A Case Study On The Implementation Of A Working Memory Programme In A Primary School

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Table of Amendments.

Amendment	Page number where the amendment has been addressed in the thesis
1. Present the research as a mainly qualitative and interpretivist study, rather than as a mixed methods study written from the position of critical realism. This would involve rewording the Abstract (p13) and throughout the thesis (e.g the presentation of the thesis in terms of it being a parallel mixed methods design p45). (If the researcher feels strongly that the original position of critical realism is to remain, this will need to be more clearly argued throughout the whole of the thesis. I think we should just say of this philosophical position because I think on reflection is critical theory which is more about power not critical realism.	Changes from mixed methods to qualitative: P13, P43, P46, P47, P48, P49, P59 (quantitative deleted) P71, (quantitative deleted) P124 - 125(quantitative deleted) P154 (quantitative deleted) Data was collected as part of mixed methods design. This was changed to reflect contextual data P48,P49, P52-55 Use of Critical Realism P44, P45. P46,P47 P67, P68, P143, P144, P152.
2. Remove details of the failed first project from the beginning of the study and instead discuss this in a section on researcher reflexivity/ researcher journey in the Conclusion section. This will enable you to focus wholly on the current study from the beginning.	Deleted from beginning of study. Added to P152-153
3. Focus the Introduction more closely on the topic making clear the link between WM and children on the SEN register. Include a description of your interest in the topic and how the project came about.	P15, P16
4. Provide details of the literature search, p 17, detailing the outcomes in terms of judgements about the quality of the literature and research that was consulted. If helpful, present some of this in the form of a Table in the Appendix.	I have added more detail on the methodology used in research studies eg sample sizes, control groups etc, This is in a narrative format in the literature review as advised by VL. P17, P29 P30, P31, P32, P34 ,P35, P39, P40,
5. Remove the wording outcomes from the primary research question and remove the third sub question altogether (p42 and elsewhere).	P43 - P44 the 3rd sub research question has been deleted. Also the word 'outcomes' and 3rd research question has been deleted from other sections i.e abstract, methodology, findings and discussion chapter.

6. Include a clear description of the COGMED programme (p46) including where, when and by whom it was developed. Some details of COGMED being used in UK schools would provide the reader with contextual detail. The word 'dosage' is currently used – how relevant is this as a word for a school based programme? You could take a critical stance towards the medicalisation of WM problems which	P50, P51. VL suggested that I explain that the use of dosage. Implementation science – Dosage this is a term used in implementation science see P53, P146 P146 medicalisation of WM problems.
7. Alter the table on p48 to reflect the heavier focus on qualitative data (within the left hand column omit the first box and alter the second to reflect 'contextual descriptive statistics of COGMED', with an interlinking arrow connected to the right hand side box Qual data analysis; thematic analysis. Omit the box at the bottom of the diagram).	P49
8. Move the quantitative data resulting from the Y5 pupils completing tests of MALS and WM into the Appendix to provide details of contextual background.	Moved to Appendices xxi, xxii, xxiii, xxiv
9. Provide a section discussing the link between working memory and MALS and Metamemory or write a section justifying your use of these assessments as contextual data. Remove references to age dependent development of metacognition or provide evidence to justify your point.	I have explained these assessments provide contextual data: P48, P52, P53, P54,P55, P56 P55- I have deleted reference to this in section 3.8.3 pupils. .
10. Present clearer details on the school as a case study, including levels of SEN/ free school meals etc (see p 49). Include details of pupil language skill if available	P52, P56-57
11. Provide more specific contextual details on the pupils such as any SEN or language difficulties and reflect on how these might have affected the qualitative data collection	P56-57 and P147
12. Separate the table on p50 into year five and year six data - displaying the additional information gathered for the year five pupils.	P55, P56

13. Provide detailed tables showing the process of data analysis from quotations (giving interview and line number) to code, show how codes have been clustered into categories and how these became themes (or sub themes and themes). You may need to review your current data analysis.	Appendix xxv, xxvi, xxvii, xxviii VL suggested to select one overarching theme and use it as an example to illustrate how the data analysis was conducted. I have used the overarching theme "Recommendations". I have included a table and a diagram to illustrate quotes - codes – categories – subthemes – theme. P65,P86
14. Provide details of the debriefing process referred to on page 67	P70.
15. Rename the sub theme pupil characteristics (p69) in order to reflect more that this was about comments about the programme rather than any 'within child characteristic'.	P72, P76 changed to pupil perceptions
16. Re-structure the Findings chapter to focus on themes rather than RQs thus making a link between this chapter and the data analysis table. Avoid quantifying the qualitative data, so removing words such as 'many' or 'the majority' and instead focus on the themes providing illustrative quotes from the data where necessary.	P71, 72 , P86 P73,P74, P75,P77, P79, I have removed words such as many. I have deleted the research questions in Chapter 4 as suggested by VL.
The Discussion section needs to be more in depth in terms of interpreting the findings and linking these to the literature. 17. Include a more in depth critical Discussion chapter, linking the findings to the existing literature and removing any quotations from the data . Currently section 3 is very descriptive and requires a more critical approach to the literature. This section is problematic because you are drawing conclusions and making recommendations based on a very small number of pupils eg. the link between MALS and progress on COGMED cannot be made with this sample size; similarly the link with metacognition is not robust because this is not part of COGMED training.	P125, P126, P127, P128, P129, P130, P131, P132, P133,P134,P135,P136,P137,P138 ,P139, P140, P141,P142. I have included more literature. I have also included more detail on Durlak and Dupre's (2008) framework for effective implementation and how it can be related to my research. The quotations have been removed from Chapter 5.
18. Describe the process of inter-rater reliability	P65-66 ,P143-144

checks (p62) and comment further on this in the discussion section (p61)	
19. Include a fuller section in chapter 5, of the limitations of the research, including detail on ethics, judgements around rigour, implications for EPs, as well as learning points/ reflexivity.	P68, P70,P143, P144,P145,P146, P147,P148,P149, P150,P151,P152, P153, P154, P155

(The changes in thesis have been highlighted in blue)

- P58 WRMS is appendix 2;***Done – now on P54***
- P85 Characteristics : ***Done – now on P88***
- P116 Positive. ***Done – now P118***
- pg 122 “indication” ***Done now on P214***
- P143 Should this read ‘ children with processing difficulties’?***I have changed it to "children who do not have processing difficulties" p138.***
- pg 154 use of word “inclusively”) ***Deleted the word inclusively, P150***
- p194 Letter to pupils should have suggested the type of researcher (TEP etc) ***Added – now P193***
- P191, 198, 199 Remove telephone number ***Deleted: 190, 191, 192,***
- Data is a plural word and should be used so throughout ***Done : P13, P53, P65, P70, P218***
- Appendices: It is not necessary or desirable to include a full interview transcript, however it would be useful to have more detail about how data were coded. ***Transcript has been reduced and example of how data was coded has been placed in Appendices xxv, xxvi***
- Appendix 4 provides a framework for interventions which looks very useful, a short explanation of how this was used in the study would be helpful: ***This has been added in Chapter 5, P125, P140- 142. Appendix iv : P176. Also P40 provides a description of the framework.***
- There are some issues with titles of some tables which are overly descriptive and not always consistent with the titles given in the Contents page. ***These have been checked***
- Tighten the academic tone of the writing especially in the Introduction section removing direct questions to the reader and colloquialisms. **Questions have been removed.**
- Check the in text citation/reference to Baddeley – WM theory is much older than 2010 ***– Changed on P18, P19***

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List of abbreviations

2sd	2 standard deviations
ADHD	Attention Deficit Hyperactivity Disorder
BPS	British Psychological Society
EP	Educational Psychologist.
EHCP	Education and Health Care Plan
ICT	Information Communication Technology
ID	Identifiers
IEP	Individual Educational Plan
IQ	Intelligence Quotient
LN	Line Number
RCT	Random Control Test
RQ	Research Question
SEN	Special Educational Needs
SENCO	Special Educational Needs Co-ordinator
TA	Teaching Assistant
TEP	Trainee Educational Psychologist
WM	Working Memory
Yr6	Year 6
Yr5	Year 5

Abstract

Background: Working memory refers to a system that temporarily holds and manipulates information (Alloway et al 2016). There is substantial literature on the descriptions of memory but a lack of research on the practical application of memory interventions in schools. COGMED is marketed to schools as an evidence-based intervention which could help individuals who have memory deficits. There have been a number of research studies on COGMED, however there is a lack of research on the implementation of COGMED in schools and also a lack of qualitative research on COGMED. The current research study focused on the 'real life' use and implementation of COGMED in a school from the perspectives of teachers, management and pupils. This research set out to find out about the barriers and facilitators which affect the implementation of COGMED in a primary school.

Participants: Five Year 5 pupils and Five Year 6 pupils from one primary school undertook a Working Memory intervention, COGMED, which was implemented by the teachers. Seven of the pupils and five members of staff participated in semi- structured interviews.

Methods: Ten pupils received COGMED which was implemented by the teachers in their school. The Year 5 pupils received the intervention in the Summer Term 2015 and the Year 6 pupils in the Spring Term 2015. Qualitative data were collected through semi–structured interviews with teachers and pupils.

Analysis/Results: Semi-structured interviews were transcribed and analysed using thematic analysis. The results were presented as thematic maps which included the facilitators and barriers of implementing COGMED.

Conclusion/Implications: This study identified a number of facilitators and barriers in relation to the use and implementation of COGMED in a primary school. The findings suggest learning opportunities for the school and support agencies and also implications for future implementation and research.

Chapter 1: Introduction

"The bridge between a promising idea and its impact on students is implementation, but innovations are seldom implemented as planned"
(Berman and McLaughlin 1976, p349).

Working as a Trainee Educational Psychologist I have experienced a number of schools in search of and under increasing pressure to find a solution to develop children's working memory. The current government's educational agenda focuses on increasing pupils' attainment in schools. Pupils' memory skills can be suggested as a crucial component for a child's ability to learn and achieve in school. Working memory is linked to a child's capability in academic skills including reading (Alloway, 2007), acquisition of language and vocabulary (Morra and Camba, 2009), mathematics, (Alloway, 2007), spelling (Service and Turpeinen, 2001) and behavioural inhibition (Mcauley and White, 2011). Children who are placed on a school's Special Educational Needs' Register may have a developmental disorder which can be associated with working memory difficulties; e.g. ADHD, Down syndrome, reading and mathematical difficulties and specific language impairment (Holmes, Gathercole and Dunning, 2010). Jarvis and Gathercole, (2003) found that pupils with low scores on working memory assessments performed poorly on national curriculum assessments. It is estimated that approximately 10-15% of pupils experience some form of working memory difficulty (Holmes, Gathercole and Dunning 2009). Ultimately if working memory training was successful in schools this could lead to a major advance in the education of children. However there is substantial literature on descriptions of working memory but a lack of research on the practical application of working memory interventions in schools. In a previous post I worked as an Assistant Educational Psychologist, where I became aware that some Educational Psychologists in the service

were recommending, in their reports, that schools implement COGMED working memory intervention with pupils who had been identified as having working memory difficulties. When I became a Trainee Educational Psychologist I was on placement in a different local authority and the Principal Educational Psychologist, who was also training to be a Neuropsychologist, discussed that she had previously facilitated the use of COGMED with a group of pupils. This led me to explore the use of COGMED in schools in further detail and identify the gaps in the literature. This thesis has been written as part of the qualification for the Doctorate in Child and Educational Psychology and the research explores the implementation of a working memory intervention in a school. In this thesis I utilize a case study design and the literature on effective frameworks for implementation (Durklak and DuPre, 2008).

The school who participated in the research had been advised by their Educational Psychologist to implement a working memory intervention; however after initially piloting the intervention with their Year 6 pupils they were concerned that the intervention had not made an impact on all of the pupils. There has been limited exploration of the implementation of computerised programmes, such as COGMED, in classrooms and the aims of this research were developed to explore the implementation of COGMED in a school in order to reveal the facilitators and barriers of using the programme in a primary school. This thesis is divided into four chapters; Literature Review Chapter, Methodology Chapter, Results Chapter and Discussion Chapter.

Chapter 2: Literature Review

2.0: Chapter Overview

This chapter provides a review of the literature and research on working memory, its place in classroom learning and the interventions to improve working memory. It will discuss the current gaps in the research and literature to identify a number of relevant research questions. A search for the most current research was undertaken and a critical stance on the research literature was adopted.

2.1: Literature Review Search Strategy

A number of methods were utilized to access the literature, these included a search of electronic databases including Scopus, Web of Science, PubMed, ProQuest Education Journals, ERIC, Taylor and Francis Online, Wiley Online, Elisevier, National Library of Sweden, Informa, Springer Link Open Access and Sage Full Text Collection. The British Library Electronic Theses Online Service (EThOS), the COGMED website, Google and Google Scholar were also used. The following search terms were used in a number of different combinations; “COGMED”, “teachers”, “school”, “pupils”, “children”, “intervention”, “views”, “implementation”, “strategies” and “working memory”. Literature was also identified from journal articles which had cited and referenced other sources and journal articles.

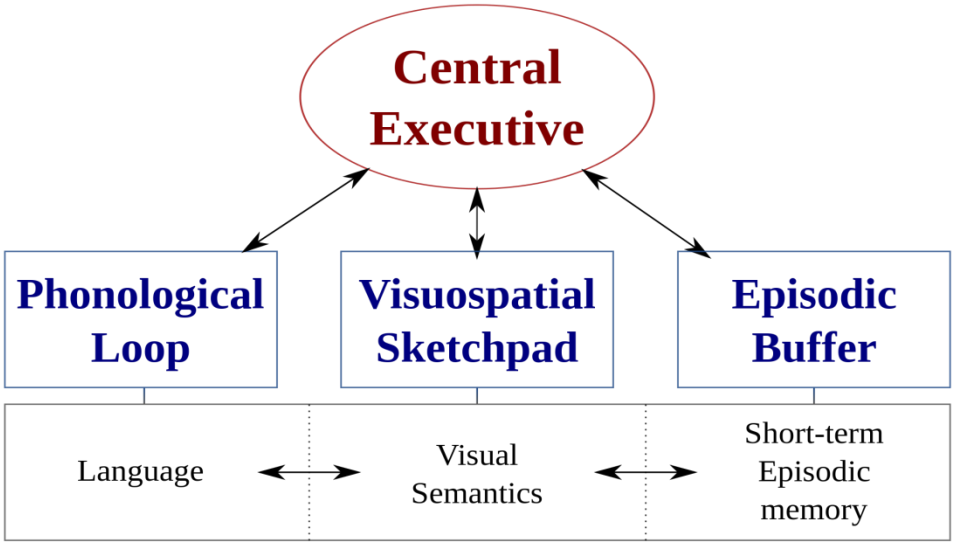
2.2: Working Memory

There are a number of theoretical models of Working Memory and they have different conceptualisations of the structure, and function of the Working Memory system, but essentially agree that there is a temporary storage only function in Short Term Memory and the manipulation of information in Working Memory (Baddeley, 2010; Barrett, Tugade,

and Engle, 2004; Cowan, 2005, 2008; Ericsson and Kintsch, 1995). Verbal and visuo–spatial “short term memory components form part but not the whole of the larger working memory system” (Gathercole and Alloway, 2008, p12). For example short term memory stores information for a few seconds without mentally manipulating the information. Gathercole and Alloway (2008) utilize a memory game (‘kim’s game’) to explore children’s visuo-spatial short- term memory. This game involves a child viewing a set of objects for a minute and then attempting to recall the objects when they have been concealed.

According to Gathercole and Alloway (2004, p2) working memory “refers to the ability to hold and manipulate information in the mind for a short period of time”. Awh and Jonides (2001) argue that attention is required for maintaining and manipulating information in working memory and argue that it is not possible to separate working memory and attention control. It is important to be clear that the structure and function of working memory within the literature continues to be deliberated and debated. Nevertheless the multi-component model of working memory (Baddeley, 2000) presented below is considered the most influential model. It proposes that there are four components of working memory which are; the episodic buffer, the visuo-spatial scratchpad, a central executive and a phonological loop. Figure A below illustrates the multi component model of working memory.

Figure A shows the multi component model of working memory (Baddeley, 2000).



The table below, Table 2.1 illustrates in more detail the proposed functions of each component according to the multi- component model of working memory (Baddeley, 2000).

Table 2.1: The proposed functions of each component according to the multi- component model of working memory (Baddeley, 2000).

Component	Role / Features
Central executive	• This has overall attention control of the working memory system. It is employed when a person needs to process and simultaneously store information. • The central executive has five main roles in distributing attention within the working memory system: selective attention and inhibition, switching attention, divided attention, updating, and manipulating and storing information to and from long term memory (Baddeley, 1999). It can be

	simulated to a management system that controls attention, selects strategies and amalgamates information from the different sources.
Visuospatial sketchpad.	• This does not have the ability to control decision making or attention (Henry, 2011). It functions by remembering spatial information and visual features.
Phonological loop	• This is proposed to be a system for storing auditory information. The phonological loop interacts with the phonological short term store and a sub vocal rehearsal process (Baddeley, 1986). It is suggested that approximately a couple of seconds' worth of auditory material can be held in this component. The rehearsal process which is the reciting of information, i.e. verbal rehearsal in the phonological store, increases the time information can be held. However in children under the age of seven years spontaneous rehearsal does not reliably occur and therefore in the phonological loop only the phonological store exists (Gathercole and Hitch, 1993).
Episodic buffer	• The episodic buffer integrates information from the other components and long-term memory

2.3: Assessment of Working Memory

The measurement of working memory is an ongoing debate. Oberauer (2005) questions what is a valid and reliable indicator of the construct and what defines a working memory task. It is discussed that complex span tasks (Daneman and Carpenter, 1980) and simple

span tasks are a measure of working memory. "Complex span tasks, like simple span tasks require participants to recall a set of items in their correct serial order. However, complex span tasks differ from simple span tasks in that some form of processing activity is interleaved between the to be remembered items" (Unsworth and Engle, 2006, p69). Baddeley and Logie (1999) state there are demands on both the phonological loop and the central executive during complex span tasks.

> "An example of a complex span task is listening recall. In this task the child has to listen to a series of sentences to decide whether each sentence is true or false (e.g., rabbits have ears – "true", bananas can fly – "false"), and then at the end of the block of sentences to recall the last word of each sentence in the correct sequence ("ears, fly"")" (Gathercole and Alloway, 2004, p3).

According to Unsworth and Engle (2006, p69) complex span tasks emerged to subsequently assess *"*a more dynamic memory system based on the Baddeley and Hitch (1974) model".

Other complex span tasks include backwards digit recall tests (see, e.g., Morra, 1994) and counting recall tests (see e.g. Case et al., 1982). Gathercole, Pickering, Ambridge and Wearing (2004) also refer to Digit Recall, Word Recall, and Nonword Recall as measures of the phonological loop and Block Recall, Mazes and Visual Patterns Test as measures of the visuo-spatial sketch pad (see Appendix i for a description of these tests). It is suggested that there is enough research literature to indicate that all of these tests mentioned above provide a valid test of one particular component of either verbal or visuo-spatial working memory (see Appendix i) (Gathercole and Pickering, 2000). Additionally Dehn (2008 p145) notes "contemporary measures of working memory capacity do reliably predict real-world performance in academic learning and daily functioning".

The critical point is when researchers, often due to time constraints, only use a single task to measure working memory function and from which they then draw conclusions. Furthermore one criticism of the use of a single task, e.g. a complex span task is that it may also measure other abilities such as reading ability (Loehlin, 2004; Wittman, 1988) in addition to working memory. Hence one single task cannot be given a monopoly as a measurement of working memory (Foster and Shipstead and Harrison, Hicks, Redick and Engle, 2014) and therefore the use of triangulation with alternative assessments is preferential. Dehn (2008, p145) suggests that "generally, the validity of assessment results improves as the number of data-collection methods increases".

Formal methods as discussed above and also informal assessment methods such as observations, rating scales and interviews can be used to collect information on working memory. A relatively recent development in assessing working memory deficits is a teacher behavioural rating scale. For example the Working Memory Rating Scale (Alloway, Gathercole, Kirkwood and Elliott, 2008) consists of twenty descriptions that could be observed in children with low working memory abilities e.g. does not follow classroom instructions accurately. Teachers complete the scale by rating the child's behaviour on a scale of 0 (not typical at all) to 3 (very typical) (See appendix ii). The scores from each scale are totalled and the total score gives an indication of how likely the pupil may have a working memory impairment. Alloway et al (2008) found that the Working Memory Rating Scale is negatively correlated with the scores in the Automated Working Memory Assessment (AWMA) (see Alloway et al., 2008) i.e. high teacher ratings on the Working Memory Scale (higher scores equal more problematic behaviour) correlated with low scores on the AWMA indicating that the WMRS and the AWMA support one another.

2.4: Working memory in the Classroom

Working memory is suggested to be an important part of children's learning and is required for many aspects of learning (Gathercole, Lamont and Alloway, 2006). However there have been few research studies that investigate pupils' poor working memory function in the classroom and the difficulties that they experience. Gathercole, Lamont and Alloway (2006 p222) assert that this lack of research "limits the practical applications of the substantial evidence that working memory plays a crucial role in supporting the acquisition of knowledge and complex skills during the school years". Gathercole, Lamont and Alloway (2006) endeavoured to observe and analyse the working memory constraints of routine classroom activities. They aimed to identify situations where working memory demands have a consequence on a pupil's ability to undertake a task. Gathercole, Lamont and Alloway (2006) observed memory failure in pupils when they struggled to engage in a challenging processing activity, whilst simultaneously storing information e.g. counting. It was reported that "the most commonly observed memory-related failure was an inability to follow instructions from the teacher" (Gathercole, Lamont and Alloway 2006 p226). They suggested that writing sentences from memory which have been generated by the teacher also places a demand on working memory. Additionally to identify how working memory difficulties impact on classroom performance Alloway, Gathercole and Kirkwood (2008) observed pupils with IQ scores in the average range but low working memory skills within numeracy and literacy lessons. They suggested that the following may be characteristics of children with poor working memory:

- they rarely volunteer answers during group discussions
- forget instructions or messages
- have high levels of distractibility
- show poor academic progress
- often lose their place in complex tasks.

It can be suggested that many classroom tasks involve a range of skills, for example a processing ability or the ability to spell a word and that failure on some tasks may not just be a reflection of the pupil's working memory skills. Hence determining working memory function is complex. Dehn (2008) offers a comprehensive list of suggested items for classroom observations of Working Memory (see appendix iii).

2.5: Interventions and approaches to promoting working memory.

This next section focuses on the approaches and interventions that aim to promote working memory. There is a requirement for more research on the practical application of memory interventions in the classroom. Currently there are a number of distinct approaches which can attempt to help children who have difficulties with attention and working memory skills.

2.5.1: Modifying the environment

The first approach is modifying the environment; teachers can "scaffold" and support children with poor working memory; for example breaking big tasks into smaller chunks, providing cues, visual aids and establishing routines.

2.5.2: Strategy use

The second approach is for teachers to explicitly teach children strategies**.** As an example strategies support working memory by helping an individual hold information for longer in short term memory so that they can manipulate it in their working memory. These strategies include using mnemonic and memorization strategies such as rehearsing and repeating information. Melterz, Pollica and Barziilai (2007) state that strategy instruction is one of the most effective ways of addressing working memory difficulties. On the basis of Baddeley and Hitch's (1974) model, rote rehearsal and elaborative rehearsal are two types

of strategies proposed to improve memory performance. Elaborative rehearsal involves connecting the information to something meaningful which is already in the individual's long term memory. Rote rehearsal involves repeating the information verbally to aid retaining the information (Gardiner, Gawlick, and Richardson-Klavehn, 1994; Broadley, MacDonald and Buckley, 1994; Baddeley, 1999; Turley-Ames and Whitfield, 2003). Other strategies identified in the literature are:

- Chunking which involves sub-segmentation of individual memory items into fewer groups (Miller, 1956; Carr and Schneider, 1991; Bor, Cumming, Scott, Owen, 2004),
- Visual/imagery based strategies (Atkinson, 1975; De La Iglesia, Buceta, and Campos, 2005);
- Strategies that propose categorising information and developing schemas (Brewer and Treyens, 1981; Shelble, Therriault and Miller, 2012);
- Mnemonics, which is using semantics such as creating meaningful links between items (Turley–Ames and Whitfield 2003) and visualization strategies (De La Iglesia, Buceta and Campos, 2005; Baleghizadeh and Ashoori, 2010; Levin, Levin, Glasman and Nordwall, 1992).

Several researchers argue that individuals who use strategies have higher memory spans than individuals who do not use strategies (Turley-Ames and Whitfield, 2003; Dunlosky and Kane, 2007; Engle Cantor and Carullo, 1992). Both Bjorklans and Douglas (1997) and Gathercole (1998) report that children only appear to use these strategies unprompted from seven years old and onwards. Additionally it is suggested that some children under the age of ten are unlikely to be able to select a suitable strategy to undertake a task and are only able to utilize simple strategies such as chunking and rehearsal. A study by Mata, Von Helverson and Rieskamp (2011) supports these assertions as they found that

children, particularly those under ten years of age, struggled to identify when a strategy would be useful and which strategy to utilize. However Wellman, Ritter and Flavell's (1979) research found that three year old children could spontaneously use a range of strategies to help them remember which cup a toy was placed under. The children placed their hand on the cup or moved the cups around to help them remember and think about where the toy was placed. Bjorklund, Miller, Coyle, and Slawinski (1997) proposed that young children and children who have cognitive difficulties may not be able to apply the strategy in an appropriate situation. Dehn (2008, p259) argues "students with learning disabilities are less adept at generating and utilizing effective memory strategies". Flavell (1979) emphasises that it is important for an individual to know how to use strategies and to know that they can use strategies to accomplish a task. Flavell (1979) distinguished procedural knowledge as knowing about a strategy and routine and dynamic knowledge, knowing when and how to use that strategy.

Knowing about strategies and when to use them in a particular situation draws on meta cognition skills which are important for optimising working memory. In simplistic terms according to Livingston (1997) meta cognition is "thinking about one's own thinking". Piaget's (1976) research with nine to eleven-year old children demonstrated that children were able to articulate the processes they had utilised in accomplishing an activity and the ways in which they were aware of their thinking. Piaget labelled this as "consciousness of cognizance," which is similar to the term meta cognition. Pupils with working memory difficulties are often aware that they cannot remember information. For example children with poor working memory have reported "I forget everything, me!", or "The teacher told me a lot and I forgot" (Gathercole et al, 2006, p234). Similarly meta memory can be seen as a type of meta cognition, which is both the introspective knowledge of processes involved in memory self monitoring and the strategies that can aid memory (Pannu and

Kaszniak, 2005). To learn about a child's meta memory, O' Sullivan (1996, p8) asked, "What did you do to try to remember the words?" and "What helped you most to remember, something you did, something about the words or something else?"

