a more hierarchical organisation that supports the identification of themes (Richards, 1999).

3.7.1.2.1. Thematic networks.
The process of using thematic analysis can be difficult to encapsulate and manage effectively. Attride-Stirling (2001) suggested that the process can be used to produce a thematic network, which is a web-like illustration allowing themes to be organised and classified either as basic themes, organising themes and global themes (Figure 3.4). This approach, similar to utilising a mind-map, provides the researcher with a way of organising the thematic analysis and can be considered as a tool for analysis rather than being the analysis itself (Attride-Stirling, 2001). It could be placed into phase four of Braun and Clarke’s (2006) description of thematic analysis.

**Figure 3.4 Structure of a thematic network (Attride-Stirling, 2001:388)**

Within Attride-Stirling’s (2001) thematic networks, a basic theme is the lowest order theme and contains basic ideas derived directly from the text. Individually, a basic theme will say very little about the data set and must be read in conjunction with and in the context of other basic themes in order to infer any sense beyond its immediate meaning. When taken together, basic themes can represent an organising theme. This is a middle-order theme that organises the basic themes into clusters of similar points or meaning. Organising themes are more abstract and more revealing of what is happening in the data set. A set of organising themes can be grouped together to form a global theme. A global theme is a super-ordinate theme and presents an assertion about an issue. Global themes provide a summary of the main ideas in the data and a revealing interpretation of the data sets (Attride-Stirling, 2001).
3.7.2. Quantitative data analysis.

The quantitative data gathered was not as straightforward to analyse as the qualitative data. The aim at the start of the research was to use the interventions in the way that they were intended and then to evaluate the outcomes and the implementation of each in their own terms of reference. There are significant differences between the monitoring provisions of each intervention. As a result it was not possible to apply a consistent approach to analysing the data gathered through each intervention. The methods used to analyse each interventions monitoring provision will be outlined below.

3.7.2.1. Memory Booster analysis.

The data collected through the Memory Booster software consisted of reports which were created after the six week period. The software enables users to create ‘student reports’, which give accuracies and scores on each level attempted or completed by a specific student. The level achieved by a child is portrayed as an objective measure of how the child’s memory skills are improving although this claim is not validated. The score gives a record of the number of points a child has achieved in each session, and it is reported that for most children this will give a reasonable indication of the amount of effort they have put in (Leedale, Singleton & Thomas, 2004). There is also an option to create ‘class reports’, which outlines the whole class progress and ‘mission reports’ which provide information on a particular mission type.

It was initially decided by the researcher to analyse progress made by the class as whole and then to analyse the progress made by the six focus group participants, to investigate whether their views were reflected in their performance and progress on the programme. Both the levels reached and the scores achieved were analysed in line with expectations although due to the undefined nature of the quantitative data it was difficult to effectively utilise descriptive statistics. For more information refer to section 4.2.3.

3.7.2.2. MeeMo analysis.

The data gathered during MeeMo consists of subjective student scores which were recorded after each session in the personalised monitoring booklet. The student was asked to use a coloured highlighter to indicate how many cards they correctly answered. The colour of the highlighter indicates whether they were using the easy, medium or hard cards. Students are encouraged to select their own difficulty at the start of each session and as a result
there can be a lack of consistency which makes it difficult to measure the child's progress. If a student had used the medium set throughout the MeeMo intervention it would be relatively easy to crudely measure improvement, as you would expect the amount of cards answered correctly to steadily increase with practice. However if a student used the easy cards for a week, then went to hard, then to medium, etc, it would be very difficult to gauge their level of progress as it is not possible to know the relative increase in difficulty from one set to the next. In addition to this, it was reported that there was an intentional variable ratio of task difficulty within each difficulty level due to the fast paced nature of the question and answer paired working process (Skelton, 2012).

In line with the researcher's aim to investigate the outcomes through the provision available within the intervention, it was decided that the data gathered from these record booklets would be analysed. It was not possible to develop a method of analysis prior to gathering the data due to the unpredictable and novel nature of the data. Within the scope of this research it was difficult to develop any meaningful or exploratory form of quantitative data analysis for the MeeMo monitoring provision, although a table and graph were created to assist visual analysis. The graph provides a simple view of the number of cards correctly completed for each activity over the six weeks. However it does not account for the difficulty level selected by the pupil. This can lead to misleading data where the number of correct responses may increase or decrease considerably each week. The table provides a full overview of each pupil's performance, including the difficulty level attempted (identified through the colours yellow, orange and red) and the number of correct responses for each activity.

3.7.3. Analysis of additional data.

The main data analysis focused on the qualitative interviews and programme monitoring systems in order to understand the perspective of those delivering and using the interventions and the utility of the monitoring provision. In order to elicit additional contextual information implementation diaries and observations were also undertaken. A summary of MeeMo was provided independently by Teacher B and Teacher C and this was also used in this way. However, the documents were also explored using documentary analysis, specifically elements of directed and summative content analysis (Hsieh & Shannon, 2005). This was not an in-depth analysis but was used to triangulate the data gathered through other methods. The data were examined in conjunction with the themes elicited through analysis of the interviews and focus groups to explore the general degree of congruence between interviews/focus groups and the observed or reported implementation. The implementation diaries provided a combination of qualitative and quantitative information while the observation schedules largely provided qualitative data. The additional data described above were also utilised to measure aspects of implementation
such as fidelity and dosage in line with Durlak and DuPre (2008). They were not used as core data for the RQs as they can be considered less rigorous and of more utility for monitoring and context rather than primary data in the present research.

3.8. Validity and Reliability

The concepts of validity and reliability in mixed methods and qualitative research are focus of debate in the literature, with some authors preferring to discuss quality, rigour and trustworthiness (Porter, 2007; Rolfe, 2006). This is due to the largely positivist associations with the terms and the very structured way in which they are measured in quantitative research (Coolican, 2009; Guba & Lincoln, 1994). The suitability of the term ‘reliability’ in particular has been contested in qualitative research (e.g. Winter, 2000; Golafshani, 2003), with Lincoln and Guba (1985) replacing it with terms such as ‘neutrality’, ‘confirmability’, ‘dependability’, ‘consistency’, ‘applicability’, ‘trustworthiness’ and ‘transferability’. Willig (2008) states that a measurement is reliable if it yields the same answer on different occasions and argues that qualitative research is less concerned with reliability as it generally does not aim to measure a particular attribute in large numbers of people. There is not scope within this thesis to further discuss the intricacies and appropriateness of different terminology. There follows a brief section outlining some of the techniques used by the researcher to support validity and reliability throughout the study.

Within this research design, validity can be viewed as the extent to which the research describes, measures or explains what it has been designed to describe, measure or explain (Willig, 2008). An important technique for the researcher throughout the present research was reflexivity. This ensured that the research process as a whole was scrutinised throughout and that the researcher continuously reviewed his own role in the research, discouraging impositions of meaning and consequently promoting validity (Willig, 2008). The researcher considered threats to validity and how to minimise them at the design stage, the data collection stage, the data analysis stage and the stage of data reporting. This was done in line with suggestions made in by Cohen, Manion and Morrison (2011). The suggestions included selecting an appropriate methodology for answering the research questions, ensuring inter-rater reliability, using respondent validation and making claims which are sustainable by the data (Cohen, Manion & Morrison, 2011). The researcher also ensured that participants were free to challenge and if necessary, correct the assumptions about the meanings investigated (Willig, 2008). In addition to individually reflecting on the process and on his role in the research, the researcher regularly accessed supervision to discuss the data gathering and analysis methods and to ensure any potential bias was recognised, discussed, reduced and removed if possible. This external support and insight helped the researcher to
remain anchored and maintain a level of reflexivity, which subsequently improved the validity of the research through awareness of subjectivity and increased objectivity. The researcher was able to recognise if his views were being imposed on the research and could take a step back to consider why this may be happening and how to rectify it.

It was decided that participant validation would be used to check validity during the data analysis. This involved the researcher consulting with participants, in this case Teacher A and Teacher B to ‘member check’ the authenticity of the emerging interpretation (Coolican, 2009; Holt & Dunn, 2004). It was not possible to conduct member checking with pupil participants due to time restrictions. The researcher also utilised inter-rater reliability checking during the analysis stage by asking an independent rater to code a small section of each transcript and calculating the difference between matched and un-matched data (Cohen, Manion & Morrison, 2011).

3.9. Critique of Method

3.9.1. Design.

In order to investigate the outcomes and implementation of the whole class working memory interventions the current research utilises a mixed-method design (Johnson and Onwuegbuzie, 2004). With regards to mixed methodologies there are a number of critiques and issues to consider. Tashakkori and Teddlie (2003a) outlined six unresolved issues and controversies in the use of mixed methods: (a) the nomenclature and basic definitions used in mixed research; (b) the utility of mixed research; (c) the paradigmatic underpinning for mixed research; (d) design issues in mixed research; (e) issues in making inferences in mixed research; and (f) the logistics of conducting mixed research. The researcher has acknowledged these six issues throughout this section and has been explicit in outlining the reasons for using a mixed methods approach.

A particularly pertinent issue of mixed methods research is related to the stage of data analysis, particularly how to integrate different sources of data. This is a complex issue that is yet to be fully resolved within the literature. Morse (2003) argues that for each design element it is essential that its methods and assumptions are adhered to, for example if all interviewees have not been asked the same questions then counting occurrences of themes may not be appropriate. Conversely Onwuegbuzie and Teddlie (2003) suggest that data can sometimes be transformed, such as quantifying interview data to yield effect sizes for different factors. Maintaining integrity and ensuring the maintenance of data is an important issue to be considered if a researcher is considering transforming data from one form to another. The researcher considered this approach but decided that more useful information would be
gleaned from the data if it was analysed in line with the conventionally appropriate methodologies, as suggested by Morse (2003). For this reason, numerical data was analysed quantitatively whilst non-numerical data was analysed qualitatively.

A further issue is that of triangulation. Some authors argue that triangulation is essential in mixed method approaches whilst others argue that “the goal of mixing is not to search for corroboration but rather to expand one’s understanding” (Johnson & Onwuegbuzie, 2004, p.19). Chen (2006) identified three benefits of mixed methods research: triangulation of quantitative and qualitative methods in order to gain convergence; one methods compensating for the weakness of another method; and each method expanding understanding of the topic in a different way. Within the present research the latter benefit is thought to be the most relevant, as the two types of data offer a different perspective and provide insight into different areas of interest.

3.9.2. Context.

The two schools represented an opportunistic sample and were chosen based on the ease of accessibility for the researcher and the school’s willingness to engage and participate fully in the research. Although similar in terms of geographical location and their status as community primary schools in the same North West Local Authority, the schools’ demographics are markedly different. As a result the schools have different ethos and teaching styles and despite efforts to match the participant sample as much as possible it is almost impossible to generalise across the two settings. However this is countered by the researcher’s epistemological stance and focus on ecological validity. It is particularly important to consider what works, for whom, and in what setting (Pawson & Tilley, 1997).

3.9.3. Qualitative data.

Semi-structured interviews were used to obtain the views of the teachers. A limitation of interviews is their time-consuming nature. However the researcher designed a relatively short semi-structured interview schedule and agreed a set time with the participants. Another potential limitation is the inconvenience to interviewees. The researcher attempted to arrange each interview at a convenient time and location. The researcher acknowledges that, as a result of their flexibility, semi-structured interviews can be considered to have a weak reliability or comparison across respondents (Coolican, 2009). This was considered by the researcher and it was decided that the potential benefits of exploring unidentified areas with the teachers fitted with the researcher’s critical realist approach and outweighed the positivist criticisms.
Focus groups were used with the student participants. Limitations to this method include several similarities to interviews, such as the potential bias and the semi-structured nature reducing reliability. There is also a concern that focus groups can lead to a lack of researcher control because the discussion is largely dominated by the group itself (Morgan, 1988). The potential for one or more vocal group member to dominate to discussion is another concern (Robinson, 1999) The researcher felt he had sufficient process and interaction skills to act as an effective facilitator and encourage all participants to speak out. Ground rules were also established to support this. This approach enabled data to be based on the groups’ beliefs, thoughts and opinions.

Regarding both the semi-structured interview schedule and focus group schedule, it may have been beneficial to conduct a pilot prior to the actual data gathering interviews and focus groups in order to establish whether the questions are likely to elicit the required data (Barbour, 2007). Unfortunately this was not possible due to time constraints. However the researcher based the questions and focus on the existing literature and research questions in an attempt to identify relevant and useful questions.

It may have been beneficial to have designed a more structured and systematic observation schedule and implementation diary to provide more rigorous quantitative data that could be used as primary data in its own right. In the present research they were designed to provide context and to triangulate or disprove hypotheses developed through the analysis of the primary data. The naturalistic, flexible, qualitative nature provided more in-depth and rich information (Coolican, 2009) which met the needs of the present research.

3.9.4. Quantitative data analysis.

A significant critique of the method is the use of the monitoring provision provided within each intervention. By the nature of each intervention they utilised very different provisions for monitoring student progress and outcomes which did not necessarily lend themselves well to quantitative analysis.

If time and resources allowed, it would have been useful and informative to utilise an objective, standardised assessment of working memory such as the AWMA. As previously discussed, the use of pre, post and follow-up measures were initially considered to measure the effectiveness of each intervention. However, due to the large sample size required to achieve an acceptable power and effect size it would not have been possible to effectively use inferential statistics within the scope of this research. Skelton (2012) calculated that in order to utilise an experimental design comparing two interventions, the parameters of his research would require a minimum of 30 classrooms (15 per intervention) to detect a moderate effect size. The limited time available in conjunction with
not being able to use inferential statistics led the researcher to discard the idea of more quantitative assessment and to focus on the implementation outcomes.

3.10.  Ethics

All of the research conducted was considered in line with the School of Education Ethical Practice Policy and Guidance (University of Manchester School of Education, 2010). Ethical approval was granted on 04/04/2013 (see Appendix J for the confirmation). The researcher was also guided by relevant professional documents including the Health Professions Council (HPC) standards of conduct, performance and ethics (HPC, 2008) and the British Psychological Society (BPS) code of ethics and conduct (BPS, 2006) which befits the professional practice as a TEP.

3.10.1.  Key ethical considerations.

As this research involves children and investigates interventions which are meant to benefit them, it was thought particularly important that their views were incorporated. This highlighted a range of potential ethical issues. Literature such as Alderson (1995) and Roberts (2008) in her work for Barnado’s, suggests ten topics raising questions which should be considered when conducted research involving children (Figure 3.5).

1) The purpose of the research: If the research findings are meant to benefit certain children, who are they, and how might they benefit?

2) Researching with children – costs and hoped for benefits: Might there be risks or costs such as time, inconvenience, embarrassment, intrusion of privacy, sense of failure or coercion, fear of admitting anxiety?

3) Privacy and confidentiality: When significant extracts from interviews are quoted in reports, should researchers first check the quotation and commentary with the child (or parent) concerned?

4) Selection, inclusion and exclusion: have some children been excluded because, for instance, they have speech or learning difficulties? Can the exclusion be justified?

5) Funding: Should the research funds be raised only from agencies which avoid activities that harm children?

6) Review and revision of the research aims and methods: Have children or their carers helped to plan or commented on the research?

7) Information for children, parents and other carers: Are the children and adults concerned given details about the purpose and nature of the research, the methods and timing, and the possible benefits, harms and outcomes?
8) Consent: do children know that if they refuse or withdraw from the research, this will not be held against them in any way? How do the researchers help children to know these things?
9) Dissemination: Will the children and adults involved be sent short reports of the main findings?
10) Impact on children: Besides the effects of the research on the children involved, how might the conclusions affect larger groups of children?

Figure 3.5 Ten topics for ethical consideration (Roberts, 2008, p. 265)

All ten topics (Roberts, 2008) were considered when devising and conducting the research to ensure the best interests of the children were at the forefront of the researchers mind. A full account of how each of these areas was considered is not possible within the scope of the present research, therefore two examples will be given.

In relation to the ‘selection, inclusion and exclusion’ consideration, the researcher gave thought to this and was influenced by his views on inclusion. Due in part to the whole-class nature of the research, it was explicitly discussed that no child should be excluded, regardless of any additional needs. The only specified exclusion criteria was based on parents/carers or CYP choosing not to consent or assent, which did not occur within this research.

When considering the ‘information for children, parents and other carers’ topic, it was decided that complete transparency would be utilised through the use of verbal communication and written information sheets for teachers and parents/carers, and through discussion and information on the assent form for CYP (Appendices A, C and E). Throughout all stages of the research the researcher has attempted to openly share the purpose and nature of the research, the methods and timing, and the possible benefits, harms and outcomes with all relevant participants and stakeholders.

3.10.2. Practitioner-researcher dual role.

A practitioner-researcher can be defined as an individual who works in a particular area whilst carrying out relevant or associated research (Kay, 2012). During the present research the researcher worked as a Trainee Educational Psychologist (TEP) with a cluster of schools, which the participants were drawn from. The researcher recognises and acknowledges that this could be considered a limitation of the research and potentially poses ethical dilemmas. Although the researcher was involved with each school in a professional capacity and as a researcher, a level of professional distance was maintained due to the interventions being implemented by teaching staff at each
individual school. The relevant advantages and disadvantages to the practitioner-researcher dual role are considered below.

A considerable advantage of the dual role is the pre-existing knowledge of the context and also positive working relationships with key staff who facilitated the set-up of the research. The researcher had good links with the head teachers and SENCos in each school. However this could also be considered a disadvantage, as potentially the class teachers may have felt pressure to agree to the research being conducted in their class. This was mediated by frank and open discussions with the class teachers where they were reassured that they were not under any pressure, had the right not to participate and could withdraw at any time. In fact, participants from both schools were forward thinking and appeared excited to be involved in the research. These relationships meant there was likely to be a substantial reduction of difficulties associated with set-up and data gathering.

A final ethical issue related to the dual role was that one CYP from each group had previously engaged with the researcher in his TEP role. This may have resulted in preconceptions or expectations which were not met when the CYP did not engage with the TEP in the same manner. An example is one student who had engaged with the TEP in a therapeutic capacity and had developed a strong relationship, good rapport and an ability to discuss a range of difficulties. Within the whole class environment it was not appropriate to continue the therapeutic relationship which may have been confusing. The dual role may also have resulted in a feeling of pressure for these students in wanting to perform well. The researcher mitigated these issues by explaining his role in the research, clarifying the anonymity of the research and reassuring the CYP that none of the information gathered through the intervention would be used or shared with teaching staff or parents/carers. The research was kept distinct from the TEP role.
4. Results

4.1. Overview of Results

This chapter will detail the findings of the research study. As described in the previous section, both qualitative and quantitative data were analysed using a mixed methods approach. The findings related to Memory Booster (Leedale, Singleton & Thomas, 2004) and MeeMo (Skelton, 2012) will be considered separately. First, a qualitative description of the intervention delivery or implementation as it evolved throughout the course of the research will be provided. This will be based upon observations conducted by the researcher and the implementation diaries completed by the teachers responsible for implementing each intervention. It will provide information regarding the implementation of each intervention and background information to the subsequent sections exploring and analysing the quantitative and qualitative findings.

Implementation information is important for several reasons. Firstly, it provides some contextual background to the data gathered from the semi-structured interviews and focus groups. It also provides an insight into the implementation factors which can be used to triangulate data to inform both research questions, particularly RQ2. As this research is interested in the feasibility of Memory Booster and MeeMo as whole class WM interventions it is important to consider the implementation factors. The present research was conducted in an ecologically valid way where the teachers took control of the interventions and implemented them in a realistic and genuine manner which was observed rather than controlled by the researcher. Due to the real world approach adopted (Robson, 2002), it was anticipated that there may be unforeseen circumstances that could not be planned for which may impact upon the research. Several factors evolved throughout the course of the research that affected the planned delivery of the intervention and subsequently the data collection.

A summary of participant information regarding the working memory abilities of the whole class and pupil focus group participants will be provided for further contextual information. The implementation of each intervention will then be considered in line with the eight measurable aspects of implementation (Durlak & DuPre, 2008). The results for each intervention will then be presented broadly in two distinct parts; quantitative and qualitative. The above process will be followed first for Memory Booster and then MeeMo. The chapter will conclude with a summary of the results in which a comparison is drawn, exploring the areas of commonality and difference between the interventions.
4.2. Results: Memory Booster

4.2.1. Memory Booster implementation.

The delivery or implementation of Memory Booster is briefly outlined below. This is informed by the three observations conducted by the researcher and the implementation diary completed by the class teacher responsible for delivering the intervention. It should be noted that the class teacher only completed the implementation diary during the second week of the intervention and claimed that the information would be repeated throughout the rest of intervention period, indicating a consistency in the implementation.

The Memory Booster intervention was implemented by the Year 5 class teacher (hereafter referred to as Teacher A), who was also responsible for information and communications technology (ICT) in the school. It was agreed that the teacher would aim to implement Memory Booster daily for between 20 and 30 minutes over a six week period during the Summer term.

Due to Memory Booster being a computer-based intervention, it required the installation of the software onto the school network. The researcher liaised with Teacher A and the programme developers (Lucid Research Ltd) to initiate contact and to provide Teacher A with the details of the technical support service provided by the programme developers. Teacher A was also provided with a manual, the ‘Memory Booster Guide for Teachers, Parents and Professionals’ (Leedale, Singleton & Thomas, 2004) which included sections such as ‘installing and running Memory Booster’, ‘quick guide to Memory Booster’, ‘Memory Booster in detail’ and ‘getting the most from your memory and Memory Booster’. The researcher used the guide as a focal point to clarify that Teacher A understood the requirements and felt confident in moving forward implementing Memory Booster.

Teacher A had access to an ICT technician once per week and requested that the software be installed for the start date of the research, which was completed. Prior to the first planned session Teacher A did not set up the student log-in details meaning the first session was not successful and the students in his class could not access the software. After contacting technical support Teacher A set up accounts for his class and continued with the intervention on a daily basis for six weeks. Several subsequent technical issues led to difficulties in using Memory Booster consistently with the whole class although Teacher A continued to encourage pupils in his class to try and access it (Sections 4.2.4.3 and 4.2.4.4). Memory Booster was reported to be delivered daily for just under six weeks but several students could not access it.
Different aspects of the implementation will be considered in more depth below, in line with Durlak and DuPre’s (2008) review of almost 600 prevention and promotion interventions which identified eight common aspects of implementation that can be assessed. Particular attention will be paid to the five aspects of implementation which are generally accepted in the implementation literature as ways of measuring fidelity; adherence, dosage, quality of programme delivery, participant responsiveness and programme differentiation (Cross et al., 2010; Dane & Schneider, 1998; Domitrovich & Greenberg, 2000; Dusenbury et al., 2003; Ennet et al., 2011). Where possible, the additional three aspects identified by Durlak and DuPre (2008) will also be considered. These are monitoring of control/comparison conditions, programme reach and adaptation.

The aspects of implementation outlined above will be considered based on data gathered through structured observations, the implementation diary completed by Teacher A and where necessary and possible will be triangulated through the semi-structured interview or focus group data. This incorporates the two primary methods of assessing implementation; provider self-reports and independent behavioural observations (Durlak & DuPre, 2008).

4.2.1.1. Programme fidelity.

The programme fidelity, or the extent to which the delivered programme corresponds to the originally intended programme (Durlak & DuPre, 2008) was high. The very nature of an adaptive piece of computer software meant that the fidelity of the programme accessed by the CYP was controlled and therefore high. However, while the content and delivery of the intervention software was fixed, Teacher A had the option to alter the settings to suit the needs of his class.

The Guide to Memory Booster (Leedale, Singleton & Thomas, 2004) indicates that;

“Although you can use Memory Booster straight away and without altering any of the program settings (or appreciating the purpose of these settings), we do recommend that you have a go with the program yourself so that you can gain a good understanding of how it works. In addition to this we also recommend that you experiment and familiarise yourself with the setting options so that you can then make suitable refinements and adjustments in order to maximise the benefits to all individuals no matter what their learning styles or abilities are.”

Data gathered indicated that Teacher A opted not to familiarise himself with the program or the settings, instead deciding to learn as he went along. In this respect, the fidelity to the intervention was poor.

4.2.1.2. **Programme dosage.**

The programme dosage can be viewed as how much of the original programme had been delivered (Durlak & DuPre, 2008). When considering a whole class intervention as in the present research, it is important to clarify whether this relates to the amount of programme delivered in terms of frequency or how much of the programme was delivered to the whole class. The dosage for Memory Booster could appear very different depending on the definition selected. The timeframe for Memory Booster provided Teacher A with 28 potential sessions. Teacher A indicated that he scheduled Memory Booster every day. This would indicate 100% dosage. However, Teacher A did not consistently complete the implementation diary so this claim cannot be verified.

When considering Memory Booster as a whole class intervention, the dosage was very poor. Teacher A reported that less than 50% of the class were able to regularly access Memory Booster. This was the result of several negative implementation factors as explored in Section 4.2.4.4. Perhaps the most significant barrier to successful implementation was the technical difficulties frequently experienced. A combination of issues with compatibility, hardware, software and access are explored in Section 4.2.4.4.1.

4.2.1.3. **Programme quality.**

As suggested by Lendrum and Humphrey (2012) ‘quality’ is a difficult concept to measure. If ‘programme quality’ is taken to mean how well the programme has been delivered (Durlak & DuPre, 2008) then to put a quantitative measurement against this concept would be arbitrary and would not be rigorous. Some elements of the delivery quality were good while others were poor. Teacher A introduced and explained Memory Booster very well and the students were aware of expectations. It was organised well into the school day and those able to access it were independent in setting it up after the first week. Subjectively there were concerns about the quality of delivery, such as log-in details and student accounts not being created on their behalf. Further issues developed and Teacher A opted to attempt to resolve them personally rather than utilise the available technical support. The overall quality could be viewed as poor.

4.2.1.4. **Participant responsiveness.**

Participant responsiveness refers to the degree to which the programme stimulates the interest or holds the attention of participants (Durlak & DuPre, 2008). Observations indicated participant responsiveness of those able
to engage to be relatively high. This comes with a caveat related to the technical issues experienced by some students. During the second and third observations on 01/07/2013 and 23/07/2013 some students had reportedly experienced failure in engaging with Memory Booster or were observed to have difficulties in accessing the software. These students appeared significantly less motivated or were simply choosing to not access the intervention, instead choosing to select the alternative option provided by Teacher A. The alternative option varied over the six weeks, but tended to be another computer programme, generally with an educational focus. During an observation a pupil participant indicated that ‘Scratch’, a programming language and online community (Massachusetts Institute of Technology Media Lab, 2014), was a particularly motivating alternative. Participant responsiveness decreased over the period of the six weeks, with the researcher’s completed observation schedules detailing a steady decrease in the number of students actually accessing the software on each subsequent observation. The observation notes from the final observation (23/07/2013) indicate that just four students accessed Memory Booster during this session.

**4.2.1.5. Programme differentiation.**

Programme differentiation refers to the extent to which the programme’s theory and practice can be distinguished from other programmes (Durlak & DuPre, 2008). Within the framework of this research it is significantly different to MeeMo, in terms of theory and practice, as this is a computerised, individually accessed intervention rather than a practical, pairs based intervention. There is not scope within this section to explore in detail the extent to which Memory Booster’s theory and practice can be distinguished from other adaptive WM programmes.

**4.2.1.6. Monitoring of control/comparison conditions.**

The researcher was interested in the comparison of the implementation of Memory Booster and MeeMo as whole class interventions. As a result, it can be argued that comparison conditions were closely monitored and described by the researcher. A comparison will be made in the context of the summary of results and in the discussion, specifically in Section 5.4.