2.5.3: Computerised programmes

The third proposed approach to improving working memory is through computerised working memory training programmes which have gained momentum and use in a number of schools in the UK. There are various computerised programmes available to schools such as COGMED, Lumosity and Jungle Memory and the literature indicates that COGMED has received the most research interest and is also the most utilized commercial working memory training programme and for the purpose of this research I am going to focus on COGMED**.** Shipstead et al (2012) notes that a lot of research studies involving COGMED have been undertaken by researchers who appear to have no links to the intervention and therefore do not appear to have an incentive to arrive at a particular conclusion. COGMED argue that professionals should be aware that they do not claim that training results in improved school achievement, improved long term memory, or work successfully for all users. Accordingly they suggest that approximately twenty percent of users will not experience any improvement as a result of the training (COGMED, 2013).

The COGMED Memory Training can be used by children, adolescents and adults and "is marketed as a computer-based solution for attention problems caused by poor memory that combines cognitive neuroscience with innovative computer game design and close professional support to deliver substantial and lasting benefits" (Roche and Johnson, 2014, p379). COGMED is based upon the multi-compartmental theory of memory (Baddeley and Hitch, 1974). Roche and Johnson (2014 p383) state that "while it is unclear if the program facilitates actual changes in neural pathways that can then promote

generalization of gains, or if it trains specific memory and attention focusing strategies that are much narrower in their application, it appears to be one of the better WM training programs currently available".

2.5.3.1: COGMED monitoring provision

The programme offers the COGMED Progress Indicator (CPI) report which is detailed as an index of improvement in non–trained tasks. The programme has a monitoring system that schools can access via a computer to track pupil engagement and progress.

2.5.3.2: COGMED Coaches

In the COGMED manual there is reference that COGMED coaches are also incorporated in the programme's implementation Following the teachers receiving initial training on COGMED they would receive regular contact with the COGMED coaches to support the implementation and offer feedback.

2.5.3.3: Types of programme

There are three types of COGMED training: JM for preschool children, RM for school aged children and QM for adults. The standard administration protocol is for twenty–five, thirty-five or fifty minute sessions a day, 5 days a week, for 5 weeks. The tasks on COGMED target short term memory and working memory. The computerised tasks are inherently visual in nature and the programme aims to develop an individual's working memory. The fundamental basis of COGMED is that it adapts to a user's performance. If the individual is able to complete the task, one item will be added to the to-be-remembered list. If the individual is unable to complete the task, one item will be removed from the to-be-remembered list. This method means that the individual is having to perform at the limit of their abilities. The programme manual indicates that COGMED is not suitable for users

with severe anxiety, severe conduct disorder or severe depression. It is unclear of the appropriateness of COGMED with individuals with an IQ score below 70 as the research evidence is still pending (Soderqvist, Nutley, Otterson, Grill, and Klingberg, 2012).

Interestingly I have noted that several Educational Psychologists from different Educational Psychology Services have made reference to COGMED in the recommendations on children's reports. COGMED thus provides a relevant and interesting case study for exploring the use of marketable working memory training in schools. The next section will therefore explore the research literature available on COGMED.

2.6: The outcomes and research on COGMED

In recent years there has been an ongoing debate on the outcomes of COGMED. The founder of COGMED emphasises the underlying assumption of COGMED being that improvements in working memory will transfer to other activities that require working memory and will impact on ADHD symptoms (Klingberg, 2010). In 2014 Chacko et al. undertook a research study with 85 children aged seven to 11 with ADHD who were assigned to either a COGMED intervention group or a placebo group. The results indicated that in comparison to the placebo group the COGMED intervention group of children showed an improvement in verbal and also visuo spatial short term memory. The main limitation of this study is that the COGMED intervention group received a lot more supportive adult interactions than the placebo group. Additionally the findings of the randomised control test indicated that COGMED showed no benefit for academic measures, ADHD measures or measures of working memory. In Klingberg et al's (2005) study 44 children with ADHD, aged between seven to 12 years, were assigned to a

computerised working memory intervention group or a placebo group. The results indicated that following the participation in the computerised working memory intervention the children obtained higher working memory scores in comparison to the control group. However the authors treated the results with caution as the results were not seen as having a robust statistical significance.

Overall the research on COGMED is mixed as some studies indicate positive outcomes with regard to working memory performance and transfer to academic performance whilst in other studies this is not apparent and this will be discussed further in the next section, section 2.6.1. The main contention is the methodological shortcomings and limitations of the research studies which can complicate the debate on what can be claimed as outcomes of COGMED.

2.6.1: Use in schools

There are some studies which report improvement following COGMED in maths and reading performance in children, but methodological problems can obscure interpretations. In exemplar Holmes et al (2009) found improvement in numeracy scores six months after COGMED, but there was no comparable assessment undertaken with the control group, therefore questioning whether the gains were influenced by repeat testing. To date there has been a lack of research studies on the use of COGMED Memory Training (CWMT) in schools. Holmes and Gathercole (2013) undertook one of the first research studies on COGMED in a school and published a paper entitled, ‘Taking memory training from the laboratory into schools’. The programme was administered by teachers who supported each pupil during the training through providing encouragement and feedback and also rewards for every five sessions the pupils undertook. In this study there were two Trials, Trial 1 and Trial 2. In Trial 1, 22 mixed ability eight to nine year olds were assigned to the COGMED programme and were given pre-intervention and post intervention working

memory tests. Trial 1 showed significant gains in working memory for all the children. However within this study they did not use a control group and this makes it difficult to conclude whether the gains were as a result of COGMED training. In Trial 2 50 Year 5 and Year 6 pupils were assigned to a COGMED intervention group. Trial 2 used a control group which consisted of pupils in the same school from the previous years cohort, these pupils were matched with the COGMED intervention group based on gender and age. Trial 2 showed that the Year 5's in the COGMED intervention group made significant larger improvements than the control group in numeracy, but not in literacy, whilst the Year 6 pupils in the COGMED intervention group made improvements in both literacy and numeracy. The findings from the research indicated that "teacher-administered training leads to generalised and robust gains in working memory and educationally significant gains in academic performance" (Holmes and Gathercole, 2013 p440). However a limitation of Trial 2 is that the control group did not receive any intervention at all, hence the gains made by the COGMED intervention group could have been influenced by the additional adult attention the COGMED group received.

2.6.2: Transfer

Several studies have established that following COGMED training the scores improved on working memory tasks, when they were similar to the tasks on the programme (e.g. Gropper, Gotlieb, Kronitz and Tannock, 2014; Dahlin, 2013). However there is a debate regarding whether the effects of the programme can be generalised and transfer onto other working memory tasks. Transfer is an important concept in educational learning; over the last 100 years it has been questioned whether transfer exists or not (Detterman, 1993). Nevertheless it has been suggested that all learning involves transfer "at least in a trivial sense: there is no such thing as learning if there is no demonstration of learning

outcome in a different context, even if the context is very similar" (Jaeggi and Buschkuehl 2014, p21).

Transfer can be conceptually divided into two categories of 'near and far'. An effect of the trained task on a similar non trained task can be classed as 'near transfer' while an effect of the trained task on a quite different non trained task is called 'far transfer'. A number of COGMED studies have found near transfer effects, but far transfer effects have proven to be more elusive. Shinaver, Entwistle and Söderqvist (2014) suggest that COGMED has an effect on verbal and visual working memory and these effects generalize to improved sustained attention up to six months. Nevertheless Roche and Johnson (2014, p381) conclude that although COGMED is "one of the better working memory training programmes currently available….how enduring and generalisable the treatment effects from COGMED training are remains to be demonstrated. This is partly due to inconsistent findings and methodological flaws within a number of studies".

A meta-analysis conducted by Melby-Lervåg and Hulme (2012) claimed that training effects from memory training programmes are not long term, they are specific to training and do not generalize. They argue the "absence of transfer to tasks that are unlike the training tasks shows that there is no evidence these programs are suitable as methods of treatment for children with developmental cognitive disorders or as ways of effecting general improvements in adults' or children's cognitive skills or scholastic attainments" (Melby-Lervåg and Hulme, 2013, p.283). However, there are also limitations of Melby-Lervag and Hulme's meta-analysis including age differences in the samples. Programmes other than COGMED are included, such as researchers implementing their own bespoke working memory training programmes rather than using replicable working memory programmes and also within the studies there are a variety of different clinical conditions.

Indeed COGMED (2013) responded to Melby-Lervag and Hulme (2013) by commenting:

> "Unfortunately, a discerning review of the current literature is a difficult undertaking and can lead to questionable analysis and flawed conclusions as found in the Melby-Lervåg and Hulme article. The authors used this review to tell us what we already know to be true: Current training programs yield reliable, short-term improvement on both verbal and non-verbal working memory tasks. However, they failed to recognize the key differences between training programs and the serious limitations inherent in comparing these programs."

A number of researchers (e.g., Gibson, Kronenberger, Gondoli, Johnson, Steeger, and Morrissey, 2012 and Shipstead et al., 2012) highlight concerns regarding the methodology used in some COGMED studies. For example Shipstead, Redick, et al. (2012), critique the studies by arguing that they are lacking sufficient measures of working memory by measuring it with only one task, confusing short-term with working memory, participants are not randomly allocated to groups, there is often a lack of a suitable control group and the sample sizes are inadequate. Shipstead, Redick and Engle (2012, p190) states, "The only unequivocal statement that can be made is that COGMED will improve performance on tasks that resemble COGMED training". In defence Gathercole, Dunning and Holmes (2012, p201) argue that

> "Shipstead, Hicks and Engle's article does a valuable job in laying out the full range of published research on the COGMED training programme in particular. We do however have concerns about how realistic are the criteria by which they evaluate (and in most cases, reject) individual studies, and argue here for a broader analysis that weighs up the evidence across the full range of relevant data".

Additionally they add that it can initially be a challenge to undertake a design such as a large scale randomized controlled study, as this needs to be preceded by prior research e.g. "studies employing these designs are time consuming and expensive and, until the existing evidence indicates that the intervention passes less stringent empirical tests the investment is risky" (Gathercole, Dunning and Holmes, 2012, p201).

More recent efforts have occurred to attempt to overcome the criticisms made by Shipstead et al (2012). In particular a study in 2013 by Dunning, Holmes, and Gathercole undertook the first randomised control trial with 94 children aged seven to nine with low working memory to investigate whether COGMED leads to generalized improvements in complex activities involving working memory typical of the classroom and also in developing academic abilities. The children who participated in the research were screened using the Automated Working Memory Assessment (Alloway, 2007) and were identified as having working memory ability at or below the 15th percentile. The children were randomly assigned into three groups, adaptive COGMED working memory training group, COGMED non-adaptive working memory training group and a control group. The research found that "first, training in low WM children leads to generalized enhancements to a wide range of untrained WM tasks. Second, these gains do not translate into capacity improvements on ecologically valid measures of WM or to gains in academic progress" (Dunning, Holmes, and Gathercole, 2013, p923).

A proposed premise of COGMED is that repeated practice of memory tasks lead to changes in neural activity and structure. However Dunning and Holmes (2014, p885) argue the advantages of training only extend to working memory tasks that are identical to the trained activities, whereas broader transfer "would be expected if training were inducing fundamental changes in brain function".

> Gathercole (2014, p256) states "The lack of transfer to structurally different working memory tasks runs counter to this concept of neural plasticity and, at a cognitive level, to the idea that training enhances the broad working memory construct. It suggests instead that intensive practice promotes neural processes (Dahlin, Neely, Larsson, Backman and Nyberg, 2008) cognitive skills and/or metacognitive practised activities*".*

It is suggested that although COGMED does not explicitly teach strategies, research indicates that it may promote pupils to spontaneously employ strategies to accomplish

working memory tasks. In a study by Holmes et al (2009, p11) twenty-five children aged eight to eleven years old receiving COGMED Working Memory Training, and following the training were asked “what they thought had helped them improve”. Fifteen children answered the question of which ten children reported using visualization and rehearsal strategies. Dunning et al. (2013) recommends that individuals could be supported to apply the skills they develop through COGMED. Further children have reported that they improve their performance on working memory tasks by paying attention, rehearsing information and shutting their eyes to concentrate (Holmes et al., 2009). St Clair-Thompson, Stevens, Hunt, and Bolder (2010) included 254 children aged between five to eight years old. The children were placed in either a computerised working memory training group or a control group. The computerised working memory training group used Memory Booster which is a computerised working memory programme that explicitly teaches strategy use. The results found that training the children to use strategies enhanced their performance on classroom tasks. The limitation of this study is that the researchers compromised the studies' reliability by using an opportunity sampling group design through the use of existing primary school classes, as either the control or intervention group.

A number of authors have taken a standpoint of rejecting the possibility of transfer. For example, a number of psychologists agree with Detterman's (1993, p21) view that; “the lesson learned from studies of transfer is that, if you want people to learn something, teach it to them. Don't teach them something else and expect them to figure out what you really want them to do”. This suggests that “the transfer of learning is not spontaneous, but requires specific learning. In this case, it is called informed transfer” (Gick and Holyoak, 1987 cited in Bossard, Kermarrec, Buche and Tisseau 2008, p152). I wonder whether this concern was considered by the COGMED designers. Therefore Dunning and Holmes

(2014, p860) argue “to bridge the gap between the specific cognitive gains induced by training and their flexible application to other working memory demanding situations, existing programmes may need to be modified to provide adaptive training that encourages the recruitment of strategies across a variety of tasks that map more directly onto the challenging cognitive situations in which working memory is used in everyday life”. In another paper it is asserted

> “One possibility is that the benefits of training are simply restricted to computer-based WM tasks that share many of the surface features of the training tasks (Dahlin, Neeley, Larsson, Backman and Nyberg, 2008). Alternatively it may be that the training regime employed here only does half of the job required. One of the cardinal principles of neuro rehabilitation is that scaffolding and support is required for training to generalize and be effective in new situations (Wilson, 2008). WM trainees may therefore need guidance, practice and reinforcement to apply their newly developed skills or strategies to everyday activities with structures that deviate substantially from the trained tasks but which nonetheless depend in part on WM” (Dunning, Holmes and Gathercole, 2013, p9).

Therefore to encourage transfer a plausible suggestion as a next step for researchers would be to explore and expand COGMED; adding advice for teachers on how to support children using strategies in a variety of situations. However, prior to this, it would be logical for research to consider implementation and feasibility of COGMED in a context such as a school. The next sections therefore will explore the literature on the implementation and the potential variables that impact on COGMED training.

2.6.3: Individual factors

There is a lack of literature on the individual differences in children and how this may affect their engagement with COGMED. Chein and Morrison (2010) speculate that individual differences and motivational factors may affect improvements in memory. Research by Klauer and Phye (2008) suggest that transfer of learning may be influenced by self-efficacy beliefs, motivation and external locus of control. Bloom (1985) argues that when undertaking any task, grit can often be as important as talent for high achievement.

Interestingly Bloom (1985) found that individuals who were not narrow-minded about intelligence are more likely to persevere on tasks that are challenging. Von Bastain and Oberauer (2013, p48) argue that further investigation is required on

> "features such as the training regime and conditions, and on the other hand individual differences potentially impacting WM training outcomes such as initial cognitive ability, genetic predispositions, and motivation and personality. By doing so, we found that there is still a lot of work to do to fill the existing wide gaps with empirical evidence before we can conclude whether and under which circumstances WM training can improve cognitive performance beyond task-specific practice effects".

2.6.4: Training factors

The meta-analysis results of Schwaighofer, Fischer, and Buhner (2015) indicated small immediate far-transfer effects to verbal ability and non verbal, as a result of working memory training, but they were not sustainable. They argued that

> "the claim that WM training has practical benefits for learning or, more generally, education is not supported by the findings of this meta-analysis. If this is a valid interpretation of the findings obtained in the field, there is a straightforward conclusion: We should bury all hopes that learning and education can be improved by boosting some general-purpose basic cognitive functions and redirect our resources for educational research and practice to more promising fields. We believe, however, that this would be premature. The findings could instead be interpreted as implicating that we have not even started to seriously design and vary the training conditions or, put more generally, the learning environment" (Schwaighofer, Fischer, and Buhner, 2015, p157).

In general there has been a lack of focus on training variables (Von Bastian and Oberauer, 2014). Klingberg (2010) acknowledged that variables such as duration and frequency of training sessions are not yet understood in terms of their impact on transfer. In exemplar Bloom and Sheull (1981) found that massed learning was less effective than distributed learning. In addition Penner et al (2012) suggested that it is advantageous to use COGMED in a distributed approach of twice a week for eight weeks compared to massed training of four sessions a week for four weeks. It is argued that dosage affects the magnitude of the training effect (Alloway, Bibile, and Lau, 2013). Schwaighofer, Fischer, and Buhner's (2015) meta analysis also identified supervision as a variable on outcomes.

For example in some studies it was found that participants may better focus their attention on an activity when supervised (Borella, Carretti, Riboldi, and De Beni, 2010; Holmes and Gathercole, 2013). According to Schwaighofer, Fischer, and Buhner (2015, p142) "a further variable that has not yet been considered systematically is the location of the training. Most of the WM training studies took place in a laboratory, but in some studies, participants trained elsewhere, such as at home". It is clearly noticeable that the existing research on COGMED lacks consideration of the training conditions and learning environment as mediators of effects (Oberauer and Von Bastain, 2014).

2.6.5: Schools as systems

When a school implements any intervention including a working memory intervention the school as a system should be considered. There is the suggestion that science fails to inform the realities of practitioners' work. Matarazzo in Bergin and Strupp (1972) emphasises his disillusionment with science by quoting "even after 15 years few of my research findings affect my practice. Psychological science per se doesn't guide me one bit.. my clinical practice is the only thing that has helped me in my practice to date" (cited in Bergin and Strupp 1972 p340). However the BPS (2005) highlight that at the core of applied practice is the scientist–practitioner model.

The relationship between practice and science and the application of science to human problems can be debated. Lane and Corrie (2006, p2) state that "the discipline of science has proved insufficient to illuminate the muddled and murky realities of problems encountered in the 'real world'". Interventions in schools are embedded in the context of a social system. It is interesting to reflect upon what informs decisions and whether research affects teachers' decisions to implement COGMED in schools. If decisions are affected by science, how do teachers conceptualise the evidence base, do they take it into

account and how do the staff interpret the quality and quantity of research behind educational interventions? Furthermore, within schools there may be a number of barriers to adhering to an intervention programme's fidelity. Essentially what is practical in the classroom and what is feasible in the clinical research context can be in opposition (Shadish, Matt, Navarro, and Phillips, 2000; Weisz, Chu, and Polo, 2004; Weisz, Weiss, and Donenberg, 1992). In the context of a primary school the feasibility of the implementation of an intervention is important (Campbell et al., 2000; Dansinger, Gleason, Griffith, Selker and Schaefer, 2005; Fixsen, Naoom, Blase, Friedman and Wallace, 2005; Power et al., 2004; Rowlands, Sims and Kerry, 2005).

2.7: Implementation

Implementation is the process of putting an intervention into practice (Lendrum and Humphrey, 2012). "The quality of the implementation of the programme turns out to be much more important in explaining the outcome than the nature of the programme" (Snow and Juel, 2005 p514). However there was no in depth research identified on the implementation of COGMED by teachers in schools. Lendrum and Humphrey (2012) claim there is a requirement for further research and publications that focus particularly on the exploration of implementation in school settings. Often intervention programmes are frequently not implemented as advised and designed (Wilson et al, 2003). A subsequent meta analysis has indicated that implementation can affect programme outcomes (Durlak and DuPre, 2008). Within the literature on implementation there are a number of main factors that can be identified (Domitrovich and Greenberg, 2000; Durlak and DuPre 2008, Dusenbury et al., 2003; Cross et al.; 2010; Dane and Schneider, 1998; Ennett et al. 2011; Lendrum and Humphrey, 2012,). According to Dane and Schneider (1998), these are: programme adherence or fidelity: programme dosage, programme quality, participant responsiveness, and programme differentiation. In total Durlak and DuPre (2008)

identified 23 factors which could affect the implementation process (see appendix iv). The presence of these factors was considered a facilitator and the absence was considered a barrier. Essentially, Durlak and DuPre (2008) argue that the ecological factors in the implementation context will affect the success of an intervention. Durlak and DuPre's (2008) study constructed a framework for effective implementation. The framework was comprised from Durlak and DuPre's (2008) meta-analysis of 500 studies of programmes implemented with children and young people in real world settings by non-researchers. The 500 studies identified barriers and enablers to implementation success. The meta-analysis is commendable as it only included quantitative studies that used large sample sizes and psychometrically sound assessment procedures, and the qualitative studies used multiple versus single methods of data collection. The factors identified by Durlak and DuPre's (2008) framework for effective implementation were also supported by three earlier systematic literature reviews by Fixsen (2005), Greenhalgh, (2005) and Stith el al (2006). All these studies agreed on at least 13 out of the 23 factors identified by Durlak and Dupre (2008). The three literature reviews also included different studies to those included in Durlak and DuPre (2008) meta-analysis.

Langley, Nadeem, Kataoka, Stein and Jaycox (2010) highlight four main barriers to implementation which are logistical barriers, competing responsibilities of the programme deliverers, a lack of support from school administrators and teachers and a lack of parental engagement. In summary implementation factors can also be argued as an important consideration when exploring the impact of COGMED and its use within a school.

2.8 Pupil and teachers' perceptions of working memory and COGMED

2.8.1: Perceptions of COGMED

Pain, et al (2002) argue that children and young people are often not consulted or have their views represented. Quantitative research undertaken can neglect the qualitative investigation of the opinions of the key stakeholders in COGMED such as teachers and pupils. The literature search did not identify any qualitative research on the pupils' views of COGMED and hence this is a gap in the literature. The present literature search also indicated a lack of literature on teachers' perceptions of COGMED training with Special Educational Needs pupils in the classroom.

2.8.2 Perceptions of working memory

Some researchers suggest that teachers may have a lack of knowledge of working memory and how it affects behaviour and learning (Alloway 2012). Teachers may misinterpret working memory problems as a result of low motivation or poor behaviour (Alloway, 2012). Alloway (2012) assessed teachers' awareness of pupils' working memory. The study included fourteen teachers who participated in semi-structured interviews. The results indicated that the teachers showed a limited understanding of working memory and the early warning signs of working memory failure. Gathercole et al (2006, p234) found that teachers often misinterpreted working memory difficulties, for example they would report that, "He doesn't seem to listen to what I say" and "It's in one ear and out the other". However rating scales such as the Working Memory Rating Scale are an available option for teachers to utilize as a tool for identifying children with working memory difficulties.

2.9: Rationale

In summary there is substantial literature on the descriptions and theories of working memory but a lack of research on the practical application of working memory interventions in schools. The evidence to conclude on COGMED's efficacy has also been impeded by methodological flaws within some of the published research. COGMED is currently being marketed to schools by Pearson Ltd. There has been a surge in the use of COGMED in schools but there is a lack of research on the implementation of COGMED within the school context and also pupils' and teachers' experiences and views on COGMED. Educational Psychologists frequently make recommendations that schools should implement working memory interventions with pupils. Therefore this research will focus on the implementation of COGMED in a school. The research questions arose from the literature review are outlined at the beginning of the next chapter, chapter 3.

Chapter 3: Methodology

3.0: Chapter Overview

This chapter outlines the methods and methodology which have been utilized to address the research questions. The ontological and epistemological positions which influenced me, as a researcher, will be considered. A critique of the research methodology will also be presented. Finally ethical considerations will be acknowledged.

3.1: Research Objective

The research focuses on 'real life' experiences and the implementation of COGMED in a school from the teachers' and pupils' perspectives. Further, it focuses on factors involved in the implementation of COGMED within a school and its effects on the school staff and pupils. The research design should state its aims by which it will be judged successful or not (Yin, 2014). The present research aim is:

- To explore the facilitators and barriers of implementing COGMED in a primary school.

This aim is encapsulated in the main research question below.

3.2: Research Questions

The following research question and sub-questions were developed:

Main question:

- "What are the facilitators and barriers to implementing COGMED Working Memory Programme in the primary school with Year 5 and 6 pupils?"

Sub questions

1) How do the pupils view the use of COGMED in school and what are the facilitators and barriers for the implementation of COGMED as a working memory intervention from their perspective?
2) How do teachers view the use of COGMED in school and what are the facilitators and barriers for the implementation of COGMED as a working memory intervention from their perspective?

3.3: Philosophical considerations

A researcher's methodology is guided by their philosophical position and research paradigm (Denscombe, 2010). "A paradigm is a basic belief system based on ontological, epistemological and methodological assumptions" (Guba and Lincoln, 1994, p105). Guba and Lincoln (1994) assert that one paradigm is not superior to others, which is why they are often debated. Ontology is derived from the Greek word "to be" and it refers to beliefs about the nature of reality. Epistemology is dictated by ontological beliefs. Epistemology refers to the making sense of reality and how we come to know 'how things are'.

With respect to these philosophical considerations, my positionality when undertaking this research fits with Critical Realism and this has underpinned the research design. Critical Realism amalgamates the subjectivity of relativism and the objectivity of positivism (Bhasker, 1986). "The strength of this perspective lies in its ability to consider realities that exist beyond those that have been socially constructed, but prevents over confidence that any knowledge gained can be directly translated into generalisable laws" (Trierweiler and Stricker, 1998, as cited in Lane and Corrie, 2006, p85). Easton (2010) articulates that critical realism assumes that although there is a reality independent of the observers to some extent this reality is socially constructed, whereas social constructionists discard the

possibility of knowing reality (Easton 2010). Trochim and Donnelly (2007 p19) explain critical realism as the belief that “There is an external reality independent of a person’s thinking (realism) but that we can never know that reality with perfect accuracy (critical)”.

Social constructionists reject an independent reality and believe that the world is socially constructed through interaction and language and that all knowledge of the world is subjective. Whereas Bhaskar (1997) argues that “social systems are real, with real causes and constraints that are external to the individual”. Bhaskar (1997) argues from a critical realist perspective that there are stratified layers of reality which are the real domain, the actual domain and the empirical domain.

The Real Domain: Mechanisms that have generated actual events. The real are the deep structures that generate phenomena. The real is a speculation of possibilities. We can't observe the real, for example gravity is a speculation.

The Actual Domain: Where aspects of reality occur but may, or may not be experienced. "Events occur whether or not we experience or interpret them and these true occurrences are often different from what is observed at the empirical level (Danermark et al., 2002, p. 20)". The actual are events which are caused by the mechanisms in the real, so although we cannot observe the real we can observe the actual. For example gravity cannot be observed but an event caused by gravity can be observed.

The Empirical Domain: The empirical domain is the position of the researcher who is actually observing the actual domain and making speculations about the real domain.

This suggests that concepts are real phenomena rather than purely of our own construction. Individuals are capable of consciously reflecting on and changing the factors involved in a phenomena (in this case the intervention and the experience of the intervention) and the process of my research aims to facilitate this reflection. Robson (2002) argues that critical realism can fit with case study design and a qualitative research methodology both of which are discussed further in the following sections of this chapter.

3.4 Case Study Methodology

This research utilized a case study design. A case study is a research strategy not a method itself (Hartley, 2004). Case study research can involve researching one or a small number of social situations using different data sources (Easton, 2010). A case study offers a framework which allows the research to "retain the holistic and meaningful characteristics of real-life events" (Yin, 2009, p.4). Easton (2010 p128) argues that "critical realism seems ideally matched to case study research. Certainly case study research cannot be justified in terms of positivism since case study research is almost always research involving small numbers. Interpretivism is more relevant but is largely epistemological in its objectives. Critical realism however provides not only a basis for justification but also guidelines as to how case research might be done and how theory can be fashioned. Critical realists argue that in the real world there are entities, such as organisations, which have powers to act and are liable to be acted upon by others. These

entities can also have internal structures, such as departments and individuals which in their turn, have their own powers".

A case study can be used in a single setting (Eisenhardt, 1989). Case studies are a useful strategy when:

- Asking “how” or “why” questions
- The investigator has little control over the events.
- The focus is on a contemporary phenomenon within a real life context (Yin, 2009, p13).

A case study design is therefore highly appropriate as I wanted to focus on a contemporary phenomenon within a real life context, where I had little control over events (Yin, 2014). According to Yin (2014) there are four different purposes for using case study research in psychology which are explanation, description, evaluation and exploration. These purposes may overlap and therefore are not mutually exclusive (Yin, 2012). The present study hopes to serve as a prelude to subsequent study and hence this study can be described as exploratory (Yin, 2014) and the ‘case’ is defined as the COGMED intervention in a primary school.

3.5: Rationale for use of the Data Collection Method

Critical Realism is not linked with any specific methods (Fletcher, 2016). It is suggested by Yin (2009) that the methodology needs to be appropriate to answer the research questions.

A qualitative methodology was adopted in this research as this allowed for the use of the most appropriate data collection to answer the research questions. Qualitative data was collected because when considering implementation issues relating to COGMED,

qualitative data offer more in depth contextual information than quantitative data and this aspect is often lacking in the existing literature. The use of qualitative methods offers the participants the opportunity for flexibility to guide the research by their own views. I wanted to explore in-depth the participants' perspectives of COGMED. Yin (1994, p.13) argues that "a case study relies on multiple sources of evidence" In addition Yin (1994) states that a researcher should uncover contextual conditions because they can be relevant to the phenomenon under study. Therefore in this research, contextual data such as pupils' T-scores on the Working Memory Rating Scale, pupil scores on Myself as a Learner and data from COGMED monitoring system (see Appendix xxii-xxv) were collected. Table 3.1 details the data collection methods used for each research question and the intended methods for analysis.

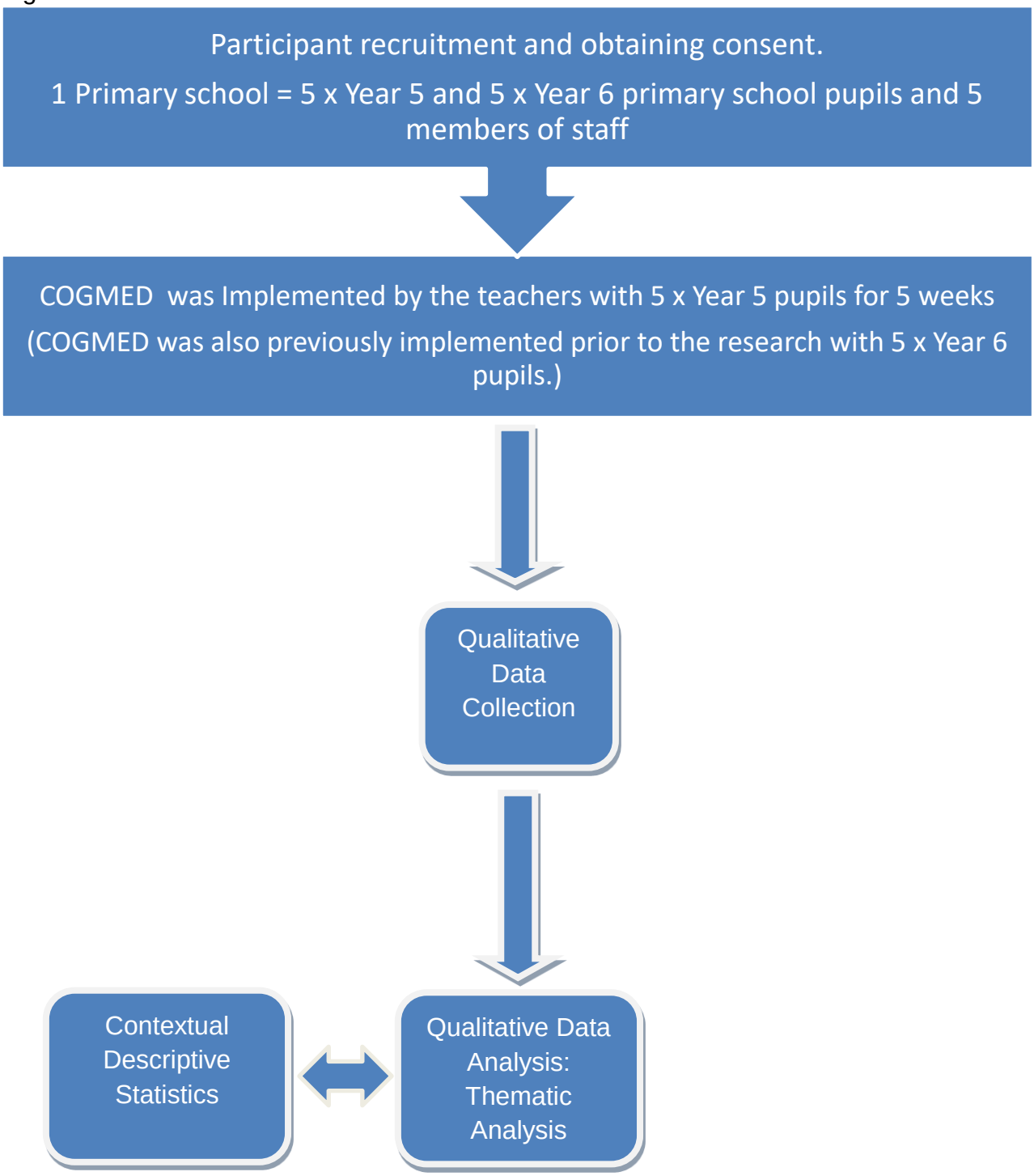
Table 3.1**:** A table to show the data collection methods and analysis.

Research Question	Data collection method	Data Analysis
RQ1: How do the pupils view participating in COGMED and what are the facilitators and barriers for the implementation of COGMED as a working memory intervention from the pupil's perspective?	Qualitative: Post COGMED Semi-structured interviews with Y5 & Y6 pupils which included working memory activities and scaling.	Thematic Analysis
RQ 2: How do teachers view the use of COGMED in school and what are the facilitators and barriers for the implementation of COGMED as a working memory intervention from the teacher's perspective?	Qualitative: Post COGMED Semi-structured interviews with teachers.	Thematic Analysis

3.6: Research Methodological Procedure

Figure B, below provides an overview of the process I undertook. Further details of the procedure are provided in Sections 3.8 & 3.9.

Figure B:



The timeline of the present study can be found in Appendix xx

3.7: Description of COGMED

COGMED was developed by Dr Torkel Klingberg in Sweden in 2002. In 2007 it was then marketed by Pearson Education Inc. Pearson currently market COGMED within several countries including the UK and USA. COGMED was based on Baddley and Hitch's (2000) multi-compartmental model of working memory. It was not possible to obtain figures on the number of schools in the UK who are using COGMED. However a Sales Consultant working for Pearson who I contacted reported that during the week beginning the 23rd of March 2015 there were thirteen schools who were actively using a six week programme in the Greater Manchester area and there were seven schools actively engaged in using COGMED in Lancashire.

COGMED aims to improve a person's working memory capacity and function. There are three types of COGMED training: JM for preschool children, RM for school aged children and QM for adults. The standard administration protocol is for 25, 35 or 50 minute sessions a day, five days a week, for five weeks. The tasks on COGMED target short term memory and working memory. There are ten tasks on RM COGMED. The following is a description of some of the types of tasks on COGMED:

- Visual data link – There are a number of lights on a robot. The lights, light up and the child is required to remember the correct order in which the lights lit up.

- Asteroids: There are a number of asteroids which light up in a specific order. The child is required to remember the correct order in which the asteroids lit up.

- Input module: An auditory sequence of digits is given to the child. The child is then required to recall and input the auditory sequence of digits backwards on a key pad that is on a robot's arm.

- Stabiliser: An auditory sequence of letters are given to the child. Simultaneously a light on the robot lights up. The child is then required to click the light that corresponds with the letters.

The fundamental basis of COGMED is that it adapts to a user's performance. If the individual is able to complete the task one item will be added to the to-be-remembered list. If the individual is unable to complete the task, one item will be removed from the to-be-remembered list. This method means that the individual is having to perform at the limit of their abilities. Once a child has completed a session on COGMED they are then given the opportunity to play a computerised reward game, Robo– Racing.

3.8: Sampling Methods

3.8.1: School

Information about the research was placed in the COGMED's newsletter for the North West of England to recruit schools interested in the research. Four schools wishing to participate in the research contacted the researcher and one of these schools was chosen. The decision was based upon the school having previous experience of COGMED, their ability to commit to the research and also having the appropriate number of participants who could potentially engage in the research. The other three schools who expressed an interest in the research only had two or three pupils engaged with COGMED and could not

commit to the capacity of research, hence this meant that I could only work with one school.

The school that was selected for the research was a Catholic primary school based in an area of deprivation in a town in the North West of England . The school has a single form entry. There are six out of a total of 190 pupils on roll from an ethic minority background. In total at the time of the research there were 31 teachers and teaching assistants employed at the school. The last Ofsted report in July 2014 classified the school as 'good' for behaviour, safety of pupils and also in leadership and management. Ofsted classified the school as "requires improvement" in the achievement of pupils and quality of teaching. In total in 2014-2015 84 pupils qualified for the pupil premium out of a total of 190 pupils on roll at the school. There were 32 pupils on the SEN register and 34 pupils who qualified for free school meals. Prior to the research being undertaken in the school COGMED had been previously undertaken once in the Spring Term 2015 with five Year 6 pupils who were all on the school's SEN register. The programme was delivered in the Year 6 classroom. Further details on how the COGMED programme was delivered is discussed as part of the results section in Chapter 4.

3.8.2 Contextual Data

Data from COGMED's monitoring system, Working Memory Rating Scale and Myself as a Learner Rating Scale were collected to provide contextual data. (See table below for further information)

Table 3.2 Categories of the contextual data that were collected

Contextual Data	**Contextual Data that were Collected**	**Why this data was collected.**
COGMED's monitoring system	• Number and duration of sessions • Time spent in Active Training • Training index: - "The Training Index, is a measure of the users' improvement during the training period" (COGMED, 2010, p17). • COGMED Progress Index	Implementation Science identifies programme dosage[1] and participant responsiveness as factors that affect implementation of an intervention (Dane and Schneider, 1998). The training index and COGMED Progress Index are accessible by the teachers which provides the teachers with data on the pupils' progress on the programme.
Working memory rating scales (WMRS)	• 1 x Year 5 class teacher completed the WMRS for 5 x Year 5 pupils pre COGMED.	Provides further information about the Year 5 pupils who participated in the programme.
Myself as a Learner Rating Scale (MALS)	• 5 x Year 5 pupils completed MALS prior to participating in COGMED	MALS measures pupil self learning concept. In this research self learning concept is not intended to be linked to working memory abilities. The rationale for collecting information from MALS is to provide further information on the Year 5 pupils who participated in the study and their self learning concept.

[1] Dosage is a term that is used in implementation science.

3.8.2.1: Contextual Data: COGMED monitoring provision

COGMED is a computerised programme which has an inbuilt monitoring system. It offers a training index and COGMED progress index (CPI) which measures the users' progress. It also offers data on the total time a pupil spent on COGMED and the time a pupil spent in active training. I collected the numerical data from the training index, CPI and the time spent in training (see Appendix xxiv). COGMED's monitoring provision provided the opportunity to monitor the outcomes of COGMED in a similar manner to how the school staff would be able to assess the pupil's progress on COGMED.

3.8.2.2: Contextual Data: Working memory rating scale (WMRS)

The Working Memory Rating Scale (Alloway, Gathercole and Kirkwood, 2008) is reported to be a valid and reliable measure for 5-11 year olds. The WMRS is a teacher behavioural rating scale which can be used to identify pupils with working memory deficits. The WMRS produces a score which indicates the level of severity that the pupils have with working memory functions. The WMRS enabled the researcher to ascertain a measure of whether the pupils selected for COGMED were displaying behaviours associated with working memory deficits (see appendix ii for a copy of WMRS).

The Year 5 teacher, teacher 'B', was given information on working memory and then asked to complete the WMRS for the five Year 5 participants before they undertook COGMED (see Appendix ii). The WMRS was not completed prior to COGMED for the Year 6 pupils as the Year 6 pupils had already undertaken the programme before the research commenced.

3.8.2.3: Contextual Data Myself as a Learner Scale (MALS)

MALS has been standardised on 8-16 year olds and is reported to be a valid, reliable measure (Burden, 2012) which offers a measure of a pupil's self learning concept. As discussed in Chapter 2 a number of research studies argue that a pupil's self learning concept is a key element in learning progress and therefore it was thought that the MALS would provide further contextual data on the pupil characteristics. Prior to the Year 5 participants undertaking COGMED they completed MALS which was then analysed and an overall score obtained (see appendix viii, appendix xviii and appendix xxiii). The Year 6 pupils did not complete MALS as they had already undertaken COGMED prior to the research commencing.

3.8.3: Pupils

Ten pupils from the primary school aged between 9-12 years old were selected as participants to take part in the research, on the basis that they were chosen by the school to undertake the COGMED programme, and were all on the school's SEN register. The table below shows the year group, gender and pupil ID of each pupil involved in the research. Further detail on the pupils selected is documented in the teachers' comments in Chapter 4: Findings Chapter.

Table 3.3: A Table to show the Year 6 pupil ID, year group and gender.

Pupil ID	Year Group	Male/ Female
u1514	Year 6	M
u1515	Year 6	M
u1517	Year 6	M
u1518	Year 6	M
u1519	Year 6	M

Table 3.4: A Table to show the Year 5 pupil ID, gender, MALS score and WMRS score

Pupil ID	Year Group	Gender	MALS Score / Description	WMRS Score/ Description of Scores
u1656	Year 5	M	74 Average Range	T score = 74 Marked Working Memory Impairment
u1658	Year 5	M	63 Average Range	T score = 78 Marked Working Memory Impairment
u1659	Year 5	M	56 Below Average	T score = 61 Moderate Working Memory Deficits
u1660	Year 5	F	61 Average	T score = 65 Moderate Working Memory Deficits
u1661	Year 5	F	73 Average	T score = 59 Average

(Working Memory Rating Scale: A child who obtains a T-score of < 60 is considered to have typical working memory behaviours for their age group and therefore is considered as having a score in the average range. Scores that are one standard deviation above the mean T score > 60 may indicate moderate working memory deficits. Scores that are two standard deviations above the mean T score > 70 may indicate marked working memory impairments).

(Myself As a Learner: A score between 60-80 is described as the average range. A score less than 60 is described as below average range.)

The pupils all had normal or corrected-to-normal vision and hearing. The Special Educational Needs Co-ordinator, who was also the school's Deputy Head, selected the pupils to undertake COGMED on the basis of whether she thought the pupils struggled to retain information**,** were on the school's SEN register and were identified on the school tracking data as not making progress. Additional information on the pupils such as SEN

information and language difficulties, have not been detailed in this study as the researcher has not been given access to sensitive and confidential information stored on the pupils' files. However I was aware that one of the pupils had a diagnosis of autism and some of the other pupils may have had language difficulties. The pupil's language abilities and how this could have impact on their engagement with the research is reflected upon in Section 5.4.1 on the limitations of the research.

COGMED report that “COGMED Working Memory Training is suitable for anybody, from the ages of four and above that want to improve their working memory” (COGMED, 2010, p4). COGMED also report that individuals with severe anxiety, severe depression and severe conduct disorder are incompatible with starting the training. The task of selecting pupils will be explored as part of the research findings. All of the pupils who took part, or had taken part in COGMED in the school at the time the research took place, were included in the sample. The Year 6 pupils had been registered to a series of COGMED sessions which were expected to last 25 minutes each whilst the Year 5 pupils had been registered to the 35 minute sessions. The Year 6 pupils undertook COGMED in their classroom and the Year 5 pupils undertook COGMED in a number of different rooms within the school. Further detail on the implementation of COGMED is documented in the teachers’ comments in Chapter 4: Findings Chapter.

3.8.4: Staff

Five staff members at the primary school participated in the research, three teachers, one teaching assistant and one deputy head/ SENCo. Two of the three teachers only had direct involvement with the Year 5 pupils and the other teacher had direct involvement with the Year 6 pupils. The SENCo was not directly involved with the day-to-day delivery of COGMED. During the interview with the Year 6 teacher she invited the Teaching

Assistant, who supervised the children during COGMED, to join in the discussion who then consented to participating in the research. All five members of staff that were involved in the research had all had some involvement with COGMED and for this reason they were participants in the study. Table 3.5 below shows the teachers ID:

Teacher ID	Job/role
Teacher A	Teacher responsible for overseeing the Year 5 pupils' participation in COGMED
Teacher B	Year 5 class teacher
Teacher C	SENCO / Deputy Head
Teacher D	Year 6 class teacher and teaching assistant

3.9: Data Collection Method

The standard COGMED administration protocol advices users to undertake eight daily tasks, five days a week, for five consecutive weeks (Roche and Johnson, 2014). The session length can be set by the teachers at either twenty-five, thirty-five or fifty minutes. Dunning, Holmes and Gathercole (2013) found that there was no significant difference in the effects for those pupils who completed twenty sessions and those who completed twenty-five sessions. Gearing et al., (2011) meta analysis on intervention research suggests that programme fidelity compromises the internal validity of the research. Fidelity was planned to be assessed through a teacher diary and the sessions each pupil undertook and if anything affected pupil engagement. However the teacher did not complete the diary. Although some information is lost from the absence of this data the COGMED monitoring system stores information on how many and how often the pupils complete sessions from which it was learned that some of the pupils completed less than twenty sessions. One of the pupils, u1517, was discontinued from engaging in COGMED by the teachers.

Data was collected through the following methods outlined in Table 3.6 below:

Table 3.6: Table to show the data collection method.

Data collection method	Data
Semi-structured interviews.	• Post COGMED interviews with 7 pupils, each interview lasting 10-15 minutes. There were ten pupils in total who participated in COGMED however only seven out of the ten participated in the interviews: three Y5 and four Y6 pupils. Two of the pupils had participated in four or less than four COGMED sessions and for this reason were not interviewed. The remaining pupil was absent from school when the interviews took place. • Semi–structured interviews with 5 staff members post COGMED lasting approximately 1 hr.

3.9.1: Equipment needed for the study

- Interview schedules (see Appendix v and vi) and supporting materials (see Appendix ix)
- Dictaphone

The next section of this discussion will describe and evaluate the advantages and disadvantages of the data collection methods as well as cover the procedures undertaken.

3.9.2: Semi–structured interviews

Semi-structured interviews were used to obtain the views of the teachers and the pupils. A pilot semi–structured interview was undertaken with one of the Year 6 pupils. At a latter point in the study in was decided that this data would be used in the main study as one of the seven interviews that were undertaken. Barbour (2007) acknowledges that pilots can be useful to ascertain whether the questions may elicit the required data. Through undertaking a pilot study I was able to practice utilising the memory activities and establish the duration of the interview and that the questions were accessible. The pilot study did not lead to any significant modifications of the pupils' interview schedule and therefore at a latter point it the study it was decided that this data would be used in the main study as one of the seven interviews that were undertaken.

There are several advantages of interviewing, including that they allow the participants to accord meanings to the theme of the interview rather than the interviewer eliciting responses within a standard format such as the questionnaire. Within the interviews the interviewees are not as likely to be influenced by other members of the sample, whilst participants of a focus group may be influenced by the general group discussion. Interviews offer flexibility as they allow for adjustments to the line of enquiry to be made during the interview. Interviews use many formats, which range from the very structured to the very unstructured, and most interviews fall within the poles of this continuum of a fixed to an absent structure. To allow for comments made by the interviewee to be explored as they arose the order in which the questions were asked during the interview was flexible.

The disadvantage of interviews is that they can be time-consuming in comparison to other data collection methods such as questionnaires. However I agreed with the participants an approximate end time. Structured interviews incorporate a specified number of

questions which the interviewer asks in a specific order and therefore are easier to analyse. However Breakwell, Smith and Wright (2012, p372) criticise structured interviews noting “all pre-structured data elicitation techniques leave little room for unanticipated discoveries. People often feel constrained because they are not free to give the information which they feel is important". Hence relevant issues may be omitted from the interview. In unstructured interviews there is the absence of specific questions and the researcher's focus is on a number of topics identified for discussion. The analysis of unstructured interviews is also time consuming and the comparability across respondents is problematic. Focus groups were considered but dismissed as they may lack the depth of individual interviews and may restrict the understanding of an individual's experiences.

The current study utilized semi-structured interviews and formulated several questions for the interview schedule. The majority of the questions posed to the interviewee were open rather than closed questions. Open questions are useful as they invite participants to generate detailed descriptions about a topic (Roulston, 2010). The questions included in the interview schedule were checked before interviews were undertaken to ensure that the questions were clear and did not use any of the following: jargon, assumptions, double negatives, or leading questions (Breakwell, Hammond and Fife-Shaw, 2000). There is also the issue of the interviewer effect and the position of the researcher (Breakwell, Hammond and Fife-Shaw, 2000). Interviewer effects cannot be eliminated but measures can be taken to control them, such as having the same interviewer conduct all the interviews. Therefore the same interviewer was used for all the interviews.

3.9.3: Semi-structured interview schedule

The two interview schedules, pupil and teacher schedules (see appendix v and vi) were devised based on the following format:

- Introductory comments (to explain the interview format);
- List of topic headings and key questions to ask under these headings;
- Set of associated prompts;
- Closing comments

(Robson, 2002, p278).

The content of the interview questions was guided by the literature review (see Chapter 2) and constructed to address the research questions. The schedules included questions relating to research question 1 for the pupils and research question 2 for the teachers. The teacher interview schedule addressed the programme implementation and outcomes of the programme. The schedule also included questions which addressed the barriers; facilitators and impact on the pupils and the general views on COGMED and understanding of working memory. Most of the teachers were asked scaling questions. For example they were asked to rate on a scale of 0-10 (10 = met their expectations, 0 = not met their expectation), “How much COGMED had met their expectations?” Once they had assigned a number out of 10, they were then asked why this number out of 10? Scaling was used to facilitate discussion and enable a greater understanding, rather than asking a closed question such as, “Has COGMED met your expectations?” which is more likely to elicit either a Yes or No answer. The teacher interview schedule also contained questions about future recommendations for the use and implementation of COGMED in a school context.

The pupil interview schedule included questions on the barriers and facilitators, delivery of the programme and general views on COGMED. The three Year 5 pupils were interviewed immediately after undertaking their last session on COGMED. This occurred so that the pupils could directly reflect on the programme. I was unable to interview three of the Year 6 pupils until they were at secondary school and therefore there was some time intervening between COGMED and the interviews. To facilitate discussion three stimulus memory activities were prepared; these were following verbal instructions, recalling digits backwards and remembering visual objects. (see Appendix ix: Discussion Tasks with Pupils). These tasks were based on descriptions of short-term and working memory and associated tasks found in the literature (Dehn 2008, Gathercole, Pickering, Ambridge and Wearing 2004; Gathercole and Alloway, 2008) (see Section 2.2 and 2.3 in Chapter 2). The three Yr 5 pupils and one of the Year 6 pupils u1515 undertook the three tasks to encourage the pupils to talk about how they remember. The Year 6 pupil, u1515 who undertook all discussion tasks was interviewed before he left the primary school. I only had a limited amount of time in the secondary school with the other three Year 6 pupils and as a result only the digit span task was used to encourage the pupils to reflect on how they remember. Following the memory task, pupils were asked, “What did you do to remember? Was there anything that helped you remember? Can you rate on a scale of 0-10 how easy or difficult it was to remember?” During the interviews I used scaling questions by drawing a scale of 0-10 (0 = negative 10 = positive) and this was used to facilitate discussion. The pupils were asked questions such as rating COGMED on a scale of 0-10. Once the pupil had given a number for example a “6” they may have then been asked, “Why “6” out of 10? What would make it one more or one less than “6”?”

3.10: Data Analysis Methods

The next section will outline the methods used to analyse the data collected during this research.

3.10.1: Qualitative data analysis

The recordings of the semi-structured interviews were transcribed, in total there were seven pupil and four teacher transcripts which were then analysed using thematic analysis (Braun and Clarke, 2006) (appendix xvii and xix). Howitt and Cramer (2008 p336) states that “thematic analysis is the analysis of textual material in order to indicate the major themes to be found in it”. It can be argued that “thematic analysis focuses on what is said rather than how it was said” (Caulfield and Hill, 2014, p187). It is a useful research tool as it can potentially offer a detailed and rich account of the data (Braun and Clarke, 2006). Thematic analysis is also advantageous as it “tends to generate research findings which are readily understood by the general public and policy makers” (Howitt 2010, p164). However the use of thematic analysis can have its limitations, as firstly there can often be an underlying lack of transparency in many thematic analyses and secondly there is a question as to the extent to which the themes encompass all of the data. It is plausible that key features of the data are ignored along with key analytical insights. Hence Howitt (2010) argues that there is the need for a systematic and transparent approach to thematic analysis and this was achieved by following Braun and Clarke’s (2006) approach to thematic analysis.

According to Braun and Clarke (2006) there are six separate stages for carrying out a thematic analysis and the researcher may work forwards and backwards between stages with the aim of checking an aspect of the analysis. The six stages are: Step one: data familiarisation, Step two: initial coding generation, Step 3: search for themes based on

initial coding, Step 4: review of themes, Step 5: theme definition and labelling, Step 6: report writing (Howitt, 2010, p173-178).