**4.2.1.7. Programme reach.**

Programme reach refers to the rate of involvement among intended participants and the representativeness of programme participants (Durlak and DuPre, 2008). Memory Booster can be considered a universal rather than targeted intervention which can be used “with all children aged 4 to 11 years or older” (Leedale, Singleton & Thomas, 2004: 25). In the setting where the intended participants were the whole Year 5 class it could be argued that due to the technical difficulties experienced the programme reach was poor, as only 50% of intended
participants experienced active involvement. As for representativeness, the intended participants were Year 5 pupils so this was good.

4.2.1.8. Adaptation.
The teacher chose to run Memory Booster on the default setting and did not alter the settings for either his more or less able students throughout the course of the intervention. Therefore it could be argued that no adaptations were made. While this was beneficial in terms of ensuring all students were able to access the same intervention it meant that some students who may have been able to progress further and learn additional memory strategies were not able to. It also meant that students who were finding the programme very difficult were unlikely to be experiencing regular success. It was also noted that the teacher did not utilise the provision for monitoring progress and providing feedback to the students.

4.2.2. Memory Booster participant information.
As discussed in Section 3.6.1, the pupils in each class were assessed using the AWMA in order to provide contextual information with regard to the overall working memory ability of the pupils in the class. This information was also used to identify a sample of six students who were representative of the range of working memory abilities to include in the pupil focus group to ensure the views and thoughts were taken from students who had good, average and poor working memory.

Standard scores are used to describe an individual’s performance on the AWMA with respect to the performance of others in the same age band. Average performance is indicated by a standard score of 100 and a standard deviation of 15. The majority (68%) of individuals tested receive a standard score between one standard deviation below (85-100) and above the mean (100-115).

The mean score of the whole class (n=28) for verbal and visuo-spatial working memory (WM) is outlined below.

Verbal Working Memory (WM) standard score=102.96

Visuo-spatial WM standard score= 104.11

The scores above indicate that the mean score for the class is in the average range for both verbal and visuo-spatial WM and suggest the class is in line with the standardisation sample. In conjunction with the class teacher, a representative sample was selected to invite to participate in the focus group. This included two pupils with low
WM, two with average WM and two with high WM. The individual scores and qualitative descriptors of each pupil included in the focus group are provided in Table 4.1.

<table>
<thead>
<tr>
<th>Student</th>
<th>Verbal WM (Listening Recall)</th>
<th>Visuo-spatial WM (Spatial Recall)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>74 (Low)</td>
<td>65 (Extremely low)</td>
</tr>
<tr>
<td>A2</td>
<td>81 (Low)</td>
<td>84 (Low)</td>
</tr>
<tr>
<td>A3</td>
<td>94 (Average)</td>
<td>103 (Average)</td>
</tr>
<tr>
<td>A4</td>
<td>102 (Average)</td>
<td>105 (Average)</td>
</tr>
<tr>
<td>A5</td>
<td>116 (High)</td>
<td>122 (High)</td>
</tr>
<tr>
<td>A6</td>
<td>119 (High)</td>
<td>135 (High)</td>
</tr>
</tbody>
</table>

### 4.2.3. Memory Booster: Quantitative.

This section explores the quantitative data gathered through the use of Memory Booster. As discussed in the methodology section the researcher aimed to utilise the monitoring and scoring provision provided by each intervention. The monitoring provision and the data provided by Memory Booster is analysed in this section. It is acknowledged that this approach does not enable an objective and rigorous assessment of the effectiveness of the intervention. However it does allow the researcher to monitor the outcomes of the interventions in line with how school staff and programme implementers would be able to assess progress and outcomes and enables the researcher to consider the utility of the monitoring provision in an ecologically valid manner.

Memory Booster includes an in-built provision to monitor progress. The ‘Memory Booster Guide for Teachers, Parents and Professionals” (Leedale, Singleton & Thomas, 2004) provides information on the scoring and progress monitoring available within the software.
“There are two types of scoring systems in Memory Booster. One is to see the actual points scored and the other is to see what level the player has achieved.” (Leedale, Singleton & Thomas, 2004: 20). Each of these scoring systems will be explained and explored below; first the points scored followed by the level achieved.

Points are accrued throughout each session and are totalled to provide a score for each student. The total score achieved by a student indicates the overall points scored through the use of Memory Booster over the period of involvement in the intervention. It is suggested that the score will give a reasonable indication of the amount of effort CYP have put in. Points are awarded in the following ways:

1. **Upon successful completion of a task** (remember there are between 12 and 36 correct task responses per level) 100 points are awarded.

2. **Following three correct responses in a row, a mini bonus system will be activated. This awards between 50 and 300 points for each consecutive correct response including the original three that triggered the mini bonus. This mini bonus will only be added to the score at the point of a task being answered wrongly.**

3. **A mega bonus is added to the main score at the end of each level. On the default setting the mega bonus would be 600 points at level 1, 1200 at level 2, 1800 at level 3, 2400 at level 4, 3000 at level 5 and 3600 at level 6. Mega bonuses are based on 50 points per correct task. So the possible number of mega bonus points will be greater where the number of ‘tasks per sublevel’ is set higher – meaning that you have to get more items correct before you can progress through the level.**

   (Leedale, Singleton & Thomas, 2004: 20)

To summarise, a player completing a mission of Type A or C may achieve a final score of close to 15,000. An advanced player (Mission Type B) reaching the end of level 6 can expect a score closer to 150,000. The score is reported to correlate with the effort expended by CYP (Leedale, Singleton & Thomas, 2004), although the information above is not congruent with this and highlights that the score is also impacted upon by accuracy and correct responses.

It is acknowledged in the manual that Memory Booster was not designed as a standardised test and therefore there are no norms against which children’s progress can be compared. However, according to Leedale, Singleton & Thomas (2004), Levels, the second type of scoring system, can potentially provide an objective measure of how the child’s memory skills are improving. The researcher could find no available evidence to support this. As children progress through the levels, the number of target objects increase concurrently. To clarify, on level one, there is one target object. One level two there are two target objects. As children progress the number of distracter objects
also increase. Table 4.2 is offered as a rule of thumb to show levels that children might be expected to achieve after several sessions with the programme.

**Table 4.2 Target levels for mainstream children using Memory Booster**

<table>
<thead>
<tr>
<th>Age range</th>
<th>After 1 – 5 sessions</th>
<th>After 5 – 10 sessions</th>
<th>After 10 – 20 sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – 7</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8 – 11</td>
<td>2</td>
<td>3</td>
<td>4 – 5</td>
</tr>
<tr>
<td>11+</td>
<td>3</td>
<td>4</td>
<td>5 – 6</td>
</tr>
</tbody>
</table>

Table 4.3 provides a breakdown of the results available to those responsible for implementing Memory Booster. The level reached and score are explained above. The correct and incorrect figures relate to the total number of tasks attempted by each student. All students started at the same point on level one.

**Table 4.3 Memory Booster sample results**

<table>
<thead>
<tr>
<th>Student</th>
<th>Level reached</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Total attempted</th>
<th>Accuracy</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>2</td>
<td>23</td>
<td>8</td>
<td>31</td>
<td>74.19%</td>
<td>3100</td>
</tr>
<tr>
<td>A2</td>
<td>3</td>
<td>315</td>
<td>35</td>
<td>350</td>
<td>90.00%</td>
<td>51750</td>
</tr>
<tr>
<td>A3</td>
<td>3</td>
<td>49</td>
<td>3</td>
<td>52</td>
<td>94.23%</td>
<td>7750</td>
</tr>
<tr>
<td>A4</td>
<td>3</td>
<td>376</td>
<td>62</td>
<td>438</td>
<td>85.84%</td>
<td>59650</td>
</tr>
<tr>
<td>A5</td>
<td>3</td>
<td>174</td>
<td>59</td>
<td>233</td>
<td>74.68%</td>
<td>25050</td>
</tr>
<tr>
<td>A6</td>
<td>3</td>
<td>276</td>
<td>62</td>
<td>338</td>
<td>81.66%</td>
<td>41300</td>
</tr>
</tbody>
</table>
Initial analysis of the data provided in the table above would suggest that five of the pupil participants reached level 3, while pupil A1 reached level 2. This indicates that none of the students in the focus group achieved level 4 or five, which is the target level for 8 to 11 year olds after 10 to 20 sessions. Information provided in the Memory Booster manual (Leedale, Singleton & Thomas, 2004) clarifies that students accessing ‘Mission A’ will only be able to access up to level 3. For students to work up to the most difficult level (level 6) the Mission needs to be altered to ‘Mission B’. Earlier in the guide it states that Memory Booster is adaptive and does not require teacher input. It is possible that this bold, and technically incorrect statement led Teacher A to adopt the stance that he did not need to engage with the programme to maximise the benefits for his class.

Despite the literature suggesting the level reached provides an objective measure of how the child’s memory skills are improving, it is not possible to draw such deductions from the information here. This is for several reasons. As outlined above, the class teacher did not change the settings to allow the CYP to access the more challenging level, so some students may have reached a ceiling and not been able to progress further. Also, this method of scoring does not take into account the starting point of users memory skills in terms of capacity or ability to use strategies and therefore cannot realistically show improvements in memory skills.

Based on the scores providing insight into the effort put in by pupils, it would appear that pupil A4 put in the most effort, followed by A2, A6 and A5. Pupils A3 and A1 appear to have put in less effort. Closer examination of the information actually shows that pupils A3 and A1 attempted many less questions than the others, which may indicate less time spent on the programme or slow processing rather than a lack of effort. Pupil A4, who achieved the highest score had attempted the most questions so this may indicate more effort or it may simply indicate that he was able to access Memory Booster the most consistently.

To summarise, it is not possible to draw meaningful conclusions from the data provided by Memory Boosters monitoring provision. It is impossible to attribute outcomes such as improved use of memory strategies or increased WM to the use of Memory Booster just by using this tool. The simple analysis of the quantitative data provided by Memory Booster and comparison to the corresponding literature indicates that the data may not accurately represent what it is supposed to, as there are too many alternative factors involved. In terms of the utility of the monitoring provision, it is useful as a basic tool to measure the level reached, the score achieved and the accuracy of the pupil which could be helpful in providing feedback and motivating CYP. It should not be used to infer progress or development of skills and abilities.
4.2.4. Memory Booster: Qualitative.

A semi-structured interview with the teacher responsible for implementing Memory Booster and a focus group with six pupil participants was recorded, transcribed and then analysed using thematic analysis (Braun & Clarke, 2006).

In total, 948 codes were applied to data in the four transcripts related to MeeMo and Memory Booster. Of those, 522 codes were applied to the Memory Booster data, with just 14 codes being allocated to the miscellaneous theme and subsequently discarded. This incorporated 312 codes for the Memory Booster teacher semi-structured interview and 210 for the Memory Booster focus group. Inter-rater reliability checking indicated the teacher interview codes had a 92.7 percent level of reliability while the focus group codes had 89.7 percent reliability. In order to assist with the analysis and comparison of the two interventions, the global themes are the same and where possible, the same headings have been utilised for the organising themes. This was not entirely possible as some data did not fit completely within this structure or was specific to one intervention. This data was still included as it was relevant, leading to some flexibility in the thematic maps as is demonstrated throughout the subsequent results section. The researcher considered it important to maintain a balance between the consistency of the structure and responsiveness to the data.

The results from the thematic analysis of the focus group and interview transcription data will be outlined below. The overarching thematic map for Memory Booster (Figure 4.1) is designed to provide an overview of the five global themes and the organising themes within them. The five global themes are: positive outcomes; negative or neutral outcomes; facilitative factors; barriers to implementation and; recommendations. Individual thematic networks representing and expanding each of the five global themes will then be presented along with supporting data. Each thematic network will include organising and basic themes. Illustrative quotes from the transcripts will be used for basic themes where possible, although some do not appear directly as they were easier to paraphrase or overlapped in meaning.
Figure 4.1 Memory Booster thematic map
4.2.4.1.  **Memory Booster Global Theme 1: Positive outcomes**

The thematic network for the positive outcomes related to the use of Memory Booster is presented in Figure 4.2.

![Thematic network for Memory Booster Global Theme 1: Positive outcomes](image)

This thematic network consists of 3 organising themes and 9 basic themes.

4.2.4.1.1.  **Organising Theme: Memory and recall.**

It was evident from the pupil focus group that pupil participants felt that they had made a number of improvements in their memory as a result of their engagement with Memory Booster. Some CYP commented on improvements in the memory of their peers. Interestingly, the teacher did not note any perceived improvements in the memory of any students, as discussed in the subsequent global theme ‘negative or neutral outcomes’ (Section
4.2.4.2. It should be noted that information in this theme refers to perceived improvements and is not supported by quantitative evidence.

4.2.4.1.1.1. Basic Theme: Improvements with recall.
Reference was made to general improvements to both immediate and delayed recall. One pupil said that “these few weeks my memory has been good, better than normal.”

Pupil participants referred to general and noticeable improvements in their ability to remember to perform tasks and follow instructions. Some pupils were extremely positive about the impact of Memory Booster.

“It’s helped me because ...I remember a lot of things that I don’t usually remember.”

One pupil explicitly linked the increase in delayed recall with the programme content or style of delivery of Memory Booster, which can increase the time given to pupils to recall and provide an answer.

Another pupil participant discussed the improvement in her memory in terms of the amount of information she is now able to retain and act upon. She felt that she was now able to hold more information in her head. When asked if she thought this was due to the use of Memory Booster, her response was “yeah, because you have to remember loads of things at once, about three things at once.”

The ability to hold multiple pieces of information in memory was also noticed in the peers of participants in the focus group.

“My friend, X [...] he’s got a better memory, because if [Teacher A] tells him a job and he has to finish his script, he can do it both now.”

It is apparent that some students believed that Memory Booster had helped them to generalise some of the memory strategies to their home life as well as their school life.

“It’s helped me in, when my mum reminds me to do something, like to go and put washing on later, I usually forget and just get on with playing out. But now I remember every single thing.”

4.2.4.1.1.2. Basic Theme: Specific memory strategies.
The students who accessed Memory Booster felt that a positive outcome of the intervention was that they were taught specific strategies to assist with their memory and to increase the potential of their working memory. The literature around Memory Booster (Leedale, Singleton & Thomas, 2004) suggests that it offers computer-based
teaching and practice of four memory strategies, namely the use of rehearsal, visual imagery, creating stories and grouping (St Clair-Thompson et al., 2010). The information gathered through the focus group and semi-structured interview suggests that the CYP readily recalled three of the four strategies as being particularly useful. The strategy not highlighted was grouping, which is not taught formally during ‘Mission A’ but can be selected by participants who perform particularly well and progress past a certain point in the game, or by participants who go to the ‘Training Room’ and select it there.

Using a story

It was felt that using a story to assist with recall can be a helpful strategy in a range of situations. One CYP suggested that if they were busy and were asked to do something by their parents they “will make a story out of it” which helps with recall. Another discussed this strategy to be particularly helpful for remembering more complex information. Student A3 said “it [the activity] got harder and harder and harder […] I couldn’t work it out and so I said I’m going to memorise it like a story or a poem or a game”. This was reinforced by others in the focus group who highlighted that the software had explicitly taught them that strategy.

Visual imagery

The use of visual imagery was not explicitly stated although discussion during the focus group indicated that this was used by some pupil participants and their peers. One student talked about focusing on a single visual element of a piece of information to act as a prompt. However she also highlighted that this was not always helpful as sometimes you may focus on the wrong part of the image and it does not help with recall, especially when there is additional visual information which can be distracting.

Rehearsal

It was apparent that some CYP in the focus group had noticed changes in their peers. The utility of rehearsal as a strategy and the positive impact it can have was highlighted by one student who said her friend had started “memorising [information] in her head” before stopping an activity or talking to her peers. By using this rehearsal strategy it was felt that she was later able to quickly recall the information.

4.2.4.1.2. Organising Theme: Curriculum organisation.

The organisation of the curriculum in terms of student preparation, engagement and independence was a positive outcome. Teacher A highlighted actual and potential outcomes in this area.
4.2.4.1.2.1. **Basic Theme: Prepares students for learning.**

Pupil participants felt that Memory Booster was a stimulating and engaging activity. It was evident that pupil participants felt that using Memory Booster was a challenging and productive way to start the afternoon and put them in the correct frame of mind for subsequent learning after the session. Pupil A5 said that after using Memory Booster “your brain is heated up for some more work, because it [Memory Booster] has already challenged you for the afternoon and it helps you after that”. It was felt that the timing of Memory Booster, implemented daily after lunch, was particularly helpful. It was compared to the physical development daily activity ‘Wake Up Shake Up’ programme (Mitchell, 2002) which the children perceive as helpful in waking their bodies up ready for learning. One pupil said that “after noticing you’re a bit tired you want something challenging to do, which is the memory project.”

4.2.4.1.2.2. **Basic Theme: Increased independence.**

A positive outcome related to the experience of using Memory Booster was the increased independence and responsibility taken on by the students. Teacher A commented during the semi-structured interview that the software appears to “have been designed so [the students] can be independent and not need a teacher”. As a result the teacher prompted the students before lunch each day and then gave them the responsibility of organising themselves and engaging with the software, which they responded well to.

This was beneficial for both the students and for the teacher. Students who may otherwise require support in certain lessons were encouraged to be independent and responsible for their own learning and this potentially freed up the teacher for other tasks.

“They didn’t really need any support at all. They know what they’re doing and why they’re doing it and this runs itself really.”

4.2.4.1.2.3. **Basic Theme: Potential outcomes.**

Several potential positive outcomes were highlighted by Teacher A during the semi-structured interview. Due to the dosage issues identified, the teacher was not able to identify the following as genuine outcomes on this occasion but felt that there was scope in the future if the whole class were able to engage and if technical issues were resolved. Teacher A said “it could very easily run as a whole class intervention. And it could, it could be really successful.”
Memory Booster engaged the students in such a way that it displayed the potential to create a calm, organised and engaged atmosphere.

“They’ll come and say are we doing the memory project today, do you want us to log on? And they just get on with it, and it’s lovely and calm and organised and they know what they’re doing.”

In creating a calm and organised class, Teacher A felt that the class were easy to manage and the use of Memory Booster potentially reduced the need for classroom management strategies. This would have led to the teacher being “freed up to go and do something different” such as engaging with individuals or working on a different project.

Teacher A had planned to use some of the time where the class were purposefully engaged to work directly with individuals, pairs or small groups on areas of learning where they needed additional support.

This is an interesting idea which would be worth exploring further. However Teacher A did not consider that the students who may require additional support in numeracy or literacy may be the students with poor working memory who also most need the intervention. The above quote also highlights that Teacher A did not use the scoring system and monitoring provision built into the software. This was reflected upon during the semi-structured interview. The possibility of using the monitoring provision built into Memory Booster, both to measure progress and to compare with the students’ academic achievement was considered as potentially useful by Teacher A.

“If I were to do this again, and to give you more of an idea, […] whether this is impacting in a general sense, that might be something that would be easy to do kind of once a week, you know check their scores and […] Have a look at who’s doing really well or who’s not doing so well and thinking okay, well does that tally with general patterns that I see from that student in other areas of their life at school. I mean it would be quite interesting to see actually, kind of who’s done well with this.”

4.2.4.1.3. Organising Theme: Positive experience.

The overall experience of engaging with the Memory Booster software was viewed as a positive outcome. Both Teacher A and pupil participants saw it as a positive experience.
4.2.4.1.3.1.  **Basic Theme: Enjoyment.**

It was apparent from the pupil focus group that they generally considered Memory Booster to be an enjoyable activity which was an additional success. Three out of the six students said that the experience of using Memory Booster was “100% positive”. Some students said it exceeded their expectations.

“At the beginning I was shocked because I didn’t think it was going to be that good.”

Teacher A also commented on the enjoyment of the pupils who were able to access Memory Booster, stating that “the 50% that have done it, as I’ve said have thoroughly enjoyed it.” When asked about the positive outcomes of using Memory Booster, teacher A replied “I’d say the enjoyment. They’re enjoying it, and they’re coming to me and telling me, you know, it’s getting faster or it’s doing this so I assume they’re doing well with it.”

Teacher A felt that the additional opportunities to engage regularly with computer software helped to contribute to pupils’ enjoyment, and both they and he were pleased that they had “been getting a lot of ICT out of it, they’re kind of doing some of the ICT bits and bobs.”

4.2.4.1.3.2.  **Basic Theme: Progress on Memory Booster.**

The progress made on the software itself was considered to be a positive outcome, as it fostered a sense of achievement and purpose in the CYP who were able to access it. The class teacher said the pupils themselves had provided feedback to him about their progress and success when using Memory Booster.

“They come and they say, you know, they tell me that it’s got harder or they are given less time to do certain things so I think they like the challenge that’s built into it.”

4.2.4.1.3.3.  **Basic Theme: Would use it again and recommend to friends and peers.**

A positive outcome was that the majority of pupil participants felt it was engaging and helpful enough that they would like to either continue to use it or use it again in the future. Teacher A also suggested that he would potentially use it again if more data and evidence was made available to prove its effectiveness. He said this would also be a factor in whether he would recommend it to other education professionals and whether they would be willing to use it.

“There’s this really great bit of software that’s, kind of supposed to improve your students memory capacity and obviously that’s got knock on effects for everything you do. I suppose, yeah, if the data was really good
and somebody explained how easy it was to set up and manage and that children were quite independent [...] I don’t see why I wouldn’t go for it.

Several students also said they would recommend it to other children so that they can experience it and form their own view.

“I would recommend it to different classes and different schools, because I feel that they should have their own experience and they might have a different opinion about it.”

4.2.4.1.3.4.  Basic Theme: Involved in research.

Teacher A felt that the opportunity to be involved in a research project was a positive experience and outcome for the pupils in his class.

“I thought that this was something [...] really different for us to be involved with and a really interesting bit of research and that doesn’t come along very often.”
4.2.4.2.  *Memory Booster Global Theme 2: Negative or neutral outcomes.*

**Figure 4.3 Thematic network for Memory Booster Global Theme 2: Negative or neutral outcomes**

The thematic network in Figure 4.3 represents the negative or neutral outcomes of Memory Booster when used as a whole class intervention. There are 4 organising themes and a total of 9 basic themes.

4.2.4.2.1.  *Organising Theme: Not utilised as a whole class intervention.*

As previously discussed, Memory Booster was not truly utilised as a whole class intervention. Although this could be considered an implementation factor, it is also a significant negative outcome. A large focus of this research was to investigate whether the interventions which claim to be practical for use with whole classes can actually do so.
4.2.4.2.1.1. **Basic Theme: 50% of the class able to access Memory Booster.**

Teacher A stated that just “50 percent of the class [...] have been able to take part in it, roughly”. This is extremely poor in terms of the expected dosage and a significant issue for an intervention which claims to be suitable for use with either a whole class or individual pupils (Leedale, Singleton & Thomas, 2004). The inability to use Memory Booster as a whole class intervention shows that, in this context and in the circumstances described in Section 4.2.1, Memory Booster is not a useful and plausible whole class intervention.

4.2.4.2.1.2. **Basic Theme: Need for a ‘plan B’**.

In response to the intervention not working as expected and half of the students not being able to access it, Teacher A was required to provide alternative arrangements for those students. Despite Teacher A being generally optimistic and well-organised in his teaching approach, this led to a strain on both time and resources.

4.2.4.2.2. **Organising Theme: Impact on teacher.**

Despite the primary focus of the research question regarding outcomes being initially designed to take into account perceived outcomes for the CYP it became apparent during the thematic analysis of the qualitative data that there were negative outcomes for the teacher responsible for implementing Memory Booster.

4.2.4.2.2.1. **Basic Theme: Emotional impact.**

It emerged that the class teacher responsible for implementing Memory Booster felt that doing so could be a disempowering experience. He made reference to feeling “redundant” due to the straightforward nature of the software which reduced or altered his input and active engagement with the students. The teacher said he felt like he was not responsible for the children’s learning and was instead responsible for fixing problems with the technology. Although he was knowledgeable in the field of ICT he was not always able to fix the problems which lead to further feelings of disempowerment.

“I was there as a kind of IT technician in a sense, kind of running around saying, okay this doesn’t work, let’s see if we can make it work.”

The frequent technical issues experienced throughout the six week intervention led to feelings of frustration for the teacher as he was not able to implement Memory Booster as he had originally planned and had to deal with multiple requests for help during each session. The feelings of frustration were compounded by the fact that Teacher A was not able to solve some of the problems.
Teacher A was able to see the potential for the intervention and said “if it wasn’t for all of the little glitches in it, it would have worked really well and it would have, kind of managed itself really well”.

4.2.4.2.2.2. Basic Theme: reduced ‘teaching’.
The teacher felt that the nature of the software led to a reduced need for actual teaching and teacher input. Although he recognised the potential for CYP to be independent and celebrated the benefits of that, he also made it clear that this did not fit with his core values of teaching.

“It’s not the most exciting prospect as a teacher, it’s not why teachers go into teaching really, you know to sit and have a room full of computers and children with their headphones on. Because you’re not really helping them, it’s all built into the software isn’t it.”

Teacher A is usually extremely “hands-on” and likes to engage with his students before giving them an opportunity to attempt an activity, for example saying “okay, I’m going to show you how to do this today and then off you go”. He felt that Memory Booster “just didn’t need it, [...] it was so straightforward that the teacher was a spare part in the room”.

4.2.4.2.2.3. Basic Theme: No change to teacher practice.
Teacher A reported that there had been no positive changes to his teaching approach or practice as a result of using Memory Booster.

4.2.4.2.3. Organising Theme: No quantifiable impact on CYP.
Although there are several perceived positive outcomes highlighted in the previous section, the class teacher was clear that there was no observable or quantitatively measurable impact on CYP’s working memory or performance in different lessons as a result of using Memory Booster. The lack of measurable or identified positive impacts could be considered a neutral or negative outcome.

4.2.4.2.3.1. Basic Theme: Hard to measure and identify impact.
The timing of the intervention made it difficult for the teacher to notice and measure any impact on the pupil participants. Teacher A felt that the busy nature of the summer term, coupled with the change in teaching style made it difficult to identify changes in CYP. The difficulty in noticing any impact could be considered a negative outcome as it led to the teacher questioning the worth of the intervention.
“It’s a funny time of year to be asking anyway because [...] things are winding down here at school and it’s a peculiar time of year. If you were asking me at the start of the year or kind of mid-way through the year, is this kind of having any effect on what they’re doing elsewhere, you know, in school. There would be more kind of, formal lessons, I mean there is still teaching and learning going on here, but it’s the kind of end of the year style teaching and learning so it’s hard to gauge.

As a result of not using the monitoring provision, the teacher had no impartial knowledge of the progress made by the pupils on Memory Booster, other than pupil reports, and could not use this to make informed assumptions about the impact. Teacher A also questioned whether the technical issues experienced by the class may have impacted upon the progress of students and therefore led to a difficulty in noticing any changes and potentially a difficulty in monitoring progress.

4.2.4.2.3.2. Basic Theme: No change in approach to other lessons.
Several pupil participants highlighted that they do not do anything different in other lessons because of the programme. They indicated that they had not consciously changed the way in which they approached other academic activities.

4.2.4.2.4. Organising Theme: Negative perception of the programme.
An organising theme that emerged from the research was that a minority of CYP had a negative perception of the programme, either during or after the six week intervention.

4.2.4.2.4.1. Basic Theme: CYP would not recommend it.
One CYP said that they would not recommend Memory Booster to other children “in a billion years”. They felt that it was not useful and was a “time waster” rather than useful software to help improve their working memory. They felt like they would rather engage in other activities on the computer which were more enjoyable.