The thematic analysis was undertaken by using both an inductive (e.g. Frith and Gleeson, 2004) and deductive (e.g. Hayes, 1997) approach. A 'bottom up' or inductive approach involves themes emerging from the data whilst a top down approach or deductive approach involves the identification of themes driven by the research questions and the literature. I was able to take a deductive and an inductive approach simultaneously. I let the themes emerge from the data and this involved naming and substantial re-naming of sub-themes. Overall there were some clear main themes such as the barriers and facilitators. This was influenced to some extent by my prior knowledge and awareness that the research aimed to answer specific research questions. However unexpected themes and sub-themes also emerged from the data. The use of both an inductive and deductive approach has been endorsed by Joffe and Yardley, (2004); Fereday and Muir-Cochrane, (2006).

Each participant was given an interview identification number or letter so they could remain anonymous (see section 3.7.2 and 3.7.3). Transcriptions were checked for fit with original recorded interviews. Once the interviews had been transcribed the data were read and re-read a number of times so that I was familiar with the data. Then I coded the data, the codes were brief descriptions of segments of data. Subsequently similar codes were collected together to create categories, sub-themes and the main themes (See Appendix xxv, xxvi, xxvii and xxviii).

The coded transcripts were given to an individual rater to achieve inter-rater reliability (Cohen, Manion & Morrison, 2011). An independent rater reviewed approximately 50 percent of the codes and the assigned themes and sub-themes at random. The individual

rater then reported on each code, category, subtheme or theme they had reviewed and whether they agreed with the codes and themes. The rater checked codes assigned to segments on both the pupils' and teachers' transcripts. There was minimal discrepancy between my coding and the independent rater's codes, but when a mismatch occurred the codes were reviewed and refined (See section 5.4.1 for a further discussion on the use of inter-rater reliability). Thematic maps were created to illustrate themes. The analysis is presented in the form of a written report in the next chapter.

3.11: Validity and Reliability

The concept of validity and reliability is debated in qualitative research methods Guba and Lincoln (1982) advocate for 'reliability' to be substituted by terms such as transferability', 'confirmability', 'consistency', 'dependability' and 'trustworthiness'. In this next brief section reliability and validity will be delineated. Table 3.4 shows features of Yin's (2014) criteria for judging a research design's quality which I was aware of during this study.

Table 3.7: Illustration of some features of Yin's criteria for judging the quality of a research design (Yin, 2014, p45).

Tests	Case study elements	Stage of research
Construct validity: whether a tool measures the construct adequately	• Multiple sources of evidence used • Maintaining a chain of evidence: • Have key informants review the case study report.	Data collection
Internal validity: the degree that the research can eliminate alternate explanations of the results.	• Undertake explanation building • Tackle rival explanations	Data analysis
Reliability: is considered to be that the same results would be obtained by following the same procedures.	• Use case study protocol	Data Collection

To counteract attacks on the validity, within this case study, a variety of data sources have been collected to corroborate conclusions. I have maintained a chain of evidence to show how the initial research questions, research data and the case study conclusions link together. Yin (2009) claims that it is important to have a clear research protocol, hence in order to increase reliability a transparent account of the research design is presented in this thesis from which a reader can assess relevance to their own study.

It is suggested that key informants review the case study report (Yin, 2014) but as a result of time constrains and the participants not being available to review the final themes. However they were informed that they could request to review the draft of the written thesis. Further, I have had my research reviewed by others, the thematic analysis was checked by inter-rater reliability and regular supervision was accessed through my research supervisor.

A frequent proposed criticism of case study research is the lack of scientific generalisability (Somekh and Lewin, 2012). However this case study offers a real-life circumstance similar to that which Educational Psychologists often experience and as such offers a useful account of the challenges faced in an under researched real life situation. Somekh and Lewin (2012) claim that there is a possibility that good case studies can have 'naturalistic generalisation'. This means that the reader identifies their own situation in the case and may be able to relate some of this to their own experiences. Guba and Lincoln (1982, p238) argue that all phenomena is time and context bound and this makes generalisations impossible. This case study fits with a critical realist stance which emphasises that knowledge is context dependent and here as in other case studies the results do not have statistical generalisation. However my research may be viewed as pilot research in which patterns may begin to emerge and rich descriptions are detailed which can inform better

understanding and be explored in more depth as part of future larger research studies. Yin (2009) notes that case studies can offer 'analytic generalisation' whereby the results generalise to theory. The results of this case study will be compared to the research outlined in chapter 2, including the findings from Durlak and DuPre's (2008) framework for effective implementation. I acknowledge that this research, like most "real life" research, is not perfect, but the case study may enlighten and expand traditional scientific theories by acknowledging the role of implementation within a school.

3.12: Reflexivity

A reflexive account can highlight how, with the benefit of hindsight, I have reached a greater understanding of the range of influences which shaped the research. I am aware that the impact of myself as the researcher is a factor which is likely to affect the findings of this research. I acknowledge that this research is imbued with the subjectivity of the participants and myself as a researcher and as discussed in Section 3.3 this fits with a Critical Realist position; "there is a reality independent of observers but we can never know that reality with perfect accuracy as to some extent this reality is socially constructed" (Trochim and Donnelly 2007 p19).

I am aware that my characteristics as a researcher may have unintentionally influenced the participants' responses. The teachers were aware that I was a Trainee Educational Psychologist and may have had a pre-conceived view of Educational Psychologists. Another important factor is the power of the interview process itself. It was noted that at least one teacher made a number of "off the record" comments that indicated she was cautious in the responses she was offering during the semi-structured interview. The balance of power between the researcher and researched can often reside with the researcher and it is acknowledged there could have been an unequal power balance in the

current study. However attempts were made to reduce this by building rapport with the interviewees, valuing their responses and explain that there are no right or wrong answers.

3.13: Ethical considerations

I submitted to Sheffield University School of Education Ethics Board documents for ethical approval before commencing the research. Informed consent, confidentiality, the right to withdraw and debriefing the participants were considered throughout the research.

3.13.1: Informed consent and the right to withdraw

I delivered consent forms and information sheets to individuals who had been selected to be involved in COGMED at the school and to the pupils' parents. The information sheet details the nature of and the procedures used in the study; what participation will require and how the participant can withdraw or seek further information, or file a complaint (appendix xi, xii and xiii). Informed Consent was obtained from the teachers (appendix xiv) and pupils (appendix xv) who participated in the research. Also informed consent was obtained from the pupils' parents (appendix xvi). The pupil's consent form and information sheet was designed so that it could be understood by an individual that had a low reading age. This would make the form easier to be accessed by any pupils who may have specific difficulties with literacy. This was then supported by research aims and consent processes being verbally explained. The participants' level of understanding was checked by asking them to offer their own explanation of their involvement in the research.

The participants and the pupils' parents were told that they were free to make a decision as to whether or not they agreed to participate in the research. They were reminded that withdrawal was permitted at any stage of the research and questions about the research could be directed to the researcher, at any time.

3.13.2: Confidentiality

The consent forms and any personal information collected, that could identify participants, were strictly confidential and accessible only to the research supervisor and I before, during and after the research activities. Throughout the study the pupils' data were identified by a unique identification number and the teachers were identified by an individual letter. The unique identification numbers and letters and participants' names were kept secure. In this way all the data throughout were anonymised and participant identities were not revealed or shared with any third parties during or after the research study. Once the data collection had been conducted the participants were debriefed. The participants were re-informed of the nature of the research and it was checked if any discomfort, self doubt or misconceptions had arisen as a result of the research so that assistance could be arranged if needed. The participants were also thanked for their involvement. The school staff who participated in my study were given my university contact details and phone number and were invited to contact me if they had any further concerns. The pupils who participated in the study were informed of a member of staff at the school they could contact if they had any further queries, concerns or wanted to discuss any issues arising from the interview.

The digital recordings were kept on a password protected computer and the data obtained was kept in a locked filling cabinet and was scheduled to be destroyed three months after the completion of the project.

3.14: Summary of methodology chapter

This chapter has given an account of the methodology used within this study. The next chapter will discuss the findings of the study and provide an analysis in order to answer the research questions.

Chapter 4: Findings

4.0: Chapter Overview

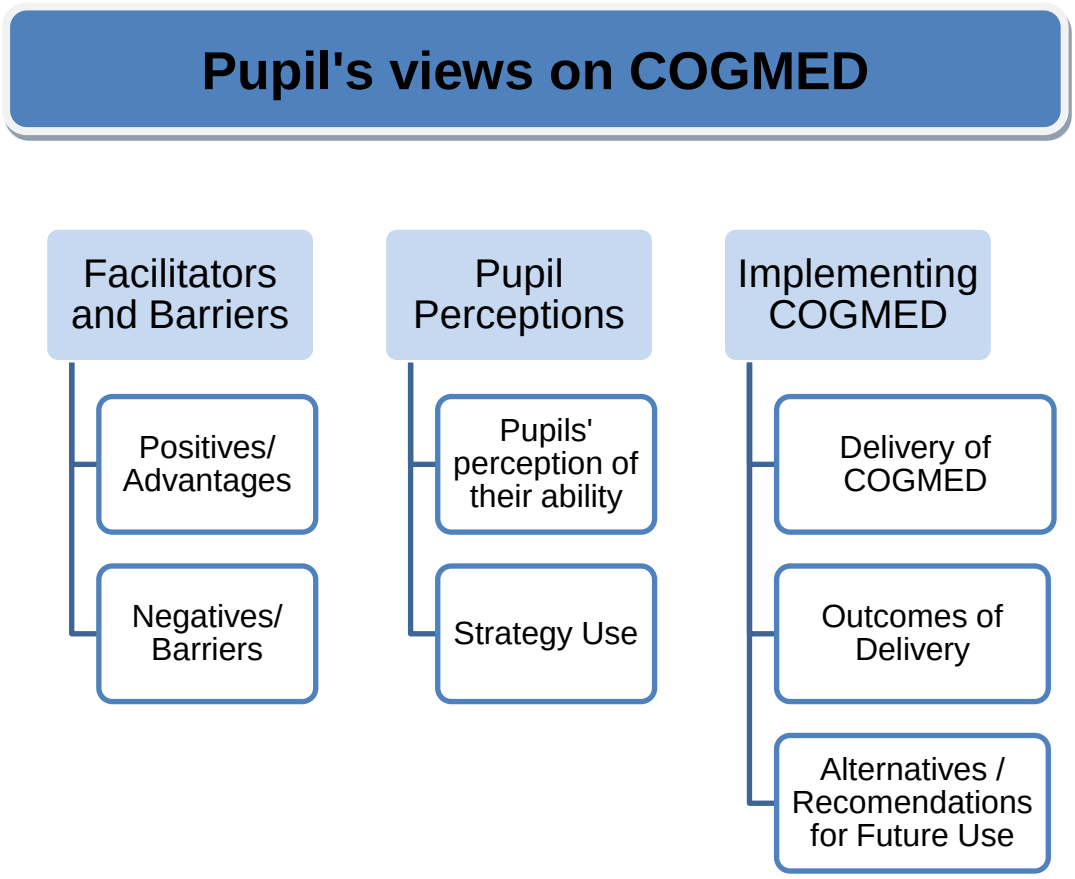
This chapter presents the analysis of qualitative data, further discussion of this analysis is presented in the next chapter, chapter 5. Braun and Clarke (2006) state the analysis should answer the research questions. Answering the main research question will draw on the integration of data and this will be discussed in Chapter 5. The results of the data collection are presented in the next sections: section 4.1 presents the qualitative data from the semi-structured interviews with the pupils and section 4.2 presents the qualitative data from the semi-structured interviews with the teachers. These interviews were transcribed and analysed using thematic analysis (Braun and Clarke, 2006). The results from the thematic analysis is presented in thematic maps, (See appendix xxvi for an example of how the quotes were coded, then categorized into sub themes and overall themes) In this chapter the themes are described and illustrative quotes from the transcripts are used.

4.1: Pupil's views on COGMED

There were three main themes that emerged from the semi–structured interviews with the pupils: these were facilitators and barriers, pupil perceptions and implementing COGMED.

The thematic map below offers an overview of the themes in relation to the pupils' views on COGMED

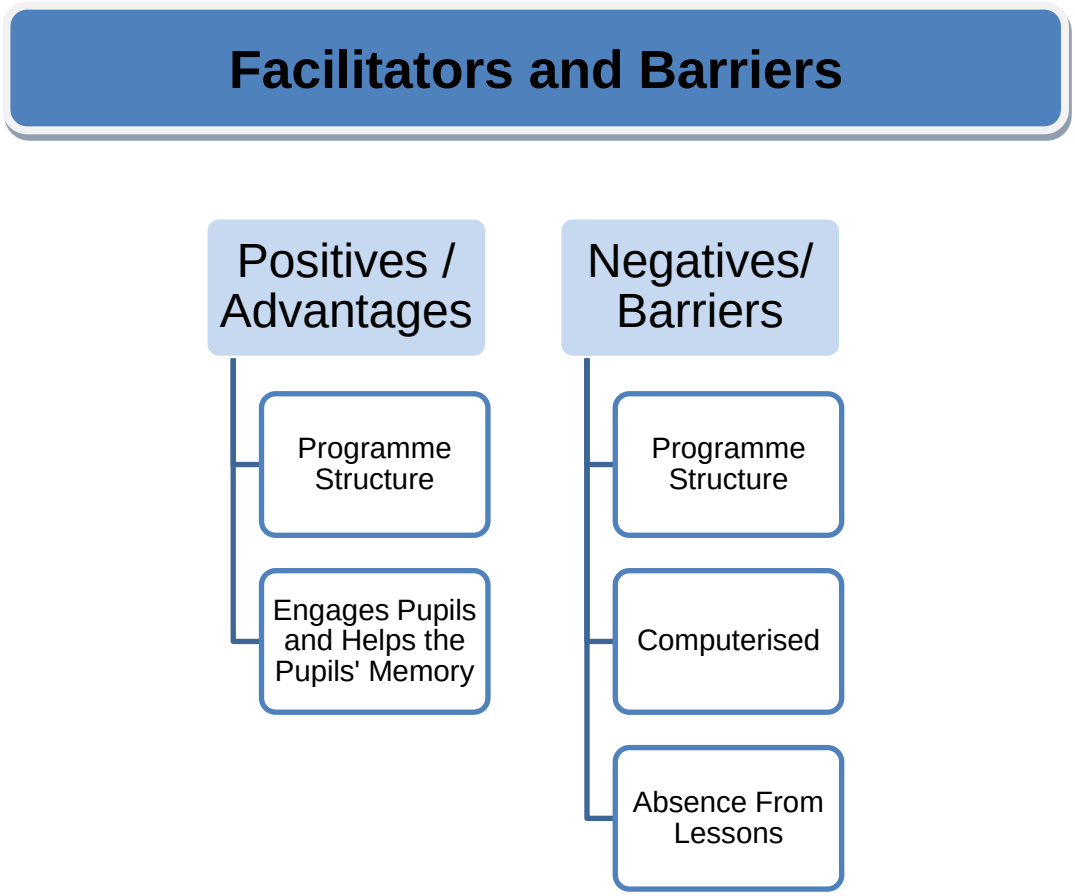
Figure C: Shows a thematic map on the overview of the pupils' views of COGMED.



4.1.1: Facilitators and Barriers

The thematic map (Figure D) below shows the pupils' views on the facilitators and barriers of COGMED.

Figure D:



4.1.1.1: Sub Theme: Positives / Advantages

4.1.1.1.1 Programme structure

A theme that emerged was that the pupils liked COGMED. The pupils were asked to rate COGMED on a scale of 0-10; 10, they liked the programme, 0, they disliked the programme. Generally most of the pupils rated the programme above 7 out of 10. Pupil u1656 rated COGMED 11 out of 10 and Pupil u1514 rated COGMED a 9 out of 10. He

said, *"I thought it was quite good for your memory and everything*" (Line Number (LN) 17). In particular the pupil reported that he liked the game at the end the most. The pupil was then asked;

> Interviewer*: "If the games at the end were not there would it have been a good programme or not?"*
>
> U1514: *"It would have been alright but not perfect".*
>
> Interviewer*: "If it didn't have the games what would you give it then?"*
>
> U1514: *"Maybe a 5 or a 4".* (LN20-23)

A theme that emerged was that the pupils particularly liked the reward game at the end which they called "Robo Racing". Another pupil u1517 reported that the game at the end was the only part of COGMED he liked. Pupil u1659 stated that he liked one of the activities which was called "asteroids". Whilst another pupil said that COGMED is *"fun and easy... because you get to do good games*" (LN34-36). In particular they liked the "rock" and "monster" games.

4.1.1.1.2: Engages and helps the pupils

It emerged that the pupils thought that COGMED was engaging and that it helped them with their memory. For example u1515 said that COGMED will engage and help the Year 5 pupils because it is hard.

> U1515*: "It was good".*
>
> Interviewer*: "Why?"*
>
> U1515: *"Because it was hard, so when Year 5 do it they will remember it"* (LN9-11).

The same pupil thought that COGMED was *"awesome"* because he said, *"It helps me remember, I am getting better now"* (LN43).

Another pupil u1514 said, *"I thought it was quite good for your memory and everything"* (LN17).

4.1.1.2: Sub Theme: Negatives / Barriers

4.1.1.2.1: Programme structure

U1517 did not like COGMED because it was boring and frustrating. He reported that it was frustrating because, *"You had to memorize stuff and like and got frustrated because I didn't know"* (LN55). He also added it was boring, *"You just had to sit there and it was boring"* (LN31).

Pupil, u1514 said that he also thought the programme was boring when, *"You have to wait quite a bit if it doesn't work"* (LN87) also *"if you can't log in or anything you had to wait a bit"* (LN89). Also u1519 said that the games on COGMED were *"hard to remember"* (LN18). U1515 said about one of the games*, "it's hard, it's going round and you have to click it as it is going round"* (LN56). Another pupil u1659 also thought that the same activity was difficult as he said, *"The one where you have to put them and they turn it"* (LN78).

4.1.1.2.2: Computerised

A theme that emerged was that COGMED was computerised and this could be a barrier, Pupil u1519 said *"It was cause we did it on tablets, if they needed charging then we couldn't do it till later on"* (LN82-83).

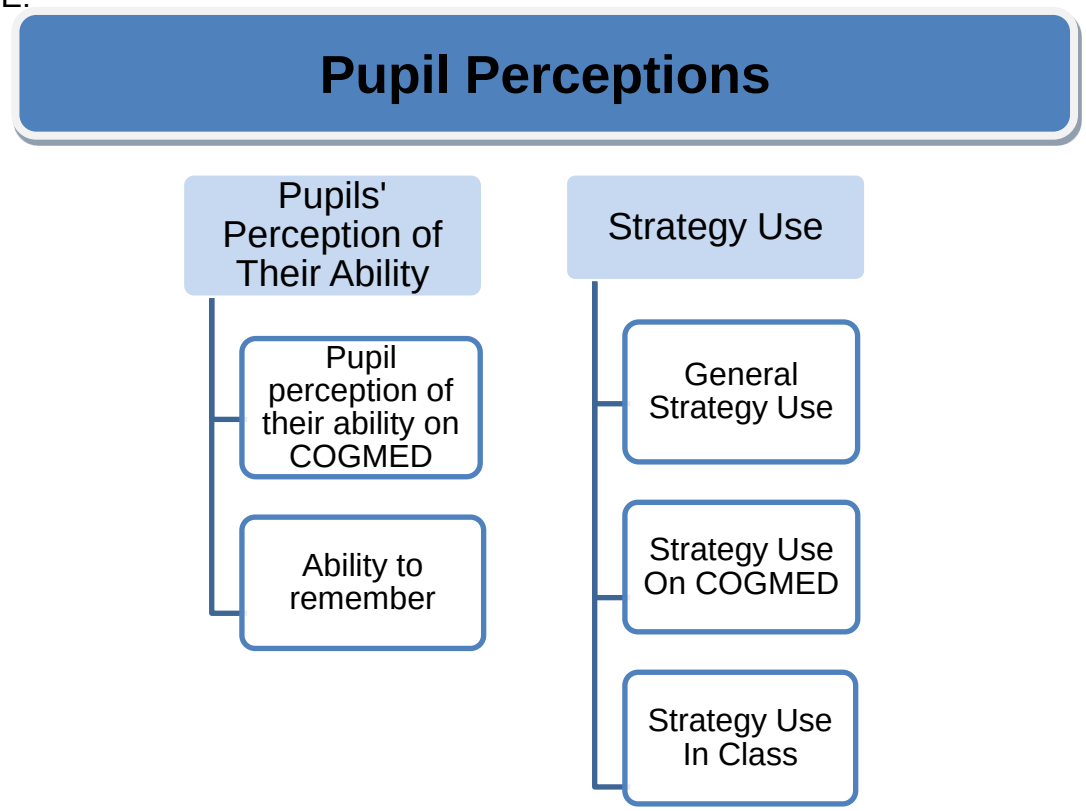
4.1.1.2.3: Absence from lessons

U1519 reported that a drawback of participating in COGMED was that he *"missed out on some lessons"* (LN35). Furthermore he said, *"it was usually a fun lesson that I was doing it as well"* (LN37). He suggested that he would rather be in the lesson unless it was boring.

4.1.2: Pupil Perceptions

The thematic map (Figure E) below shows the pupil perceptions.

Figure E:



4.1.2.1: Sub Theme: Pupils' perception of ability

4.1.2.1.1: Pupil perception of their ability on COGMED

U1658 reported that out of all the tasks on COGMED he thought he was good at *"asteroids".* Another pupil u1515 reported they struggled with one of the COGMED tasks, *"I do remember a tricky one that I wasn't very good at, a circle and it spinned round and you had to remember where it was"* (LN30-31).

4.1.2.1.2: Ability to remember

Some of the pupils reported that they had difficulty remembering things. After participating in COGMED the pupils were interviewed and asked to scale their ability to remember on a

scale of 0- 10 (10 – very good 0 – poor). For example two pupils u1658 and u1656 rated their ability 5 out of 10, another pupil u1659 3 out of 10.

4.1.2.2: Sub Theme: Strategy use

4.1.2.2.1: General Strategy Use

It emerged as a theme that pupils in this study were not able to report whether they used a strategy to recall information out of context. However if they were given a specific task such as recalling a four-digit number then some of the pupils were able to identify if they used a strategy. Inclusively u1515 said that some of the tasks used to facilitate discussion were similar to the COGMED tasks.

U1517 was asked, "If I said to you 7392 and I want you to repeat the numbers backwards". The pupil was able to recall the numbers. U1517 was able to report that he used rehearsal to help him remember, for example he said, *"I kept saying it in my head"* (LN90). U1517 was the pupil who the teachers thought had difficulties engaging with COGMED and therefore withdrew him from the programme. Also u1658 was able to report that he uses rehearsal when prompted to think about how he remembered on the discussion tasks.

> Interviewer: "*What helps you remember? You told me earlier something that helps you remember?"*
>
> u1658: "*Like erm, it helps me to remember like I think of a word erm like what sort of word it looks like, say sleepy, no not sleepy erm..... hurm....."*
>
> Interviewer: *"What did you do when I gave you those numbers, what do you do to remember?"*
>
> u1658: *"Hur..er..m .....Oh right! I counted them and I said them"* (LN34-38).

However one of the pupils was able to report the use of strategy without being prompted or being asked to recall a four-digit number. The pupil was asked;

Interviewer: *“Is there anything that helps you remember?”*

u1515: *“Yes I say it in my head”* (LN12-13).

In addition to rehearsal u1515 reported that he was able to use chunking to help him remember the numbers. Another pupil u1656 reported that he used pointing at the objects to help him remember, whilst pupil u1658 reported to help him remember he said, “*I was concentrating very hard”* (LN133).

4.1.2.2.2: Strategy use on COGMED

The pupils were asked if they used anything to help them remember and this is also detailed in 4.1.3.2, outcomes of delivery. U1658 was asked how he remembered the tasks on COGMED.

Interviewer: *“Did you do anything to help you remember the asteroids and remember where they were?”*

U1658: *“I was concentrating very hard”.*

Interviewer: *“Anything else?”*

U1658: *“I don’t think so”* (LN132-135).

With additional prompts, through the use of the discussion memory tasks, the pupil was able to *report, “I say it in my head”.* The pupil was then asked*, “Do you ever do that in class?” and he responded by saying, “Erm no, I dunno”* (LN1*53-156).*

4.1.2.2.3: Strategy use in Class

Strategy use in class emerged as a theme. U1656 reported that they try to use rehearsal in class. He said:

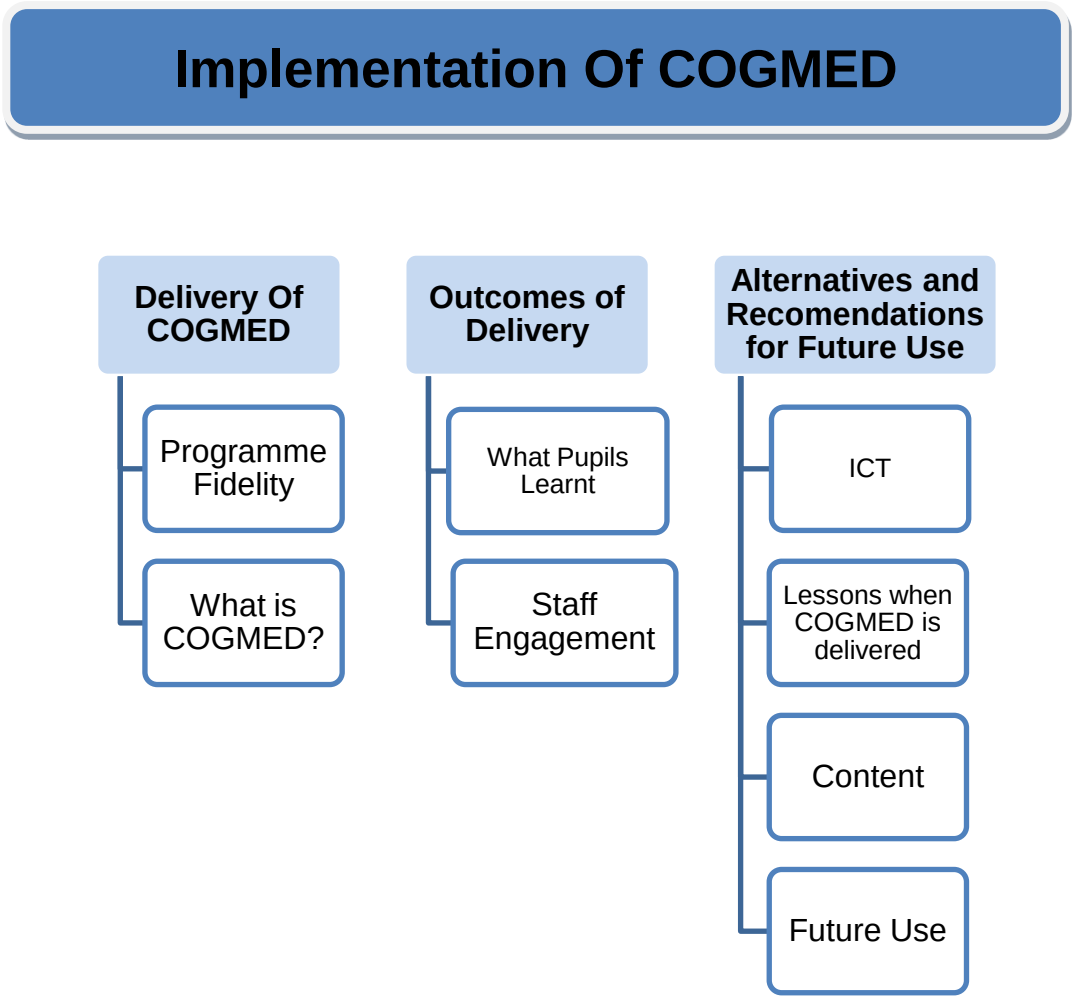
U1656: *"Erm yeah but sometimes, when I repeat it in my head to remember the teacher is saying another word that I have to try and remember and then I look at her, listen to that bit and after that then I forget"* (LN165-167).