4.2.4.2.4.2. Basic Theme: Not helpful during the first week.
One CYP, pupil A4, had missed the introduction to Memory Booster and had said that when they first used it they “didn’t really understand it and it didn’t really help for the first week”. However it is important to note that the same CYP said that “when I got the hang of it, it was really helpful.”
4.2.4.3. **Memory Booster Global Theme 3: Facilitative factors.**

The thematic network for the third global theme, facilitative factors, is presented in Figure 4.4. The factors which facilitated the implementation of Memory Booster are considered in this global theme. It consists of 5 organising themes and 14 basic themes. It is noted that the facilitative factors fit well into areas highlighted in the implementation literature. This was not deliberate as the thematic analysis was largely inductive in nature however it suggests that these findings are consistent with other implementation research. This will be explored further in the discussion section.

4.2.4.3.1. **Organising Theme: Teacher attributes.**

Some of the attributes and skills of Teacher A were considered to be instrumental in the setting up and running of Memory Booster and could be considered facilitative in its implementation.

4.2.4.3.1.1. **Basic Theme: Knowledge of ICT.**

Teacher A was responsible for teaching and improvement in Information and Communications Technology (ICT) in the school in which Memory Booster was implemented. As a result he possessed a good working knowledge of ICT and was comfortable using technology. Although the interventions were randomly allocated, Teacher A queried whether he was approached due to his role and area of expertise within the school. Teacher A’s knowledge of ICT also meant that he was able to try and fix faults and issues when they occurred. This meant as many pupils as possible were able to try and continue with the intervention as long as the technical fault was within Teacher A’s knowledge. Although this is highlighted as a facilitative factor it could also be considered a limitation as apart from during the initial set-up, Teacher A attempted to fix the technical issues himself rather than refer to the available help and technical support provided either by the school IT technician or the software technical support.
Figure 4.4 Thematic network for Memory Booster Global Theme 3: Facilitative factors
4.2.4.3.1.2. **Basic Theme: Motivation.**
Teacher A was enthusiastic about engaging in the research, the potential impact of the intervention and the potential of using ICT and software to support CYP. This was a factor which helped to facilitate the implementation of Memory Booster and helped him to remain positive through any setbacks or difficulties. Teacher A appeared to be extremely enthusiastic about using software and ICT and felt that it offers education professionals a range of opportunities.

“When it [technology] works it’s fantastic and it makes life easier and you can do things that you just couldn’t do otherwise.”

The values and beliefs held by Teacher A could be considered facilitative to the positive implementation of Memory Booster. He held the belief that fixing issues is part of being a teacher, which enabled him to stay motivated and ensure the students were not impacted upon.

Teacher A had strong beliefs and values about being open and explicit with his students and felt this helps to increase motivation. He said “I believe, you know, explain to kids what you’re doing all the time and include them in things if you can.” The CYP were aware of the purpose of Memory Booster and the research it was part of.

“I think if I had just gone in and, I think a lot of the time teachers probably say, well, you know, here you go, get a laptop and play this game. No real explanation why and I don’t know whether that is the best way to motivate kids.”

4.2.4.3.1.3. **Basic Theme: No preconceptions.**
Teacher A said he had “no knowledge at all” of Memory Booster and what it would entail prior to his involvement in the research. He said that he preferred to work in this way and to learn about the intervention as he and the students progressed with it.

“I was glad in a sense that I was just left to it, I don’t mind that to be honest.”

Although this lack of preconceptions meant Teacher A was open to the idea of implementing Memory Booster and was not biased in any way it also led to some difficulties due to his lack of preparation for the initial session.

4.2.4.3.2. **Organising Theme: Student/class attributes.**
Some attributes of students in the class or the class itself were considered to be facilitative in the implementation of Memory Booster and helped the class teacher to establish a routine which assisted in its delivery.
4.2.4.3.2.1. **Basic Theme: Pupil characteristics.**

The overall positive behaviour and organisation of the class was considered to be a facilitative factor. They were willing to engage in different activities and this helped Teacher A to implement Memory Booster and establish it in a regular routine.

“I’ve got a really good class, they’re a well behaved and kind of diligent class this year, so dutifully every afternoon they get their laptops out and that’s been quite nice building it in at a certain set time every day, I think that’s maybe helped.”

The pupil participants confirmed in the focus group that they wanted to engage and use Memory Booster, corroborating the view of Teacher A.

“I kept on playing it, it started working and I liked it. When it didn’t work I got angry.”

The class who were randomly allocated to use Memory Booster as part of this research consisted of more boys than girls. Teacher A presupposed that this led to his class being quite competitive and enjoying a challenge. He was able to utilise the competitive nature of the class to motivate them to engage productively and consistently with Memory Booster.

The class teacher felt that the fact the students could challenge the computer software and challenge themselves to beat their previous scores, as well as compare scores with their peers, helped to facilitate the implementation. Pupil A3 and Pupil A5 confirmed that the challenges built into the software were motivating.

“I liked it when they tried to challenge you but you beat them.”

“The bit I liked was when you had to find the computer virus stopper, but when you were trying to get it, you need to memorise three things at a time.”

4.2.4.3.2.2. **Basic Theme: Familiar with ICT.**

Teacher A suggested that the fact he had easy access to a bank of laptops and frequently utilised them with his class meant that they were familiar with using ICT as a regular part of their week. This was viewed as a facilitative factor as the intervention was computerised and the “class use computers a lot”.

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4.2.4.3.2.3.  Basic Theme: Provide feedback to teacher.
Teacher A considered the class as a whole to be good at talking to him and providing feedback, whether positive or negative. The ethos of his classroom encouraged students to ask for help if it was needed and to celebrate the success when appropriate. This naturally followed on to the implementation of Memory Booster, meaning the students were equally comfortable in telling Teacher A when something wasn’t working as when they had progressed and were earning rewards in the game.

“They kept coming and telling me, you know, oh I’ve earnt this many credits and now I’ve just seen this really hilarious thing.”

4.2.4.3.2.4.  Basic Theme: Aware of purpose of Memory Booster.
The class teacher was clear that he is generally open with his class and as a result they were aware of the purpose of Memory Booster. Teacher A viewed this as facilitative to the implementation. As suggested by Teacher A, pupil participants largely had clear expectations of Memory Booster and what it would entail, generally suggesting that they thought “it would boost the memory so we’d get better”. This was motivating for the students accessing Memory Booster as they could identify the purpose of the programme and felt it would be helpful to them.

4.2.4.3.3.  Organising Theme: Programme factors content/design.
The design, content and processes of the programme itself were deemed to be facilitative. Both Teacher A and pupil participants discussed a range of aspects of Memory Booster which helped to engage, motivate or interest the class.

4.2.4.3.3.1.  Basic Theme: Design/content.
The visual presentation of the software was considered to be child-friendly as it was “colourful and bright and fun”. The teacher went on to discuss how this helped to make it engaging which ultimately assisted him in implementing it.

The use of a narrative to engage the students and to frame the introduction of memory strategies was a helpful part of Memory Booster. This was evident in some students’ responses when they discussed the plot of the storyline as the reason for learning the memory strategies. The pupil participants also discussed the different characters and clarified that they had different roles. Some helped them to understand while others made them think.
“The computer makes you understand, but the girl, when she’s telling you something [...] ; when she talks she’ll say ‘one blue shoe’ and she doesn’t say it again. That’s meant to be for your memory.”

Teacher A felt that the production of Memory Booster as an adventure game with clear objectives was a facilitative factor, particularly for the boys in his class.

“I think the fact that it was done as a game was really beneficial for them. I think that games are certainly something that, you know, all teachers..., particularly when you’re working with lots of boys which we do here, [...] they love games, they love something where [...] there is a really clear objective.”

4.2.4.3.3.2. **Basic Theme: Processes/structure.**

Throughout the use of Memory Booster, pupil participants received periodic feedback on their performance. This reduced the need for the class teacher to provide feedback on their performance, and may have contributed to his choice not to use the monitoring facilities. The pupils liked the characters from the software talking to them, liked being encouraged to try harder and recognised that the positive, rather than negative feedback used by the programme made them want to try harder.

“I liked the bit where the girl says, ‘You need to try a bit harder,’ because they’re not being negative, they’re being positive.”

Pupil participants discussed the reward system which was built into Memory Booster. They enjoyed the fact that as you progress through the game “you get coins and you can use a coin and one video costs a coin.” This reward system was viewed as being a motivator for progressing on the game.

“Once you’ve done it you can rest your memory with the video.”

Teacher A also suggested that the use of coins and cartoons as tangible rewards was motivating, engaging and helped to facilitate the implementation.

“They loved the fact that you could earn kind of credits and then watch the funny little cartoon clips. They really liked that. They kept coming and telling me.”

Memory Booster is marketed as an adaptive intervention, which can automatically adapt the difficulty according to the individual child’s needs and progress, helping to maintain the right degree of challenge and maximise learning.
(Lucid Research Ltd, 2004b; 2004c). The adaptive difficulty was highlighted by Teacher A as a positive factor for keeping students engaged.

“They tell me that it’s got harder or they are given less time to do certain things so I think they like the challenge that’s built into it.”

Pupil participants discussed how their levels of engagement altered as the intervention progressed and either became easier or more difficult. This was different for different pupils, so it is likely that this was the result of the programme automatically adjusting the difficulty levels.

“When I started at first I thought it was really boring so I didn’t know what to do, but when you start playing it, it gets really interesting, but it helps your memory as well.”

When the difficulty level increased, there was the risk that students would perceive this as their performance decreasing rather than the programme becoming harder.

“When I first had it I found it really easy, but then when I kept on going on it and on it I thought my brain was getting more and more worse after and then it got to the point where I actually found it quite hard to do it and spent really long on it.”

The pupil participants felt that the ability to amend their response and correct any potential mistakes was a beneficial part of the programme and helped them to achieve and succeed.

“One thing I do like about it a little bit, [...] when there are about three you pick the first one and it’s wrong and you notice it’s wrong, you can click it again and it goes off that one and you can pick a different one. “

4.2.4.3.4. Organising Theme: Delivery/implementation.

Aspects of the delivery or implementation of Memory Booster in this context during the six weeks were particularly important to monitor. The class teacher and pupil participant highlighted three basic themes which assisted in the implementation of Memory Booster.

4.2.4.3.4.1. Basic Theme: Technical/logistical factors.

The software was considered to be simple to set up and run. Teacher A reflected that after contacting the programme developers the actual process of setting up and running the programme was straightforward and did not cause any implementation difficulties.
Once the software was correctly installed and the pupil accounts created, Teacher A said the programme was straightforward and encouraged independence. He discussed the need to fix the technical issues but said that after that, Memory Booster would be easy to manage.

“If you can get this running, and you can kind of iron out some of the bugs then I’m sure it will work really well [...] It’s very easy to run in theory.”

The use of headphones was considered to be essential. This allowed multiple students to access the software independently and at their own pace without disturbing anyone else in the classroom.

“When I put the headphones on people didn’t hear.”

Despite the reduced teacher input being one of the contributing factors to the teacher feeling disempowered as discussed in Section 4.2.4.2.2, it was also considered to some extent a facilitative factor in the implementation of Memory Booster.

“From what I can tell of the software, it seems to have been designed so they [pupils] can be really independent and not need a teacher.”

Due to Memory Booster being structured, engaging, adaptive and providing feedback where necessary, no adaptations to the programme itself were required and it was implemented as expected. The only significant adaptation made to the recommended implementation was that Teacher A explicitly linked Memory Booster to this research which may have positively influenced the pupils’ attitude towards it.

4.2.4.3.4.2. Basic Theme: Structure and routine.

Memory Booster was structured to occur at a specific time each day immediately after lunch. Teacher A said it had “been quite nice building it in at a certain set time every day, I think maybe that’s helped.” This high level of routine assisted Teacher A with the implementation as the class soon became aware of what was expected of them and needed just a small prompt before or after lunch to remind them. Pupil participants also acknowledged the routine.

4.2.4.3.4.3. Basic Theme: Motivational factors.

The teacher reportedly provided incentives for pupils to engage in and complete the session of Memory Booster. These incentives helped to keep the pupil participants motivated, although during observation it was noted that the teacher was not keeping time so some students may have chosen to move on more quickly than others.

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Pupil participants also discussed the opportunity to use the computers to access other fun education games and said that knowing they could do that after Memory Booster made it more enjoyable.

“Teacher A said you could go on something like ‘Scratch’ and education games, and [pupil X] found a site called ‘Math games’ and it comes up with math, puzzles, and then we used that sometimes after it. So, it’s actually quite fun doing it.”

One considerable adaptation to the overall implementation of Memory Booster was Teacher A explicitly linking the programme to the research. The researcher is aware of the impact which this may have had on the engagement of the pupils and their perceptions of progress. Teacher A believes that being open and explicit with his class led to them being interested and motivated by knowledge of the research which subsequently facilitated the implementation.

“It’s actually been a good opportunity to say well Mr Rumble’s doing an experiment here; he wants to get some data. And I’ve actually told them, you know, well he’s doing the same experiment in a different school but they’re not playing a computer game, [...] they’re going to play a game and who do you think will do the best, do you think we’ll do the best? And they’ve bought into it, they’re quite interested in your project now, and I think that’s probably helped as well.”

4.2.4.3.5. Organising Theme: Contextual factors.

Some contextual or external factors were thought to positively impact on the implementation of Memory Booster.

4.2.4.3.5.1. Basic Theme: Access to ICT facilities.

The ease of access to school ICT facilities was a considerable help in the implementation of Memory Booster. Teacher A identified that each student would need a laptop and headphones and due to the location of his classroom, there was ready access to this. It was also noted that the class were able to book out the laptops at the specified time each day which reduced any potential interruptions to the intervention.

“My class are very fortunate [...] There are 30 laptops in a cupboard at the back of my classroom. Which are [...] pretty much mine to use.”
4.2.4.3.5.2.  *Basic Theme: Access to support from developers.*

Teacher A had contact details for the software developers in case he required technical support. He utilised this when he realised he needed a password to set up the pupil accounts but opted not to use the technical support again, despite persistent difficulties for certain students.

4.2.4.4.  **Memory Booster Global Theme 4: Barriers to implementation.**

This thematic network (Figure 4.5) consists of 5 organising themes and 17 basic themes. It represents both pupil and teacher responses to direct questions in the focus group and semi-structured interview exploring the barriers to implementation and negative factors which impacted on the successful delivery of Memory Booster.

4.2.4.4.1.  **Organising Theme: Technical issues.**

Perhaps the most significant barrier to successful implementation of Memory Booster as a whole class intervention was the technical issues experienced throughout the course of the intervention. It was not always easy for Teacher A to identify the root cause of the difficulty, whether it was a problem with the software, the hardware such as the laptop or the school network.

4.2.4.4.1.1.  *Basic Theme: Compatibility.*

The compatibility of the Memory Booster software with the school computers and network was questioned by Teacher A, although liaison between the researcher, class teacher and the programme developers indicated that the system requirements and network settings were adequate for the demands of the software. Teacher A discussed the unreliability of the school computers and network.

“There are so many variables and [...] either our computers or our network are quite prone to just being really strange [...] When it works it’s fantastic and it makes life easier and you can do things that you just couldn’t do otherwise. But, when it doesn’t work it’s just incredibly frustrating.”

Teacher A suggested that there may have been a compatibility issue as the software did not appear to work at all with certain laptops, and with others it would not work initially but would work after it had been restarted. There appeared to be little consistency as to which laptops would and would not work.
Figure 4.5 Thematic network for Memory Booster Global Theme 4: Barriers to implementation
4.2.4.4.1.2. Basic Theme: Hardware.
The hardware used by the class occasionally presented a problem or was considered to be broken beyond utility, which was considered a frustration and a barrier to successful implementation.

“We’ve had laptops or headphones that maybe have been broken and that’s been a pain to replace them, you know.”

4.2.4.4.1.3. Basic Theme: Programme crashing/software faults.
Teacher A and the pupil participants indicated a range of faults with the software which were viewed as barriers to implementation but also led to feelings of frustration and decreased motivation for the students and stopped the effective use of Memory Booster.

One pupil participant reported that “when you go on [Memory Booster], it just turns off sometimes straightaway.” Another said that “sometimes it crashes when you’re in the middle of a game and then you don’t want to carry on.”

A particular issue of the screen freezing but the audio continuing was also raised during the pupil focus group. Some students had found ways of fixing or solving that problem but said that in trying to do so it could sometimes finish their game abruptly.

“It usually happens when you’re on the last question, when you need to get the computer virus stopper. What happens is it sends you back the main menu but you can still hear the computer and you can’t click anything on it. What you need is, you need to get your control-alt-delete, then you cancel, then you can get back on to the screen [...]sometimes it would take you off completely, saying you need to re-sign in.”

4.2.4.4.1.4. Basic Theme: Access.
Access to Memory Booster was significantly impacted upon as a result of technical difficulties. Teacher A indicated that the whole class could not engage with Memory Booster. Some students were not able to access the intervention at all. Others were initially able to access it but then began experiencing difficulties.

“Mine worked on the first two weeks, but now when I click on Memory Booster it says ‘error’ and it can’t be opened.”

4.2.4.4.1.5. Basic Theme: Teacher attempting to resolve issues.
Teacher A opted to attempt to resolve the issues himself rather than refer on to the technical support of the programme or the ICT technician available in school on a weekly basis. Due to his position related to ICT it is
possible that Teacher A felt he had the competencies to resolve the difficulties or did not want to delegate the issue to another person.

4.2.4.4.2. **Organising Theme: Programme content/software factors.**

Some aspects of the content of Memory Booster were thought to be a barrier to implementation and engagement.

4.2.4.4.2.1. **Basic Theme: Repetitive.**

Teacher A highlighted the repetitive nature of the activities as something which made it difficult to use the intervention daily for five to six weeks. He said “I think it’s possibly run for as long as it maybe can do, if I’m being honest [...] They’ve enjoyed it, but I don’t think this is something they could do for weeks and weeks and weeks.” Although the programme is adaptive the interface and experience perhaps feels repetitive and the activities “look and feel the same.”

4.2.4.4.2.2. **Basic Theme: Certain characters.**

Pupil participants felt that the characteristics of certain characters were negative or led to people becoming less engaged. They indicated that the female character could be hard to understand and that the computer character ‘Pooter’ led to people being off-task and becoming distracted.

“I don’t like the way it was ‘Pooter’ because it makes some people laugh and then they get off focus and start talking to their friends, saying, ‘who’s Pooter’.”

4.2.4.4.2.3. **Basic Theme: Childish language.**

Memory Booster is aimed at children aged 4 to 11+, although the upper age range is not clarified. The students involved in this research were in Year 5, aged 9 to 10. Some of the pupils felt that the aesthetic and the language of the game was potentially too young and would be better suited to younger children.

“In the first two bits of it where it says ‘Pooter you have lost memory’ [...] it was a bit childish, as in Key Stage 1. [...] Yeah, the talking, I found it a bit childish.”

4.2.4.4.2.4. **Basic Theme: Initially difficult to understand.**

Several students made reference to finding Memory Booster difficult to use or understand to begin with. This may have negatively impacted on the ease of implementation as pupils may have been less motivated. It emerged from the data that the understanding and enjoyment generally increased as the students had more opportunities to access Memory Booster. This may be related to the adaptive difficulty adjusting to the needs of each pupil.
“When I started at first I thought it was really boring so I didn’t know what to do, but when you start playing it, it gets really interesting, but it helps your memory as well.”

4.2.4.4.2.5. **Basic Theme: Pause function.**

Pupil participants reported that Memory Booster did not have a pause function and said that this was an issue as if the teacher wanted to talk to the class or they were responsible for completing a job they had to just do it and miss the instructions and activities on Memory Booster. In fact, there is a pause function but this was not explicitly shown to the students by the class teacher as the teacher had not read the manual or engaged in the game himself.

4.2.4.4.3. **Organising Theme: Delivery/implementation factors.**

Some elements of the actual implementation or delivery were considered to be barriers.

4.2.4.4.3.1. **Basic Theme: Timescales.**

A barrier to the implementation was timescales, of both individual sessions and the overall length of the implementation period. The length of the session for which Teacher A expected the students to engage in Memory Booster was thought to be too long. Twenty minutes to half an hour per day was deemed to be too long, both for the students to purposefully engage and also to take out of a busy curriculum. To implement Memory Booster daily for six weeks was thought to be too long by Teacher A. He noticed that the enthusiasm decreased after the third or fourth week and Memory Booster appeared to become less intrinsically motivating as the time went on.

4.2.4.4.3.2. **Basic Theme: Not ‘boundaried’.**

Memory Booster was implemented at the same time each day. However it was apparent that the teacher did not protect and boundary the time spent using Memory Booster. It emerged from the focus group that Teacher A would sometimes talk or interrupt the session, expecting pupils to stop the programme and listen, before potentially continuing. This led to the pupil participants missing prompts or not being able to correctly answer the task when they returned to the game.

4.2.4.4.4. **Organising Theme: Teacher factors.**

Elements of the approach to implementing the intervention and decisions made by Teacher A led to subsequent difficulties and barriers in the delivery of Memory Booster.
4.2.4.4.1. **Basic Theme: Lack of preparation.**

It emerged that the teacher did not thoroughly read the manualised information provided with Memory Booster. As a result, he assumed it would run without any setup and was not aware of the need to create student accounts and provide log-in details which caused an issue in the initial session.

The lack of thorough preparation led to Teacher A not adapting the settings which would have enabled more able students to progress further and less able students to achieve more consistently. It also meant he was not fully aware of the scope of the monitoring provision available.

4.2.4.4.2. **Basic Theme: Did not engage with Memory Booster.**

Teacher A did not attempt to use or engage directly with Memory Booster. He relied instead on “watching over their [pupils] shoulders” and on feedback from students to inform his perception. Through not engaging and the lack of preparation it is possible that he was not fully aware of what his students were experiencing. Therefore he was not able to help them to generalise the skills and strategies learnt.

It also meant that Teacher A did not utilise some of the available motivational elements of the programme such as the Memory Booster certificates which are designed to maximise encouragement for each player (Leedale, Singleton & Thomas, 2004).

4.2.4.4.5. **Organising Theme: Contextual factors.**

External or wider contextual factors emerged as barriers to the successful implementation of Memory Booster.

4.2.4.4.5.1. **Basic Theme: Busy school.**

Teacher A believes that Primary schools in general are busy places, which makes it difficult to fit in all required curriculum activities. It emerged that he felt that in a busy school it was difficult for him reconcile the daily sessions alongside the national curriculum. Teacher A was concerned about what he had to sacrifice in order to accommodate Memory Booster.

“When are my History and my Geography going to get done? What about Science? Does that mean that we don’t do any music that week, or what about circle time?”

4.2.4.4.5.2. **Basic Theme: Summer term.**

Further to the basic theme highlighted above, Teacher A felt that the Summer term was a particularly difficult time to consistently and successfully implement a new intervention, referring to it as a “peculiar time of year”. He also
felt that the Summer term was a difficult time to notice differences and monitor progress in pupils due to the “end of year style teaching and learning” which he perceives to be less formal and structured.

4.2.4.5. Memory Booster Global Theme 5: Recommendations.

During the thematic analysis a number of recommendations emerged from both pupil participants and Teacher A, particularly when discussing barriers and facilitators. A fifth global theme was developed to reflect this although to reduce duplication across sections in this chapter the recommendations will be briefly summarised in Table 4.4 rather than presented as a thematic network. Please refer to Appendix K for the full thematic network created during analysis. Recommendations were made in relation to five organising themes; pupil aspects, teacher/deliverer, implementation, programme adaptations and further research. Salient points are explored in more depth in the discussion.

<table>
<thead>
<tr>
<th>Table 4.4 Memory Booster recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pupil aspects</strong></td>
</tr>
<tr>
<td>1. Pupils highlighted that it could be beneficial for use with children with SEN and disabilities.</td>
</tr>
<tr>
<td>2. It emerged that Memory Booster may be more suitable to younger CYP such as those in Key Stage 1 (aged four to seven).</td>
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<tr>
<td><strong>Teacher/deliverer</strong></td>
</tr>
<tr>
<td>1. The programme implementer does not need to be the class teacher. Once it is set up it is could be implemented or facilitated by a teaching assistant or other member of staff.</td>
</tr>
<tr>
<td>2. It was recommended that the monitoring provision should be utilised</td>
</tr>
<tr>
<td>3. Teacher A felt it was important for programme deliverers to have a ‘plan B’ in case of unexpected difficulties.</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
</tr>
<tr>
<td>1. Preparation was highlighted as important, in reading the available literature, practically ensuring the programme is ready to use by creating student profiles and adapting the ‘mission settings’ to enable appropriate differentiation.</td>
</tr>
<tr>
<td>2. It was recommended that a short and regular session time (e.g. 15 minutes) would be beneficial. The overall length of session could also be reduced to four weeks rather than six.</td>
</tr>
<tr>
<td>3. It emerged that the time during Memory Booster should be protected from interruptions by the class teacher and pupils should be made aware of</td>
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when it is going to finish, through the use of a visual countdown timer.

- Autumn or Spring term may be the optimal time for implementing Memory Booster.

| Programme adaptations | Teacher A stressed the importance of fixing the existing technical or compatibility issues.  
- Technical and visual content were highlighted as areas for adaptation.  
  Pupils highlighted that the save and pause capability when in the middle of an activity should be reviewed and clarified. Teacher A indicated that different visual interfaces would increase variation and engagement.  
- Pupils enjoyed the motivational elements of Memory Booster and felt that they would like it to incorporate additional bonus content and rewards. |

| Further research | Further research into the effectiveness of Memory Booster would be beneficial.  
- Memory Booster should be trialled in other contexts to further investigate implementation factors and the possibility of whole class use.  
- Research into the impact of term time on the implementation and effectiveness would be useful. |

### 4.3. Results: MeeMo

#### 4.3.1. MeeMo implementation

MeeMo was jointly implemented by two teachers who shared the teaching of the Year 5 class. One was a newly qualified teacher (NQT) in her first year of post-qualification teaching (hereafter referred to as Teacher B) and one was a very experienced teacher who was also the deputy head-teacher and Special Educational Needs Coordinator (SENCo) (hereafter referred to as Teacher C). It was agreed that the teachers would aim to implement MeeMo for the recommended duration; 15 minutes per day over a half term.

The researcher liaised with Teacher C to provide the school with the complete MeeMo kit, to explain the premise and to answer any initial questions. On a subsequent visit the researcher liaised with Teacher B to ensure all details

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1 The rationale and structure for exploring the implementation of MeeMo are the same as for discussing the implementation of Memory Booster. Please refer to section 4.2.1. for more information.
had been shared and both teachers fully understood and were happy to continue. The MeeMo kit contained a manual or ‘Teacher’s Guide’ which the researcher used to discuss the structure of the sessions and the intervention. Teacher B and Teacher C were initially very independent in setting up, organising and introducing MeeMo to the class. During the first week the teachers were concerned that MeeMo was not being implemented correctly as several students were recording extremely high scores, above 25 which is the highest scoring point on the monitoring booklets. Observation and discussion with the teachers led to the researcher talking to the Teacher C and the class simultaneously to discuss with pupils the scoring system and how to use their monitoring booklets.

It transpired that initially some pupils were collecting and counting cards regardless of whether they were correct or incorrect, and others were using the ‘easy’ difficulty level which was not challenging enough. After this support the implementation was reported to be straightforward, with pupils taking responsibility and ownership for setting up, distributing and tidying the MeeMo resources. One issue referred to regularly was the timing; Teacher B felt the total length of the session was rarely 15 minutes as outlined in the Teacher’s Guide.

The delivery of MeeMo will be considered in more depth below, in line with Durlak and DuPre’s (2008) eight common aspects of measurable implementation. Refer to Section 4.2.1 for definitions and explanations of the terminology used. As with Memory Booster, the aspects of implementation for MeeMo will be primarily considered based on data gathered through structured observations and the teacher implementation diary, with data from the semi-structured interview and focus group utilised to triangulate the information where possible. Teacher B and Teacher C also wrote and shared an unprompted ‘MeeMo summary’ (Appendix L) with the researcher at the end of the intervention. This included insights, observations and recommendations which will also be drawn upon.

4.3.1.1. Programme fidelity.

The programme fidelity was largely observed to be good. The implementation of MeeMo corresponded to the originally intended programme (Durlak & DuPre, 2008) as all of the key features indicated in the Teacher’s Guide were included during each observation. It is important to note that although the Teacher’s Guide provides key features to support teachers in implementing MeeMo, it is not entirely prescriptive and does not include scripts or standardised instructions. Therefore there is scope for some flexibility whilst maintaining compliance and integrity to the programme making it difficult to accurately quantify the fidelity or adherence. The implementation diary corroborated evidence from the observations that programme fidelity was good indicating that MeeMo was implemented as per the manual on all but two occasions. On the first of those occasions it was reported that only
one individual session was conducted, meaning the ‘thinker’ and ‘questioner’ did not swap roles. The second occasion the following day involved this being rectified, with three individual sessions being conducted.

4.3.1.2. **Programme dosage.**

The implementation diary completed collaboratively by Teacher B and Teacher C shows that of the 32 available slots, 23 were utilised to implement MeeMo. This is a dosage of 71.9% in terms of frequency. The implementation diary shows that the whole class was able to access MeeMo on all but one occasion, when seven students were absent for an extra-curricular trip. Therefore when implemented on the 23 sessions, MeeMo was utilised as a truly whole class intervention on 95.7% of occasions.

4.3.1.3. **Programme quality.**

As discussed in Section 4.2.1.3, the quality of delivery is a very subjective measure. However, as the same researcher was responsible for observations of each intervention it can be considered useful to discuss and compare the perceived quality of delivery. MeeMo was delivered competently, enthusiastically and without significant difficulties from either teacher. The teachers adhered to the key features of MeeMo (adherence), were responsive to the needs of the participants and sought to ensure any difficulties were dealt with quickly to maximise participant engagement, indicating a high level of implementation quality according to Dusenbury et al. (2005).

4.3.1.4. **Participant responsiveness.**

Participant responsiveness was observed to be high during all three observations. Students were positively engaged as evidenced by the positive body language and eye contact highlighted on the observation schedule during observation two (Appendix M). A summary provided by Teacher B and Teacher C at the end of the intervention stated that “the children were enthusiastic at the start, but have now [during the final week] become jaded by the repetitive nature of the sessions”. It is possible that this reduction in enthusiasm was not observed during the final observation as the presence of the researcher may have influenced the engagement and motivation of the pupil participants.

4.3.1.5. **Programme differentiation.**

MeeMo is a unique WM intervention designed in response to the perceived shortcomings of currently available computerised WM interventions. As a result the programme’s theory and practice is distinguishable from other
programmes, both in this research and in a wider context. Programme differentiation can therefore be said to be high.

### 4.3.1.6. Monitoring of control/comparison conditions.

Please refer to Section 4.2.1.6.

### 4.3.1.7. Programme reach.

In the context of this research the intended participants were pupils in the Year 5 class. All pupils in the class accessed MeeMo regularly when it was scheduled, indicating the programme reach to be good.

### 4.3.1.8. Adaptation.

Teacher B and Teacher C largely implemented MeeMo as outlined in the Teacher’s Guide. One adaptation to two sessions which impacted on the fidelity is highlighted in Section 4.3.1.1. A further adaptation was that the teaching staff were frequently required to engage directly in the intervention, partnering a pupil when there was an odd number of students in the class. This was confirmed through observation and the implementation diary and was seen as a positive adaptation which enabled the whole class to engage and also offered the teacher an insight into the pupil experience. Teacher C wrote on the implementation diary that “*taking part myself was brilliant. A real eye opener.*” During the final observation no introduction was given to MeeMo, the teacher was simply observed to say “5, 4, 3, 2, 1, go” and the students knew the expectations.

### 4.3.2. MeeMo Participant Information\(^2\).

As for Memory Booster, standard scores are used to describe an individual’s performance on the AWMA with respect to the performance of others in the same age band.

The mean score of the whole class (n=37) for verbal and visuo-spatial working memory (WM) is outlined below. As with the Memory booster class, the class due to receive MeeMo had mean WM scores in the average range.

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\(^2\) As with the Memory Booster class, all pupils due to engage with MeeMo were assessed using the AWMA to gain a contextual insight into the overall working memory ability in the class. This information was also used to identify the sample of six students who were representative of the range of WM abilities to include in the pupil focus group to ensure the views and opinions were gathered from students with good, average and poor WM.
Verbal Working Memory (WM) standard score=98.68

Visuo-spatial WM standard score=105.04

In conjunction with Teacher C, a representative sample were invited to participate in the focus group at the end of the intervention period. This included two pupils with low WM, two with average WM and two with high WM. The individual scores and qualitative descriptors of each pupil included in the focus group are provided in Table 4.5.

<table>
<thead>
<tr>
<th>Student</th>
<th>Verbal WM (Listening Recall)</th>
<th>Visuo-spatial WM (Spatial Recall)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>81 (Low)</td>
<td>76 (Low)</td>
</tr>
<tr>
<td>B2</td>
<td>84 (Low)</td>
<td>78 (Low)</td>
</tr>
<tr>
<td>B3</td>
<td>90 (Average)</td>
<td>96 (Average)</td>
</tr>
<tr>
<td>B4</td>
<td>93 (Average)</td>
<td>107 (Average)</td>
</tr>
<tr>
<td>B5</td>
<td>115 (Average/High)</td>
<td>118 (High)</td>
</tr>
<tr>
<td>B6</td>
<td>117 (High)</td>
<td>121 (High)</td>
</tr>
</tbody>
</table>

4.3.3. **MeeMo: Quantitative analysis.**

This section explores the quantitative data gathered through the use of MeeMo. Section 4.2.3 clarifies that although this does not enable an objective and rigorous assessment of the effectiveness of MeeMo, it does allow the outcomes to be monitored in line with how programme implementers would be able to assess progress. This facilitates the consideration of the utility of the monitoring provision available through using MeeMo.

MeeMo provides a monitoring provision in the form of individual personalised Monitoring Booklets for each pupil. Skelton (2012) suggested children monitor their progress by visually drawing the number of correct responses achieved over a six minute time period. Due to CYPs supposed familiarity with visual ‘progress bars’ which are a common feature utilised in computer games to provide feedback (Ostlund, Winterbauer & Balleine, 2008; Stalnaker, Takahashi & Schoenbaum, 2009), it was felt that a series of bar charts for each activity would enable
participants to monitor their correct responses on a weekly basis (Skelton, 2012). CYP mark the number of correct responses in the six minute time limit for each activity, with the colour of the pen denoting the difficulty level attempted on that occasion.

Broadly speaking, the three difficulty levels reflect the following number of items per card: easy) 2-3 items; medium) 3-5 items; hard) 5-6 items. There is a variable ratio of task difficulty with each difficulty level based on four factors: the number of list words to be remembered; the phonological similarity of list words; the semantic similarity of list words and; activity specific variations (Skelton, 2012).

The monitoring booklets are designed to be used by the students rather than teachers. However as no monitoring provision is available for teacher the researcher has attempted to interpret the data gathered in the booklets. A completed anonymised monitoring booklet can be viewed in Appendix N.

A table and graph were created for the purpose of the present research to represent the data from the monitoring booklets for each student from the focus group. MeeMo consists of five different activities, one for each day of the week: Group Up; Location; Spot the Difference; Order, Order and; Mix Up. The colours used in the graphs and tables are representative of the colour of the activity in MeeMo. Three of the graphs and tables are analysed below to provide an insight into the utility of the data gathered through the monitoring booklets. The remaining three graphs and tables can be referred to in Appendix O.

The graph provides a simple view of the number of cards correctly completed for each activity over the six weeks. However it does not account for the difficulty level selected by the pupil. This can lead to misleading data where the number of correct responses may increase or decrease considerably each week. For each graph the X axis indicates the week of the intervention. The Y axis shows the number of correct responses for each activity during that week.

The table provides a full overview of each pupil’s performance, including the difficulty level attempted (identified through the colours yellow, orange and red) and the number of correct responses for each activity. A brief summary of the results will be provided for each pupil.
The scores provided for pupil B1 indicate that she made steady progress on the ‘Location’ activity. For this activity she consistently chose the medium level difficulty and achieved a higher score each week. However scores on the other four activities do not suggest regular improvements, even when taking the different difficulty levels into consideration. For example, the table shows that pupil B1 scored extremely highly on the easy ‘Group Up’ activity.
During subsequent weeks she used the medium cards but her score fluctuated, never increasing higher than her first medium score of 10 and dropping to 5 and 7.

On the ‘Order, Order’ activity, pupil B1’s score on the medium cards varied from 10 to 20 down to 12 over the course of three consecutive weeks.

There were some scores which suggest either a significant discrepancy in the difficulty of certain activities or additional factors impacting on B1’s performance. For example, she achieved a score of 3 then 10 on week 2 and 3 of ‘Spot the Difference’. The possible reasons for this discrepancy are explored in the qualitative section (Section 4.3.4).

Pupil B1’s table shows she accessed MeeMo on 22 occasions.

**4.3.3.2. Pupil B2**

![Figure 4.7 MeeMo Pupil B2 Graph](image)

Figure 4.7 MeeMo Pupil B2 Graph
Table 4.7 MeeMo Pupil B2 Data

<table>
<thead>
<tr>
<th>B2</th>
<th>Easy</th>
<th>Medium</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Up</td>
<td>Easy</td>
<td>Medium</td>
<td>7</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Easy</td>
<td>Medium</td>
<td>10</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spot the Difference</td>
<td>Easy</td>
<td>Medium</td>
<td>34</td>
<td></td>
<td>21</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard</td>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order, Order</td>
<td>Easy</td>
<td>Medium</td>
<td>18</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mix Up</td>
<td>Easy</td>
<td>Medium</td>
<td>11</td>
<td>12</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis of the line graph above broadly indicates that student B2 made continued improvements across all activities except for ‘Spot the Difference’, where his score on the medium difficulty level decreased considerably from his first score (34) to his final score (14), and ‘Order, Order’, in which his score from week 2 to week 5 dropped considerably and then increased back to the same starting point. Analysis of the table confirms that B2 used medium difficulty on all activities except for week 4 of ‘Spot the Difference’, although that did not account for his lowest score.

Pupil B2 accessed 17 sessions.
Pupil B3 accessed 22 sessions. The graph does not show indications of progress, with the majority of scores appearing to decrease over the six weeks, with the exception of ‘Spot the Difference’ and ‘Location’. Investigation into the table of scores highlighting the difficulty level selected does show that pupil B3’s scores largely decreased when he moved up a difficulty level, in line with expectations. However when he returned to the previous difficulty level his scores on the medium difficulty did not progress as may be expected, as evidenced in ‘Group Up’.
4.3.3.4. **Summary of MeeMo monitoring provision.**

The data provided by MeeMo is extremely difficult to extrapolate meaning from. The above descriptions of the data gathered are perhaps arbitrary and do not generally demonstrate progress or improvement on the intervention itself. Even where progress was apparent, such as with pupil B2, there is no way of interpreting that data to identify improvements in working memory. Therefore without the use of a separate, objective measure of WM those using MeeMo have no way to monitor progress and assess its impact. They will be reliant on accepting that the research conducted by Skelton (2012) suggesting MeeMo is effective and can be generalised to their setting and context. It was also noted that continued access at the same difficulty level did not always relate to improved scores, perhaps due to the variable level of difficulty on each difficulty level (Skelton, 2012). This may be detrimental to the pupils’ self esteem if they see their scores decreasing and appear to be getting worse at an activity.

Skelton (2012) specified that the monitoring booklets were to be used by the pupil participants and not by teachers or those responsible for implementing MeeMo. That they do not provide useful data for monitoring progress has been confirmed here, however the analysis has raised some potential concerns about the benefit of the monitoring booklets when utilised by pupils. The data highlights that pupils may need guidance to structure their progression through MeeMo and to gain the most from not only in terms of progress on the programme but also in terms of their confidence and self-esteem.

4.3.4. **MeeMo: Qualitative.**

A total of 426 codes were applied to the MeeMo data set; 258 codes for the MeeMo teacher interview and 168 for the MeeMo focus group. Inter-rater reliability checking indicated the teacher interview codes had a 93.5 percent level of reliability while the focus group codes had 92.2 percent reliability. The codes were developed into basic, organising and global themes.

The overarching thematic map for MeeMo (Figure 4.9) provides an overview of the global and organising themes. The five global themes are: positive outcomes; negative or neutral outcomes; facilitative factors; barriers to implementation and; recommendations. The global themes are then presented and expanded in the form of thematic networks with supporting data such as illustrative quotes provided for the organising and basic themes.

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3 A semi-structured interview with the teacher responsible for implementing MeeMo and a focus group with six pupil participants was recorded, transcribed and then analysed using thematic analysis (Braun & Clarke, 2006). The analysis for this data was conducted in the same way as for the Memory Booster qualitative data (section 4.2.4.)
Figure 4.9 MeeMo thematic map
4.3.4.1. **MeeMo Global Theme 1: Positive outcomes.**

The thematic network in Figure 4.10 represents both pupil and teacher responses in the focus group and semi-structured interview highlighted the perceived outcomes to using MeeMo and whether it has proved beneficial.

4.3.4.1.1. **Organising Theme: Executive functioning.**

Some perceived positive outcomes were associated with the executive functioning of CYP engaged in using MeeMo, particularly in relation to memory, attention and concentration.

4.3.4.1.1.1. **Basic Theme: Memory improvements.**

Pupil participants discussed perceived improvements to their own and their peers’ ability to recall information. When asked about the impact on memory, one pupil said “it helped me quite a lot.” Another said “it’s helped me with all my memory, because I used to have a really bad memory. But now I kind of have a good memory.” A third pupil participant indicated that MeeMo had helped with the ability to retain and recall planned events. “It helped because I need to remember stuff like what I am doing today.”

One pupil discussed a noticeable improvement in a peer, reporting “I know it helped X [...] they didn’t have the best memory ever when they started. But now I asked, ‘where did I leave my cardigan’ yesterday and she said ‘you left it on the field’.”

For reasons subsequently explored in later sections, the class teacher reported that she had not herself noticed a positive impact on the memory of her students. However she had received positive feedback suggesting that they perceived it to have been useful.

“Although I can’t say for definite it has had a positive effect on their memory, I can say that individual children have said that.”

Despite the lack of quantifiable progress, Teacher B was positive that “given time and given the right settings, I’m sure that it would make a difference.”
Figure 4.10 Thematic network for MeeMo Global Theme 1: Positive outcomes
4.3.4.1.2. Basic Theme: Attention and concentration.

A significant concern of Teacher B and Teacher C at the start of the six week period of intervention was the noise levels produced by a whole class using MeeMo and whether the students would be able to concentrate. In fact, increased concentration and ability for students to either ignore or filter out the noise was highlighted as a positive outcome.

“Lots of them complained to start with and I kept saying to them, I’m the same. I find it very difficult to concentrate with noise but actually it’s beneficial if you get used to it.”

Teacher B went on to clarify that the ability to filter out noise and to be able to concentrate in the noisy environment were valuable skills which some students did develop. This was not discussed during the pupil focus group.

4.3.4.1.2. Organising Theme: Social and emotional gains.

Teacher B felt that students benefited from the paired element of the tasks and from the fact that the activities do not necessarily rely on writing and more traditional skills stereotypically required for success in a classroom. Pupil opinions tended to support the view of the teachers that it was beneficial for social interaction and development.

4.3.4.1.2.1. Basic Theme: Social benefits.

Teacher B discussed the design of MeeMo as a pairs based game and the subsequent benefits related to social skills and social relationships. She felt that MeeMo utilised and tested skills and abilities which are not routinely assessed or noticed in the classroom, providing opportunities and benefits to a range of students. She went on to discuss how it provided increased opportunities for social interactions which reduced any difficulties or barriers to interaction. Teacher B gave the example of a new student from Australia who was experiencing some difficulties socially and academically but who was very good at MeeMo and who was able to achieve and start to build relationships and positive interactions with a range of peers in the class.

The method of regularly changing partners for MeeMo meant that students had increased opportunities to interact with peers who they may not normally choose to, either due to social groupings or due to students working in sets according to ability level.

“Obviously a low ability child will be paired with a higher ability child.”

Teacher B also referred to the routine implementation of MeeMo and the fact that it encouraged a purposeful and structured interaction between pairs across the entire class.
“I like the fact that they get together in the morning and have that interaction, you know, have something like that to do, that’s been good.”

4.3.4.1.2.2. Basic Theme: Increased success and self-esteem.
Teacher B was extremely positive about the ability for MeeMo to provide a wide range of students with an opportunity to succeed. She spoke about the fact that MeeMo did not rely on traditionally academic forms of output such as writing to prove success.

“[Student X] found that a breeze you know, because his memory’s brilliant, he just can’t convey it very well when you ask him to write a newspaper report on a Roman theme or something [...] So watching him do this and you know, have such careful consideration for what he was saying and being very calm and very sort of, not scatty at all about it was just sort of, a real joy to see because it makes you think actually people learn in such different ways.”

Teacher B felt that the increased success for different pupils outlined above subsequently impacted on self-esteem. She gave the example of a student who was achieving success in MeeMo whereas usually he experiences difficulties with more academic tasks.

“And then he was really proud. Because it was nothing to him when we started but when I was paired up with him I just went, wow [student X], that was amazing you know. And then he kind of thought, yeah actually it is. [...] a real bit of kudos for him I think.”

4.3.4.1.3. Organising Theme: Positive experience.
The overall experience of engaging with MeeMo was considered to be a positive outcome by both Teacher B and pupil participants.

4.3.4.1.3.1. Basic Theme: Enjoyment.
Analysis of the pupil focus group indicated that several students largely considered MeeMo to be an enjoyable activity.

“I really liked it, it was really good fun.”
Despite the general enjoyment, one pupil participant highlighted that it could be boring and that the level of enjoyment “depends who you’re with sometimes.” Additional analysis of the summary provided by Teacher B and Teacher C and the transcripts indicated that the level of enjoyment decreased as the intervention progressed.

4.3.4.1.3.1.1. Basic Theme: Increased independence.

Teacher B discussed the way in which MeeMo was organised and facilitated and revealed that, after the first few days, the students were motivated and organised to take ownership and facilitate the intervention, ensuring the resource is ready to use each morning.

“What they do in the morning is they change the tubs around. So they’re stacked up [...] on the sides, so the children come in and change them every morning and put the lids underneath and they hand them round.”

The pupils also take responsibility for packing away the cards at the end of the session and in completing their monitoring booklet. This increased independence was viewed as a positive outcome of using MeeMo with the whole class.

“They take that on themselves. It’s great that they can facilitate it themselves.”

4.3.4.1.3.2. Basic Theme: Would use it again and recommend to friends and peers.

Pupil participants largely said they would like to be able to use MeeMo again in the future. It was also suggested that they would recommend it to their friends, peers and members of their family as it is both helpful and enjoyable.

“I would recommend it to this girl [...] she’s my best friend, who was in Spain, because she didn’t have a good memory. I think she would like it.”

4.3.4.1.4. Organising Theme: Academic impact.

It was discussed by Teacher B that the students had reported improvements in academic activities. In the focus group the pupils were clear that they felt some of the MeeMo activities were more useful and relevant to school life than others.

“It depends what lesson it is [...] we won’t really do ‘Order, Order’ in our work. So depending on what it is, it depends if it helps you.”
4.3.4.1.4.1. **Basic Theme: Mental maths.**
Teacher B reported that “it’s been great to hear children say [...] that they think it has affected things, had a positive effect, you know on things like their mental maths every week.” She was clear that this was the perception of the CYP and not something which she had measured or been able to quantify in any way. This was also corroborated in the MeeMo summary sheet (Appendix L).

4.3.4.1.4.2. **Basic Theme: Reading.**
Teacher B indicated that other students had suggested that an improved ability to recall information had lead to improvements when participating in guided reading.

“We do a guided reading session and we read a couple of paragraphs and they have to recall what they’ve read, they think that MeeMo has helped them with that.”

4.3.4.1.5. **Organising Theme: Impact on teacher.**
The final organising theme related to positive outcomes is the impact on the teacher responsible for implementing MeeMo.

4.3.4.1.5.1. **Basic Theme: Noticing pupil progress.**
Teacher B was enthusiastic in the opportunities MeeMo provided to notice success in a range of CYP. She felt like she was able to recognise students’ successes and praise them for it, which was sometimes difficult when teaching the curriculum. Talking about a student who was new and experiencing difficulties accessing the curriculum, Teacher B said “he was a bit behind on his reading and writing and stuff like that. So again, to see him doing this, and doing it really, really well was, you know, it was great.”

MeeMo allowed Teacher B to engage with or observe her students in a busy and focussed class. As highlighted in the social and emotional gains theme (Section 4.3.4.1.2), the paired nature of the intervention meant teaching staff were sometimes utilised to participate as a pupil’s partner. Teacher B stated that she “think[s] it’s good to have a look at [...] to understand what it is that they are actually doing.” This allowed Teacher B to engage directly with students who she may not usually get time to work with in such a focussed way, which can lead to an opportunity to further build a relationship, provide feedback and boost self-esteem.

“That was really nice. Because [...] in a busy and a very large classroom like that, [...] those opportunities are unfortunately few and far between so that’s really helped with those sorts of things.”
4.3.4.1.5.2.  *Would recommend to colleagues.*

Teacher B was generally positive about MeeMo, with some caveats related to the implementation as discussed subsequently. It was felt that she would feel comfortable in suggesting it as a useful intervention to colleagues.

“I would, yeah, recommend [MeeMo] […] I would definitely say that it’s worth giving it a go.”

4.3.4.2.  *MeeMo Global Theme 2: Negative or neutral outcomes.*

![Thematic network for Memory Booster Global Theme 2: Negative or neutral outcomes](image)

Figure 4.11 Thematic network for Memory Booster Global Theme 2: Negative or neutral outcomes

The thematic network in Figure 4.11 represents pupil and teacher perspectives of the negative or neutral outcomes of using MeeMo.

4.3.4.2.1.  *Organising Theme: Pupil impact.*

Thematic analysis of the focus group and interview transcripts suggest that the impact on the pupils was not entirely positive. It was indicated by Teacher B that she was not able to report any specific impact on the working memory of pupils in her class and was concerned at the impact on the self-esteem of more vulnerable students who were not as confident or able when using MeeMo.
4.3.4.2.1.1. *Basic Theme: Impact on memory.*

Analysis of the data provided a basic theme indicating that Teacher B was not able to report any impacts on the working memory of her students. This was both in terms of the monitoring provision of MeeMo and the observable or qualitative differences. It can be considered a negative or neutral outcome as perhaps an expected outcome would be to see progress in the area which the intervention is purportedly targeting.

“I’ve spoken about this with [Teacher C] and we’ve not noticed anything really significant in terms of, yeah in terms of the memory... but I don’t want to say that and then have a line drawn underneath it because it’s such a difficult time of year to notice changes in students”

The fact that there was no quantifiable impact and the associated difficulties measuring progress implied by Teacher B are also implementation factors and are therefore explored further in Section 4.3.4.4.

4.3.4.2.1.2. *Basic Theme: Self-esteem.*

Teacher B was largely positive about the opportunity to succeed in a different way and the potential impact on self-esteem that this could have. However she was wary of the potential negative impact on pupils who did not perform as well as their peers or who were not as confident.

“A low ability child will be paired up with a higher ability child and it does mean, sometimes you know they are embarrassed about not being able to do it properly, and I think to start with they were all kind of trying the, they all tried the easy ones to start with because, [...] you think I don’t want to embarrass myself.”

Some pupil participants reflected that they disliked the perceived pressure to perform well and score highly. This was particularly related to working in pairs and the reaction of their peers when they scored more highly.

“It was quite difficult, because if people got high scores then they’d boast about it.”

4.3.4.2.2. *Organising Theme: Perceptions of MeeMo.*

The second negative or neutral outcome of using MeeMo is related to the perceptions of the pupil participants and Teacher B after using or implementing it for six weeks.
4.3.4.2.2.1. Basic Theme: Pupil perceptions.

Pupils involved in the focus group had a range of perceptions about the utility of the intervention and whether any benefits were long-term. Some pupils felt that the use of MeeMo did not help their working memory and did not perceive there to be any progress at all.

“I don’t think it’s helped my memory.”

Other pupils felt they had made progress and were improving but questioned whether the effects were long-term. Several pupils discussed their performance being worse on a Monday and attributed that to not practising daily and not having to concentrate over the weekend.

“It’s helped me with all my memory, [...] now I kind of have a good memory, but it’s also a bit dodgy, because I have weekends and then lose my memory.”

Other pupil participants discussed whether it would continue to help their peers after they had finished using it. One pupil highlighted a peer who had made progress, but felt that “she’s going to get a worse memory throughout the summer holidays.

The pupil participants’ perception of progress and the way in which young people perceive progress may not be compatible with the monitoring provision of MeeMo, which may impact on the motivation and enthusiasm of the CYP. Teacher B believes that CYP generally perceive progress to be linear, with an increase in correct answers equating to progress. The variable difficulty levels and pupils selecting easy, medium and hard led to scores which were rarely linear.

“In reality if you move up to medium and then hard, the actual scores will go down before it goes back up.”

Some CYP would not like to use it again and were quite clear that they did not see the utility of using it daily.

“I think it was alright when I started it for the first week, but then when I realised it said six weeks, I was like, ‘Why the heck are we doing this? Why can’t we just do guided reading?’”

4.3.4.2.2.2. Basic Theme: Teacher perceptions.

Teacher B reported that MeeMo had not led to any changes in her perceptions or practice. She also highlighted that it had not met her initial expectations in terms of the visible results. This may have been linked to several
factors, including the timing of the intervention and the lack of a robust monitoring tool to measure progress and impact. These factors will be discussed in subsequent sections and in the discussion.

“I think I was expecting better sort of results I suppose. But, for all those factors that I’ve already brought up then you know, I realise that my expectations may be slightly [high]. It’s hard to expect at that time of year to be honest with you.”

4.3.4.3. **MeeMo Global Theme 3: Facilitative factors.**

The thematic network for the facilitative factors in implementing MeeMo is presented in Figure 4.12 below. It incorporates four organising themes and 11 basic themes which represent the facilitative factors as perceived by pupil participants and Teacher B.
Figure 4.12 Thematic network for MeeMo Global Theme 3: Facilitative factors
4.3.4.3.1. **Organising Theme: Teacher attributes.**

The attributes of the teachers and the ensuing approach taken was seen to be facilitative in implementing MeeMo.

4.3.4.3.1.1. **Basic Theme: Motivation and attitude.**

Analysis of the data indicated that the teachers implementing MeeMo were both enthusiastic and open to new interventions. Although one was newly qualified and one was very experienced with additional senior responsibilities, both understood the importance of working memory to success in the classroom and were excited by the possibilities of a whole class intervention.

“A whole class intervention sounds amazing, so erm, yeah I was really looking forward to it to start with, I think it sounded, a, good fun for the children, well thought out and, erm, you know, anything that improves their memory is great, so we were really up for it.”

Teacher B discussed her lack of preconceptions and positive attitude to trialling new interventions, which were positive facilitative factors in implementing MeeMo.

“I had no expectations, nothing at all really, we just thought yeah, let’s just go for it and see how we go with it.”