Another pupil u1515 reported that he counts on his fingers to remember. He also would use chunking whereby if the numbers were 2, 8, 5, 9 he reported, *"So you had 2859 you would think of it as two thousand eight hundred and fifty nine"* (LN37). U1658 reported that he remembers words by remembering the shape of the word, *"Erm like what sort of word it looks like"* (LN35).

4.1.3: Implementation of COGMED

The thematic map (Figure F) below shows themes associated with the implementation of COGMED.

Figure F:



4.1.3.1: Sub Theme: Delivery of COGMED?

4.1.3.1.1: Programme Fidelity

One of the pupils reported that he breached the fidelity of the programme. This was the pupil whom the teachers discontinued from engaging with the programme.

Interviewer*: "Were you good at any of the tasks?"*

U1517*: "Only when like I cheated a bit".*

Interviewer*: "How did you cheat?"*

U1517 "I wrote them down that's it".

Interviewer*: "So you wrote them down as you went along?"*

U1517*: "No I just do sums, so instead of working them out in my head I worked them out on a piece of paper"* (LN71-75).

4.1.3.1.2: What is COGMED and its purpose?

The main feature that several of the pupils reported they could remember about COGMED was the Robo racing reward game at the end of each session. There were mixed reports of their understanding of COGMED. U1658 reported it was a programme where they had to memorise items. U1656 reported, *"COGMED is er game that helps you remember, like if had bad, like you were very bad at remembering stuff and you had to remember.. like where like you put the keys something"* (LN122-123). Another pupil reported that he did COGMED because his teacher wanted to help him with his memory ability. U1659 said he didn't know what COGMED was;

U1659: *"I don't know, miss didn't tell us what COGMED is".*

Interviewer*: "Did she tell you why you were doing it?"*

U1659: *"No"* (LN42-44).

Additionally another two pupils, u1517 and u1518 also said they didn't know why they were doing COGMED or how it would help them. For example u1517 reported:

Interviewer: *"So why were you doing COGMED?"*

U1517: "*Learning in year 6".*

Interviewer: *"Do you know what you would get from doing it?"*

U1517: *"No"* (LN57-59).

4.1.3.2: Sub Theme: Outcomes of Delivery

4.1.3.2.1: What the pupils learnt

Pupil u1517 reported that COGMED had not taught him anything new and that it didn't help him. U1656 indicated that he was aware he used strategies on COGMED such as pointing at the items, but had not considered whether he used strategies in class as he said, *"I hadn't thought about that"* (LN101). The same pupil thought that COGMED had helped him remember things, and when he was asked how it had helped him he said, *"Cause erm there are these remembering tasks..... that you have to do to remember"* (LN82). The pupil was then asked, *"Has COGMED taught you anything?"* The pupil said *"Listening, pointing, trying to remember a bit more and my brain has got smarter"* (LN129). He also said, *"It has made me remember stuff better, like it might remind me of the maths homework that we are doing"* (LN152). Some of the pupils didn't think they had learnt anything from COGMED, for example u1519 reported:

> *Interviewer; "Has it taught you anything or helped you in any way?"*
>
> U1519*: "With memory and listening".*
>
> Interviewer: *"Did it teach you new ways to remember things?"*
>
> U1519: *"Not really".*
>
> Interviewer*: "Has it taught you anything that you can use in the classroom?"*
>
> U1519: *"No"* (LN70-74).

One pupil reported that it was helpful but couldn't report how it was helpful or what strategy they use without additional prompting:

> Interviewer: *"Why would you recommend it?*
>
> U1514: *"Because if they have trouble remembering things it would help them to adapt".*
>
> Interviewer*: "How would it help them?"*

U1514: *“It would help them by … not sure”*

Interviewer: *“Why were you doing COGMED?”*

U1514: *“It was to help with my memory”.*

Interviewer: *“So before you did it what did you expect to be different after it?”*

U1514*: “That I’d have much more, know how to memorise things more”*

Interviewer*: “Do you think it did that?”*

U1514: *“Yeh”.*

Interviewer*: “You do?”*

U1514: *“Yeh”*

Interviewer: *“How do you know that?”*

U1514: *“Cause since I’ve done that its helped to remember things more often”*

Interviewer*: “Is there anything it taught you to remember or anything new?”*

U1514: *“That you can remember sequences in a different way”.*

Interviewer*: “So what were you doing to remember them?”*

U1514: *– “Remember them backwards and then put them in the right order, try it that way then try it the other way”.*

Interviewer: *“So can you remember if you were doing anything to help you remember?”*

U1514: *“Not really”.*

Interviewer: *“If I said to you 7923 say it backwards what would it be?”*

U1514 *: “3297”.*

Interviewer: *“Brilliant how did you do that?”*

U1514: *“I went through it in my head twice then tried it the other way”.*

Interviewer: *“So you did something to remember there, what did you do?”*

U1514: *“I said it to myself in my head”.*

Interviewer: *“Did you do that before you did COGMED?”*

U1514*: “Not really”.*

Interviewer*: “So how did you learn that?”*

U1514: *"Off the programme"* (LN29-59).

This indicates that the pupil finds it difficult to identify explicitly what he has learnt from COGMED, but in the context of a task he was able to make use of a strategy.

4.1.3.2.2: Staff engagement

The pupil, whom the teachers reported made the most progress on COGMED, reported that the teachers did not help him to develop strategies to use on COGMED as he said

Interviewer: *"How would you remember?"*

U1515*: "By keep saying it in my head".*

Interviewer: *"Keep saying? And did you always used to do that?"*

U1515: *"Yeah".*

Interviewer: *"Even before COGMED?"*

U1515*: "No because I didn't know about it".*

Interviewer: *"Well did someone tell you about it?"*

U1515: *"Ms and erm erm erm showed it, and told us we would be doing it mostly nearly every day".*

Interviewer: *"Did she tell you to say it in your head?"*

U1515: "*No .. yeah she said, she was like she was telling u1517 to erm concentrate".*

Interviewer: *"Did she tell you to say them in your head?"*

U1515: "*No".*

Interviewer: "*What made you start doing that that?"*

U1515: "*I thought it was a good strategy so I started doing it".*

Interviewer: *"So you just did it without anyone telling you to do it?"*

Pupil u1515*: "Yeah"* (LN12-27).

In u1514's view he perceived the teachers to not engage with them during COGMED as he said:

> U1514:"*They just sat and watched us do it".*
>
> Interviewer*: "Did they talk to you while you were doing it ?"*
>
> U1514*: "Not really"* (LN65-67).

4.1.3.3: Sub Theme: Alterations / Recommendations for Future Use

4.1.3.3.1: ICT

Some of the pupils reported ICT issues. U1656 reported he would improve an ICT issue:

> "*I would change one thing, erm when you go on the game with the little lights, red lights sometimes when you lose signal and you go back on, the lights go on twice at a time you never know which is which"* (LN137-139).

Another pupil u1519 said, "*It was just cause we did it on tablets if they needed charging then we couldn't do it till later on"* (LN82-83). Whilst u1514 said he found it boring if he had to wait "So if you can't log in or anything you had to wait a bit" (LN89).

4.1.3.3.2: Lessons when it is delivered

U1519 suggested for COGMED to be delivered when it wasn't a science or history lesson. Another pupil u1517 would have liked to have been taken out of class to undertake COGMED.

4.1.3.3.3: Content

One pupil said that they would like more games in the programme at the end.

4.1.3.3.4: Future use

Some of the pupils said that they would participate in COGMED again, whilst u1517 said he wouldn't as it was boring.

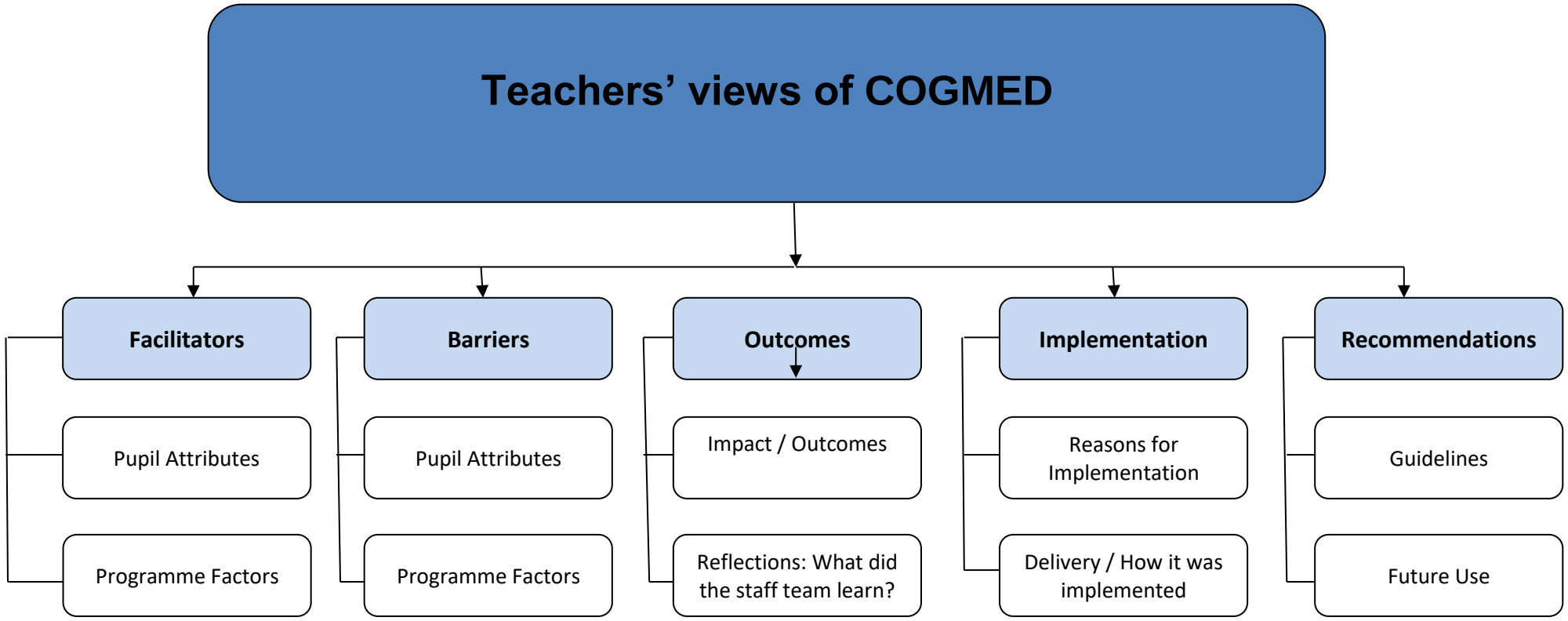
The next section describes the results from the thematic analysis of the teachers' semi-structured interviews.

4.2: Teachers views' on COGMED

The thematic maps (Figure: G, H, I, J, K and L) offer an overview of the five global themes of facilitators, barriers, outcomes, implementation and recommendations and their sub-themes (See appendix xxvi and appendix xxvi for an example of how the quotes were coded, then categorized into sub-themes and overall themes). It is important to note that the teachers discuss the implementation of COGMED with Year 5 pupils and also Year 6 pupils. One of the teachers implemented the programme with the Year 5 pupils in the summer term and another teacher implemented the programme with the Year 6 pupils in the spring term and hence implementing COGMED with different year groups in different school terms may be a factor that influenced their experiences of implementing COGMED.

The thematic map Figure G offers an overview of the teachers' views on COGMED including the fa
barriers for the implementation of

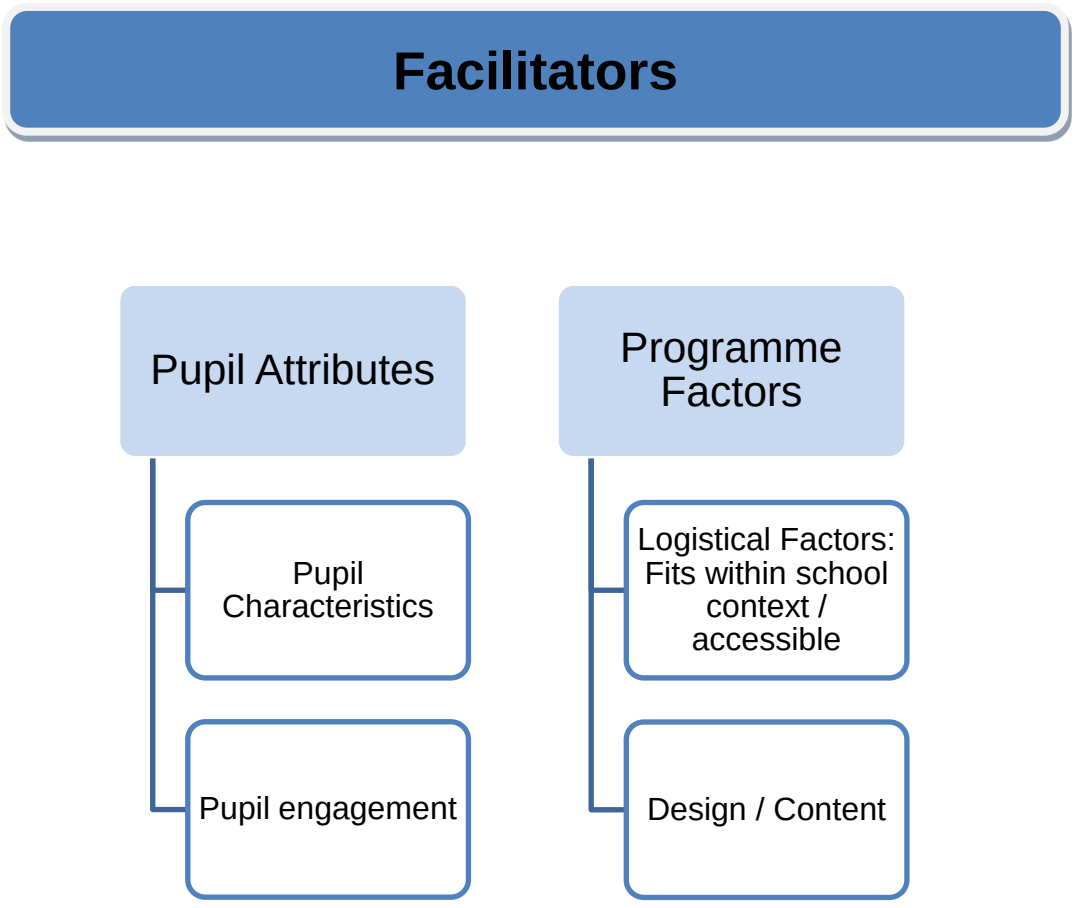
Figure G: Shows a thematic map on the Teachers' views of COGMED.



4.2.1: Facilitators

The theme of Facilitators has two sub themes of Pupil Attributes and Programme Attributes and four basic themes of pupil characteristics, logistical factors, pupil engagement and design/content. The thematic map (figure H) below shows the teachers' views on the facilitators.

Figure H:



4.2.1.1: Sub Theme: Pupil Attributes

The attributes of the pupils were described by the teachers as facilitators.

4.2.1.1.1: Pupil Characteristics:

a) Attendance

The teachers discussed a number of pupil characteristics which were facilitative factors. One of the teachers noted that all the Year 6 pupils were good at attending school and this aided the ability to deliver the programme.

b) Perseverance

The teachers thought that out of all the Year 6 pupils the one who appeared to make the most improvement on COGMED was u1515 who appeared to have the most perseverance and had better concentration in class. Interestingly teacher A reported that she thought that out of all the Year 5 pupils u1656 had made the most progress on COGMED and also she noted that when the pupils were undertaking the programme he was the one who persevered the most.

c) Following instructions.

Teacher A said that U1656 was very confident with the programme, he understood what he needed to do and was able to follow the instructions well.

4.2.1.1.2: Pupil engagement

Teacher A said that the three Year 5 boys were able to log on and engaged well with the programme.

> "*One thing I did notice that was quite interesting was the way that they all sat..... towards the end they were all sat upright in their chairs, you know erm and holding the ipad properly and you know working away.....Even when they came down here into reception one afternoon to do a couple of catch up sessions for COGMED and reception is an incredibly busy environment to try and work in so they had their headphones on but even so in this kind of environment it is easy to be distracted. They were all incredibly focused so that was interesting to see"* (LN111-118).

4.2.1.2: Sub Theme: Programme factors

4.2.1.2.1: Logistical Factors:

a) Accessibility

Teacher D reported that the programme was accessible and easy to implement.

"Well it was quite easy to set up and do, you just went ahead" (LN293) and "*I suppose the advantages are they can do it independently and at their own level and at their own pace"* (LN330-331).

Teacher C also thought that the programme was accessible as it was not expensive, she commented, *"It wasn't that expensive and you could start with a small number I thought it's worth a go"* (LN92-93).

b) Fits within the school context

Teacher C said that COGMED was easy to use within a school context. The teacher reported

> "*It's really easy to fit in your day, so even if you had a Christmas show practice or something that disrupted when you would normally deliver COGMED it wouldn't matter. It's so easy to pick up and do, so nothing gets in the way of it happening really"* (LN229-231).

Teacher D reported that the best time of year to deliver the programme is after Christmas, whereas Teacher A suggested that the autumn term is the most appropriate term to deliver the programme.

4.2.1.2.2: Design and content

Features of the design and programme content of COGMED were described as facilitators**.**

a) Computerised

COGMED is a computerised programme and this was considered to be a facilitative factor. Three of the teachers reported that the pupils liked that the programme could be accessed on an Ipad. It was mentioned that COGMED was given to the Year 6 pupils once the school had purchased a laptop for the teacher to log onto the system. Teacher C said that she liked that COGMED was a computerised programme and did not require much adult intervention. She also discussed that the graphics on COGMED were visually appealing and she then compared them to the computerised literacy intervention IDL.

> *"I think that they really enjoy being on the computers.....This is a real motivator, even I mean IDL the other one we use isn't like COGMED, COGMED's graphics are lovely for children IDL looks so boring but they love it because it's on the laptop"* (LN347-350).

Additionally Teacher A said that she also thought that by COGMED being computerised it was appealing to the pupils, particularly to the boys who participated in the programme. Teacher D also said that one of the pupils liked using an ipad *"he didn't want to work.... they enjoyed it just because they were on an ipad"* (LN548).

Teacher C liked that COGMED was a computerised programme also because the staff could deliver the intervention simultaneously to more than one pupil. She reported:

> *"To take them out of class and do it 1 to 1 we just couldn't do it so to be able to have six sat on ipads in one room in the school with one TA it seemed like we would be able to help more children"* (LN109-112).

> *"Yeh so to help six children in 15 minutes it's as easy as picking up an ipad and having a go on a thing, we haven't really got much option"* (LN257-258).

Teacher C also discussed that a teacher would not need a high level of knowledge of ICT. *"I did like the design and as someone that is not ICT confident I felt that it was easy to use"* (LN259-260).

Teacher D also liked the concept that COGMED is computerised. It may be suggested that Teacher D, Teacher C and Teacher A seemed to like that COGMED was on a computer

so it didn't place additional demands on adult time. As an example Teacher D said *"That was really good that side of it cause they are actually doing it, all on their own its theirs"* (LN170).

b) Programme support

i) <u>Pupils</u>

It was noted by Teacher A that u1656:

> *"Never had to ask for help when he was undertaking COGMED and he was able to request COGMED programme to repeat any instructions and was able to complete half an hour on the programme without any issues"* (LN8-12).

Teacher A said that u1656 was the Year 5 pupil who made the most progress according to the COGMED monitoring system.

Teacher A reported that the programme would help the pupils by repeating the instruction, *"Erm well the instructions, they just repeat what they have to do"* (LN23).

ii) <u>Teachers</u>

Teacher C reported the programme is designed so that it is simple to use, and that staff do not need additional support

> *"It's pretty simple to use and I don't feel you need any additional support, the Teaching Assistant who's overseeing the implementation of it, she's erm did some online training. I had training at the SENCO forum, but it's pretty simple to use"* (LN188-190).

c) *Integrated monitoring system*

Teacher C liked that COGMED gives a numerical score at the start and at the end of the programme. She also said;

> *"I like the fact that there would be quantifiable data to show an improvement, so that I could justify why I had spent money on it, why I am using it, so after this small group. I liked the fact that if it worked for them and I got it for more children there would be data from the start and data from the end"*(LN95-98).

d) Reward at end of COGMED

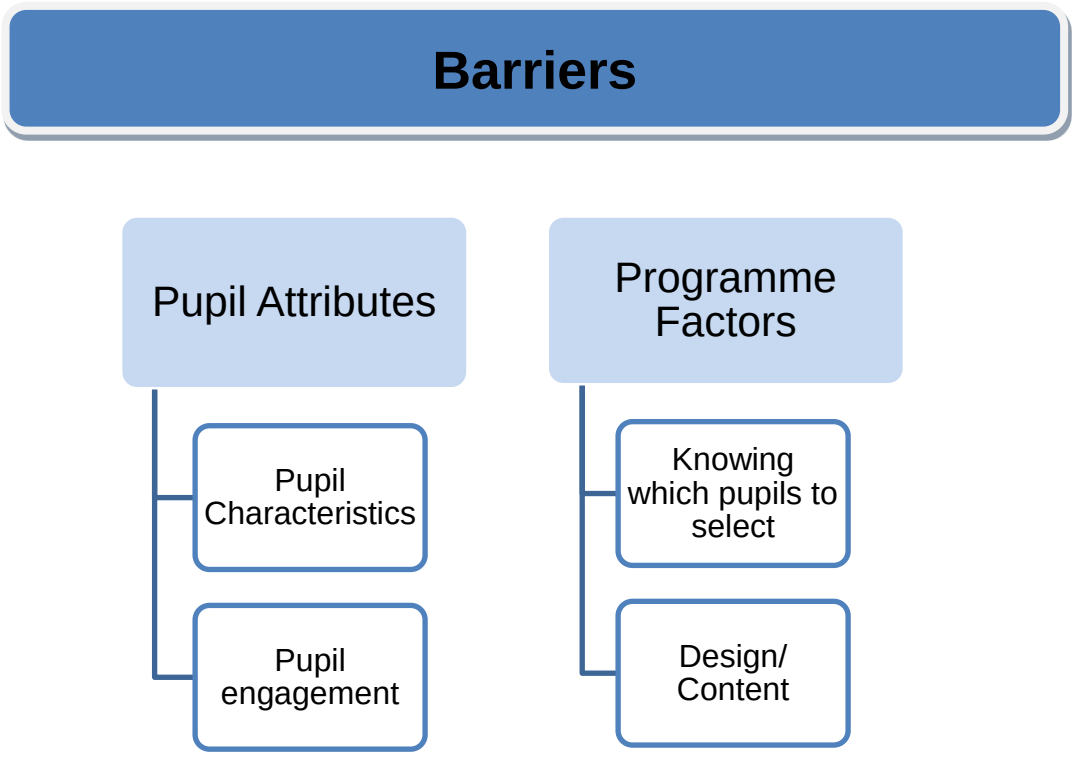
Teacher D talked about how the pupils got a reward at the end of every completed session on COGMED and that this was a facilitative factor,

> "*The games they got at the end of it when they'd finished it... so there's a little incentive"* (LN172-173) and "*Every now and then they got a game, they were all games really*" (LN550-551).

4.2.2: Barriers

The theme of Barriers has two sub themes of Pupil Attributes and Programme Factors and each sub theme has two underlying themes. The thematic map (figure I) below shows the teachers' views on the Barriers.

Figure I:



4.2.2.1: Sub Theme: Pupil Attributes

4.2.2.1.1: Pupil Characteristics

The teachers described some of the pupils' characteristics and abilities as a barrier to accessing COGMED.

a) Pupil's Processing difficulties

Teacher D talked about how she suspected that one of the pupils had processing difficulties and therefore she thought that COGMED would not be effective with that pupil. She said, *"This won't work again, that's not your problem, cause if she can't process it, it's no wonder she can't remember it cause she can't process it"* (LN427-428).

b) Pupil's Anxiety

Teacher A discussed that one of the pupils had a diagnosis of autism and anxiety. She talked about the Year 5 group and the pupil, saying;

> *"You know the only one who showed any negativity was "u1658" and that was more to do with his stress levels and his anxieties. So he found it difficult*" (LN40-41*). She also said, "He would get really frustrated with it and would be tapping the screen really hard and could get quite oral about it, but he has made the next stage of progress with it after u1656"* (LN47-48).

c) Pupil's Motor skills

Teacher D thought that one pupil found it difficult to access the programme because he had motor skill difficulties. The teacher said, "*And that's when we thought it's not suitable for him because maybe he's making mistakes because of this shaking"* (LN269-271).

d) *Pupil Concentration*

Teacher D and Teacher C indicated that the pupils' ability to concentrate was a barrier to the pupils accessing COGMED. As an example Teacher D suggested that one of the pupils could not access the programme as they were unable to concentrate on COGMED

for the full time period of a session which was 25 minutes. She said, *"Maintaining your concentration for twenty–five minutes, he struggled anyway, he struggled to maintain his concentration for ten minutes"* (LN364-365).

Teacher D continued to say, *"They were like away with the fairies, they couldn't that's the problem, some of them had, poor concentration, they couldn't even for ten minutes. We had to sort of come on get back on, sit up, get on".* She also said, *"I mean daydreaming, drifting off was one of the problems, they couldn't retain anything because they weren't listening in the first place"* (LN77-79).