Teacher B wondered whether her relative lack of teaching experience meant she was more open to new ideas, although Teacher C’s enthusiasm indicates this is not necessarily true.

“I don’t know whether I would have come across other things if I would have been teaching for a long time, you know, maybe my preconceptions would have been different”

4.3.4.3.1.2. **Basic Theme: Actively engaged in MeeMo.**

Teacher B and Teacher C engaged directly and actively with MeeMo in the classroom setting at some point over the intervention period, as did all Teaching Assistants (TAs). This helped those facilitating the intervention to gain an experiential understanding of it and the demands it placed on pupils, both in terms of the MeeMo content and also the potential difficulties concentrating and filtering out the external noise.

“We partnered up. As teachers we had to partner up a few times, sometimes you know children are out of the classroom [so there was an odd number] so we [...] paired up with the children sometimes”
The increased awareness of the utility of MeeMo and the requisite abilities could have provided Teacher B with the opportunity and impetus to help children to generalise skills to other curriculum areas, however this was not reported to have occurred.

4.3.4.3.2. Organising Theme: Student/class attributes.

The following attributes of the students and the class as a whole were deemed to be facilitative. It is likely that some class attributes could also be credited to the teaching approach and style although ultimately it is the attributes of the class which assisted the implementation.

4.3.4.3.2.1. Basic Theme: Well organised class.

The class were considered to be well organised and responsive to routines and schedules implemented by the teachers. Their ability to respond to routines and to be organised with activities and tasks was a considerable help in implementing MeeMo.

“I imagine if they were a bit more chaotic there’s the possibility that it wouldn’t work as well. It’s possible that it [MeeMo] would be quite chaotic.”

This correlates with the structure and organisation of MeeMo, which enables students to take ownership of the intervention and be responsible for facilitating it, as explored subsequently in the ‘programme factors’ and ‘delivery/implementation’ themes.

4.3.4.3.2.2. Basic Theme: Aware of expectations.

The pupil participants were aware of the expectations which the teachers had for them in relation to MeeMo. The researcher observed and commented during the interview that “all you [Teacher B] did was count 5, 4, 3, 2, 1 and that was it, off they went. They’ve obviously got it, they know what they’re expected to do.” Teacher B confirmed this and highlighted that the repetitive nature of the implementation meant the pupils were aware of what would happen and therefore were able to quickly get ready and engage with it.

The pupils reported that they were generally aware of the purpose of the intervention, “to help your memory”, which helped to engage them and eased the implementation for the teachers.

4.3.4.3.2.3. Basic Theme: Competitive.

Teacher B perceives some students in the class to be competitive. Some pupils displayed evidence of wanting more time to enable them to collect more cards and others wanted to beat their score from the previous week. This is
beneficial and increases motivation but this was not true of the whole class, as some students did not like the competitive nature of their peers.

Some pupil participants indicated that they enjoyed being challenged.

“I liked the one we did today. It said ‘forwards’ for object and then you said it again to see if it was the same or different. And then you said the two different ones and I thought that was good and hard.”

4.3.4.3.2.4. Basic Theme: Like working in pairs (partner attributes).

Pupil participants highlighted that they liked and preferred working in pairs, which was capitalised on by one of the central tenets of MeeMo. This was important to pupil participants in a social sense and also for support or help in case of any difficulties.

“I like it when you’re working in partners, because you know you’ve got someone to help you with it.”

In terms of being able to access the activities and engage with MeeMo to their potential, pupil participants highlighted the importance of having a “good partner” to work with. Partners who spoke clearly, at a reasonable rate and loud enough to hear correctly were considered to be the best partners to work with.

4.3.4.3.3. Organising Theme: Programme factors.

The intervention itself was largely considered to be facilitative, in terms of the content, design, structure and organisation. Teacher B highlighted that several elements of MeeMo made it easy to implement.

4.3.4.3.3.1. Basic Theme: Content/design.

The content and design of MeeMo was considered to be a facilitative factor. Primarily, it was seen as fun and engaging by Teacher B. One of the unique aspects of MeeMo, the five different activities for each day of the week were considered to be beneficial.

“Benefits were that they really, really enjoyed the fact that they had different things to do on different days, so that was good. So it tested lots of different skills.”

An additional benefit to there being different daily activities was that although the CYP were engaging with MeeMo on a daily basis “they are in fact not doing exactly the same thing every day.” As a result the intervention was not as repetitive as a daily intervention could potentially be.

Teacher B felt that some activities were more motivating than others.
“Obviously [...] some of them didn’t like, you know, some days and others, when it came to one day others would be like, yes, You know, it’s such and such a day, you know. So, that was a good thing for them”

The MeeMo summary (Appendix L) provided by the two teachers suggested that the children preferred the ‘Mix Up’, ‘Spot the Difference’ and ‘Order, Order’ activities. Pupil participants confirmed that they enjoyed or found certain activities easier than others. Within the focus group there was no general consensus, with four out of the five activities being selected as the preferred activity by the pupil participants.

The choice of difficulty level was also seen as facilitative as it enabled pupils to take control of their learning.

4.3.4.3.3.2. Basic Theme: Structure/organisation.

When discussing MeeMo and how it is packaged and organised, Teacher B was extremely positive, suggesting that this played a large part in the user-friendliness of the intervention and the ability to implement it quickly and efficiently.

“In one respect you know it has been made quicker already by the fact that, you know, it’s all organised.”

With so many component pieces MeeMo has the potential to be difficult to manage but the structure and organisation were positive implementation factors.

4.3.4.3.4. Organising Theme: Delivery/implementation.

Certain aspects of the delivery or implementation by Teachers B and C were considered to be particularly helpful.

4.3.4.3.4.1. Basic Theme: Routine.

Pupil participants generally reported the routine established was helpful in ensuring they knew what was expected and subsequently were able to engage in a productive manner. It was indicated that the routine helped to foster a sense of confidence.

“When you do it every day you know what you’re going to do.”

“I thought it was a bit difficult at first and then it just got much more easy, because you’d already done it the day before.”

Teacher B felt that routine is important in establishing an intervention and in consolidating the learning but questioned when the useful element of the routine strays into repetition, which can also be helpful but can potentially lead to a loss of motivation and engagement.
“You do get lots of children who come in every morning, what are we doing today Miss, as in their life depends on it, you know. So they like that basic level of routine but they, a lot of them do not like that repetitive element. So it’s kind of trying to get a balance.

4.3.4.3.4.2.  **Basic Theme: Organised and stored in class.**

The fact that MeeMo was organised and stored in the classroom in which it was implemented was perceived to be helpful. It reduced the time required for setting up and tidying away and increased the sense of ownership of the class, as it was stored in their room.

4.3.4.3.4.3.  **Basic Theme: Adaptations.**

Generally, minimal adaptations were required to implement MeeMo. Teacher B said she did not have to adapt the way in which it was introduced or the way in which it was used. However, all teaching staff engaged directly in MeeMo, pairing up with children to ensure an even number so that the whole class could access it. Although this is highlighted as a positive teacher attribute in Section 4.3.4.3.1.2, it is important to highlight that the class teacher or TA engaging directly with MeeMo can be considered an adaptation as it is not identified or recommended in the literature provided with MeeMo. In this context, being actively engaged with MeeMo helped Teacher B to understand the intervention and the skills required to access it, as well as working closely with students providing opportunities to build relationships and recognise strengths.
4.3.4.4. **MeeMo Global Theme 4: Barriers to implementation.**

Barriers to implementation

**Programme content**
- Misprinted cards
- Indistinct colour scheme
- Repetitive

**Monitoring provision**
- Measuring progress/impact
- Threshold

**Delivery/implementation**
- Timescales
- Noise levels
- Human error
- Technical issues

**Contextual/environmental factors**
- Large class
- Summer term
- Busy school

**Peer/partner attributes**
- Negative peer attributes

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Figure 4.13 Thematic network for MeeMo Global Theme 4: Barriers to implementation
Figure 4.13 represents the barriers to implementation of MeeMo, as experienced by pupil participants and Teacher B. The thematic network consists of 5 organising themes and 13 basic themes.

4.3.4.4.1. **Organising Theme: Programme content.**

Some elements of the programme content were considered to be a barrier to implementation.

4.3.4.4.1.1. **Basic Theme: Misprinted cards.**

It was reported by both Teacher B and pupil participants that some of the cards contained printing errors, such as the answer containing items which were not listed in the question, rendering it impossible to correctly answer those specific cards. Pupil participants in the focus group highlighted some examples.

“Some of the cards would say, ‘Say the numbers in this order,’ and then on the answer there would be numbers that weren’t on the instructions.”

This led to some difficulties for pairs of pupil participants who were confused and resulted in delays during that particular activity. Consequently, the class teacher at the time was required to intervene, although this was relatively rare it was still considered to be an avoidable inconvenience. Teacher B felt that towards the end of the six week intervention period any cards with mistakes on became a more significant issue as the CYP’s enthusiasm was decreasing. Some students also identified cards as having mistakes even when there were none.

The list of misprinted cards can be viewed in Appendix P and has been shared with Skelton, the programme developer.

4.3.4.4.1.2. **Basic Theme: Indistinct colour scheme.**

The colour scheme in MeeMo is important, as it is supposed to direct the user in an intuitive way. It contains different colours for the activity (corresponding to the day of the week), the difficulty level and to indicate the question and answer side of the card. Teacher B felt some of the colours for difficulty and day of the week were not distinct or bold enough, leading to some confusion.

4.3.4.4.1.3. **Basic Theme: Repetitive.**

Some pupil participants highlighted the repetitive nature of the programme as a barrier to engagement.

“I disliked it all, because it was so boring, because you do it every day constantly.”

As a consequence, motivation is likely to have decreased for some students over the six week period and it may have been difficult for Teacher B and Teacher C to maintain high levels of engagement. This was reinforced by the
summary of MeeMo written by Teacher B and C, which indicated that pupil motivation decreased over the six weeks.

“It can affect your motivation can’t it, if you’re doing the same thing over and over.”

4.3.4.4.2. Organising Theme: Monitoring provision.

The lack of monitoring provision provided for implementers was viewed as a barrier to implementation as the class teachers were not able to measure the progress of the CYP. Some elements of the design of the pupil monitoring booklet were also considered to be a barrier.

4.3.4.4.2.1. Basic Theme: Measuring progress/impact.

Teacher B discussed the difficulties in measuring and noticing the progress and impact of MeeMo. The monitoring booklets provided were used, as indicated in the MeeMo Teacher’s Guide, for the pupils to record their own progress rather than as a tool for teachers to monitoring it. As reported in Section 4.3.4.2.1.1 this meant that no quantifiable impact was identified, which may have impacted on the motivation and subsequent implementation.

Pupil participants reportedly had issues with the monitoring booklets and the scoring system within. Teacher B reported that “they still stand by the fact that the scoring system should increase” and discussed the possibility that pupils did not understand or accept that when moving up a difficulty level the scores may drop before increasing again. Some pupils may have been more concerned with getting as many cards as possible rather than challenging themselves, deciding to stick with the easy cards resulting in “the scoring system [going] through the roof with a lot of them”, particularly during the first week.

Some pupils did not find the monitoring booklets to be intuitive and were making mistakes with knowing which page and column they should complete, leading to delays while the teacher provided support, decreasing the effectiveness of implementation. This may be related to the indistinct colours provided as outlined above.

“I think it’s just getting used to them, you know the columns, lots of the wrong columns were coloured in, I think that was just getting used to. I think there were less incidents of that the further we continued.”

4.3.4.4.2.2. Basic Theme: Threshold.

Teacher B suggested that the perceived threshold of 25, which is the highest number on the ‘scoring ladder’ in the monitoring booklets, was not high enough as pupils regularly exceeded 25 correct cards. Although the majority of
pupils were happy to write their score in the booklet, others saw it as a threshold which they were not supposed to surpass.

“It says on the piece of paper that you’re only allowed to get 25, but loads of people get over it. Then the teacher says you are only allowed to get below 25.”

4.3.4.4.3. Organising Theme: Delivery/implementation.

Some elements of the actual implementation of MeeMo emerged as barriers to implementation.

4.3.4.4.3.1. Basic Theme: Timescales.

The timescales of the delivery were not conducive to the continued implementation according to both pupil participants and Teacher B. This was in relation to both the length of each individual session and the overall length of the intervention.

“The timing is certainly an issue I think. Both for adults and for the children because it does take too long.”

Teacher B felt that to implement MeeMo consistently took longer than the 15 minutes proposed by Skelton (2012). She indicated it varied between 20 and 30 minutes, although it did become quicker as the weeks progressed.

“It’s great that this takes 20 minutes but we haven’t got that 20 minutes and so you’re kind of thinking actually if we could do them for a short 3 minute bursts, you know 6 minutes overall, you know, that could be possible, whereas when you’re taking a good sort of 20 to 25 minute chunk out of your day, it’s, you know there is so much to fit into the day.”

Teacher B felt that six minutes per student per session was too long, both for maintaining concentration in such an intense way and also because some pupils would go through a pack of 10 cards very quickly, leading to the class running out of packs of certain difficulty levels.

Teacher B felt the overall length of the intervention impacted on the enthusiasm of the class and that “towards the end children were getting slightly jaded with it”. She suggested that it was likely that the focus group would give much more negative responses at the end of the intervention compared to if they were asked during the first week. This was clarified by pupil participants in the focus group.

“I thought it was really good at the start of it, because I knew it was going to help my memory and it was going to help you and it was really fun. But then, on the fourth or fifth week, it started to get boring.”
4.3.4.4.3.2. Basic Theme: Noise levels.

When MeeMo was implemented, the noise level created by a class full of students talking at once was extremely high. This was considered to be a barrier to successful implementation, particularly by pupil participants who found it difficult to concentrate and were sometimes misled by overhearing the instructions or prompts from another pair nearby.

“Sometimes, this is what’s really, really annoying, you can’t hear people because people are just shouting and you hear someone shouting. Say I did this for [pupil X], she said a different word and then said ‘pencil’, but I said ‘pencil’ but I thought she said ‘tree’, but someone else said ‘tree’.”

In an attempt to mitigate this difficulty pupils tended to speak louder, leading to a further increase in noise level and subsequent difficulties hearing the partners.

“I know a way to solve that problem. I can just speak over them, just shout over them.”

The noise level potentially impacted on some pupils more than others. It is likely that those with sensory sensitivities or hearing impairments may find it particularly difficult.

“We’ve tried different ways to kind of contain the noise levels because you’ve got the likes of Child Y who just cannot stand that amount of noise.”

The noise levels were considered to be less of an issue as the implementation progressed, with some students appearing to improve in their ability to concentrate and filter out the external noise.

4.3.4.4.3.3. Basic Theme: Human error.

Human error was thought to account for some implementation difficulties. Teacher B discussed that some pupils found it difficult to ensure ten cards were placed back in a pack or were placing a mixture of cards into the same pack after using them. This caused extra work as someone had to go through the cards to ensure there were ten in each pack.

“Most days you had to go through them and see that there are 20 cards in one pack, stuffed right in so you can’t actually get them out of their plastic sheath anymore and then there’s two cards in another pack.”
Another issue which impacted on the efficacy of MeeMo was that some peers did not cover the back of the card when reading it, meaning the partner could see. This was observed to be resolved through verbal instructions and reminders from Teacher C at the start of a session.

4.3.4.4.3.4. Basic Theme: Technical issues.

To ensure the timing of six minutes per individual session was correct, Teacher B and Teacher C utilised an online timer displayed through the whiteboard. As the pupils became more independent they also controlled this aspect. However there were occasions when there were technical issues with the timer or the whiteboard. This was resolved through the use of visual timers or stopwatches available in the classroom.

“When the screen works in the classroom they [pupils] do the timing themselves as well, they do the whole thing themselves. But unfortunately you know the computer screen hasn’t always worked.”

4.3.4.4.4. Organising Theme: Contextual/environmental factors.

Context specific environmental factors impacted on the implementation of MeeMo, including the size of the class, the time of the year and the busy nature of the school.

4.3.4.4.4.1. Basic Theme: Large class.

The class engaged in MeeMo was unusually large, with 37 pupils. The large class could foreseeably have led to implementation difficulties in terms of organisation, however this was mitigated by the positive teacher attributes and the ethos within the class.

The large class did lead to difficulties which may not have been anticipated by Skelton (2012) during the development of MeeMo. One such difficulty was the number of cards available. The MeeMo kit contains a total of 4800 cards, with 320 in each difficulty level for each activity (Skelton, 2012). This equates to 32 packs of cards for each difficulty level. Teacher B highlighted that pupils used two to three packs on average for each six minute session and if the majority of the class were using one difficulty level such as medium there would not be enough cards to meet the demand.

Teacher B also discussed the difficulties with behaviour management associated with such a large class. She felt that if MeeMo did not engage specific students in the class, they could potentially have a negative impact on the rest of the class as it required full attention and concentration to fully engage.
4.3.4.4.2. Basic Theme: Summer term.
The timing of the intervention was seen as a barrier to implementation. Teacher B felt that the Summer term is a particularly busy time of year when it is difficult to establish and adhere to a routine and notice changes in pupils skills and abilities.

“I don’t think that this time of year is a good time to do it because we’re not really in a routine. I think they would have found it easier if it was there [at the start of the school year] […] and everything was routine.”

4.3.4.4.3. Basic Theme: Busy school.
Teacher B discussed that the school is an extremely busy environment and highlighted that it can be difficult to fit curriculum content into the timetable in addition to the various interventions and programmes which are running throughout the school year. She highlighted that a “20 to 25 minute chunk out of your day” is difficult to justify and balance. She said that was not a criticism of MeeMo, but a reflection of the busy nature of a Primary School.

“It may not be MeeMo’s fault, it might be the fact that you’ve just got so much stuff to pack into the day anyway”

4.3.4.4.5. Organising Theme: Peer/partner attributes.
The attributes of the partner was highlighted as extremely important by pupil participants. The speed and volume of the partner when reading the cards emerged as a barrier to implementation if they were not perceived as acceptable by the Thinker.

4.3.4.4.5.1. Basic Theme: Negative peer attributes
As highlighted above, the volume of the Questioner when reading the cards was an issue when it was too low.

“I was with [student X] today and I didn’t really like it when I was with him because he was really quiet.”

The speed of questioning was also a potential issue. Pupil participants became frustrated when the partners were too slow but experienced difficulties to process the information accurately when it was too fast.

“When I was with [X], if we were doing it and he was doing the questions, he would speak really quickly and then he says, ‘Go on, say is it different or the same.’ And I don’t know because he said it so fast.”

Pupils were frustrated if their peers inadvertently used up their ‘Thinking’ time.
“Sometimes what I disliked was when people were reading them out and then they went, ‘Oops, I read it out wrong,’ so they started reading it out again.”

Pupil participants discussed making some adaptations to the desired implementation in order to make it easier for their partner to understand. Some discussed giving their peers clues either verbally or through the use of gestures. Although they thought this was helping their peers, in fact it was removing the challenge of the programme which is the aspect which is purported to make an impact by stretching the capacity of children’s WM (Skelton, 2012).

4.3.4.5. **MeeMo Global Theme 5: Recommendations.**

During the thematic analysis a number of recommendations emerged from the perspective of pupil participants and Teacher A, particularly when discussing barriers and facilitators. The recommendations made may improve the implementation of MeeMo and potentially lead to more useful outcomes. A fifth global theme was developed to reflect this. To decrease replication across sections the recommendations will be briefly summarised in Table 4.9 rather than presented as a thematic network. Please refer to Appendix Q for the full thematic network created during analysis. Recommendations were made in relation to five organising themes; pupil aspects, teacher/deliverer, implementation, programme adaptations and further research. Significant points are explored in more depth in the discussion.

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<th>Table 4.9 MeeMo recommendations</th>
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<tr>
<td><strong>Pupil aspects</strong></td>
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<td>• Logistical recommendations were made, such as considering how to pair up the CYP and planning for odd numbers of students.</td>
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<td>• Pupils engaging in MeeMo need a certain level of basic literacy, speaking and listening skills.</td>
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<td><strong>Teacher/deliver</strong></td>
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<td>• It was recommended that anyone implementing or facilitating MeeMo should experience it themselves.</td>
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<td><strong>Implementation</strong></td>
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<td>• Recommendations were made about the overall length of the intervention, the length of each individual session and the time of year which the intervention should be run. Teacher B felt each individual session should be shorter, between three and four minutes.</td>
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<td>• Include MeeMo in a consistent routine.</td>
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<td>• It was recommended that implementers should consider ways of monitoring and measuring progress. Teacher B discussed structured and rigorous</td>
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methods, such as using a working memory assessment pre-and post-intervention.

| Programme adaptations | It would be beneficial to incorporate a monitoring provision for programme implementers.  
|                       | Recommendations were made regarding programme presentation, specifically; rectify the printing errors and make indistinct colours more discrete and bold. It was also suggested that making the cards one-sided would reduce issues with partners reading the answer on the back.  
|                       | Pupil participants also suggested altering the response style to incorporate written and visuo-spatial responses as well as verbal responses.  
|                       | Pupil participants suggested the idea of presenting MeeMo as an app or piece of software to enable the option of paired or independent work with the same resource. |

| Further research | Teacher B discussed the need for further research into the effectiveness of MeeMo as a WM intervention.  
|                 | It emerged that research into timing would be beneficial. This could incorporate how either the length of each session or the term in which it is implemented impacts on the outcomes and effectiveness. |
4.4. Summary of Results

A summary of results will now be presented. Table 4.10 provides a visual representation of the global and organising themes for Memory Booster and for MeeMo. This assists the evaluation of each intervention and allows a comparison to be drawn between the two.

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<th>Table 4.10 Global and Organising Themes by intervention</th>
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<td>Global Theme 1: Positive outcomes</td>
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<td>Global Theme 2: Negative or neutral outcomes</td>
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<td>Global Theme 3: Facilitative factors</td>
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<td>Global Theme 5: Recommendations</td>
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Thematic analysis of both Memory Booster and MeeMo developed the same five global themes. Positive outcomes, negative or neutral outcomes, facilitative factors, barriers to implementation and recommendations emerged for both interventions. This helps in the comparison of the two interventions. The thematic analysis largely provides consistency at the global and organisational level with flexibility at the local or basic level. Of course, there are some exceptions, as will be highlighted below and in the context of the discussion (Chapter 5).

The results indicate a range of positive and negative or neutral outcomes for both Memory Booster and MeeMo. In terms of WM and recall, pupil participants generally indicated a perceived improvement in both interventions but this was not shared by either teacher and could not be corroborated by the data gathered through the monitoring provision. Pupil participants also indicated improvements in other areas of executive functioning through the use of MeeMo, but not Memory Booster. Both interventions were seen to provide a positive experience for the CYP accessing them. Beyond this, the positive outcomes which emerged were different, with MeeMo reporting a broader range. Memory Booster appeared to help and improve the curriculum organisation. Teacher A also highlighted several potential outcomes which did not occur due to the implementation issues. Outcomes through the implementation of MeeMo included perceived social and emotional gains, academic impact and a positive impact on the teacher.

In the present research, MeeMo was successfully implemented as a whole class WM intervention while Memory Booster was not. This is a significant negative outcome in the context of research investigating whole class interventions, which contributed to a negative impact on Teacher A. In addition, no quantifiable impact on the CYP was evident and some pupils had a negative perception of the programme. Negative outcomes of MeeMo also included the pupil impact (or lack thereof) and some negative perceptions. Neither intervention provides a rigorous monitoring provision.

In terms of facilitative factors, both interventions broadly shared four factors, although the specifics were different. The four shared facilitators were teacher attributes, student or class attributes, programme factors and elements of the delivery or implementation. Contextual factors also supported the implementation of Memory Booster, specifically the ease of access to ICT facilities. No specific contextual factors were highlighted as facilitators in MeeMo. This may not necessarily mean there were none but possibly Teacher B and the pupil participants did not reflect upon them.

As highlighted above, Memory Booster was not utilised as a whole class intervention. A range of interacting implementation factors emerged which helps to explain and explore this, both in terms of facilitators and barriers.
Perhaps the two most significant barriers to the successful implementation of Memory Booster were technical difficulties, which was programme specific, and teacher factors. Other significant barriers included some elements of the programme content, the delivery or implementation and contextual factors such as the time of year. Some barriers to implementation were broadly the same for MeeMo, although they did not prevent the whole class implementation. They were programme content, delivery or implementation and contextual or environmental factors. MeeMo also had some programme specific barriers, such as peer/partner attributes and the monitoring provision.

Practical recommendations emerged for both interventions. Although different in detail, recommendations for both Memory Booster and MeeMo include pupil aspects, teacher or deliverer factors, implementation aspects, programme adaptations and suggestions for further research. A strong theme within the latter recommendation was the time of year in which the intervention is implemented; it is felt that the summer term is not conducive to either implementation or monitoring.

The following chapter will provide further discussion of the more salient findings in relation to each research question and will place the research in the context of the existing literature.
5. **Discussion and Conclusion**

5.1. **Overview of Discussion**

This chapter will start by revisiting the two research questions (RQs) which this research set out to answer. The key findings will be summarised and discussed in relation to each RQ, drawing primarily on the thematic networks developed in the results chapter but also referencing the quantitative data analysis for RQ1 which relates to the outcomes of each intervention. RQ2 is interested in implementation factors and as such the quantitative data is not taken into consideration. Where necessary, information from the structured observations, implementation diaries and the summary provided by the teachers responsible for implementing MeeMo will be used to further the discussion. Both interventions will be considered concurrently for each RQ, allowing the researcher to highlight and examine the similarities and differences between the two. The extent to which the RQs are answered will then be summarised. A framework for effective implementation will be presented in line with RQ2. Unanticipated findings which do not explicitly fit within either RQ will then be discussed, and a retrospective consideration of whether the two RQs were adequate will be briefly explored. The contribution to knowledge will be presented before the limitations of the present research are explored. The implications will then be considered, including implications for professional practice, programme developers and further research. Finally, a conclusion will be provided.

5.2. **Research Aims**

The current research aimed to address the following RQs:

RQ1: What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory?

RQ2: What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions?

The findings in relation to each of the research questions will be summarised for each intervention below in an attempt to answer both RQs.
5.3. Research Question One

What are the general outcomes and views on feasibility for children and teachers utilising MeeMo and Memory Booster as whole class interventions for working memory?  

The term ‘outcome’ in this research is broad and incorporates both measurable and perceived outcomes, whether they are positive, negative or neutral. It could be argued that a neutral outcome is not necessarily an outcome, however the researcher would argue that a lack of any change for better or worse needs to be considered within the context of outcomes as it indicates whether or not an intervention has had an impact. This incorporates type III error (Dobson & Cook, 1980) issues, where the lack of implementation has led to a neutral outcome when actually if implemented more effectively the intervention does work or is likely to work (Rezmovic, 1982).

Table 5.1 provides an overview of the outcomes of both Memory Booster and MeeMo. For detailed analysis of the themes provided please refer to the results section (Chapter 4).

<table>
<thead>
<tr>
<th>Positive outcomes</th>
<th>Memory Booster</th>
<th>MeeMo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory and recall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curriculum organisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive experience</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negative or neutral outcomes</th>
<th>Memory Booster</th>
<th>MeeMo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not utilised as a whole class intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on teacher</td>
<td></td>
<td>Pupil impact</td>
</tr>
<tr>
<td>No quantifiable impact on CYP</td>
<td></td>
<td>Perceptions of MeeMo</td>
</tr>
<tr>
<td>Negative pupil perception of the programme</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 As indicated in Table 3.1, RQ1 is answered through the use of the quantitative and qualitative data gathered and analysed as outlined in Sections 3.6 and 3.7. The quantitative and qualitative results have been analysed independently within the results section and will now be synthesised as much as possible, in accordance with the partially mixed concurrent methodological design (Leech and Onwueguzie, 2009) described in Chapter 3.
5.3.1. Whole class and working memory related outcomes.