Another Teacher, Teacher C said, *"in hindsight right now some of the children we chose were the wrong children, because some of the children I chose had other difficulties, around concentration and attention things and it didn't work as well on them, erm so the ones who's on the tracking data are not making great progress"* (LN14-17).

e) Other factors

Teacher D talked about a pupil's behaviour as a barrier to accessing COGMED. The pupil was described as acting *"silly*" in class and wanted to fit in so she said he *"acted like a clown*" (LN328).

She also mentioned that the pupil's ability was a barrier to accessing the programme as she said, "*He used to get mad with it .... because he suddenly realised I can't do this and everyone else can"* (LN223-226). Another teacher, teacher C, also mentioned that behavioural problems and home factors including trauma impacted on the pupils' progress on COGMED e.g. "*One boy I think of that goes to a pupil referral unit that's being assessed for ADHD who has had some trauma at home recently for him it didn't have the same impact"* (LN70-72). Additionally she reported *"I chose some other children who had*

other needs to do with behaviour, in hindsight I wouldn't say it worked as well for them" (LN25-26).

She also discussed how the pupils were individually different, particularly in their self-esteem and self-image. For example, *"From looking at the data at the end I would say the ones, even the ones with self-esteem differences, low attainment all did well with it. The ones that didn't are the ones with behavioural concentration"* (LN53-56).

f) Pupil Perseverance and Patience

Teacher D described one of the pupils as having a lack of patience and this was thought to be a barrier to engaging with the programme. U1517 was thought to not persevere, also became frustrated with the programme. She thought that the pupils needed patience to engage with COGMED. For example she said, *"It didn't improve his, he didn't have the erm patience, can't do it ... then he'd have a paddy"* (LN87-88).

The teacher also said, *"And if you've got no patience, you know if you're not erm a resilient learner and you can't cope with failure and move on you know with it, u1517, it didn't actually work with him because he had no he had no, resilience in anything, if he couldn't do it ... no patience, no tolerance, give up, sulk and strop"* (LN212-216).

4.2.2.1.2: Pupil Engagement

a) Attendance

Teachers A and B mentioned that Year 5 pupils, u1661, u1659 were absent from school for a significant amount of time and this was a barrier to being able to deliver the programme. Teacher A said, *"Erm so because certainly a couple of the children who because we had signed up for COGMED one of the children had been off for quite a chunk of time so could of actually done with more teaching input but because he had started the COGMED we felt he had to carry on, so it's quite a big chunk"* (LN192-195).

b) Pupil response to programme

It was discussed how one of the pupils responded to COGMED. Teacher D said, *"And one child in particular used to throw it about because he got so frustrated he couldn't remember a four digit number"* (LN81-82). Also she said that, *"He used to get mad and try and hit the Ipad"* (LN371-372).

In addition Teacher D reported that the Year 6 pupils were not using any strategies to assist them to complete the COGMED tasks. She discussed that they couldn't remember and complete the tasks, for example they could only remember part of the sequence of numbers, *"And sometime they weren't even getting the full number repeated they would get the first, no they would get the last maybe"* (LN496-496).

4.2.2.2: Sub Theme: Programme Factors

4.2.2.2.1: Knowing which pupils to select

Teacher A was unsure how the pupils would respond to COGMED, she thought it was important to have an understanding of how the pupils may respond to and engage with the programme. *She said, "Erm because one child got quite distressed by it, but they had to keep going to get used to it so it's making you know it's understanding the children as well I think before they do it"* (LN154-156).

Teacher A discussed that some pupils may not be suitable for the programme, but she thought that until the pupils had undertaken the programme she wasn't able to judge who would be suitable for the programme. She noted that,

> *"I think there are a couple that I wouldn't of selected no erm and one was because erm he has got autism and it was just too frustrating for him. He couldn't cope with that frustration of erm like the speed the reaction of the programme wasn't quick enough for him, which you know but then you know there was another child who really seemed to benefit from it, he worked really well on it so, until you do it you don't really know that's the trouble"* (LN201-206).

4.2.2.2.2: Design / Content

a) Transfer

It was identified that if any of the pupils made progress on COGMED, a reported drawback of the programme structure was that the progress the pupils made on COGMED did not transfer to the classroom. This was particularly indicated by Teacher C who said, *"Yeh sometimes they improve in COGMED but do not bring those strategies back to class, but I'm not saying that's the fault of the programme, I think that is probably an indicator of the teacher and teaching assistant"* (LN314-316). The teacher was then asked a further question

> Interviewer: "*They can't generalise, transfer the skills from COGMED?"*
>
> Teacher: *"Sometimes yeh, so that's on the skills of the teacher"* (LN317-318).

b) Design

Teacher D talked about how they thought that a drawback of the programme content was that it was just number sequences or patterns. It was discussed that one of the pupils became frustrated with the task, whereby he had to remember some numbers in reverse order. She went on to discuss how the programme could have been modified. These suggestions are acknowledged in section 4.2.4 Recommendations. Teacher A and D both explained that they thought the design of the programme was frustrating for some pupils as it was repetitive. Teacher A said,

> *"I'm not sure erm how well that worked for certain children because some of them were frustrated....they were just doing the same thing over and over again whereas the programme adjusted slightly to their scores and things like that but it was the same type of activity over and over and over again which I guess is part of reason, but it did frustrate some children"* (LN165-169).

At another stage in the interview she also said that repetitiveness was an issue:

> "*So repetitive, because that kind of put one of the children off who could of actually really benefitted from it, had it not been so repetitive but then that's just one child"* (LN2553-254).

Another challenge of the programme was in relation to technology. Teacher A mentioned;

> "*Well for us, a school, it was you know making sure the Ipads were working and that we had headphones and you just didn't. Especially with the headphones side of thing you didn't really, I didn't sort of think that was a necessity until we actually started using it and then we sort of had to scrap around"* (LN183-186).

c) Time consuming and mis-matched with contextual demands

Teacher D, thought that COGMED was difficult to administer in the context of the classroom. COGMED was described as time consuming, it was reported that having five pupils in the classroom accessing the programme was difficult to manage and said that they were aware that COGMED recommended the programme needed to be delivered every day. The teacher said, *"Well it's quite disruptive actually because I was trying to teach while that group were getting on so that is quite a disruption to you*..." (LN633-634).

Teacher D, also said,

> *"It messed the class up really because we had five children over there doing that, I'd be trying to teach the class something else and they weren't you know, they were behind because they didn't know what I'd just talked about, cause I'd give them something else to do, it messed up the afternoon really. I didn't want it doing in the morning cause I didn't want it to interfere with literacy and numeracy and I suppose if you've only got one or two children in the class on it, it wouldn't be too bad, but five of them and they struggled anyway"* (LN193-201).

Additionally another Teacher A also said that the programme is time consuming

> Interviewer: *"What would you say are the disadvantages of using COGMED?"*
>
> Teacher A: *"Erm I think the fact that it does take a good chunk out of teaching time"* (LN189-190).

Teacher A said in the summer term there are lots of other activities happening in school including assessments, events and school trips. She stated,

> *"If we are doing something like COGMED that you need to be doing it every day...so the summer term is not the best time to do it er I mean that there is going to be something in every term. In the autumn term you have the nativity plays and all that sort of thing errrr spring certain children getting ready for tests or SATS or whatever"* (LN78-84).

Teacher B also discussed how the summer term was not a suitable time to implement COGMED. She said,

> "*Well normally on other terms it would not of been a problem, it would have been a lot more secure, a lot more routine, it would of happened the same time every day or the about the same day and I feel I would might of seen, of picked up on any differences"* (LN235-237).

This teacher indicated she didn't observe any differences in the pupils in the classroom but thinks that if they had employed a routine for delivering the programme then this may have occurred.

d) Lack of feedback / monitoring progress provision

COGMED has a monitoring system that provides data on the participants' progress on the programme. This is described in further detail in a later section of this chapter in Section 4.3.3. However Teacher A stated,

> *"I think that because it takes them out of a good chunk of learning time it ... they may not of had more summative assessment that you would do while they are learning while you're teaching them, that sort of day to day assessment, you couldn't really do that with the programme. It's difficult to get feedback for the programme"* (LN279-282).
>
> She also said, *"I don't know erm if you could sort of assess as you go really and then you could take children off it or something but you kind of feel that you've got to do the whole programme otherwise you won't see the impact and there are some children that won't ever make that have that impact so is it then wasted you know however many weeks wasted"* (LN196-199).

This can be compared and contrasted to Teacher D who reported that they were aware that COGMED had an integrated monitoring programme and she accessed it to observe the pupils' progress after undertaking some sessions on COGMED.

e) *Cost*

Teacher A reported that COGMED's cost is a barrier. *She said, "I think you know cause it's not a cheap option so you feel you need to keep going at it to get your money's worth"* (LN205-206).

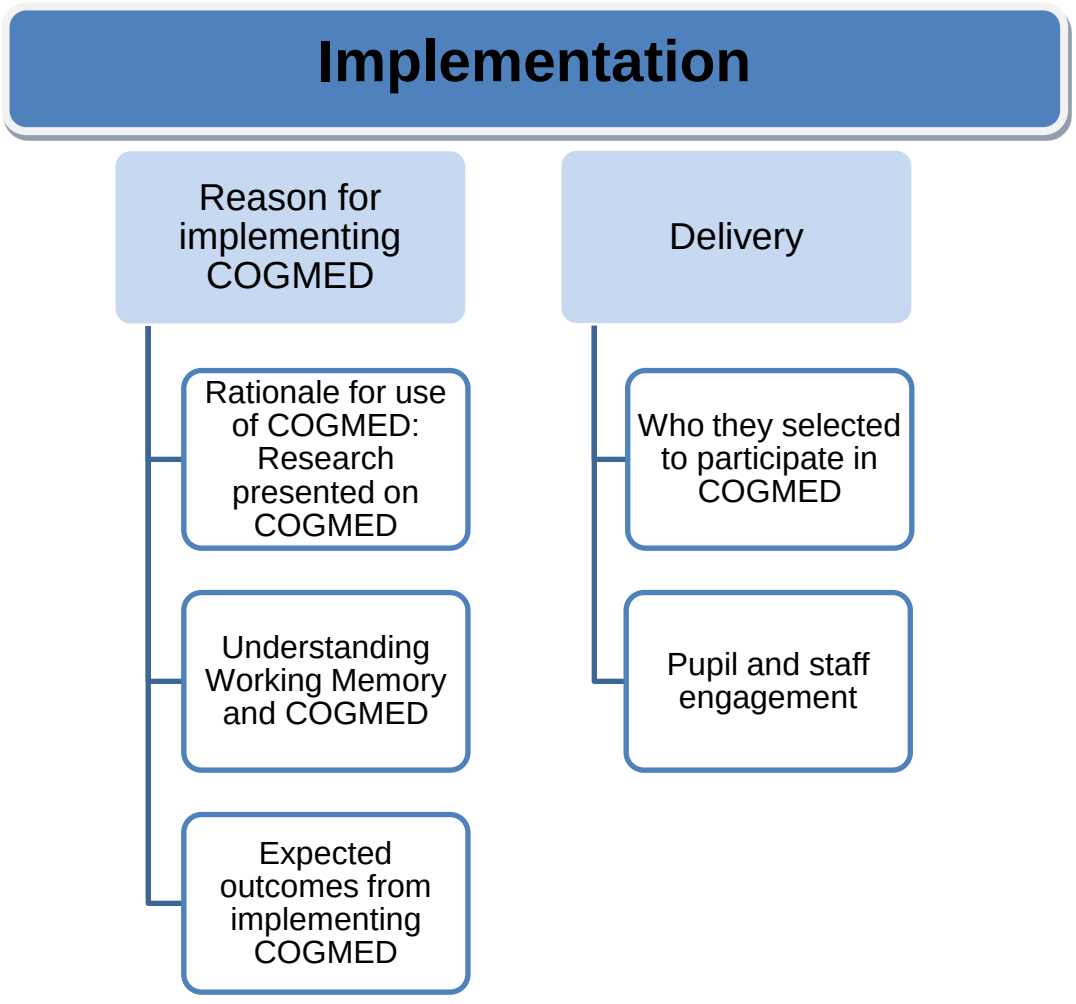
f) Teachers' understanding and accessing the programme

Using ICT was reported by one teacher as a difficulty, she also mentioned that the teachers may not have had regular conversations about the programme and understood COGMED and also another difficulty was identifying the children that will benefit from COGMED.

4.2.3: Implementation

The theme of Implementation has two sub themes of reasons for implementing COGMED and Delivery. The thematic map (figure J) below shows the teachers views on the implementation of COGMED.

Figure J:



4.2.3.1: Sub Theme: Reason for Implementing COGMED

4.2.3.1.1: Rationale for use of COGMED

One of the teachers explained that the school initially bought COGMED to use with five Year 6 pupils as a trial as they wanted to explore how effective it was. It emerged that there were three main factors that influenced the rationale of using COGMED.

a) Research presented on COGMED

Teacher D explained they first became aware of COGMED when they went on a training course delivered by Pearson Ltd. The presenter indicated that there was research to suggest that all participants on COGMED would improve. The teacher said, "*I was told all children would have made an improvement, you kind of get sucked in really"* (LN113) also

> *"they did say they had a lot of research ... they did it on quite a few different schools, it was all very high the results and I think that's probably what has swayed... you know let's have a trial"* (LN163-167).

Additionally they reported that they were told that COGMED would be effective with any children, "*You're kind of led to believe that it was anybody*" (LN422). Interestingly I was aware that the COGMED manual specifies that it is not suitable for some individuals.

Teacher C mentioned that the pupils on the SEN register received 20 minutes a day one to one on over learning literacy and numeracy. However she explained the rationale for choosing COGMED:

> *"So they are getting other input but the reason why we tried COGMED as well is that even though we had tried other interventions and 1 to 1 every day the gap wasn't really closing"* (LN42).

Teacher C also said,

> *"I have been told by an Ed Psych that these children have got working memory difficulty and as a school we need to provide for them and I need to do it in a way and in my budget"* (LN387-390).

Furthermore another rationale for using COGMED was that the school management thought the teachers didn't have to engage with the pupils while they were undertaking COGMED, Teacher C reported that she liked the concept of COGMED because she thought it didn't require a lot of teacher input.

> "*Well it was only half a day and I was well aware that it was a sales person it wasn't a psychologist, well I don't think it was.... which is why I only bought the site licence for 5 children, but I do feel like schools' hands are a little bit tied, because our education psychologist don't really do work with children in school they come in and do assessments. They sometimes give us reports with suggestions in but those suggestions are labour intensive and if you have a child who has no funding with moderate learning difficulties which most of ours get diagnosed with in this school.....that means we need to use the SEN money that comes into school. We find that the strategies given off an Educational Psychologist for these children, that money does not cover that labour... so you've got to be creative, and memory is mentioned a lot in the report I get with moderate, so I feel like my hands are tied, I need something like this app even if doesn't work for every child"* (LN369-382).

Teacher C discussed the rationale for using COGMED as there being a lack of alternatives.

> "*In real life we are just teachers and don't know how to improve working memory. So erm, ... For all the disadvantages I can find in COGMED, that's actually really my only option if I am going to help that number of children"..."Because teachers I wouldn't say have had that much training on working memory and neither have I even as SENCO. Our options are quite limited in how we can try and address issues with working memory so we do have to look out there to see what there is and there is not much. So especially if you are going to try and help a group of 6 in 15 minutes a day, something that's quick and easy to do, because your alternatives, the other games and things you are told about as a SENCO that help working memory are usually one to one with a TA or a couple of children to one TA, which means a TA having resources ready, finding somewhere to do it*" (LN243-255).

Teacher C discussed why she chose COGMED:

> Teacher C: *"There are so many children in our school that staff will come to me and say...they can't remember it, they knew it that day and they don't know it this day. Erm so because there is that many that seem to have the same need so be able to take them out of class and do it 1 to 1 we just couldn't do it, so to be able to have 6 sat on ipads in one room in the school with one TA it seemed like we would be able to help more children"* (LN107-112).

4.2.3.1.2: Understanding Working Memory and COGMED

a) Working Memory`

There were four semi-structured interviews conducted and it appeared that only one teacher, Teacher B, had a clear understanding of working memory. I had met with Teacher B before the focus of the research had shifted from transfer to implementation and therefore I had given her some informal training on working memory.

Teacher B was able to articulate the types of behaviours she associated with working memory difficulties. She discussed how the pupils struggled to copy information from the board into their books and hold numbers and manipulate them in their heads.

Teacher D was asked about her understanding of working memory and she talked about children who couldn't retain things for 10 minutes. She also said, *"You know it wasn't going into the long term memory so we were having to over learn to try and get those pathways made, that's how I understand it*" (LN18-19). For example I also asked this teacher;

> Interviewer: "*What is your understanding of working memory?"*
>
> Teacher: *"My understanding of it is that something actually goes from your working memory into your long term memory so that you can access it"* (LN11-13).

The same teacher also described working memory as

> "*You'd tell them something one day to do something the next day totally gone"* also "*even in your initial part of your teaching and then when it comes to them actually doing it independently, nothing, looking at you blank"* (LN29-31).

Teacher D was also asked what she thought was the general school staff understanding of working memory. Teacher D said:

> "*Well we have had a document on it off our Ed Psych because all the children in here, so we are using the strategies from there in the over learning you know as many tools in the tool bag really as we can for the children. Other people have the same experience. They just keep going back and going back over it and revisiting"* (LN176-179).

Teacher C was also asked the same question about what she thought was the staff's understanding of working memory she said;

> *"I don't know if they would call it working memory, they would call it sort of here today and gone tomorrow. The TAs do a lot of the 1 to 1 precision teaching so they will talk a lot about that, so especially things like phonic sounds or number facts. They might do numbers 1 to 10 and the child's totally got it....they will come back after the weekend and it's gone. So they might not call it working memory, but they understand it as here today gone tomorrow and we have used practical ways of trying to improve working memory but they are very staff intensive aren't they, when you're doing them on a 1 to 1 basis, so I think they would know a little bit"* (LN115-122).

Teacher D also talked about how she finds it difficult to distinguish between processing and memory, "*It's a difficult thing to tell if it whether it's memory, processing, cause they are so far behind it's difficult to tell"* (LN433-435).

b) Understanding COGMED

One of the teachers mentioned that they didn't have a good understanding of COGMED.

> Interviewer: *"Was it difficult to understand?"*
>
> Teacher A*: "Yes unless you sat right next to the child and watched it the whole time that they did it"* (LN276-277).

Teacher A was not aware of the data that can be obtained through COGMED; for example she wasn't aware that COGMED monitoring system offers data on the time the pupils spent in active training.

> Interviewer: *"I wanted to ask you about time in active training".*
>
> Teacher: *"Yeh you know it doesn't really give too much detail does it?"*
>
> Interviewer: *"Does it not give you that?"*
>
> Teacher: *"No you would want to break things down even further because especially with children who require those interventions their steps of progress are so small erm that you need to be able to see those small steps rather than just an overall score".*
>
> Interviewer: *"What would that look like? Week to week?"*
>
> Teacher: *"Yeh week to week and a breakdown so like whichever task it was, that task was about exactly and how well they did in that task"* (LN265-273).

In relation to teacher A's comments, it mentions in COGMED manual that programme implementers can view data on active training times and a trainee's progress.

4.2.3.1.3: Expected outcomes from implementing COGMED.

The teachers articulated their expected outcomes of COGMED. Teacher C said,

> "*But I had read the research that was behind it and what I was hoping to see was an improvement in the retention of those basic facts that they need, basic skills in numeracy and literacy really. So I was hoping they would do COGMED and show progress on the app and then they would be able to take that back into class and use those strategies to retain facts"* (LN80-84).

Teacher C mentioned on a few occasions about the children developing strategies from COGMED.

> *"It's about drawing that out then using those strategies in class, so that's almost an extra task after COGMED isn't it? So you've done COGMED and you've improved like this but now we need to use these strategies in class"* (LN324-326).

Therefore she was then asked about what strategies she thought the pupils would develop:

> Interviewer: *"What strategies do you think they develop?"*
>
> Teacher C*: "Oh no that's a hard one".*
>
> Interviewer: *"Do you think it does develop strategies?"*
>
> Teacher C: *"Well they did do improve on these games don't they and use memory so they do on the app, erm so it's about asking them so what did you do to get better at that?"*
>
> Interviewer: *"You have a sense they have learnt strategies, what gives you that sense?"*
>
> Teacher C: *"I don't know how to describe it. I think because of how much they improve and develop on the actual game on the app erm they are developing strategies ways to do it, so however its worked for them with the app, I want them to use that in class"* (LN327-335).

Essentially Teacher C expected the pupils to develop strategies as an outcome of COGMED, however she was unable to identify which or what strategies she would like the pupils to develop. The teacher was also unsure how the pupils had improved.

Interviewer: *"Do you think that there are specific tasks that some of them have improved on?"*

Teacher C: *"Erm I don't know really, they have said about following instructions, erm I'm not really sure what to say because I've not been sitting with them when they have played the game and I don't teach them in the classroom"* (LN336-339).

Teacher D reported that an expected outcome of COGMED would be to help with memory, specifically she said, *"With number bonds going into your tens and twenties"* (LN539).

Teacher B who I had given information on working memory said that she had expected that

"COGMED would build up their confidence and show awareness when they haven't followed instructions because that is something, it will just go in one ear and out the other" (LN197-198) *and "It's really just being able to be aware it's the awareness of when they hadn't done something it's the switching off"* (LN208-209).

a) Expected time frame for change and outcomes

One of the teachers reported that they would expect that it may take longer than six weeks before they noticed any improvements whilst another teacher, Teacher D thought that she expected improvement after a few weeks.

b) Expected improvement in working memory

Teacher C commented that she would like there to be improvements in the pupils' working memory in the classroom. Teacher C,

"I want to see improvement in working memory, and what I hope to see from that they would be able to retain new learning of facts, they would be able to call up those facts when they needed them, erm and that's still what I would hope to see from it if you picked the right children".

Interviewer*: "Would there be any way of capturing that?"*

Teacher: *"In the pupil progress meetings we talk about the children who are not making the progress, we look at all sorts. We look at the work in the books, we look at the data at the tracking we talk. It's conversations about the observations of the teacher, all those things really"* (LN301-309).

Teacher D discussed improvements in working memory

"*In year 6 we get children every year with SEN, who have very poor memory they cannot remember, they cannot retain anything and we just thought ah this is brilliant if it really fixes that*" (LN153-155).

c) Expected improvement in concentration and perseverance

Teacher D added that COGMED had not met her expectations.

> Interviewer: *"How far has COGMED met your expectations, on a scale of 0-10 yeah 10 it really met my expectations and 0 being not at all, what would you say?"*
>
> Teacher: *"I wouldn't say very high really, somewhere in the middle, about 5 really."*
>
> Interviewer*: "Why a 5 out of 10, what was your expectation?"*
>
> Teacher: "*I was expecting them to retain things and concentrate (laughs), basic facts but like we'd expect them to maybe remember a table" ..... "but no she couldn't she still have to write every simple one down, in order cause she couldn't tell you like 7, 8's she still had to write the whole thing down and point to it"* (LN520-534).

Teacher C also expected an improvement in concentration and perseverance

d) Expected improvement in processing

Teacher A hoped that COGMED would help the pupils with processing*. "That it would help with their processing really erm and so that they could then you know access the academic side of things a bit better really"* (LN161-162).

4.2.3.2: Sub Theme: Delivery

4.2.3.2.1: Who the staff selected to participate in COGMED

The Year 5 pupils who participated in COGMED were all reported to have literacy and numeracy difficulties. The teachers chose five pupils in Year 6 and five pupils in Year 5. In a package the minimum number of user ID's for COGMED that could be purchased was five. The staff reported they chose pupils who had characteristics such as struggling with focusing in class, processing, responding to questions, were below age related expectations, had IEPs, accessed additional interventions and were not retaining information because of their memory. Teacher C identified the pupils with working memory

difficulties as pupils whose memory is *"here today gone tomorrow"* (LN120). Additionally she said she selected the pupils in the following way:

> Teacher C*: "So we looked at our school tracking data and we chose children but some of them had behavioural needs as well".*
>
> Interviewer: *"So when you were looking at the tracking data what were you looking for?"*
>
> Teacher C: *"To see how far behind they were really for age related expectations, and also from just chatting with the teachers and the ones they felt that even though they were doing the pre teaching and over learning were still struggling to retain facts, erm basic number of facts"* (LN19-25).

Additionally the Year 6 teachers reported on the children's difficulties:

> *Interviewer: "So what kinds of difficulties are the children who were selected for COGMED experiencing?"*
>
> Teacher D: *"They didn't have any basic fact knowledge in maths.... like your number bonds to ten..... your tables, could remember then could not retain anything"* (LN49-52).

I asked Teacher D to explain what was meant by "retaining things" and the teacher said,

> Teacher: *"I dunno 2 plus 7 you know they couldn't even remember that"*
>
> Interviewer*: "In the head?"*
>
> Teacher*: "Yeah they couldn't keep any facts in the head, spellings or you know anything really"* (LN24-27).

Teacher B discussed the characteristics of the pupils before they engaged in COGMED. She said that they could not recall procedure or techniques for undertaking their work, they will remember only the first part of an instruction, they may also "daydream". Teacher B also talked about how she would test the pupils later in the week and they wouldn't remember anything. For example Teacher B said,

> *"I will test them later in the day no cannot remember, erm and test them later in the week and still cannot remember or simple words if they, err how to spell a word I've got with them it's got to be constant for it to really sink"* (LN100-104).

She said that the Year 5 boys were *"very low achievers, lack of motivation. They need constant support, if they were left in class they wouldn't get any work done because of the*

amount of support they need" (LN128-130). The teacher mentioned that a couple of the pupils were motivated in class but may have low self-esteem.

4.2.3.2.2: Pupil and staff engagement

a) Pupil engagement with COGMED and staff engaging with the pupils during COGMED.

Teacher A reported that she did not supervise the pupils during COGMED whereas the Teacher D reported that she did not initially but after a couple of weeks she did supervise the pupils when they participated in COGMED. She said "*initially we kind of left them to their own devices, you were under the impression they could just get on with it"* (LN68-69).

Also the Teacher D was asked:

> Interviewer: "Were you with them when they did the programme?"
>
> Teacher D: "*No they were not on their own I was sort of sat there and they were sat in the corner, I was right by them, but when I turned around to make sure a couple of them just day dreamed. It's not like they were not doing it properly they daydreamed off so I was like come on, come get back on"* (LN202-206).

Whereas Teacher A reported on the level of interaction:

> Interviewer*: "When they were doing the sessions did they have any dialogue with you?"*
>
> Teacher*: "Not really no, I mean they all had headphones on, because we did try, because erm the other teacher had said that the children had the volume turned down low, and then the children would ask if they needed help or anything, but with the children we had, u1658 could not cope with all the different noises and erm I think... er u1517 struggled a bit with that erm so we made sure that they all had headphones on, and I think it's that kind of when you put head phones on somebody they go into just a little bubble and they forget that you're there really and only if something, the Ipad lost connection, which does happen, erm that is when that kind of spell is broken and they sort of come out. So a lot of the time I would not necessarily know if u1658 or u1656 was struggling unless I was actually sat next to them"* (LN89-97).

Teacher D discussed how she tried to support the pupils she said:

> *"Looking at them they are actually cause we had them sat around a table together, with me at one, so you were making sure, keep on task, keep on"* (LN71-73).

and after looking at the COGMED data the teacher decided that:

> *"The ones that did not make much, I just sat right by them when they were doing the COGMED and I was trying to help them come up with some strategies" .... "To help them remember, I said get those two in like 57 and get one in as 38, ... 57 38 57 38 but then it did not really help (sigh)"* (LN480-485).

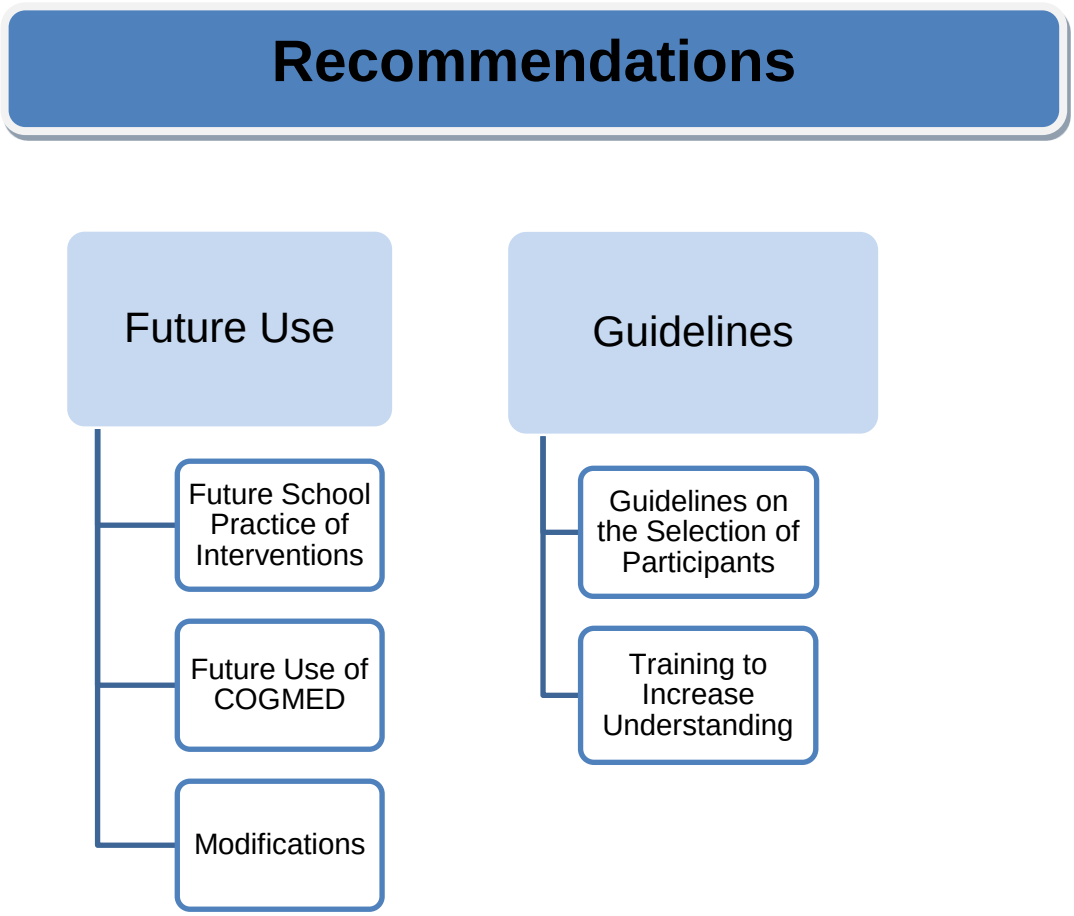
Teacher D explained that they altered the programme by stopping some of the pupils playing the reward game at the end of the training session. She said "*Then they got a game at the end but sometimes we had to take them off the game because it was taking so long"* (LN310-311).

Additionally, it was reported that overall the Year 6 pupils had more COGMED sessions than the Year 5 pupils. Teacher A, mentioned that 35 minute sessions were initially too long for the Year 5 pupils, but after a couple of weeks the pupils were more able to participate in a 35 minute session.

4.2.4: Recommendations

The theme of Recommendations has two sub themes Future use of COGMED and Guidelines. The thematic map (figure K) below shows the teachers' views on the recommendations.

Figure K:



4.2.4.1: Sub Theme: Future Use

4.2.4.1.1: Future School Practice of Interventions

Teacher A and Teacher D reported that the use of COGMED had not had an impact on their future use of interventions or changed their practice.

Teacher C reported that the school's practice on delivering interventions is influenced by the Educational Psychologist's recommendations and a perceived lack of alternatives

> *"if the teachers feel like it has got value you have to trust that it is because it's on the Educational Psychologist report they need an intervention in that area, so until somebody says this has been brought out why don't you try this or this, there is not really much of an alternative for us that's manageable"* (LN426-430).

4.2.4.1.2: Future Use of COGMED

Teacher D said that they would need more information on selecting pupils if they were to use COGMED again in the future. Teacher D: *"I would like more input from them* (COGMED) *about what type of children it would be suited to"* (LN589-591). Also the teacher said that the programme requires more dedicated time to help it work.

Teacher C discussed that if COGMED is to be used in a school in the future the teacher needs to support the children:

> *"So the teacher needs to be on board so it's not a disadvantage but if you did not have a teacher that was on board and you did not have a teacher that's interested in it or … taking it into account when she was trying to help students then I don't think it would really work"* (LN222-225).

Teacher C also mentioned that she would use COGMED in the future. She was asked why because prior to the interview she had said she would not use COGMED again,

> *"The recommendations in the reports were that the children need to work on working memory ....As we are just teachers they panicked, and they want something like COGMED to know they are addressing that need"* (LN446-448).

She was then asked

> Interviewer: *"If there were alternatives to COGMED how likely would you be on the scale of 0–10, 10 being you would 0 being not at all, how likely would it be you use an alternative as opposed to COGMED?"*
>
> Teacher C: *"Oh yeh I would definitely try it, if they brought something out with the research to back it up I would definitely try it. So on a scale 0–10 would I try something else well ... Erm I'd say 7."*
>
> Interviewer: *"What makes you say 7?"*
>
> Teacher C: *"Erm if the research was there like it was for COGMED and it was as, and it looked as attractive and it was in the same, I think….. price obviously, if it*

was competitively priced against COGMED I would try it because budget is an issue."

Interviewer: *"So what would make you stop using COGMED and use an alternative intervention?"*

Teacher C: *"Budget would be a big one, so price would be a big one, just because it's always hard ermm".*

Interviewer: *"If they were the same price?"*

Teacher C: *"Erm Recommendations off other schools maybe or errm, COGMED is all I found, COGMED is the best I've seen in terms of one teaching assistant to that many children and that kind of thing, but ermm, ... I would be willing to try something different. I'd probably keep COGMED going in one class and try something new in another class to compare them, yeh I would try something"* (LN449-467).

Teacher A discussed whether the programme will be used again in school she said,

"*it wouldn't be my decision .... I think in my personal opinion it wouldn't be used again because of the cost and number of children you are required to have to do it"* She also said when asked if she would recommend it to other schools, *"Personally I probably wouldn't recommend it just because.... the sort of issues arising outweigh the benefits, sort of thing, because there are so few children that benefit from it"* (LN289-301).

Teacher D talked about the support and other interventions the pupils receive and said *"They are making progress so do we need COGMED?"* (LN441). Teacher D said that she would not recommend COGMED to another school, however she said that if another school was using the programme they need to consider who they choose and how they are going to manage delivering the programme. Teacher D explained that she thought that none of the staff are using COGMED in school this academic year and she also said *"We certainly haven't thought oooo yes! Let's use it, it solves all the problems"* (LN570). She thought that the child who made progress would have made progress in her class despite COGMED because she said in her class it is *"very structured and very much you know they are not allowed to switch off and not listen"* (LN583-584).

Teacher C said that she does not think she chose the right children for the programme and that it is important to choose the right children in the future. She also said even though

she is not sure if COGMED is effective she would use it again, as there are a lack of alternatives, *"so even though I'm not 100% sure, I would use it again because I don't really feel like I have other, I feel like what else could I do, so it's kind of even though I'm not 100% sure it's just that I'm going to carry on with my precision teaching and my COGMED"* (LN391-394). However she reported that when the Educational Psychologist tells school they need to implement an intervention for working memory then COGMED is an option, however if this is not a recommendation she said, *"I think there is probably other things you can do for a bigger impact"* (LN501).

4.2.4.1.3: Modifications

Teacher C said that she wouldn't change anything about the programme, she said it would not have been appropriate for her pupils but she did suggest it would be useful if it was cloud based so that other children in other schools could access COGMED from home.

Teacher D reported that she wouldn't adapt the programme as it doesn't allow for it to be adapted, however she also commented that she would like the programme to be shorter and delivered three times a week. She also said,

> *"It would have been useful if some of it was word based, because you know that would of helped them if it was stringing sentences together and things, you know the literacy, the word processing part of your brain would have been helpful too"* (LN341-345).

The minimum purchase from COGMED was for five pupils. Teacher A said, *"There is a minimum if you could do it, pupil by pupil, then that would be a lot more appealing*" (LN293) The teacher also commented that it was essential that the pupils had headphones so that they wouldn't be affected by background noise.

4.2.4.2: Sub Theme: Guidelines

4.2.4.2.1: Guidelines on the Selection of Participants

a) Recommendations from teachers on which pupils to select

Teacher D and Teacher C said that they do not recommend selecting the lowest ability pupils. Teacher D reported:

> *"You wouldn't want your lows" and "you might go with slightly higher that the... maybe the children, that not being so so low,…. so like one child who used it last year who's here now, she started it next door, but I've found out SENCO's tested her for processing and she's got a processing problem. Now I've wondered if that's a problem, so there is no point putting them on that thing, she struggles to remember what someone has said two seconds ago"* (LN398-409).

Teacher D also mentioned that perhaps pupils with a longer attention span should be selected *"Have got a bit of an attention span already"* (LN117). Teacher C recommended that COGMED is more suitable with pupils at school support level one, she said,

> *"I was looking at my SEN register to choose these children where as if I was to choose again they wouldn't necessarily be children on the SEN register they would be the ones on a more targeted intervention group. I think those children benefit better from COGMED than those who are SEN, so the ones on with educational health care plan or ones on school support level 2. I think there is so much going on there that COGMED doesn't have the most impact whereas if you pick the ones that are just sort of below where they should be but not way below, or they are on the SEN support register but at that earlier level"* (LN143-149).
>
> Interviewer: *"Yeh".*
>
> Teacher C: *"....when it's more like school support level 2, educational health care plan, I have felt like no".*
>
> Interviewer: *"And what's made you come to that conclusion?"*
>
> Teacher C: *"Not just the data from COGMED because some of them did well on the COGMED but didn't transfer it back to class,* not just going on what I have seen from the COGMED data*"* (LN154-159).

Teacher C also discussed what she would suggest when other schools were selecting pupils for COGMED she said, *"If there are loads of other barriers I wouldn't use COGMED"* (LN185).

b) Guidelines from COGMED on who to select to participate in the programme

It was discussed that it would have been useful to receive guidelines on how to select pupils for COGMED. Teacher D reported that the programme did not offer advice on the selection of pupils. Teacher D said that for a school to use COGMED again they would need some guidance from COGMED. She also said;

> *"Yeah but what would have been useful was if they said, well test their reading age, test their spelling age if they are so much behind.... Test the processing cause we all have tests for processing"* (LN424 -425) *"well maybe you need more advice on who you choose"* (LN114) *....."because it isn't, it isn't actually for everybody"* (LN417).

4.2.4.2.2: Training to Increase Understanding

a) Guidelines and training on COGMED

Teacher A suggested that the staff would benefit from training on working memory, *"I think that's an area where people would need some training"* (LN297). *"You know like a webinar or something just some brief training that you can access"* (LN177-178). She also said, *"Staff members could probably do with a bit more training of how they could support the children... you know the teaching assistant might need a bit of sort of an understanding of what the programme is about and the reasons doing it and how to support the children while doing it"* (LN150-156).

Teacher A suggested it would be good to have some tips on using the programme such as using headphones.

Teacher C described the training that the Year 6 teacher received on COGMED as positive. Teacher D made the following comments:

> *"It basically talked you through the programme so it actually wasn't training. There was no benefit for me where I could help the children. It was this is the programme and this is how it works".*
>
> Interviewer: *"Okay so what would you have liked to have seen in the programme training instead?"*

Teacher D: *"Like guidelines er, if they are not making any improvement because obviously you can go in and check is there some things you need to change? Are the there things you need to do differently? erm if a child is getting frustrated? What can you do? erm things like guidelines really".*

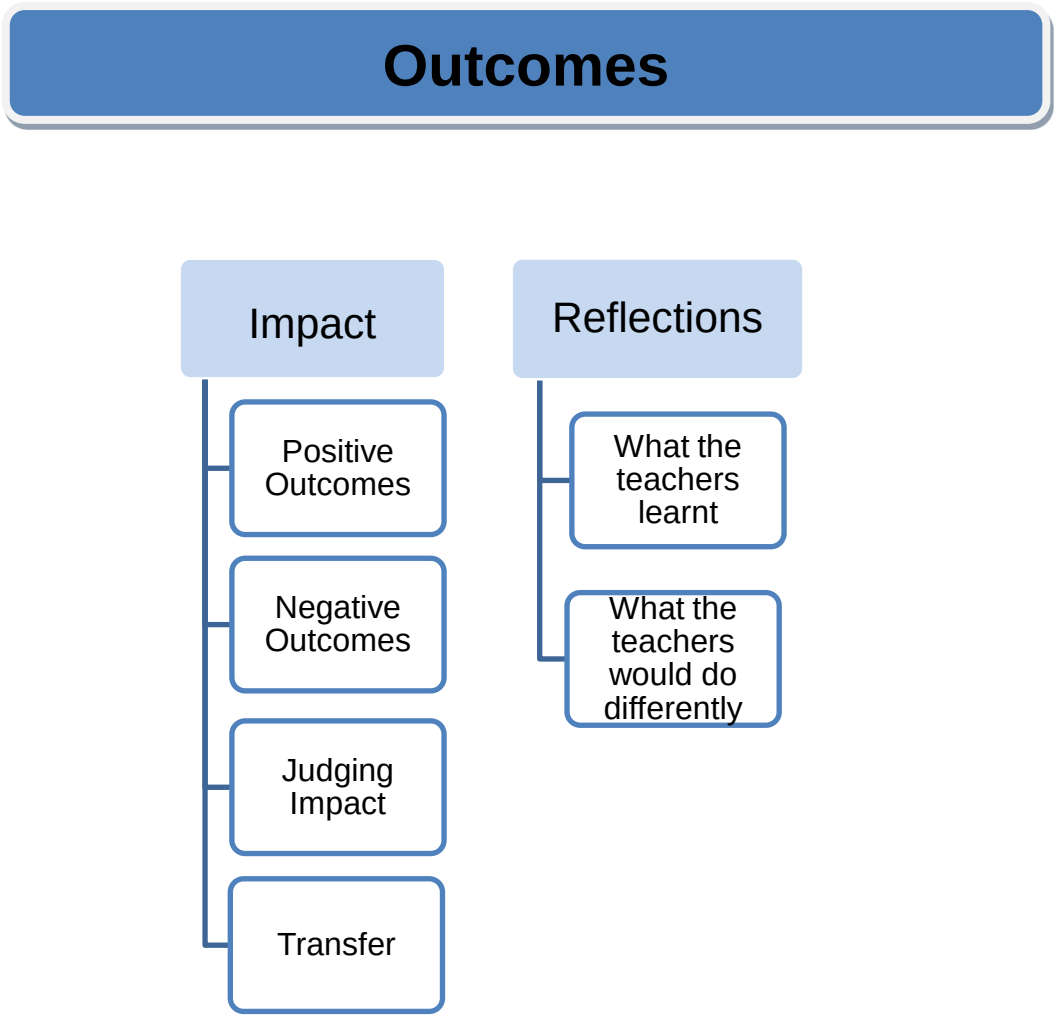
Interviewer: *"So did you talk to them during the implementation at any point or did you just get the initial training?"*

Teacher D: *"No that was it"* (LN241-252).

4.2.5: Outcomes

The theme of Outcomes has two sub themes of Impact and Reflections. The thematic map (Figure L) below shows the teachers' views on the outcomes of using COGMED.

Figure: L



4.2.5.1: Sub Theme: Impact

4.2.5.1.1: Positive Outcomes

The teachers discussed the positive outcomes of COGMED. Specifically Teacher A thought that one of the Year 5 pupil's ability to retain information had improved. Teacher A also articulated that one of the pupils, *"was very focused and actually he is doing really well in Year 6 at the moment so erm but he's the one I would of said it had an impact"* (LN210-211).

Teacher D discussed the pupil who they thought had made progress as she said, *"Probably u1515 was the worst attendee out of all of them, but the one who made the most"* (LN285). She also said, *"He was the only one who made an improvement in his work"* (LN56). She also discussed that the programme developed perseverance.

> Teacher: *"I think for the right children it does develop perseverance".*
>
> Interviewer: *"Yeah".*
>
> Teacher: *"You know helping them to, training their brains to remember things"* (LN381-383).

Teacher C reported that COGMED had benefitted the pupils who didn't have the lowest ability. She stated that,

> *"Erm it's benefitted the children, who were not a million years away from where they were supposed to be, it's benefitted them because they've been able to take those strategies back to class. The children who are quite far away from where they are supposed to be, who've got other factors influencing erm their ability to make progress in school, not as much"* (LN279-283).

4.2.5.1.2: Negative Outcomes

a) Lack of improvement

The teachers thought that the lack of progress made by some of the pupils was a negative outcome. Teacher D described how after the pupils had undertaken the programme for a couple of weeks she checked the monitoring system on COGMED which indicated that

some of the Year 6 pupils had made no progress. Teacher C expected that she would see an improvement in all the pupils but she said this did not occur, "*Yeh, no it didn't work for everybody, I thought I would see improvement in everybody but it didn't"* (LN365-366).

Teacher B was asked if she had noticed any differences in how the three Year 5 boys were able to remember instructions after receiving 19 or 20 sessions of COGMED. The teacher said there had been no improvement, *"concentrating following instructions, it still needs to be repeated"* (LN224).

b) Negative impact on pupils

COGMED was perceived to have a negative impact on a few pupils. Teacher D said:

> "*So then we actually realised that probably wasn't the best intervention for him, because it was making him more frustrated and not improving, there was no point continuing with it"* (LN374-377).

4.2.5.1.3: Judging Impact

a) Impact of COGMED

Despite two of the teachers reporting that overall they thought that two out of the ten pupils had progressed on the programme they discussed how they found it difficult to judge the actual impact the programme had made on these two pupils.

For example Teacher A said that one of the pupils,

> *"Is a lot more confident with self confidence and you know he always got a sense of satisfaction for COGMED. You know he was pleased at the end of the session that he had managed to do what he had done erm, so hopefully that will of benefited, it's hard to say really whether how much was down to COGMED and how much of it was down to teaching, but he has certainly come back this September a lot more open to learning and his sort of learning attitude has changed quite a lot so it could be a bit of maturity as well but you know I would say that the COGMED probably definitely helped"* (LN222-228).

Additionally Teacher D talked about one of the pupils' ability to follow instructions had improved but she thought that was because of the teacher being "like a sergeant major" (LN559) rather than using COGMED.

Another Teacher, Teacher C, also was unsure of the impact COGMED has had on the pupils; "*I don't know if that's the precision teaching or COGMED because we do both at the same time."* (LN297-298). Teacher A had a similar view, "*So it could be the combination of the three things or it could be that the COGMED has made a bit of a difference for them but I think it is very hard to tell in such a short time, because this time of year as well"* (LN7-73).

For one of the pupils in Year 6, Teacher D thought he had made some improvement post COGMED she reported;

> *"He actually knuckled down more.... he concentrated and got on and he actually made improvement but it could have been all the other interventions as well, you can't say it is that, we did lots of other intervention as well"* (*LN390-392). Also, "At the same time as using COGMED we were also using over learning"* (LN157-158). *"was it the COGMED? Was it us teaching them, again and again and again and going over it?"* (LN160-162).

In addition to the two pupils who were thought to have made progress, Teacher A talked about another pupil who had anxiety and how it was difficult to judge his progress, "*I found it hard to tell with u1658 because of his anxieties and stress levels but in the last sort of couple of weeks"* (LN51-52).

It was discussed during the interview whether the teachers used the COGMED data system to judge the impact and progress the pupils had made.

> Interviewer: *"Did you use the integrated COGMED scores to judge the pupils' improvement or did you have a different opinion?"*
>
> Teacher A: "*It was kind of a bit of both really, erm so I think the scoring backed up what I as a professional was thinking was happening, erm so I could judge that side of things as a professional"* (LN215-218).

4.2.5.1.4: Judging impact and transfer

Teacher A mentioned that part of judging the impact would be considering there to be an impact still present a few years after COGMED as she said, *"That wouldn't happen over a year and you would need to see its impact over a few years"* (LN246-247). Teacher D discussed how she would look at the percentage of progress the COGMED system measured to judge the impact and whether the pupils were transferring the skills to the classroom. She said

> *"The percentage, so you could measure it using that, that's how we would track him, whether they were making progress with it or not and then we were thinking well is it working in class, are they able to retain facts are they you know?"* (LN449-451).

I then went on to ask whether COGMED had any impact on the strategies the pupils were using in class.

> Interviewer: *"I am just wondering if you were aware of any new strategies the pupils were using after COGMED, like pointing or rehearsing?"*
>
> Teacher D: *"No nothing like that, no they didn't seem to use strategies from that in their own work"* (LN475-478).

However the teacher reported that the pupil who she had judged to have made progress on COGMED his behaviour in class had changed, *"He was just switched on, he just switched his brain on in class, it was much more, you could see it in him"* (LN457-458).

Also Teacher D reported that she'd looked at COGMED scores after a few weeks to judge the progress, *"I can't think how many weeks they had been doing it, not long, and I said oh gosh there's only u1515, cause there was only one at that point that had made any"* (LN463-464).

4.2.5.1.5: Transfer

Teacher C discussed that the programme could be considered as having an impact if the students demonstrated an improvement in the classroom;

> *"I think the success of it depends on how well the child can then use those techniques they have used on COGMED in their academic subjects, ...those children were then able to use those strategies that they learned in COGMED and take it back to the basic skills and try it in numeracy and literacy"* (LN60-64).

4.2.5.2: Sub Theme: Reflections

4.2.5.2.1: What the teachers learnt

One of the themes that emerged was what the teachers learnt from implementing COGMED. Teacher C reflected on selecting pupils for the programme,

> *"They don't remember anything and I chose them, now we have been through that cycle once I've realised there is a lot of other barriers to learning to think about"* (LN360-362). Also she said*, "Just choosing of the children, would be more careful next time"* (LN238). She also added that she wouldn't necessarily "*choose the ones furthest behind"* (LN177).

Teacher D was asked if she learnt anything from using COGMED.

> Interviewer: *"Has it affected what types of interventions you might use in the future?"*
>
> Teacher D: *"Don't think so I don't think it's made you think either way"* (LN566-567).

4.2.5.2.2: What the teachers would do differently

In addition to the theme of what the teachers had learnt there was also the theme of whether the teachers upon reflecting, would do anything differently. Teacher A mentioned that she would have given the pupils more sessions if it had been possible:

> "*I suppose I would of preferred to be able to erm you know been able to run for a longer period of time and ideally I would have had a bigger sample of children because we had two that were off sick for quite a long time"* (LN243-245).

Teacher C talked about what she would do differently, *“If I was to carry on doing it I would probably make sure there was more timetabled time, a dedicated slot for the teacher and TA to be just talking about COGMED*” (LN232-233).

4.3: Summary

This chapter has provided a summary of the results from the data collection. The next chapter, Chapter 5, will discuss and interpret the qualitative results in correspondence with the individual research questions.

Chapter 5: Discussion

5.1: Chapter Overview

This chapter will discuss the qualitative data presented in Chapter Four to answer the research questions. There will also be reference to the data collected in appendix xxii-xxiv as this provides a contextual background to the qualitative data. Within this chapter there will be reference to research within the literature review to link with the findings from this study. The essence of case study and its links to theory was discussed in Chapter 3, Methodology. Yin (2014, p38) states that theory plays a critical role within the case study, therefore the framework for effective programme implementation (Durlak & DuPre, 2008), will be considered within this discussion in relation to the facilitators and barriers for the implementation of COGMED and finally the limitations and implications of the research will be explored. The chapter will answer the main overarching research question which is; "What are the facilitators and barriers to implementing COGMED Working Memory Programme in the primary school with Year 5 and 6 pupils?"

5.2: Research Question One: How do the pupils view participating in COGMED and what are the barriers and facilitators for implementation?

5.2.1: Positive experience / facilitators

A theme identified was that the pupils reported that undertaking COGMED was a positive experience. In particular they reported that they liked the reward game at the end of each session and one pupil said he would have liked COGMED to have more reward games in the programme. It is suggested that enjoyment correlates with interest and motivation for an activity (Schutz and Pekrun, 2007). Also Andrade (2001) suggests that greater

motivation can be associated with greater achievement on working memory tasks. Hence the question can be posed whether the pupils' motivation and achievement on COGMED was influenced by the games. However one of the teachers reported that they modified COGMED by not allowing some of the pupils to engage in the reward games as they were time consuming. Blase, Van Dyke, Fixsen and Bailey (2012) state that before considering making adaptations it is important to implement an innovation with fidelity. It may have been interesting to explore in more detail how much the pupils' engagement and motivation on COGMED was influenced by the prospect of receiving the reward game at the end of each session.