Perhaps the two most obviously anticipated outcomes of implementing whole class WM interventions would be that they were accessed by the whole class and that they would have some impact upon the WM of the participants. Memory Booster was not utilised as a whole class intervention due to significant implementation factors explored below in response to RQ2. This failure to use the intervention with the whole class subsequently means the outcomes explored cannot be attributed to the use of Memory Booster as a whole class intervention but rather they can be considered the outcomes of its use as a group intervention. Approximately 50% of the class were able to access it over the six week period, with the number decreasing towards the end with just four out of a potential 28 class members engaging during the final observation. Although MeeMo was delivered on just 23 out of 32 available slots, when it was delivered MeeMo was successfully and consistently implemented as a whole class intervention, suggesting the subsequent outcomes could realistically apply to the whole class. This corroborates the intended target of MeeMo as a whole class intervention (Skelton, 2012).

Regarding the second point about anticipated outcomes, it is perhaps harder to give a straightforward answer about the impact on WM for either intervention. This is in part due to the inability to objectively measure impact through the provision of either intervention. MeeMo provides individualised monitoring booklets designed to be completed by CYP and not used as monitoring by teaching staff (Skelton, 2012). Analysis of the data gathered through this provision proved it to be of limited utility as a monitoring tool even when analysed. It does not provide an accurate insight into progress made on the activities, due to the differentiated difficulty levels and the student choosing their difficulty. There is no information provided for programme deliverers that details the discrepancy between the easy and medium level, the medium and hard level or the easy and hard level. The researcher also questioned the utility of the monitoring booklets as tools for CYP, as scores achieved did not consistently improve and CYP may have a different understanding and perception of success and progress to that which is obtained through MeeMo.

Memory Booster does provide a dedicated section for monitoring progress with two different measurement tools; scores and levels. It is claimed that ‘scores’ indicate how many points CYP have achieved in each session, providing an indication of the effort put in, while ‘levels’ indicate how far a CYP has progressed through a mission, allegedly providing an objective measure of how the child’s memory skills are improving (Leedale, Singleton & Thomas, 2004). This is a useful tool for measuring progress through the game’s task-based activity and for providing feedback to CYP, however claims that it provides an objective measure of improvements in memory skills are
questionable and appear to be unfounded, with no evidence available to confirm that statement. It is not within the scope of this research to further investigate this claim and whether memory improvements are accurately represented by students progressing through the levels, although it is briefly discussed in Section 4.2.3. It can be argued that neither intervention appears to provide a monitoring provision that is truly fit for purpose.

Alternative commercially available WM interventions do offer monitoring provision which appear to be more rigorous and of greater utility. Jungle Memory (Memosyne, 2011) provides two graphs detailing individual improvement since starting the programme and a WM ability percentile based on normative data gathered from thousands of children. Cogmed (Cogmed, 2006) utilises qualified coaches to assist users in reviewing and monitoring daily results, feedback data from rating scales immediately after completion of the programme and at a six-month follow-up. Both Jungle Memory and Cogmed can be considered more established interventions and as such also have a wider research base indicating the efficacy and effectiveness of the interventions.

Teacher A opted not to utilise the monitoring provision during the implementation of Memory Booster so his perception of outcomes was based on his observations and student reports. Neither teacher felt that they had noticed progress related to improvements in WM and both said they had no way of knowing if the intervention had had any significant impact. This is highly plausible, as WM is not a visible process and any improvement on the existing intervention could be attributed to practice effects. Pupil participants from both interventions indicated that they perceived improvements and highlighted that MeeMo and Memory Booster had resulted in a positive impact on their memory and recall. Without quantitative data to triangulate this, it is possible that these opinions may reflect expectations that were created through receiving the programme, rather than actual changes caused by MeeMo or Memory Booster (Allinder, 1994).

5.3.1.1. Memory strategies.

MeeMo and Memory Booster both have a common goal, which is to improve the WM of children and subsequently improve their ability and capacity in range of related tasks and activities. The primary methods employed to achieve this are markedly different, with Memory Booster explicitly teaching memory strategies while MeeMo focuses on frequently encouraging CYP to use and stretch their WM capacity (Holmes et al., 2010; Skelton, 2012). A distinct outcome of Memory Booster that was not provided by MeeMo was the fact that pupils were explicitly taught memory strategies as part of the process and were regularly encouraged to use them through the software. It is thought that memory strategy training can be particularly beneficial for young children because they may not spontaneously employ strategies (St Clair-Thompson et al., 2010), with rehearsal not emerging until approximately
seven years of age (Gathercole, 1998) and other strategies developing later (Bjorklan & Douglas, 1997). It is plausible to argue that CYP may be able to generalise such strategies to a range of tasks.

Skelton’s doctoral thesis (2012) identified the importance of the four rehearsal strategies explicitly taught through the use of Memory Booster and initially planned to incorporate the teaching of the strategies as part of the implementation. During an early stage of MeeMo’s development it was suggested that to minimise the cognitive load when trying to apply new strategies (Swanson et al., 2010), they would be introduced by the teacher through modelling and prompting after three weeks. Skelton (2012) reasoned that at this stage, CYP would be better able to manage and use the strategies. Although this occurred during the doctoral research, teaching memory strategies is not included in the MeeMo Teacher’s Guide. It may be beneficial to explore the impact and utility of including the teaching of memory strategies as part of implementation on WM and other related areas of development compared to using MeeMo without any explicitly taught strategies.

5.3.1.2. Executive functioning.

Shipstead et al. (2010) highlight that while it is important to be able to state that a training intervention caused an increase in test scores, the true goal of WM training is to change the generalisable cognitive abilities of the individual, particularly Gf (fluid intelligence), and attention. Potential methodological limitations of the previous research into the two interventions include a focus on effectiveness in terms of improvements on WM assessments (e.g. St Clair-Thompson et al., 2010; Skelton, 2012) with a distinct lack of measurement of more generalisable cognitive abilities. Although not measured objectively, it emerged that pupil participants engaged in MeeMo were perceived to have made gains in executive functioning, specifically attention and concentration. There is a well established overlap between the concepts of WM and attention (Perrig et al., 2009), with evidence directly implicating attention in the active maintenance of information in WM (Engle, Kane & Tuholski, 1999; Kane & Engle, 2003).

The design of MeeMo requires participants to selectively attend to their partner and their subsequent mental representations whilst continually blocking out salient yet irrelevant speech sounds (Skelton, 2012). Due to the class talking simultaneously, MeeMo can create an extremely noisy and distracting environment. This can be considered a significant challenge for CYP as attentional resources are easily captured by speech (Kok, 1999; McDowd, 2007), particularly when the speech consists of goal-relevant target words (Chein & Fiez, 2010; Elliott & Briganti, 2012b). The opportunity to regularly practice highly demanding selective attention is likely to have been the reason for the increase in attention and subsequently concentration and may explain why it was not identified
in the Memory Booster group. It is possible that other facets of attention such as switching attention and sustained attention may be impacted upon by one or both interventions, although it is not possible to explore this further within this research.

5.3.2. **Academic impact.**

In addition to the additional perceived increase in executive functioning, participants engaging in MeeMo appeared to enjoy a wider range of beneficial outcomes compared to those engaged in Memory Booster. There were tentative suggestions of improvements in academic activities, such as mental maths and reading. Existing literature has argued that WM systems, particularly verbal WM which is the central tenet of MeeMo, are an integral structure for reading development (Baddeley & Wilson, 1993; De Jong, 1998) and there are tentative indications that training induced WM improvements may have a secondary impact on improving reading comprehension ability (Van Der Molen *et al.*, 2010). WM is also thought to be highly important in achieving fluency in numerical concepts (Geary, Hoard, Byrd-Craven & Desoto, 2004) and mathematical calculations (De Smedt *et al.*, 2009a). Although improvements in mental maths and reading cannot be claimed as a result of using MeeMo, it is interesting to note that the perceived improvement and correlation was made by the CYP engaging in MeeMo. This is certainly an area which would benefit from further research.

5.3.3. **Additional or unanticipated outcomes.**

Some outcomes identified through the implementation of Memory Booster and MeeMo could be considered additional or unanticipated as they do not fit neatly within the WM intervention literature in terms of well documented outcomes. That is not to say there is no existing evidence on the subsequent outcomes, but that they may not be and well researched as more directly associated aspects of development.

5.3.3.1. **Social and emotional.**

Social benefits were highlighted as a positive outcome for those using MeeMo but not Memory Booster. This is perhaps to be expected as MeeMo is a pairs-based intervention whereas Memory Booster involves individual work on a computer with headphones, reducing the possibility of any social interaction. Teachers felt that the opportunities to engage with a range of classmates during a fun and structured activity helped some peers with their social interaction skills. Skelton (2012) suggested this may be a potential additional outcome; that children quickly made progress in the social processes of working together, particularly in their abilities to speak clearly, use non-verbal communication skills, be patient, offer assistance and take turns. The findings relating to social gains complement previous research which has demonstrated that conceptually similar activities to MeeMo can lead to
increases in social skills (Canney & Byrne; Glick & Rose, 2011; Johns, Crowley & Guetzloe, 2005). Indeed, it was felt that children were positive about working in pairs and felt that it enabled an opportunity to socialise but also an opportunity to seek or give help if necessary. Research indicates that the sense of cooperation promoted through the use of MeeMo helps to support engagement which subsequently facilitates feelings of competence and autonomy which increases motivation (Ayers et al., 2005, Hromek & Roffey, 2009).

Skelton (2012) used research conducted by Clariana et al., (2000) to argue that the social element of the programme will have allowed for continual sensory feedback from their partners facial, gestural and postural expressions, which will serve as a powerful reinforcement to maintain attentional focus. While this is likely to be true and positive for those students experiencing success and achieving their targets, it is highly possible that for students experiencing difficulties they may have been receiving negative feedback through the same expressions. Several students in the focus group discussed the importance of the partner to their perceived success and enjoyment during the session. This is discussed further in relation to RQ2.

The class teacher also raised concerns about the impact on certain students’ self-esteem if they were paired with a peer who was considerably more able or successful when using MeeMo.

5.3.3.2. Positive experience: enjoyment, motivation and independence.

Both interventions were largely seen as a positive experience for those able to access them. This was for a range of reasons, not least the children’s enjoyment. Both MeeMo and Memory Booster were seen as enjoyable activities which are conducive to creating positive emotions during engagement. There is a growing understanding that emotions are of significant importance for learning and cognitive development (Oatley, Parrott, Smith & Watts, 2011; Wong et al., 2012) and positive emotions related to the enjoyment of an activity correlate positively with interest, motivation and a desire to continue to engage in an activity (Schutz & Pekrun, 2007).

Motivation can enable WM resources to be fully employed and can also enable increased levels of sustained attention (Jaeggi et al., 2011; Perrig et al., 2009). Andrade (2001) found that increased motivation is positively correlated with successfully achieving on WM tasks and this is supported by evidence of a functional correlation of motivational influences on verbal WM within the prefrontal cortex (Dovis, Van Der Oord, Wiers & Prins, 2012; Ishi et al., 1999; Krawczyk & D’esposito, 2013). Acknowledging this, Skelton (2012) explicitly set out to create a programme which CYP would find enjoyable, engaging and motivating by considering design factors in line with the constructs of flow theory (Jaeggi et al., 2011). It is thought that computerised WM interventions also recognise the importance of motivation as they often endeavour to incorporate features of video games that make them
engaging (Smith, Halari, Giampetro, Brammer & Rubia, 2011). This was reflected as pupil participants did find both programmes engaging and were motivated, particularly during the first three to four weeks.

Participants in both intervention groups were reported to display decreased motivation and enthusiasm as the interventions progressed, largely in the fifth and sixth weeks. This has implications for the ongoing effectiveness of both Memory Booster and MeeMo. As the aim of the interventions is to practice memory strategies or stretch WM capacity it can be argued that it is imperative that CYP are motivated to fully engage and employ their WM to its fullest capacity (Skelton, 2012). In the present research this did not appear to be the case towards to end of the intervention period and also at the end of some individual sessions, which were thought to be too long. There are indications that a lack of interest during WM training may lead to little improvement in WM (Szatkowska, Bogorodzki, Wolak, Marchewka & Szeszkowski, 2008). This has potential implications for the implementation of both interventions, particularly in relation to timings of the interventions. This will be explored further in relation to RQ2 below.

A further positive outcome of both interventions was the level of autonomy or independence which they offered to CYP. After the first week pupils in the MeeMo class took responsibility for the setting-up, running and tidying away of MeeMo by themselves while those in the Memory Booster class were able to independently collect a laptop and log on to the software as long as no technical difficulties were experienced. It is thought that as well as being beneficial for the confidence of CYP, activities and environments that promote CYP’s sense of autonomy can enhance their perceived control as well as increasing the value they place the activities (Patrick, Skinner & Connell, 1993).

### 5.3.3.3. Impact on teacher.

The two different interventions had very different impacts on those implementing them which is likely to be a result of the very different experiences in implementation and the approach taken. Broadly speaking, implementing MeeMo had a positive impact on Teachers B and C, enabling them to observe and directly engage with a range of CYP in a positive way, recognising new strengths and skills which had not been noticed or celebrated through the national curriculum. Conversely, Teacher A found that implementing Memory Booster had a negative impact.

The nature of Memory Booster as an adaptive piece of software which includes all necessary instructions and potentially differentiation led to Teacher A experiencing feelings of disempowerment at the reduced need for him as a teacher. This fits with previous research which suggests that teachers can often feel that the use of
computerised programmes can cause them to feel disempowered and reduces their self-efficacy (Roberts et al., 2011). Despite this, the teacher was able to identify potential positives of adaptive nature of Memory Booster if it had been successful as a whole-class intervention, such as focussing on targeted teaching or intervention with specific students or groups. If the technology and software were working correctly, the structured and adaptive nature of the programme could feasibly lead to regular slots of time where the class are quietly and purposefully engaged. It was highlighted that Teacher A had planned to use some of this time to withdraw specific students to work on literacy and numeracy skills or to provide opportunities for repetition and over learning. It is apparent that the teacher would not feel comfortable in leaving his whole class to engage in a computerised intervention for the duration of the programme as this would lead to increased feelings of disempowerment. However, in line with the research which highlights the far-reaching effects of poor working memory on academic progress in areas including literacy and numeracy (e.g. Alloway & Alloway, 2010; Alloway et al., 2005; Alloway, Gathercole & Elliott, 2010; St Clair-Thompson & Gathercole, 2006), it is likely that the students who he planned to withdraw and work with would be the students who are in most need of support for their working memory. In removing these students and reducing the dosage of the intervention it is possible that they will miss out on support which could potentially have a significant impact.

5.3.4. Summary of RQ1.

The data gathered has supported the answering of RQ1. It is apparent that when using MeeMo or attempting to use Memory Booster as a whole class intervention there are a range of outcomes, both positive and negative. Pupil participants in both intervention groups generally perceive there to be an improvement in memory and recall, although this was not independently observed or noticed by the teachers. The monitoring provisions of each intervention do not appear to be fit for purpose and do not support in the identification of outcomes. It can be argued that without an objective assessment tool, it is not possible to quantifiably identify an impact. Both interventions provided a positive experience for CYP, in terms of enjoyment and increased levels of independence. It was noted that levels of motivation decreased over the six weeks for both interventions. Memory Booster provides pupils with knowledge of and practice in using memory strategies. MeeMo appears to provide a wider range of additional benefits than Memory Booster, including improvements in concentration, social and emotional gains and academic impact. MeeMo also impacted positively on the class teachers, whereas Memory Booster had a negative impact on the teacher responsible. Although the present research has answered RQ1 to some extent, it has simultaneously led to the creation of further questions, areas for development and points for the consideration
of researchers, programme developers and those responsible for implementing the programme. The implications will be considered in Section 5.8.

5.4. Research Question Two

What are the facilitators and barriers for implementation of MeeMo and Memory Booster as whole class working memory interventions?\(^5\)

The discussion around RQ2 will not be delineated explicitly by barriers and facilitators as often they are simply inverted or opposite constructs as demonstrated by the same organisational themes appearing in both facilitators and barriers in Table 5.2. An example of this is that preparation and engagement in the intervention were facilitators for the implementation of MeeMo, whereas a lack of preparation and engagement were barriers to the implementation of Memory Booster.

<table>
<thead>
<tr>
<th>Table 5.2 Facilitative factors and barriers to implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilitative factors</strong></td>
</tr>
<tr>
<td>Memory Booster</td>
</tr>
<tr>
<td>Teacher attributes</td>
</tr>
<tr>
<td>Student/class attributes</td>
</tr>
<tr>
<td>Programme factors</td>
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<tr>
<td>Delivery/implementation</td>
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<tr>
<td>Contextual factors</td>
</tr>
<tr>
<td>Technical issues</td>
</tr>
<tr>
<td>Programme content</td>
</tr>
<tr>
<td>Delivery/implementation</td>
</tr>
<tr>
<td>Teacher factors</td>
</tr>
<tr>
<td>Contextual factors</td>
</tr>
</tbody>
</table>

It is apparent that a great deal of the themes which emerged from the analysis mirror and complement existing implementation literature, such as Durlak and DuPre (2008) and reinforce claims regarding the importance of studying implementation in school settings (Lendrum & Humphrey, 2012). Rather than repeating and expanding

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\(^5\) Focus groups with pupil participants, semi-structured interviews with teachers, observations and data from the implementation diary were used to address RQ2. For each intervention two global themes emerged in relation to the implementation factors; ‘facilitative factors’ and ‘barriers to implementation’ (Table 5.2). These implementation factors are outlined in depth in the results section and inform successful implementation of each intervention.
directly upon the information provided in the results chapter, the structure of the discussion around RQ2 will be based upon the framework for effective implementation (Durlak & DuPre, 2008, p. 335). This was selected rather than Kay’s (2012, p. 179) model due to Durlak and DuPre’s (2008, p. 335) framework being validated in relation to a large number of implementation studies. The five categories in which implementation factors will be considered are community, provider, innovation, delivery system and support system. This enables an ecological perspective to be taken, which is considered to be essential in understanding successful implementation. Global or general implementation factors will be considered within each category, as will intervention specific factors for either MeeMo or Memory Booster.

5.4.1. Community factors.
Community factors did not emerge as facilitative or barriers to implementation. Durlak and DuPre (2008) indicate that community factors can include prevention theory and research, politics, funding and policy. The researcher did not explicitly attempt to explore factors at this level and they did not emerge inductively from the analysis. This may indicate that participants either did not see community factors as directly related to the implementation of the interventions or it could be alleged that the community factors are currently conducive to implementation of such interventions. Alternatively, potential factors may have been removed due to the nature of the research but would need to be considered for future implementation. For example, Durlak and DuPre (2008) discuss the importance of funding and while this research provided the interventions free of charge, it is likely that the cost of the intervention and the potential range of access will impact on the implementation process in the future. Memory Booster provides a set number of licences depending on the version purchased whereas MeeMo can be reused throughout the school for as long as the kit is serviceable.

It is possible that although it was not made explicit, politics and policy may have impacted indirectly on the implementation of the interventions. School staff in England have in recent years been expected to implement ever-increasing numbers of new interventions, resulting in ‘initiative overload’ (Ofsted, 2010c). Lendrum (2010) suggested that this also resulted in cynicism about the longevity and sustainability of interventions and a reluctance to invest limited time, resources and personal effort into potentially short-lived and quickly replaced new interventions. This was not observed in the implementation of MeeMo as teaching staff were extremely positive and willing to invest in the intervention. It is possible that this may have impacted on Teacher A and could explain some of his decisions not to fully prepare and engage in all aspects of the intervention to maximise the experience for his class. It has been argued that school staff who feel pressured by more senior colleagues or
professionals to offer new programs often do not implement them very effectively due to them not becoming committed to the intervention (Berman & McLaughlin, 1976). This is explored further in Sections 4.2.4.4.4 and 5.4.6.

Durlak and DuPre (2008) discuss the various methods in which communities can access information regarding different programmes and indicate that this can impact on the implementation. Within the UK context and the context of the researcher’s dual role as a TEP it can be argued that EPs are extremely well positioned to offer insight into relevant interventions for a range of issues and inform schools of potential implementation issues if necessary.

### 5.4.2. Provider characteristics.

Durlak and DuPre (2008) suggest that the four provider characteristics most consistently related to implementation related to the need for, and potential benefits of the innovation, self-efficacy and skill proficiency.

A facilitative factor emerging from the present research was the attributes of the teacher or individual responsible for implementing the intervention. The motivation, attitude and enthusiasm of all teachers were seen as facilitative for both interventions. All teachers were excited about the possibilities and appeared to understand the benefit of potentially improving children’s’ WM. For Memory Booster, it was seen to be facilitative that Teacher A was knowledgeable about ICT as this meant he was comfortable in setting up the programme and attempting to deal with difficulties. As the implementation progressed, the persistent technical issues with Memory Booster appeared to reduce Teacher A’s confidence in managing and overcoming the difficulties, reducing the fidelity and dosage. This concurs with the literature which suggests that providers who recognise a specific need for an intervention, believe it will produce the desired benefits, feel confident in their ability to do what is expected (self-efficacy), and have the requisite skills are more likely to implement a programme at higher levels of dosage or fidelity (Barr et al., 2002; Ringwalt et al., 2003.

A significant implementation factor related to the provider was preparation prior to the delivery of the intervention. The lack of preparation and willingness to learn as Teacher A progressed rather than prepare beforehand led to several elements of delivery which made the overall implementation more difficult or impacted on the overall experience for the CYP accessing it. This lack of preparation led to Teacher A not understanding or being aware of the subtleties of the intervention and a subsequent lack of adaptation which could have been beneficial for a range of CYP. It is apparent that he thought it was less flexible than it was and therefore did not adapt it. This is also related to an innovation factor, explored in more depth in Section 5.4.3.
The level of active engagement in the intervention was also seen to impact on the implementation. Teacher A did not experience Memory Booster whereas Teacher B and C engaged directly with MeeMo as paired participants on several occasions. This led to an increased understanding of MeeMo but also provided a better understanding of the class’s general learning capacity, the nature of children’s WM difficulties and an insight into those who may be struggling due to these limitations (Skelton, 2012). This may lead to the teacher being better able to modify the curriculum and provide more targeted and appropriate curriculum differentiation which can have considerable benefits for CYP’s learning (Loosli et al., 2012). Teacher A’s decision not to actively monitor progress using the in-built monitoring provision or to help pupils to generalise strategies learnt in the intervention lead to the potential utility of the programme being reduced.

5.4.3. Innovation characteristics.

Two innovation characteristics consistently related to implementation are adaptability (flexibility) and compatibility (contextual appropriateness, fit, match, congruence) (Durlak & DuPre, 2008). Both interventions were found to be compatible in terms of the definition provided above. Memory Booster was not compatible as a whole class intervention due to the technical issues experienced, which may pose an issue in relation to its adaptability. It was apparent that MeeMo was adaptable to the classroom environment in school B and was integrated well into the class environment and routine.

Within this category four key innovation characteristics will be explored in relation to their impact on successful implementation: timescales, whether or not Memory Booster is truly adaptive, pairing CYP in MeeMo and monitoring provision. Additional innovation characteristics including programme specific design or content are not explored in detail here but can be referred to in Sections 4.2.4 and 4.3.4.

5.4.3.1. Timescales.

A recommendation and implementation factor highlighted by both Teacher A and Teacher B was related to the timing of the intervention in terms of the length of the session, the frequency and the total length of the intervention. It was felt that shorter, frequent sessions, a “little and often” approach, would be helpful in relation to the implementation but also in relation to student engagement and potentially the overall outcome of the intervention. This suggestion is reinforced by consistent and longstanding evidence that indicates that optimal progress is made in the development of new skills when practice or learning is distributed over a large number of brief sessions rather than in a more massed learning approach (Berends & Reitsma, 2006; Boot et al., 2010; Hintikka, Aro & Lyytinen, 2005; Thaler, Ebner, Wimmer & Landerl, 2004; Whalen, Massaro & Franke, 2009).
Distributed practice is also thought to support the retention and transfer of gains across novel tasks (Benjamin & Tullis, 2010; Litman & Davachi, 2008) and is an important consideration of attentional training programmes (Schmidt & Tim, 2011).

Skelton (2012) claims that MeeMo reflects and adheres to the principles of distributed practice more so than computerised WM programmes, by employing shorter sessions over a more frequent and intensive training period (i.e. 30 sessions). Despite this, participants indicated that shorter sessions of three to four minutes for participant could be beneficial.

5.4.3.2. Memory Booster: Adaptive?

A relevant question which can be asked of Memory Booster is whether it is truly adaptive or whether it requires some degree of input from the adult who is implementing or facilitating it. A significant implementation factor in the delivery of Memory Booster was Teacher A’s decision to let the class access the programme without making any changes to the settings.

Claims made in the available literature are potentially misleading for teachers or those considering implementing Memory Booster. All available manuals, articles and research state that Memory Booster is an adaptive piece of software which requires no or little supervision.

Singleton, one of the programme developers, claims that “for teachers seeking a suitable tool that can be used without supervision, Memory Booster is worth trying” (2005: 22-23). He goes on to highlight that “the program is adaptive so it automatically adjusts to each individual child’s level of performance, providing just the right amount of challenge” (Singleton, 2005:23).

While this is technically true, it does not accurately reflect the reality, which is that without the teacher altering the settings, students’ ability to access the whole programme is reduced. Further research into Memory Booster by St Clair-Thompson et al. (2010) reinforces the sense that students can access the entire programme with no teacher input. It is claimed that students can access levels four, five and six and will then be taught the memory strategy of grouping if they perform well and progress.

The Memory Booster Guide (Leedale, Singleton & Thomas, 2004, p. 14) states that whilst on the default setting, known as ‘Mission Type A’, children can only access the first three game levels and will not be introduced to the fourth memory strategy in the context of the game. The guide goes on to highlight that Mission Type B provides a
more automated and adaptive way to stretch players of a wide ability range. It potentially allows participants to access all six levels and all four memory strategies.

Some of the children reported feeling bored and one suggested Memory Booster would be more suited to younger children in Key Stage 1 (KS1). It is possible that this pupil found the levels available to him too easy and could not progress to the more difficult tasks. Research indicates that if the activities are too easy, the incentive value of tasks may be reduced to the extent that boredom is experienced and considerably reduced motivation ensues (Hedegaard, 2005).

A clear suggestion to the developers of Memory Booster is to clarify the importance of selecting the difficulty level for students in the class. The default setting only enables pupils to access ‘Mission A’, which has a ceiling of level 3 and will prevent the more able students from progressing, potentially impacting on motivation, enjoyment and engagement. It appears to this researcher that ‘Mission B’ should actually be the default setting, as this would potentially enable progress throughout all six levels while still providing an adaptive experience.

5.4.3.3. **MeeMo: How to pair up CYP?**

The research provided insight into participant characteristics in relation to MeeMo and how CYP were paired up. In the initial research, Skelton (2012) noted that the partner was typically chosen based on the child they were sitting next to. Within the present research partners were regularly changed and were primarily based upon the current ‘talk partners’ system. Partners were not selected based on ability and this was seen as positive by teaching staff as it enabled positive structured social interactions between peers who may not otherwise have the opportunity to engage in this way, for example those considered to have high and low academic ability. An additional factor which could potentially impact on the implementation of MeeMo is the need for an even number of participants. Teacher B and Teacher C overcame this by engaging directly in the intervention when required. This had additional benefits, as described in Section 4.3.4.1.5.

It emerged that pupil participants felt the attributes and questioning style of their partners impacted on their enjoyment and ability to fully engage and achieve to their potential. The speed and volume of questioners were particularly relevant. Due to the high noise levels created by a whole class talking simultaneously the main concern around volume was when it was too low to hear. The preferred speed of questioning was much more variable with some pupils finding the speech was too fast to fully comprehend and respond to, while others reported that their partners spoke too slowly which was perceived as wasting time. Both fast and slow presentation was perceived as unhelpful and frustrating by different participants. This variation could be explained by the range of different
learning styles, listening comprehension skills and processing speed found in a Primary School classroom. It can also be explained by the presentation rate having a differential effect on the amount of information CYP were able to remember and process dependent on the demands of the particular activity (Skelton, 2012). Research suggests that presentation at a faster rate enables more information to be remembered in STM, while performances on some WM tasks (such as those that closely resemble ‘Mix Up’) increase with a slower presentation rate (Gisselgård, Petersson & Ingvar, 2004; Little, Martin & Thomson, 2010). This needs to be considered for future implementation. Students may be better paired on the preferential speed of questioning although this could be logistically difficult. An alternative is encouraging CYP to ask the Questioner to change their presentation rate based on the Thinker’s personal preference for the activity (Skelton, 2012). It would be helpful for some guidance to be included in the programme literature to inform teachers of the possible ways in which CYP can be partnered. It may also be beneficial for further research to investigate the impact of this fundamental aspect of programme delivery on implementation and effectiveness.

5.4.3.4. Monitoring provision.

A significant limitation of MeeMo is the lack of built-in monitoring provision. The pupil monitoring booklet does not lend itself well to measuring progress and was not intended to (Skelton, 2012). In its current guise, MeeMo relies heavily on users to simply accept that students will make progress based on the limited evidence base which cannot be generalised. It would benefit from the addition or inclusion of a monitoring system that can be simply used by school staff.

While Memory Booster does provide a simple monitoring tool which shows progress on the programme, it is not clear how analogous these improvements are to the impact on WM and the use of memory strategies in CYP. It may be beneficial to conduct further research to inform whether the monitoring tool data correlates with improvements on objective WM measures such as the AWMA.

The analysis of the monitoring provision of each intervention and the subsequent limitations of quantifiably measuring outcomes highlighted in both settings raises questions about how schools monitor and evaluate the impact of interventions. In the current climate of measuring impact and demonstrating value for money and cost-effectiveness of interventions and strategies, it is not unlikely that schools may wish to be able to demonstrate the impact of selected interventions. An example of this may be through the use of provision mapping which is explicitly mentioned in the new draft SEN Code of Practice (CoP) (DfE, 2013c) as the preferred method for recording, tracking and managing additional interventions and provisions. Two key steps of successfully using...
provision mapping include identifying criteria and processes for tracking pupils’ progress and monitoring impact and establishing systems for evaluating the effectiveness of the provision (Massey, 2013). Currently it is unlikely that teachers will be able to effectively do this with either intervention, particularly MeeMo.

5.4.4. Delivery system (organisational capacity).

According to Durlak and DuPre (2008) the delivery system, or organisational capacity, can be described in line with three categories; general organisational factors, specific practices and processes and staffing considerations. Kay (2012) created a separate category of environmental factors however for the purpose of this research the environmental and contextual factors are included in this section.

Both schools can be considered as forward thinking and adventurous, both in relation to their enthusiasm in engaging in the present research but also for engaging in providing fieldwork placement experience for a TEP in a unique arrangement (Morewood & Rumble, 2013). Early diffusion research characterised individuals who were quick to adopt innovations as open to change and innovative (Rogers, 2003) and Durlak and DuPre (2008) argue that these descriptions can apply to organisations. Therefore the innovative nature of the organisation is likely to have cultivated an atmosphere conducive to trying new approaches. Both schools can arguably be referred to in line with the above description but some elements of the organisational capacity are likely to have impacted negatively on School A such as shared decision making.

An important factor in the successful implementation of a new intervention which can be drawn out from this research is the sense of ownership and of association with the intervention by those responsible for implementing it. This is likely to impact on and be impacted upon by the extent to which the implementer believes in and values the intervention. Within this research, Teacher C, who is also the SENCo and Deputy Head of the school in which MeeMo was implemented, had been engaged in discussions about the research and the WM interventions from the start of the process. She had already developed knowledge about the importance of WM through discussion with the researcher in his role as a TEP. It is possible that the fidelity and dosage was largely more adhered to by the teachers implementing MeeMo than by the teacher implementing Memory Booster, as he was not engaged in the initial discussions about the research and may not have felt responsible for it. This is reflected in the literature, which indicates that shared decision making is considered to be important in supporting implementation (Durlak & DuPre, 2008), with situations where it occurs among providers, researchers, administrators and community members consistently leading to better implementation (Berman & McLaughlin, 1976; Mihallic et al., 2004; Riley et al., 2003).
With regard to specific processes and practices, it was apparent that for both interventions the ability to create a routine and schedule regular and consistent opportunities to engage was beneficial. This helped to increase the independence of the CYP accessing them.

A facilitative environmental or contextual factor for Memory Booster was that Teacher A had ready access to a bank of laptops and headphones which he could utilise on a daily basis. It is possible that this may not always be the case in different contexts and may pose a potential barrier if not available in others settings. Skelton (2012) claims that MeeMo has advantages over computerised training programmes in that it is contextually embedded and employed in the naturalistic classroom setting shortly before and after other WM demanding activities. He posits that computer-based training would be in a quiet, isolated and individualised environment, leading to the assumption that MeeMo would potentially demonstrate more direct and transferable benefits into daily classroom practice. Within this piece of research both were contextually embedded and employed in the naturalistic classroom setting.

The time of year in which the interventions were delivered was considered to be a barrier to successful whole-class implementation. Both teachers discussed the disadvantages of running an intervention in the summer term and concurred that the reduction in routine activities associated with the end of the school year made it more difficult to consistently schedule and engage in the intervention with the whole class. In addition to this it was felt that the summer term is the most difficult time of year to monitor progress and the impact of interventions as there is less structured opportunities to observe pupil’s engagement and approach in different academic activities. The researcher is not aware of any existing literature exploring this phenomenon, therefore it would benefit from further research.

5.4.5. Support system (training and technical assistance).

No formal training was provided in the use of either intervention. For both interventions the researcher described the intervention, highlighted the key implementation factors based on the available literature (which was shared) and ensured the teachers felt knowledgeable and confident enough to continue with the set-up and introduction of the respective interventions. This may be reflective of input provided by an EP in professional practice. Neither teacher mentioned the lack of formal training as an issue but it may be a development point for programme developers as it is clear from Teacher A that teachers are busy professionals and do not always find the time to read manuals in preparation. While it may be unrealistic to develop and deliver formal training for the interventions in this research, it may be possible to provide short video clips detailing the key implementation
factors for the intervention while displaying clips of it in use. However, while this would help to attend to implementers expectations, motivation and knowledge of the intervention (Durlak & DuPre, 2008) it may not help to develop mastery and a sense of self-efficacy. Research indicates that active forms of learning promote skill acquisition with training that includes modelling, role playing and performance feedback in a supportive atmosphere being viewed as successful (Dufrene et al., 2005; Sterling-Tuner et al., 2002). It is apparent that Teacher B and C achieved this independently through engaging in the intervention and subsequently discussing it.

Technical assistance refers to the resources available to providers once the intervention begins. The goals are to maintain providers’ motivation and commitment, improve skill levels where needed and support local problem solving efforts (Durlak & DuPre, 2008). Although used sparingly, the access to support from developers to assist Teacher A in the initial set up of Memory Booster was considered to be easy and straightforward. After the initial support in creating profiles and log-in details for the class Teacher A opted not to utilise the available support which led to significant implementation difficulties.

Teacher B and Teacher C requested early feedback and reassurance on their implementation of MeeMo. It is apparent that some support for implementation is either required or desired and creates an opportunity for EPs to support teachers in maximising the potential of any intervention.

5.4.6. Summary of RQ2.

The implementation of Memory Booster and MeeMo were considerably different as would be expected from the very different methods of delivery, with the former relying on access to and engagement with an individual, adaptive piece of computer software and the other utilising a practical, paired, card-based approach. Despite this, the implementation factors could broadly be placed within the same categories although there were some intervention specific factors. This was particularly noticeable in the more negative factors which could be considered barriers to implementation.

The researcher initially aimed to distinguish explicitly between the facilitators and barriers of each intervention but due to the degree of overlap this has not occurred. In this sense, RQ2 has not been answered as may have been expected. Instead, a range of key implementation factors have been considered, which can be collated to develop a framework for effective implementation (Figure 5.1) based on the two contexts and environments utilised in the research. The framework may not be entirely generalisable but it does provide guidance for implementation and may be useful for professionals or researchers interested in using either of the interventions. It could be utilised as the basis for a practitioner or researcher tool to highlight and prompt consideration of key implementation issues.
The implementation factors could be measured in line with the eight commonly measured aspects of implementation (Durlak & DuPre, 2008) to assess their impact on the effectiveness of the interventions.

<table>
<thead>
<tr>
<th>A framework of effective programme implementation</th>
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</thead>
<tbody>
<tr>
<td>The framework for effective implementation suggested by Durlak and DuPre (2008, p. 335) was adapted and utilised to support the consideration of key implementation factors for both Memory Booster and MeeMo across five categories. Where possible general factors thought to contribute to effective implementation will be provided with intervention-specific factors provided where necessary.</td>
</tr>
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<table>
<thead>
<tr>
<th>Community factors</th>
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<tbody>
<tr>
<td>No specific community factors emerged that were directly relevant to the implementation of either intervention, although some were reflected upon, such as:</td>
</tr>
<tr>
<td>- Acquire sufficient funding to purchase and implement the intervention. It may be beneficial to consider the cost and longevity of each intervention.</td>
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<tr>
<th>Provider characteristics</th>
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<tbody>
<tr>
<td>Provider characteristics involve perceptions related to the need for, and potential benefits of, the intervention, self-efficacy and skills proficiency (Durlak &amp; DuPre, 2008). The provider characteristics emerging from the present research are as follows:</td>
</tr>
<tr>
<td>- Programme implementers should be allowed time to prepare and become confident in delivery before implementation begins.</td>
</tr>
<tr>
<td>- Ensure programme implementers understand the potential benefits and limitations of the interventions and the requirements it places on them.</td>
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<table>
<thead>
<tr>
<th>Memory Booster</th>
<th>MeeMo</th>
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</thead>
<tbody>
<tr>
<td>- Read the manual and set up profiles, including selecting differentiated ‘mission types’ as required.</td>
<td>- Teachers should engage directly and experience MeeMo as a participant.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Innovation characteristics</th>
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</thead>
<tbody>
<tr>
<td>Innovation characteristics are specific to the individual intervention.</td>
</tr>
<tr>
<td>- There should be adherence to the programme manual where possible, with adaptations made only as necessary by those who are familiar with the participants and the context, with the needs of the participants in mind.</td>
</tr>
</tbody>
</table>
- Be aware of the impact of the length of intervention sessions on engagement and motivation – both Memory Booster and MeeMo could benefit from shorter sessions in line with distributed learning.
- Be aware of the limitations (Memory Booster) or lack (MeeMo) of the monitoring provision and consider how impact/progress will be measured. If using an independent measuring tool ensure data is collected before and after the intervention.

**Memory Booster**
- Ensure the most appropriate settings are selected to maximise differentiation and engagement through the adaptive facet. ‘Mission Type B’ potentially allows participants to access all six levels and all four memory strategies.

**MeeMo**
- Consider how CYP will be paired up (ability, proximity, talk partners, etc) and whether the pairs will be remain constant or change.
- Ensure a contingency plan is in place to manage an odd number of students: teaching staff participating is a useful methods for this

### Delivery system (organisational capacity)
The delivery system is comprised of general organisational factors, specific practices and processes and staffing considerations.
- Where possible, ensure the intervention is contextually embedded and employed in the classroom setting.
- Ensure decision making about the implementation is shared with the potential implementer to increase ownership and belief in the intervention.
- Consider the time of year; Autumn and Spring terms are thought to be more conducive to effective implementation.
- Establish a consistent routine and schedule when the intervention will be implemented.

**Memory Booster**
- Ensure regular and easy access to ICT facilities including headphones.

**MeeMo**
See above – (no MeeMo specific factors)

### Support system (training and technical assistance)
No formal training is provided for either intervention, although the following support system is recommended:
- Ensure knowledge of the intervention and foster a sense of self-efficacy through practice and discussing the intervention with a colleague where possible.
• Utilise local support such as T/EP for consultation, observation and feedback regarding implementation and evaluation.

<table>
<thead>
<tr>
<th>Memory Booster</th>
<th>MeeMo</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Utilise the available technical support as necessary.</td>
<td>See above – (no MeeMo specific factors)</td>
</tr>
</tbody>
</table>

**Figure 5.1 Framework for effective implementation of Memory Booster/MeeMo**

### 5.5. Unanticipated Findings: Recommendations

In addition to the findings representing and answering the two research questions related to outcomes and implementation, a third cluster of codes were developed into themes with a common premise: recommendations. The researcher considered the themes indentified within the global theme of recommendations to be distinct from the two research questions. The fact that recommendations relate to five different aspects (Table 5.3) incorporating implementation as well as for future research highlights that an inductive approach had been taken, resulting in themes that are concurrent with the data because assumptions are data-driven (Boyatzis, 1998). Some were related to correcting flaws or removing barriers, others were about maximising the experience and improving the likelihood of participant engagement.

**Table 5.3 Recommendations**

<table>
<thead>
<tr>
<th>Memory Booster</th>
<th>MeeMo</th>
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<tbody>
<tr>
<td>Pupil aspects</td>
<td>Pupil aspects</td>
</tr>
<tr>
<td>Teacher/deliverer</td>
<td>Teacher/deliverer</td>
</tr>
<tr>
<td>Implementation</td>
<td>Implementation</td>
</tr>
<tr>
<td>Programme adaptations</td>
<td>Programme adaptations</td>
</tr>
<tr>
<td>Further research</td>
<td>Further research</td>
</tr>
</tbody>
</table>

On reflection, it may have been beneficial to include a third RQ focussing on recommendations for Memory Booster and MeeMo, in terms of participant characteristics, programme development and implementation. In the present research, the recommendations made by participants responsible for implementing or using the intervention will be combined with implications and suggestions made by the researcher in Section 5.8.
5.6. Contributions to Knowledge

The expected contributions to knowledge discussed in Section 2.12 were a greater understanding of the ease and success of implementation and the outcomes of activity-based and computerised WM interventions when used as whole-class interventions. A review of earlier literature highlighted that existing research had not thoroughly explored the implementation of WM interventions, and had not investigated the implementation of WM interventions when used with a whole class. This research has provided an in-depth understanding of two distinct WM interventions in relation to the implementation factors in specific contexts. A framework for effective implementation has been developed to support future practitioners and researchers considering the use of Memory Booster or MeeMo.

The present research highlights that MeeMo can be considered a whole-class intervention that is more likely to result in whole-class engagement and offer a range of additional benefits. The present research indicates that technical difficulties can significantly impact on the utility of the computerised intervention in terms of students’ ability to access it. Despite this, there is potential for it to be used as a whole class intervention. The outcomes gained through the interventions have been analysed and this demonstrated that neither of the interventions provide an effective and evidence-based provision to monitor progress and impact.

5.7. Limitations of the Present Research

Perhaps the most obvious limitation of the present research is the lack of genuine quantitative data gathered to provide information regarding the effectiveness of the interventions. The researcher only collected quantitative data which would be available to those implementing the interventions through the provision of each intervention. The data gathered was not suitable for rigorous statistical analysis and did not provide robust evidence to support the outcomes indicated by pupil and teacher participants. As such, although the researcher intended to utilise a mixed methods approach the research was primarily qualitative, particularly for RQ2. It could be argued that the mixed methodology design detailed in Section 3.3 was not implemented as is usually expected in the research methods literature as it did not involve rigorous statistical analysis. Subsequently, is apparent that this research does not readily fit with effectiveness or efficacy research usually conducted at this point in intervention diffusion (Campbell et al., 2000; Flay et al., 2005). A counterargument would draw on the evidence that the researcher followed the procedures outlined in the methodology but had not successfully anticipated the type and quality of data which would be acquired through the provision of each intervention. It can also be argued that the researcher had set out to gather information on the implementation and outcomes, not effectiveness nor efficacy, of each
intervention. The effectiveness/efficacy model is not always appropriate as it may attempt to enforce a top-down model that might work in a controlled environment. The bottom-up approach taken to consider implementation outcomes in a real-world setting is in line with the guidance provided by TAMHS (DCSF, 2008; Kay, 2012) and results in information informed by what actually happens in school, the context and how the different factors interact. In this respect the research can be considered an implementation pilot to inform future research of the key factors likely to impact on the effectiveness.

One of the outcomes was the data gained through each intervention’s monitoring provision. Through using and analysing the monitoring provision of each intervention, it became apparent that any outcome recognised and discussed by participants was not informed by the aforementioned provision. This is useful in itself as it indicates that the monitoring provision of each intervention does not appear to be fit for purpose. In fact neither Memory Booster nor MeeMo appear to provide practical and evidence-based monitoring tools.

Several changes to the planned delivery of the interventions occurred over the course of the research, reflecting the unanticipated challenges which are perhaps to be expected in real world research (Robson, 2002). The most significant change to the planned delivery was caused by the technical difficulties experienced by Teacher A implementing Memory Booster with the whole class. This meant the whole class was not able to access the intervention and receive the full dose of the intervention, leading to difficulties monitoring the whole class outcomes of Memory Booster. Due to the research not focussing on the effectiveness of the intervention this limitation was not significantly impactful. In fact, these technical difficulties provided valuable information regarding implementation factors for Memory Booster and provided useful insight into implementation of interventions in schools in general.

A methodological limitation of the research was that two members of teaching staff were jointly responsible for implementing and facilitating MeeMo but only one was interviewed due to logistical issues and Teacher C’s additional commitments as SENCo and Deputy Head. It is possible that Teacher C may have had some important and alternative insights into the outcomes provided by MeeMo and the barriers and facilitators to implementation. Unfortunately these insights could not be gathered and studied as part of this research. This was mitigated to some extent by Teacher B and C liaising throughout the six week implementation period, discussing their opinions prior to the semi-structured interview and collating a summary of salient points related to MeeMo (Appendix L).

The use of the data gathered through the implementation diaries and observation schedules as secondary to the interviews, focus groups and monitoring provision can be considered a limitation. Though they were useful as
monitoring tools to provide contextual information and triangulate some findings it may be possible to use them in a more structured and rigorous way to provide more primary data for in-depth analysis. An example for future research could be to use systematic observations with sampling to gather more quantitative data on specified behaviours such as engagement (Coolican, 2009).

The small sample size of one Year 5 class per intervention included in the present research could be considered a methodological limitation as it limits the generalisability of the findings, both in terms of outcomes and implementation factors. It is acknowledged that the findings related to each intervention need to be considered within the specific context of the participating school and the characteristics of the teacher and pupil participants. The inclusion of more schools and classes would have allowed the researcher to begin to consider the transferability of outcomes and implementation factors more widely. However, as this research is exploratory in that no other research has explored and compared the whole class implementation of two WM interventions the inclusion of one class per intervention allowed for a more thorough exploration and more in-depth analysis of data. It also enabled the identification of implementation aspects which might inform a larger scale study.

The teachers and pupils were active participants in either delivering or receiving the two interventions. As a result, the use of subjective semi-structured interviews and focus groups may have resulted in post-programme opinions and thoughts which do not reflect actual changes brought about the intervention, but rather expectations that were created by simply being involved in the research and receiving the intervention (Allinder, 1994). Indeed, it was clear that students in both intervention groups were aware of the purpose of the intervention and it may be that they were therefore more perceptive to occasions when they did display good use of working memory or utilising strategies, whereas previously they may have done so without explicitly noticing or discussing it. It is also possible that they may have wanted to please the researcher and therefore responses could be biased.

5.8. Implications of the Present Research

The researcher expected to be able to provide EPs, schools and researchers with a greater understanding of the implementation, practicalities and outcomes related to the use of MeeMo and Memory Booster as whole class interventions to improve WM. The present research has developed further understanding in these areas and has also highlighted implications for programme developers. The implications for professional practice will be considered first, before implications for programme developers and considerations for future research.
5.8.1. Implications for professional practice.

The present research provides further evidence supporting the role of the EP in evaluation research (Frederickson, 2002; Greig, 2001; Marsh, 2011) to encourage the development and use of interventions grounded in research, evidence-informed practice and practice-based evidence (DCSF, 2008). It also highlights the need for EPs to be knowledgeable about implementation factors which may affect interventions and strategies that are recommended by them. The EP potentially possesses knowledge of the environment, context and systems within a school as well as being aware of the key implementation factors of an intervention. In this respect, EPs are ideally placed to support teaching staff in planning and reviewing the implementation to ensure it is successful. The research indicated that teachers were pleased to receive EP support regarding implementation to maximise ease of use and subsequent effectiveness. EPs could also present themselves as technical advisors (Durlak & DuPre, 2008), particularly in relation to the need for problem solving at the local level.

The research has demonstrated that in different contexts, factors such as teacher attributes, student attributes, resources and contextual issues will impact on the fidelity, dosage and level of adaptation. This is likely to lead to different degrees of success and effectiveness. This is a potential area for further research and certainly an area in which EPs can offer support in a practical sense. With the skills and knowledge of research and the ability to monitor impact and effectiveness, EPs are ideally placed to support school staff in monitoring and evaluating the impact of interventions and the implementation of them (Cline, 2012).

It is perhaps assumed that interventions and programmes which are commercially available and which make claims regarding effectiveness have been thoroughly researched and undergone quality assurance and efficacy procedures. Teaching staff did not attempt to monitor progress on the intervention. This may have been related to the lack of appropriate monitoring tools. Although Flay et al. (2005) state that interventions should be supplied with appropriate monitoring or evaluation tools so users can measure impact this is not always the case. An implication for practice is that staff looking to implement interventions should consider how they can measure the impact and evaluate its effectiveness afterwards.

Several implementation factors relevant to Memory Booster and MeeMo are provided in Section 5.4. Practitioners looking to implement either Memory Booster or MeeMo could utilise the framework for effective implementation (Figure 5.1) as a tool to guide delivery. With regard to the MeeMo monitoring booklet, the data highlighted that pupils may need guidance to structure their progression through MeeMo and to gain the most from it not only in terms of progress on the programme but also in terms of their confidence and self-esteem.
5.8.2. Implications for programme developers.

Dusenbury et al. (2003) proposed that greater co-operation is required between programme developers, who should be aware of the critical and non-essential components of an intervention, and teachers, who have a greater knowledge of students, pedagogy and their own contexts, so that prescription and adaptability can be combined for maximum effectiveness. Indeed, participants were forthcoming with recommendations for programme developers. It is hoped that this research will go some way to bridging this gap and sharing the perspectives of the teaching staff and implementation issues with the programme developers to inform any future adaptations.

Some practical recommendations were related to the interventions themselves. It is within the scope of this research to ensure the findings are shared with the developers of each programme when it is complete. The response of the developers and the capacity to act on and incorporate the recommendations made will be interesting to observe, as the two interventions are at very different stages. MeeMo is a new development and its developer is currently in discussions about it being published and made more widely available. It may not be too difficult to make amendments at this stage and in fact, this is likely to increase the usability and marketability of it. Memory Booster on the other hand is more established and is commercially available to a wide customer base. Whilst the findings from this research are useful and could prompt Lucid Research Ltd to review and update the software, whether they are willing or able to amend a decade old programme in light of recommendations made here without evidence of the impact on effectiveness is perhaps questionable. The most relevant recommended adaptations to improve usability and implementation are provided in Table 5.4. For more information refer to Sections 4.2.4.5 and 4.3.4.5.

| Table 5.4 Programme adaptations for Memory Booster and MeeMo developers |
|---|---|
| **Memory Booster** | **MeeMo** |
| • Investigate and resolve technical issues/compatibility issues. | • Amend and rectify printing errors. |
| • Explore possibility of incorporating different visual interfaces at different stages. | • Include monitoring provision for teaching staff (e.g. WM assessment at the start and end). |
| • Revise/clarify pause and save functions. | • Revise pupil monitoring booklet in terms. |
| • Include more bonus content and rewards. | • Make colours more discrete and bold (specifically blue/purple activity colours and yellow/orange difficulty colours). |
| • Review utility of monitoring provision and update if possible. | • Develop an app based on the same concept. |
that still utilises a pairs based approach.

- Ensure enough cards are provided for large classes.

The present research offers information regarding implementation factors and information regarding what works in specific contexts and why. This information could be utilised in the development of future interventions and also by teaching staff when considering the implementation of similar interventions and any potential adaptations.

5.8.3. Considerations for future research.

The present research has clearly indicated the importance of implementation and implementation factors on the delivery of different types of interventions. It is apparent that computer-based and activity-based interventions require different skills and a different focus from those implementing them. Although this research did not focus on effectiveness the researcher could develop a reasonably sound hypothesis that these factors are likely to impact on the overall efficacy of the interventions. An example of this is Teacher A not engaging with the software and not encouraging students to generalise the strategies learnt through the programme. It is plausible that had he done so, the pupils may have felt more confident in using the strategies and be more likely to use them to approach a wider range of problems. Therefore, as recent implementation literature suggests, it is important that researchers who are interested in effectiveness take more of an interest and place more value on the importance of measuring and monitoring implementation (Durlak & DuPre, 1998; Lendrum & Humphrey, 2012). This should be both for programme specific reasons and for developing a wider understanding of the processes of implementation and how they impact on the effectiveness of interventions (Lendrum & Humphrey, 2012).

There are several limitations and difficulties presented to those attempting to monitor and measure implementation. One is that there is not a consistent and agreed framework outlining how each of the different aspects should be measured, particularly for those after fidelity and dosage, which are generally reported using a percentage. Questions raised by the researcher when considering the eight aspects of implementation in relation to Memory Booster and MeeMo included: how should researchers measure and analyse the implementation of an intervention and; what is the most effective and valid way to do so? These questions would benefit from additional research as although Durlak and DuPre (2008) suggest that there are indications that observational data are more likely to be correlated with outcomes than self-report data (e.g. Hansen et al., 1991; Lillehoj et al., 2004; Resnicow et al., 1998), there are few studies directly clarifying these important questions related to implementation.
The time of year in which an intervention is implemented was highlighted by both Teacher A and Teacher B as a barrier to both the implementation and to the ability to notice progress in the CYP. This was not considered in the initial literature review but it is apparent that existing research does not include the impact of the time of delivery as a variable. It would be extremely interesting and potentially of high practical utility to explore the impact of the time of year on the implementation, effectiveness and whether gains made are maintained over the summer holiday into the following academic year. It could be hypothesised that impact may be maximised during the Autumn or Spring term when CYP have settled into class but are not under additional pressure in terms of exams or other extra-curricular commitments. If an intervention is implemented during the Autumn or Spring term, there is the potential for key strategies to be rehearsed at school, helping CYP to retain and utilise them, whereas if it is implemented in the Summer term it is unlikely that CYP will continue to rehearse strategies over the six week break.

Further to the discussion in Section 5.4.3.1, it would be useful to investigate and measure the impact of ‘distributed practice’ on WM interventions. Skelton (2012) was in favour of distributed practice in the development of MeeMo however participants still highlighted the length was too extensive. Further research could investigate whether shorter bursts of the interventions lead to increased motivation, attention, engagement and subsequently greater WM improvements.

A recommendation for future research specific to Memory Booster is to investigate the additional benefits offered through the class teacher or facilitator encouraging CYP to generalise and utilise the learnt memory strategies across the curriculum, rather than leaving students to do so independently. Indeed, in his review of computerised WM programmes, Apter (2012) indicated that it is probable that teaching CYP to use memorisation and recall strategies would economically provide a curricularly valid and useful way of promoting improved learning outcomes. He goes on to suggest that teaching memory skills, rather than training WM, may also impact positively upon the speed, efficiency, accuracy and confidence of using WM functions. A further piece of research could be to incorporate the explicit teaching of memory strategies into MeeMo to investigate the impact it has on top of the delivery of MeeMo without the additional strategies.

A further recommendation for future research is to utilise the framework for effective implementation (Figure 5.1) to investigate the effectiveness of MeeMo and/or Memory Booster using the delivery method highlighted. This will also enable the identification of whether any additional implementation factors arise. This could help to build evidence which could lead to the consolidation of a more generalisable model of effective implementation.
5.9. Conclusion

The present research has contributed to an understanding of the implementation of computerised and practical whole class WM interventions, specifically Memory Booster and MeeMo. The outcomes of both Memory Booster and MeeMo from the perspective of those delivering and engaging in it have been explored. Within the context of this research, it has been demonstrated that MeeMo can be successfully implemented with a whole class and although Memory Booster could not be in this particular context, the potential for doing so has been highlighted. It was evident that MeeMo was specifically designed as a whole class intervention with consideration to the practicalities of the classroom (Skelton, 2012).

Based on the perspectives of those delivering and engaging in the interventions, it is apparent that a positive outcome of Memory Booster is the explicit teaching of memory strategies which may be generalisable. MeeMo appears to provide a more diverse range of benefits, including social and attentional gains.

The research identified facilitators and barriers to the implementation of each intervention, allowing a framework for effective implementation to be developed (Figure 5.1) for Memory Booster and MeeMo. This framework is designed to assist further exploration and investigation into these two WM interventions.

The present research has reinforced the claims made by Lendrum and Humphrey (2012) that information about implementation is not only important for formative reasons such as improving programme design, it is also critical for summative evaluations and could be important when interpreting impact data in rigorous research such as randomised controlled trials and the avoidance of a Type III error (Dobson & Cook, 1980) which may lead to the inaccurate attribution of the cause of results.

It is hoped that the present research will have utility for professionals interested in implementing whole class interventions and provides ecologically valid recommendations that will support successful implementation and sustainability of the interventions, leading to an impact on more CYP receiving the opportunity to engage in programmes which can improve their working memory.
References


Department for Children, Schools and Families (DCSF) (2008). *Targeted Mental Health in Schools Project (TaMHS).* Nottingham: DCSF.


University of Manchester School of Education (2010). *School of Education Ethical Practice Policy and Guidance*. Manchester: University of Manchester.


Appendices
Appendix A – Teacher participant information sheet
Appendix B – Teacher consent form
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Appendix A: Teacher participant information sheet

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

Participant Information Sheet – Teacher – Memory Booster

You are being invited to take part in a research study designed to investigate the effectiveness and usability of whole class working memory training programmes for Primary aged children. The research will evaluate and compare an adaptive computerised programme (Memory Booster) and a practical, paired card-based package (MeeMo) in two year 5 classes in two Primary schools. It will independently evaluate how user-friendly each intervention is, and will also evaluate and then compare the effectiveness of each in terms of improving children’s working memory. The findings will be used to inform a doctoral thesis and will be disseminated to the cluster of local schools involved in the Trainee Educational Psychologists placement and also to the Local Authority to inform the practice of professionals who will or may be interested in whole class working memory training.

Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

Who will conduct the research?

The research will be conducted by Adam Rumble, who is a second year Trainee Educational Psychologist at the University of Manchester. Adam is currently on placement at a cluster of schools in the North West Local Authority and is based at Woodlands High School. During the research, Adam will be supervised by Dr Caroline Bond, Fieldwork Director and lecturer in Educational and Child Psychology at the University of Manchester.

Title of the Research

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

What is the aim of the research?

There are several aims associated with this research. One is to increase the evidence base for working memory interventions, specifically to investigate whether Memory Booster and MeeMo are effective in improving children’s working memory immediately after a six week intervention and also at a follow up approximately two months after the intervention. This will be assessed using the Automated Working Memory Assessment (AWMA). The effectiveness of each intervention will be analysed independently and they will also be compared to one another.

The ease of use, practicality and relevance for use as a whole class intervention will also be explored. A further aim is to investigate whether computerised (Memory Booster) or card-based (MeeMo) interventions are better suited to whole class interventions to improve working memory. The benefits and limitations of both interventions will be explored from the
perspective of those likely to be administering them. The research will aim to provide an objective overview and comparison of the interventions when used with a Year 5 class.

This will inform a doctoral thesis and may be used to inform the thinking of teaching staff, Special Educational Needs Coordinators (SENCo), Educational Psychologists and other professionals when considering interventions to support and increase working memory at a whole class or group level.

**Why have I been chosen?**

The idea for this research project has been discussed at review meetings between the Trainee Educational Psychologist and the cluster of schools. A representative from each school (either Headteacher, Deputy Headteacher or SENCo) was asked to indicate their interest in their school participating in this research and whether they felt able to fully commit to it.

You have been chosen because the representative for your school indicated an interest in participating, and it has been decided that a Year 5 class would be a suitable class for this research to be based on. As the Year 5 teacher, you are ideally placed to implement the intervention, and are thought to have the skills and expertise required to do this.

**What would I be asked to do if I took part?**

There are three main aspects that you would be asked to do if you agreed to take part in this research. They are the implementation of the intervention, the keeping of an implementation diary and participation in an interview with the researcher.

You would be asked to implement Memory Booster with your whole class for approximately 15-20 minutes on a daily basis for six weeks. Memory Booster is computerised, and requires individual computer access for each child. Greater detail about the intervention will be given nearer the time. If you require more information now, please don’t hesitate to contact the researcher on the details at the end of this document.

You will be provided with an implementation diary, which you can use to make notes on your thoughts as you progress through the six week intervention. This can be used flexibly, but may be useful to record your thoughts on the pros and cons of the intervention, any thoughts on the implementation, any observations on the class or individual pupils linked to Memory Booster and any other useful information.

The researcher will observe the intervention on three occasions, once at the start, once approximately three weeks in, and once in the sixth week. This is to observe how the programme is being implemented and to answer any questions you may have about the intervention you are using. You may also contact the researcher during the intervention phase.

After the six-week intervention period, the researcher will conduct an interview which will last between 40 minutes and one hour. You may use the implementation diary to help you to recall thoughts and observations during the interview. The interview is likely to be completed at your school, although arrangements could be made for it to be completed at the University of Manchester or a location convenient to you if necessary.

Some of the children in your class would also need to be allowed to leave the class individually or in pairs for approximately 15 minutes at each assessment point. The whole class will be assessed using the AWMA before the intervention (a baseline, or pre-intervention measure). This will also be used to identify a sample of six children (two with the lowest scores, two in the middle and two with the highest scores). The whole class will receive the intervention but the sample will also be assessed using the AWMA immediately after the six-week intervention (post-intervention measure) and again approximately two months after the intervention has finished (follow-up measure). These assessments are automated and can be done two at a time. The researcher will take responsibility for administering these assessments.
After the intervention has finished, the sample of children will be invited to take part in a focus group where they can share their views about Memory Booster. This will last for approximately 30 minutes. All of the above will be negotiated with yourself in terms of dates and times to ensure it is convenient and to minimise disruption.

**What happens to the data collected?**

Confidentiality and anonymity will be maintained with all data collected.

The data from the pre, post and follow up AWMA assessments will be analysed using descriptive statistics.

The interview will be recorded, fully transcribed and then analysed by the researcher. At the end of the interview, you will be asked whether you would like to access and read the transcript when it has been produced. If yes, the researcher will aim to get a copy to you within two weeks of the interview. If you say no, but later decide that you would like to access the transcript you can contact the researcher on the contact details below to arrange access.

All data, including the assessments and transcriptions will be stored securely on an encrypted memory stick provided by the University of Manchester. Upon completion and submission of the thesis, the memory stick will be handed in to the researchers University tutor, Dr Caroline Bond. In accordance with University policy, it will be stored securely for five years.

**How is confidentiality maintained?**

All assessment data resulting from the AWMA will be anonymised. No individual student will be identifiable. The interview will be audio recorded and fully transcribed by an experienced transcriber. The transcript will be fully anonymised. As soon as the full transcript is available, the audio recording will be permanently erased.

All written information will be fully anonymised. No names of school staff, students, schools, local authorities or any other identifiable information will be used. Where appropriate, pseudonyms may be used to ensure the text flows and makes sense.

**What happens if I do not want to take part or if I change my mind?**

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time without giving a reason and without detriment to yourself.

The researcher is aware that your schools representative indicated your schools willingness to be included in this research, and that you may not have been party to initial discussions. Ultimately, as you will be responsible for the implementation of the intervention and will be expected to keep an implementation diary and participate in an interview, it is your decision whether or not you take part.

**Will I be paid for participating in the research?**

No. You will have the opportunity to gain a better understanding of working memory and a chance to trial an intervention (Memory Booster) that may support children in the classroom.

**What is the duration of the research?**
The data gathering aspect of the research which you will be involved with will last for between three and four months. Of this, the intervention (Memory Booster) will need to be implemented daily for approximately 15 minutes over a six week period.

The interview, conducted after the six week intervention, will last for between 45 minutes and one hour.

**Where will the research be conducted?**

The research will be conducted at two Primary schools in the North West Local Authority, mostly in two Year 5 classes.

The interview will be conducted at a place convenient to the participant. This is likely to be at their school but may be at the University of Manchester or another location. The location will be confirmed between the researcher and participant when informed consent has been given by the participant.

**Will the outcomes of the research be published?**

Findings will be written up into a Doctoral thesis as part of the researchers Doctorate in Child and Educational Psychology. A summary of the findings will also be disseminated to the cluster of local schools involved with the Trainee Educational Psychologists placement and also offered to North West Educational Psychology Service. The findings may later be published in academic books or journals.

**Contact for further information**

Adam Rumble
Tel: 07914842485
School of Education
Email: adam.rumble@postgrad.manchester.ac.uk

Ellen Wilkinson Building
The University of Manchester
Oxford Road
Manchester
M13 9PL

**What if something goes wrong?**

If something goes wrong please contact Adam Rumble on the above contact details

Or

Dr Caroline Bond
Tel: 0161 275 3686
School of Education
Email: caroline.bond@manchester.ac.uk
If there are any issues regarding this research that you would prefer not to discuss with members of the research team, please contact the Research Practice and Governance Co-ordinator by either writing to 'The Research Practice and Governance Co-ordinator, Research Office, Christie Building, The University of Manchester, Oxford Road, Manchester M13 9PL', by emailing: Research-Governance@manchester.ac.uk, or by telephoning 0161 275 7583 or 275 8093.
Appendix B: Teacher consent form

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

CONSENT FORM - Teacher

If you are happy to participate please complete and sign the consent form below and return to Adam Rumble. This can be done by hand or via email at adam.rumble@postgrad.manchester.ac.uk

I confirm that I have read the attached information sheet on the above study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.

1. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason.

2. I understand that I am agreeing to implement a working memory training programme (MeeMo or Memory Booster) on a daily basis for six weeks, and that the researcher will observe this on three occasions throughout these six weeks.

3. I agree to complete an implementation diary which will later be used as a reference during the interview.

4. I understand that the interview will be audio-recorded and agree to the use of anonymous quotes.

5. I agree that anonymous transcription data collected may be shared with the researchers supervisor during the research project.

6. I agree that any data collected may be published in anonymous form in academic books or journals.

I agree to take part in the above project:

Name of participant: ___________________________ Date: ___________________________ Signature: ___________________________

Please initial the boxes below

_________________________
Appendix C: Parent/carer information sheet

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

Participant Information Sheet – Parents / Carers - MeeMo

You are receiving this information sheet as your child’s class has been invited to take part in some research. The research aims to find out whether working memory can be improved using training programmes. It will compare two different training programmes, one which children use on the computer (Memory Booster), and one which is a card game that they play in pairs (MeeMo). Working memory is something that we all use, and it is important as it helps us to hold something in our memory and do something with it, for example mental arithmetic or following instructions.

Before you decide whether to give consent for your child to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask your child’s teacher or contact the researcher if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish your child to take part. A 10 minute briefing will be arranged at your child’s school where you can listen to the researcher and have the opportunity to ask any questions.

Thank you for reading this.

Who will conduct the research?

The research will be conducted by Adam Rumble, who is a second year Trainee Educational Psychologist at the University of Manchester. Adam is currently on placement at a cluster of schools in the North West Local Authority including your child’s school. Adam will be supervised by Dr Caroline Bond, Fieldwork Director and lecturer in Educational and Child Psychology at the University of Manchester.

Title of the Research

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

What is the aim of the research?

- To find out if Memory Booster (computer programme) and MeeMo (card-based game) are effective in improving children’s working memory, and if the improvements made are maintained over time.
- To compare the effectiveness of Memory Booster and MeeMo.
- To find out whether they can be used with whole classes, and what is good and bad about each one.

The research will also be used to write up a thesis, and the findings may be used to help teachers and other professionals make decisions about whether these interventions can be helpful in supporting children in improving their working memory.

Why has my child been chosen?
Your child’s school has expressed an interest in being part of the research, and your child’s teacher has agreed to try Memory booster to help find out whether they improve working memory. Your child is part of the Year 5 class who will be involved in the research.

**What would my child be asked to do if I give consent?**

Your child will be involved in a six week working memory training programme. This will be MeeMo, which is a card game that they play in pairs. These working memory programmes are designed to be fun and child-friendly. The whole class will play the programme for between 15 and 20 minutes per day for 6 weeks. The researcher will observe the teacher and the whole class 3 times over the 6 weeks.

Your child will also be assessed on their working memory. The whole class will be assessed before the start of the training, then the results of this will be used to select a small group of 6 children who represent the class. You will be contacted if your child has been chosen as part of the small group. The entire class will receive MeeMo, and the group of 6 children will be assessed 2 more times to see whether the training has been effective. They will be assessed immediately after the 6 weeks and again 2 months after the training has finished. This will be done using a computerised assessment called the Automated Working memory Assessment, and lasts for up to 15 minutes. If the assessment indicates a significant concern with working memory, then you and the class teacher will be informed. Your child will receive the intervention (MeeMo), which was designed to help improve working memory and after the intervention has finished you and the class teacher will have the chance to discuss any further concerns and strategies with the researcher.

The group of 6 children will also be invited to take part in a focus group where they can give their opinions on MeeMo, whether they liked it or not, whether they thought it was helpful and what could be better about it. This will last for no longer than 30 minutes.

**What happens to the data collected?**

Confidentiality and anonymity will be maintained with all data collected. Your child will not be identifiable in the research. The data collected from the 3 working memory assessments will be analysed by the researcher using computer software called SPSS. This will show whether the training has been effective.

All data will be stored securely on an encrypted memory stick provided by the University of Manchester. When the research and the thesis are finished, the memory stick will be handed in to the researchers University tutor, Dr Caroline Bond. In accordance with University policy, it will be stored securely for five years.

**How is confidentiality maintained?**

All assessment data will be anonymised. No individual child will be identifiable. All written information will be fully anonymised. No names of school staff, students, schools, local authorities or any other identifiable information will be used.

**What happens if I do not want my child to take part or if I change my mind?**

It is up to you to decide whether or not to give consent for your child to take part. If you do decide that you want your child to take part you will be given this information sheet to keep and be asked to sign a consent form. Even if you decide to give consent you are still free to withdraw at any time without giving a reason and without detriment to yourself or your child.

If you do not want your child to take part in the working memory training then alternative provision will be made with your child’s school. If you want your child to take part in the training but not in the assessments that is fine, please indicate this on the consent form.

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Will I or my child be paid for participating in the research?

No. Your child will effectively receive a free 6 week working memory training programme but there will be no payment or other incentive.

What is the duration of the research?

MeeMo will be used for 15 to 20 minutes every day for 6 weeks.

Each working memory assessment will take 15 minutes each. For most of the class this will only be carried out once at the start of the training. For the 6 children in the group, two further assessments will be done at the end of the 6 week training, and again after 2 months.

The 6 children in the group will also be invited to take part in a focus group for up to 30 minutes.

Where will the research be conducted?

The research will be conducted in Year 5 classes at two Primary schools (your child’s school and one other) in the North West Local Authority.

Will the outcomes of the research be published?

Findings will be written up into a Doctoral thesis as part of the researchers Doctorate in Child and Educational Psychology. A summary of the findings will also be given to the cluster of local schools involved with the Trainee Educational Psychologists placement and also offered to North West Educational Psychology Service. The findings may later be published in academic books or journals.

Contact for further information

Adam Rumble
Tel: 07914842485

School of Education
Email: adam.rumble@postgrad.manchester.ac.uk

Ellen Wilkinson Building

The University of Manchester

Oxford Road

Manchester

M13 9PL

What if something goes wrong?

If something goes wrong please contact Adam Rumble on the above contact details, or:
Dr Caroline Bond  
Tel: **0161 275 3686**

School of Education  
Email: caroline.bond@manchester.ac.uk

Ellen Wilkinson Building

The University of Manchester

Oxford Road

Manchester

M13 9PL

If there are any issues regarding this research that you would prefer not to discuss with members of the research team, please contact the Research Practice and Governance Co-ordinator by either writing to 'The Research Practice and Governance Co-ordinator, Research Office, Christie Building, The University of Manchester, Oxford Road, Manchester M13 9PL', by emailing: Research-Governance@manchester.ac.uk, or by telephoning 0161 275 7583 or 275 8093
Appendix D: Parent/carer consent form

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

CONSENT FORM – Parent / Carer

If you are happy for your child to participate please complete and sign the consent form below and return to Adam Rumble. This can be done by hand at your child’s school or via email at adam.rumble@postgrad.manchester.ac.uk.

1. I confirm that I have read the attached information sheet on the above study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.

2. I understand that my child’s participation in the study is voluntary and that they are free to withdraw at any time without giving a reason.

3. I understand that I am agreeing to my child taking part in a working memory training programme (MeeMo or Memory Booster) on a daily basis for six weeks, and that the researcher will observe this on three occasions throughout these six weeks.

4. I agree to my child taking part in at least one, and a maximum of three assessments of his/her working memory. I understand that the first assessment will be done before the training, and the results of this will decide if he/she is part of the group who will be assessed again after the training, and again after two months.

5. I agree that if my child is part of the group identified by the first assessment, then they may participate in the focus group to discuss the programme and whether it has helped them.

6. I agree that anonymous assessment data collected may be shared with the researchers supervisor during the research project.

7. I agree that any data collected may be published in anonymous form in academic books or journals.

I agree and give my consent for my child to take part in the above project:

Name of child: ____________________________ DOB: ____________________________ School: ____________________________

_________________________________________ ________________ ______________________________
Name of parent/carer giving consent: Date: Signature:

Please initial the boxes below
Appendix E: Pupil assent form

Whole class working memory interventions: An evaluation and comparison of computerised training and a practical, class based programme

ASSENT FORM – STUDENT

This is to check that you understand what Adam Rumble is going to be doing in school with your class. Adam is the man who came to talk to you all earlier. He is a Trainee Educational Psychologist who goes into lots of different schools and tries to help different children.

He is doing some research, and wants to find out what can help children get better at remembering things. He needs your help.

- He will ask you and the other boys and girls in your class to spend 15 minutes on a computer programme which will tell him all about your working memory. It is not a test, and you don’t need to worry about it.
- Then, a few weeks later you and the whole class will start using a new game which is designed to help children to get better at remembering things and learn new strategies to help them. This will happen every day at school for 6 weeks.
- After the 6 weeks, you will stop using the new game. You might be asked to use the computer programme again to see what your working memory is like and to see if the game has helped you.
- If you have done this, you might be asked to talk to Adam in a group of 6 children to tell him all about the game, if you liked it or not and if it helped you.
- Adam might come in one last time at the start of year 6 so you can use the computer programme one last time for 15 minutes.

It is really important that you understand what is going to happen. Please ask Adam or your teacher if you are not sure.

If you understand what will happen in the research, and you are happy to take part, please write your name on the line below and draw a circle around the thumbs up. Even if you say yes now, you can stop at any time.

If you don’t want to take part, please draw a circle around the red cross.

Name: ________________________       DOB: ______________       School: ________________________

**I WANT** TO TAKE PART IN THE RESEARCH

**I DON'T WANT** TO TAKE PART IN THE RESEARCH
Appendix F: Observation proforma

Observation proforma

MeeMo / Memory Booster Date of observation: Observation number: 
(delete as applicable)

How is the intervention introduced? Is it scheduled? How do the children respond?

Is the suggested implementation followed? If no, outline any amendments and adjustments made.

Are all children engaged? If no, outline behaviours displayed & teachers response.

Are the children working independently or requiring adult support? If the latter, how are they supported?

Any other observations / comments
Appendix G: Implementation diary

<table>
<thead>
<tr>
<th>Intervention (delete as applicable): MeeMo / Memory Booster</th>
<th>Completed by (initials): __________</th>
<th>Week commencing: __________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you implement the intervention?</td>
<td>Monday</td>
<td>Tuesday</td>
</tr>
<tr>
<td>If yes, for how long? (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If no, why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was it implemented as per the manual? If no, please list any amendments you made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the children need instruction and/or support to get set up?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the whole class able to participate?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the class need support during the intervention? (As: All, M: Most, S: Some, F: Few, N: None)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you notice any positives or facilitators to implementing the intervention?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you notice any negatives or barriers to implementing the intervention?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional comments (may include general understanding of using the intervention, any issues or difficulties, any progress with particular students or the class group):

Please complete and return to A. Rumble. Thank you
Appendix H: Example interview schedule

Semi structured interview schedule

Topics for discussion (Please note – this is not a rigid schedule, and may be altered and reorganised dependant on the participant’s responses and the direction of the interview):

1. What were you expecting before you used MeeMo / Memory Booster?
2. Please can you describe your recent experience(s) of using MeeMo / Memory Booster?
3. Was it overall a positive or negative experience?
4. Were there any significant facilitators which affected the use of MeeMo / Memory Booster?
5. Were there any significant barriers which affected the use of MeeMo / Memory Booster?
6. What was the level of support/input required for MeeMo / Memory Booster?
7. Did you need to adapt the implementation of MeeMo / Memory Booster?
8. In your opinion, what were the benefits of MeeMo / Memory Booster?
   o Specifically
   o Whole class
9. In your opinion, what were the drawbacks/disadvantages of MeeMo / Memory Booster?
   o Specifically
   o Whole class
10. Have you noticed any significant impact on your class or specific children as a result of MeeMo / Memory Booster)?
11. Has there been any changes in your practice as a result of you using MeeMo / Memory Booster?
12. Did MeeMo / Memory Booster meet your expectations? Did it achieve what you expected it to?
13. Were there any unexpected outcomes of using MeeMo / Memory Booster?
14. What are your perceptions on the design of MeeMo / Memory Booster for use as a whole class intervention?
15. What are your perceptions on the effectiveness of MeeMo / Memory Booster for use as a whole class intervention?
16. Would you consider using MeeMo / Memory Booster in the future?
17. Would you recommend MeeMo / Memory Booster to colleagues?
Appendix I: Focus group schedule

Semi structured schedule for focus group

Topics for discussion (Please note – this is not a rigid schedule, and may be altered and reorganised dependant on the focus groups responses and the direction of the discussion):

1. Please can you describe your experience of using MeeMo / Memory Booster
2. Did you know what it was for? What were you expecting before you used MeeMo / Memory Booster?
3. Was it overall a positive or negative experience?
4. Which part did you most like?
5. Which part did you dislike?
6. Was the computer programme / cards helpful or unhelpful?
7. Did you find it easy or difficult to use?
8. Did you enjoy it or not?
9. Do you think it has helped you in any way? How? If not, why not?
10. Has it helped other people in your class or not?
11. Has it changed the way you do things in other lessons?
12. Would you like to use MeeMo / Memory Booster in the future?
13. Would you recommend MeeMo / Memory Booster to your friends in different classes and schools?
Appendix J: Ethical approval application confirmation

Dear Adam

Ref: 8193726

I am pleased to confirm that your ethics application has now been approved by the School Research Integrity Committee (RIC) against a pre-approved UREC template.

If anything untoward happens during your research then please ensure you make your supervisor aware who can then raise it with the RIC on your behalf.

This approval is only for the Ethical Approval Application, you are still required to have received approval from your Panel before carrying out any research.
Appendix K: Thematic network for Memory Booster Global Theme 5: Recommendations

- Pupil aspects
  - Use with SEN
  - Key Stage 1
    - Need for a 'plan b'
- Teacher/deliverer
  - Does not necessarily need to be a teacher
- Implementation
  - Preparation
    - Protected time and countdown timer
  - Timing
- Programme adaptations
  - Fix technical issues
    - Technical/Visual content
    - Motivational/individual adaptation
    - Different terms
- Further research
  - Effectiveness
    - Trial in other contexts/whole class implementation
- Autumn or Spring term
Appendix L: MeeMo summary provided by Teacher B and Teacher C

MeeMo summary

The following comments were made by the children when they were asked to sum up their experience of MeeMo:

- The children found that they preferred the 'Mix Up' day on Friday, followed by 'Spot the Difference' and 'Order, Order'.
- Many of the children found the session too noisy. Attempts to lower the noise levels in the class fairly unsuccessful due to class size.
- Some of the children were enthusiastic at the start, but have now become jaded by the repetitive nature of the sessions.
- Most of the children think that 6 mins is too long, they have suggested that the time be reduce to 4 mins.
- The children find it difficult to keep the right amount of cards in the packs, we often end up with too many or too little cards I each pack.
- There are a few cards with typing errors.
- There are not enough packs to go round - the children go through 2/3 packs in a 6min session.
- The scoring ladder needs to have a higher end score - children are still gaining high scores.
- A small number of children have said that the sessions have had a positive impact on their mental maths.
- 1 child said that she felt it did not improve long-term memory because you only have to remember things for a very short period of time.
Appendix M: Completed observation schedule (MeeMo observation two)

Appendix 4

Observation proforma

MeeMo / Memory Booster
(delete as applicable)

Date of observation: 24/06/13  Observation number: 2

How is the intervention introduced? Is it scheduled? How do the children respond?

- Specified rules & importance for questions to monitor progress
  appropriately.
- Children encouraged to choose own difficulty.

Is the suggested implementation followed? If no, outline any amendments and adjustments made.

Yes - 6 misc. 2 child independent implementation. Can teacher adapt planning to context.

Are all children engaged? If no, outline behaviours displayed & teachers response.

All engaged v. well
- Body language, eye contact, good
  - Manage to ignore external noise
  - Different as asking in different voice

Are the children working independently or requiring adult support? If the latter, how are they supported?

All independent. One needed help with answer
- Students fetched extra papers independently

Any other observations / comments (PTO)

Some students (question) asking.
Appendix N: Completed anonymised MeeMo monitoring booklet
Appendix O: MeeMo quantitative data: Tables and graphs (Pupil B4, B5 and B6)

**Pupil B4**

Pupil B4 accessed 21 sessions.

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<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
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**Pupil B5**

Pupil B5 accessed 17 sessions.
Pupil B6 accessed 18 sessions.
Appendix P: Misprinted MeeMo cards
Instructions
- First say the numbers in order,
  Then say the letters in order...

4  M
2  8
C

Answer ✓
- Say the numbers in order.
- Say the letters in order.

Numbers  Letters
2  C
5  M
8
Appendix Q: Thematic network for MeeMo Global Theme 5: Recommendations