5.2.1.1: Impact on working memory

A theme within the data from the pupils' interviews was that pupils thought that COGMED had had an impact on their memory. However without a quantitative measure to triangulate their reports, it might be suggested that the pupils' perceived an impact of COGMED on their memory may be a reflection of their expectations of the programme rather than improvements as a result of COGMED (Allinder, 1994). COGMED was designed with the premise that repeated practise of memory tasks would lead to changes in neural activity and structures leading to more efficient attention/working memory (COGMED, 2010). COGMED does not explicitly teach strategies. However a theme that emerged from this research was that through undertaking memory tasks the pupils thought that they developed strategy use skills. This research is not inferring a causal link between undertaking COGMED and the development of strategy use or that COGMED is a meta memory programme. Tentatively this is discussed as it arose as a theme within the interviews and no firm conclusions will be drawn. Holmes, Gathercole and Dunning, (2009) questioned whether COGMED training might promote the development of strategy

use. The teachers reported that they were not aware of the pupils using any new strategies after COGMED. However one pupil reported that he was not aware of rehearsal as a strategy prior to COGMED and he said he started using strategies without any prompts from adults whilst he was engaged in COGMED. Interestingly this was the pupil who staff thought had made the most improvement following COGMED and had in fact made the greatest improvement according to COGMED data. Essentially these findings can be considered alongside Roche and Johnson's (2014, p382) argument that it is unclear whether COGMED inadvertently "trains specific memory and attention focusing strategies" Some of the pupils reported that they learnt strategies from using the programme. Randall and Tyldesley, (2016, p34) argue that further research is needed "to better understand the mechanism through which working memory training may improve working memory".

5.2.2: Negative experience / barriers

A theme emerged that the pupils thought that the programme was challenging and it was difficult to complete. COGMED is adaptive, hence it increases in difficulty so that the pupil is having to perform at the limit of their abilities (COGMED, 2010). Some of the drawbacks of the programme were that COGMED was perceived to be boring and the pupils missed a lesson that they liked. Also if the computers were not charged or if the pupils had difficulty logging on this was a barrier to engaging with the programme. This links with Durlak and DuPre's (2008) findings that technical issues can be a factor affecting implementation.

5.2.2.1: Fidelity of the programme

A common aspect of implementation of an intervention is adaptation. One of the pupils reported that he adapted COGMED and this could be a potential barrier. Specifically the pupil reported that he cheated by writing some of the numerical activities on paper.

Although the other pupils did not report this it is not known if they adapted the programme in a similar manner, which emphasises the value of collecting qualitative data as the pupils' modification of the programme would not have been reflected within the contextual data (Appendix xxii-xxiv) containing the scores on the COGMED monitoring system. Scores would have been potentially distorted by such pupil adaptations.

5.2.2.2: Understanding the purpose of the programme

Understanding the purpose of the programme was a theme that arose. Some of the pupils did understand, while others did not understand the purpose of COGMED. Although it is not clear whether the lack of understanding of the purpose of COGMED was actually a barrier as it can be questioned whether this could have affected the participants' responsiveness or progress. The literature search was unable to identify existing literature available on this topic.

5.3: Research Question Two: How do teachers view implementing COGMED in school and what are the barriers and facilitators for implementation?

The next section will discuss the implementation of COGMED from the teachers' perspective including the barriers and facilitators and will be structured on the literature on implementation.

Although the facilitators are mainly discussed in Section 5.3.1 and the barriers are mainly discussed in Section 5.3.2 there will be some overlap and therefore it is not totally possible to discuss them entirely separately.

5.3.1: Facilitators

The following points were sub themes that were facilitators that emerged from the data:

5.3.1.1: Easy to implement

A theme that emerged was that the teachers liked that COGMED was computerised and felt this to be a factor in the programme being accessible. The staff reported that they thought COGMED did not require a high level of computer knowledge, and this was important as they were not confident with ICT. They also thought that they did not need a lot of training before they administered it to the pupils. This raises their point for consideration alongside Durlak and DuPre's (2008) findings that self-efficacy and skill proficiency are both factors which influence the implementation of a programme. Self–efficacy is the extent to which the teachers "feel they are able to do what is expected" and skill proficiency refers to the teachers having the skills necessary for implementation (Durlak and DuPre, 2008, p337). From the teacher's perspective a facilitator of COGMED was that it was not essential to have a knowledge of working memory to use the programme. However this also could be interpreted as a barrier and will be discussed in the latter sections of this discussion.

5.3.1.2: Contextual appropriateness

There was a clear theme within the interviews that one of the greatest advantages of COGMED from the teachers' perspectives was that the programme fitted within the school context and did not require any teacher input. COGMED was described as not being labour intensive. This complements Durlak and DuPre's (2008) findings that a facilitator of implementation is the integration of the programme. Integration of the programme "refers to the extent to which an organization can incorporate an innovation into its existing practices and routines" (Durlak and DuPre, 2008, p137). COGMED was suggested to fit

within the school resources as the staff did not need to identify a specific room for undertaking COGMED or allocate a teacher to deliver it.

As highlighted in the literature review (Chapter 2) supervision can be a variable on outcomes; for example participants may more strongly apply their attention on the tasks when supervised (Borella, Carretti, Riboldi and De Beni, 2010). It appeared that for the majority of the time when the pupils undertook COGMED they did so independently of the teachers. It was found that the pupils used headphones and overall the staff had minimal dialogue with the pupils. Although not providing supervision was considered a positive feature from the teachers' perspective, this also indicates that teachers' skills were not utilised within the process and hence scaffolding of the children's learning did not transpire. The term scaffold is defined as a process "that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts" (Wood, Bruner and Ross, 1976, p90). The staff reported that the programme difficulty was a barrier as one of pupils became extremely frustrated, finding it too difficult, and staff responded by discontinuing the pupil's use of the programme.

It emerged from this study that the staff perceived that they did not have the skills to support the development of pupils' working memory. Moely, Hart, Leal et al (1992, p653) undertook a study in which the teachers supported pupils to use memory strategies and the findings indicated that "those whose teachers were relatively high in strategy suggestions showed better maintenance and more deliberate use of the trained strategy than the children whose teachers rarely made strategy suggestions". The absence of teacher supervision may also be inferred as a barrier to positive outcomes, especially if the pupils become frustrated and do not receive support to utilise strategies. Additionally if the teachers had supervised the pupils they may have gained an insight into the pupil's difficulties and been able to modify the classroom curriculum according to their working

memory capacity (Skelton, 2012). This leads to further considerations in the use of COGMED, particularly the potential benefit for staff to receive training on supporting pupils with strategies to use within COGMED; or for the COGMED programme developers to consider incorporating the explicit teaching of strategies, e.g. Memory Booster (Leedale, Singleton and Thomas, 2004) is a computerised working memory programme which explicitly teaches rehearsal strategies.

5.3.1.3: Funding and policy

Durlak and DuPre's (2008) framework for effective implementation identifies community factors as an aspect for effective implementation. Community factors include funding and policy (Durlak and Du Pre, 2008). The purchase cost of COGMED emerged as facilitator and barrier implementation factors. Forman, Olin, Hoagwood, Crowe and Saka's (2009) research identified that school policies and funding are significant factors that affect implementation. Specifically in my research it emerged that the teachers liked the COGMED monitoring system, not only because it offered an indication of pupil progress but also justification for spending school funding on the programme. In addition to considering funding this links to policy, as within the contextual data collected the school's OFSTED report indicated that the school needed to improve pupil achievement. Therefore COGMED's monitoring system was a facilitator in implementing the programme as the monitoring system offers data on the pupils' achieved progress on the programme. This can be considered in relation to Fixsen et al's (2005) literature review on implementation of interventions which also identified the availability of an accurate monitoring system as a facilitator.

5.3.1.4: Engages pupils

COGMED is a computerised programme and this was described as engaging most of the pupils and influencing their enjoyment. Pupil enjoyment might be an important aspect of the programme as it may affect the outcomes and pupil progress. Oatley, Parrott, Smith and Watts (2011) explored how positive emotions can positively influence attention and memory.

The staff concluded that the pupils who benefitted the most were either the most intelligent or had the most perseverance. Terman and Oden (1947, p351) discussed that more predictive of success than IQ are "non cognitive qualities such as perseverance, self confidence and integration towards goals". Hence Cox (1983) argued that intelligence alone does not lead to achievement.

5.3.2: Barriers

The following themes were considered by the teachers as barriers affecting implementation.

5.3.2.1: Innovation Characteristics

The literature identifies innovation characteristics as a factor related to effective implementation (Durlak and DuPre, 2008), and in particular two characteristics; adaptability and compatibility. Compatibility refers to "the extent to which the intervention fits with an organization's missions, priorities and values" (Durlak and DuPre, 2008, p337). There was some indication that the school felt they had to implement a programme such as COGMED as a result of the recommendations from their Educational Psychologist. Langley, Nadeem, Kataoka, Stein and Jaycox (2010) identified compatibility and competing responsibilities of the programme deliverers as a barrier. A theme emerged that COGMED was not compatible with the Year 6 agenda, as it was time consuming,

difficult to deliver every day and the pupils missed lessons which the teacher had to deliver at a later time. COGMED was reported to be not compatible with the school's priorities in the summer term and therefore the summer term was not considered an appropriate time to implement COGMED. In a systematic literature review on the factors that affect the implementation of interventions compatibility of a programme was identified as a factor (Greenhalgh et al, 2004). It emerged that COGMED would have been more compatible if the teachers had had the opportunity to alter the required number of sessions, for the activities to be less repetitive and to include activities that are literacy based. Overall some teachers said they would not use COGMED again because it was thought to be incompatible with the school context and few pupils benefitted from it. However this can be juxtaposed by the fact that it may not have been implemented as the COGMED designers intended it to be implemented. For example the contextual data (see Appendix xxiv) indicates that only 30% of pupils received 20 sessions or more, none of the pupils received the recommended 25 sessions.

The lack of programme fidelity may diminish a programme's impact and outcomes. Carroll, Patterson, Wood, Booth, Rick and Balain (2007, p2) argue that "it has been demonstrated that the fidelity with which an intervention is implemented affects how well it succeeds". The contextual data indicate that the teachers may have had difficulties in adhering to the fidelity of the programme as the COGMED data (see appendix xxiv) showed that the teachers varied the session lengths from 20 minutes to 78 minutes. The data (see appendix xxiv) show that as the time spent in training increased, a participant's engagement decreased. Dawson and Guare (2004) state that a ten-year old can sustain their attention for approximately 30 minutes. The COGMED active training time data (see appendix xxiv) indicate that approximately 25 to 30 minutes is an appropriate length of time for the pupils to sustain high levels of engagement on the programme.

5.3.2.2: Pupil attributes

Pupil attributes were considered to be a barrier to implementing the programme. The pupils who were described as having attention and concentration difficulties, processing difficulties, motor skills difficulties and a lack of patience and, or, no resilience were thought to find COGMED the most challenging. However the COGMED monitoring system indicates that all the pupils who participated in COGMED made an improvement (see Appendix xxiv)

COGMED is an adaptive programme, as it adjusts in difficulty based on the participants' correct responses, hence constantly challenging them. It may be that as it increases in difficulty some of the pupils' patience and motivation may decrease. Social learning theory (Bandura, 1977) indicates that when participating in a task, attention and motivation are key components of success. However attention is one of the skills that COGMED claims to improve, so it is interesting that it was reported as a barrier to pupil engagement. For example COGMED (2010, p7) state that, "COGMED Working Memory Training improves your working memory. The general effects that have been shown after completing training include: better ability to concentrate".

In 2014 findings of a randomised control test indicated COGMED should not be used as a remedy for ADHD in children (Chacko et al, 2013). The teacher discussed that COGMED was not effective with a pupil who she perceived to have "ADHD". Overall it was reported by the teachers in this study that pupils with poor behaviour and concentration had poorer outcomes than pupils with low self esteem.

It was noted that the pupil who the staff reported made the most progress out of the Year 5 pupils also obtained the highest score on the MALS which measures self concept. However this research is not implying that there is a causal link between MALS (see

appendix xx) and working memory. MALS was utilised in this research to offer contextual information and an insight on the pupils selected to undertake COGMED.

Overall, this research is not making causal links between pupil characteristics and working memory, but reporting the teachers' perceptions, and future research may endeavour to explore whether pupil difficulties and a range of characteristics affect outcomes on the implementation of COGMED in a school.

5.3.2.3: Selection

Selecting pupils was a significant barrier for the teachers and it was frequently discussed throughout the teachers' interviews. The teachers felt that they were unclear who to select for the programme due to a lack of knowledge. The staff's lack in having the appropriate skills to select the pupils for the programme fits with Durlak and Du Pre's (2008) findings that skill proficiency can effect implementation. For example; a pupil who had a diagnosis of autism and was often anxious was chosen for participating in the programme. However the COGMED manual specifies that the programme is not suitable for individuals with anxiety (COGMED, 2010). Additionally research indicates that anxiety may impair attention control and cognitive processes (Eysenck, Santos, Derakshan and Calvo, 2007). The teachers including the SENCO were only able to conclude that particular pupils were not suitable for COGMED once they had delivered the programme to the pupils. This indicates that the SENCO may have had difficulties selecting the pupils and there may be a role for a professional, such as an Educational Psychologist to assist in the selection and evaluation process for COGMED.

5.3.2.4: Staff skills and effective communication.

5.3.2.4.1: Staff skills

A theme that emerged was that the staff felt they didn't have the knowledge to support pupils with working memory difficulties on COGMED. Most of the staff showed an inaccurate understanding of working memory, however they did not identify their awareness of working memory as problematic. It can be argued that an understanding of COGMED and working memory is a key component for implementation. Alloway, (2012) found that teachers show a limited understanding of working memory and how it affects behaviour and learning. A lack of understanding of working memory and COGMED would impact on several aspects of its implementation such as the selection of participants and expected outcomes of COGMED. For example the contextual information (See Appendix xxii) on the results from the Working Memory Rating Scale, which one of teachers completed on the Year 5 pupils, indicated that not all the Year 5 pupils had working memory difficulties which highlights the process of selection of pupils as problematic.

The work of Forman, Olin, Hoagwood, Crowe, & Saka, (2009) identifies staff self perceived knowledge and staff training as factors which influence implementation. The training currently available from COGMED was described as ineffective as it failed to disseminate how the staff can help the pupils, for example one teacher would have preferred more support on how to intervene if the children are frustrated and if they can modify the programme if a child is experiencing difficulties. The COGMED manual indicates that the school should receive regular contact from a COGMED coach to support the implementation of the programme and to assist with difficulties, though for some reason the school did not receive this contact. It has been argued that implementers would benefit from receiving assistance from a qualified 'purveyor' whose function would be to

support implementation (Blase et al. 2012). The lack of technical assistance, including the provision of support once an implementation commences has been identified as an important factor (Durlak and DuPre, 2008).

The staff difficulties in understanding the purpose of the programme and the concept of working memory and therefore may have impacted on their perceived outcomes of the programme and what can be realistically expected. Overall it was difficult for the teachers to be able to judge the actual impact of COGMED. Forman, Olin, Hoagwood, Crowe, & Saka, (2009) identified visible impact as a facilitator or a barrier to implementing interventions in schools.

5.3.2.4.2: Effective communication

Frequent and open communication has been identified as an important factor in effective implementation (Durlak and DuPre 2008). Effective communication between school and COGMED providers, communication between teachers may also be a factor identified in this research. Not all of the staff had an awareness of COGMED's monitoring system as they reported they found it difficult to assess the progress the pupils had made from the programme and would have liked a monitoring system. Therefore the teachers would have benefited from the opportunity for frequent communication in relation to the structure of COGMED and access to the monitoring system**.**

5.3.3: Teachers' views on the factors relating to the implementation

In addition to the teachers' views on perceived facilitators and barriers, the teachers also articulated their views on the future use of COGMED in school.

- Future use and recommendations / adaptations

The views on the future use of COGMED were mixed. Some of the teachers reported that they would use COGMED while others would not use COGMED again and this was for a number of reasons, including COGMED not meeting their expectations. This could be positioned against the data that indicate that some of their expectations of the programme may not have been appropriate. There was variance in opinions on the timescale in which the staff expected to notice improvements from a few weeks to six weeks and also what the programme should achieve. Overall, teachers made the following recommendations:

i) COGMED designers could explore the possibility of it being cloud based so that pupils can access the programme at home.

ii) Teachers should select pupils who are not the lowest ability children and children who do not have processing difficulties. It was suggested that they should have chosen the pupils at support level 1, which equates to school action, rather than choosing school support level 2 and EHCP pupils.

iii) It was indicated that if the school was to use it in the future the staff need to take an interest in the programme and that if they were to use COGMED in the future there should be dedicated time to discuss how the pupils were engaging with COGMED.

5.4: Conclusion and integrating the findings

The aim of this research was to explore the facilitators and barriers of implementing COGMED in a primary school. The following table has been created to offer a concise summary of the above sections on the facilitators and barriers of implementing COGMED in a primary school, providing a response to the overarching research question, "What are the facilitators and barriers to implementing COGMED Working Memory Programme in the primary school with Year 5 and Year 6 pupils?".

Table 5.1: A table to show a summary of this study's findings on the facilitators and barriers of implementing COGMED.

Pupils' views on the Facilitators and Barriers of COGMED	
Facilitators • Most of the pupils liked the programme. • Liked the games • Perceived to help with memory	**Barriers** • Boring and frustrating, difficult to complete • Computers didn't always work • Missing lessons was perceived as a negative aspect of COGMED
Teacher views on the Facilitators and Barriers of COGMED	
Facilitators • Easy to implement – as didn't need a lot of training to deliver it / a room or a teacher to deliver COGMED. • Not essential to have a knowledge of working memory • Not labour intensive / teachers did not need to supervise the pupils • Perceived to engage the pupils • Pupils who persevered most on COGMED were the ones the teachers thought had made the most progress. • Cost effective • The data from the COGMED monitoring system was perceived	**Barriers** • COGMED was time consuming, it was difficult to deliver the programme every day • COGMED did not fit with teachers' agenda: particularly as pupils had to miss a lesson to undertake COGMED • Teachers thought that only a few pupils benefitted from COGMED (however only 30% of the pupils received 20 sessions or more.) • Selection: – teachers found it difficult to know who to select for the programme • Perceived to be not as useful with

to be useful.	pupils with processing, attention, behaviour difficulties, no patience and no resilience. • Teachers found it difficult to judge the impact of COGMED • Cost: perceived to be expensive • Lack of technical assistance and support on implementing the programme. • Lack of communication between staff was a perceived barrier.
Other findings from the teachers or pupils that weren't perceived as either a facilitator or a barrier. • Teachers did not understand working memory which may have affected the pupil selection and expectations of COGMED. • Some teachers reported that they would not use COGMED again. • One pupil adapted the programme • Training time was an issue: more than a 30 minute session was too long • The pupil who appeared to benefit from COGMED had not had the most sessions.	

This research identified that there were various barriers which were perceived to have affected the implementation of COGMED. Durlak and DuPre (2008 p337) argue that "expecting perfect or near perfect implementation is unrealistic". A significant conclusion from the research is that the findings of this study link with the literature on implementation factors identified by Durlak and Dupre's (2008) meta-analysis, which has been discussed through the previous sections in this chapter. The framework for effective implementation by Durlak and DuPre's (2008) was comprised from their meta- analysis on over 500 studies of programmes implemented with children and young people in real world settings by non-researchers. The 500 studies identified barriers and enablers to implementation success (see appendix iv). Therefore factors affecting the facilitators and barriers of implementing COGMED, discussed in the above sections in this chapter, have been collated and summarized and comparisons have been made between the perceived COGMED implementation factors and aspects of implementation factors highlighted by Durlak & DuPre's, (2008) meta–analysis (see Table 5.2)

Table 5.2: A table to summarize the key implementation factors for COGMED in relation to the framework for effective implementation (Durlak & DuPre, 2008, p.335).

I. Community Factors

A. Funding: cost of the intervention emerged as directly relevant to the implementation of COGMED. The funding and cost of the programme was described by the teachers as both a facilitator and barrier.

B. Policy: relating to the school's need to demonstrate academic attainment. Policy was a factor in the implementation of COGMED as the staff indicated that they were able to use COGMED's monitoring system to demonstrate pupil progress. However there are limitations of COGMED's monitoring system (see Section 5.4.1) and therefore programme implementers may consider how they might monitor pupil progress.

II. Provider Characteristics

Perceived Teacher self efficacy and skill proficiency emerged as both facilitators and barriers of implementation. The identified facilitators were that a high level of knowledge of computers and working memory was not required. The skill proficiency in relation to the teacher's perceived ability to select the pupils was a barrier. Therefore staff may benefit from training to select pupils for the programme. Programme implementers should be given the opportunity to develop an understanding of the programme before commencing delivery.

III. Characteristics of the Innovation

Compatibility and adaptability of the intervention emerged as both facilitators and barriers to implementation. A facilitator was that COGMED was compatible with the school's agenda as they needed to deliver a working memory intervention. A barrier was that COGMED was perceived as time consuming and difficult to deliver every day and within particular school terms, therefore before the commencement of the COGMED programme implementers should consider whether they have the capability and capacity to deliver the sessions. Consideration could be given to the delivery of shorter sessions.

IV. Factors Relevant to the Prevention Delivery system: Organisational capacity

The integration of new programming is the degree to which the staff can integrate an innovation into existing routines and practices and this was identified as a factor influencing implementation. A facilitator was that the programme was perceived to be not labour intensive, as the school did not need to allocate a teacher to deliver the programme. Access to headphones and ICT was considered a facilitator. Therefore programme implementers should ensure easy access to headphones and ICT equipment.

Effective communication between staff was also a barrier. Programme implementers may consider frequently allocating time to discuss the delivery of COGMED within other programme implementers.

V. Factors Related to the Prevention Support System

Training and technical assistance were key factors of implementation. A barrier was the lack of technical assistance and a lack of support on how to modify the programme if a pupil was experiencing difficulties, therefore all programme implementers should be able to access support and technical assistance.

Table 5.2 shows that there are a number of facilitators and barriers identified in the study which fit with Durlak and DuPre's (2008) framework for effective implementation. The local context is regarded as an important element in implementation of a programme (Durlak and DuPre, 2008). It is acknowledged that the implementation factors outlined in Table 5.2 are the findings from one school context and therefore are not entirely generalizable. However Table 5.1 and Table 5.2 may be useful for researchers or professionals to utilise as it may highlight key implementation issues for consideration in their own contexts. The remaining sections of this discussion will offer a critique of the study including limitations, reflections on my research journey, identify the implications of the research findings and will finally conclude by identifying considerations for future research.

5.4.1: Researcher reflexivity and critique of the methodology and limitations of the research

This section will offer a critique of the methodology and reflect on the quality of this qualitative research study. Northcote, (2012 p99) states that "while over one hundred sets of qualitative research criteria have been identified (Stige et al.,2009), some researchers warn against the absolute application of any criteria to qualitative research which is, by its nature, wide-ranging and varied, and does not necessarily lend itself to the straightforward application of any evaluation criteria". In this section there will be a discussion on the impact of myself as a researcher, a critique of the research design and of COGMED monitoring system.

- The impact of myself as a researcher

Within a critical realist framework and qualitative research, techniques such as member checking (Cohen, and Crabtree, 2008) and examining bias can be undertaken to address the issues of validity and reliability. Member checking is a way of finding out whether the data analysis is congruent with the participants' experiences" (Curtin & Fossey, 2007, p.92). Within this research due to time constraints this research was unable to use member checking. However Cohen and Crabtree, (2008) argue that member checking can be problematic as the participants may not recall what they said.

In considering reliability the research study utilised inter rater reliability, whereby an independent individual reviewed the codes and themes. Inter rater reliability is the level of consensus among raters. Armstrong, Gosling and Marteau (1997) argue that the use of an independent rater can enhance the reliability of the research results. "The use of inter-rater reliability is underpinned by the (realist) assumption that there is an accurate reality in

the data that can be captured through coding" (Braun and Clarke 2014 p1948). In this research the independent rater had an understanding of the topic and examined the codes and themes that had been assigned to the quotes (See Chapter 3 for further information). The purpose of inter rater reliability is to reduce researcher bias (Marques and Mc Call, 2005). To reduce researcher bias in this research it could be argued from a positivistic stance that the use of an independent rater would have been a more rigorous technique if a coding frame (Joffe 2011) or a codebook (Guest el al, 2012) and the calculation of inter-rater reliability scores (Boyatizs, 1998) had been used. However in contrast, from an interpretivist or critical realist stance, (given that a critical realist stance underpins this research) it is argued by Braun and Clarke (2014 p1848) that coding is "understood as an active and reflexive process that inevitably and inescapably bears the mark of the researcher. With no one 'accurate' way to code data, the logic behind inter-rater reliability disappears (it can be argued that it shows that two researchers have been trained to code data in the same way, but not that coding is accurate)".

Reflexivity "requires an awareness of the researcher's contribution to the construction of meaning throughout the research process" (Willig, 2001, pp.10). An appraisal of the methodology should consider reflexivity because as a researcher I am aware that I could have unintentionally impacted on the findings. Researcher bias can influence the research findings (Miles and Huberman, 1994). I did not have any preconceived expectations for the research findings or personal investment in the intervention and this was advantageous as it reduced the potential impact of researcher bias. However I may have unintentionally affected the teachers' reports as they may have been influenced by their knowledge that I was a Trainee Educational Psychologist and this could have affected the answers they offered during the semi-structured interviews. It was noted that one of the members of staff, who was interviewed, made specific comments about the programme on

a few different occasions between April-October 2015 but did not discuss these views in their interview when it was recorded. The interviewee was aware that the interview was being recorded and this may have altered their responses. Additionally the participants in this research may have reported what they thought I wanted to hear which links to the Hawthorne effect,(McCarney, (2007).

- Critique of the research design

A limitation of this research is that teachers may have found it difficult to notice a change in pupils' memory skills as this is not a construct that is easy to access and the teachers may have difficulty understanding working memory and the changes they could expect to occur. Furthermore some of the pupils may have reported that COGMED helped with memory because they may have been told by the teachers that it was to help with memory. Therefore in further research studies measures of the pupils' working memory may be beneficial.

Some of contextual data did not match with teacher reports on the descriptions of the pupils, for example one teacher described the three Year 5 pupils as potentially having low self-esteem, however the scores obtained from the Year 5 pupils who completed the MALS did not indicate that the pupils had low esteem as the pupils all obtained a score within the average range. During the pupil interviews some of the pupils were asked to rate their self efficacy in relation to their ability to remember on a scale of 0-10, (10 = good, 0 = not good). Three pupils rated their ability at 5 or less. These data suggest the importance of multiple sources of contextual data in future research, as opposed to limiting data collection to just one set of data, because it can offer a more in-depth perspective on the pupils who participated in the intervention.

A critical stance can be offered for ‘medicalisation’ of working memory difficulties. Computerised working memory training programmes are underpinned by the assumption that working memory functions can be 'fixed'. The term such as dosage is used in implementation science and in COGMED’s monitoring system. The COGMED monitoring system records the dosage or number of sessions undertaken. Dosage is also a term that is positivistic and also used in medicalised discourse and the appropriateness of the use of this term with a school intervention, can be questioned.

A further possible challenge to this research is that it is a single-case design rather than a multi-case study design as the study included one school (Yin, 2014). Initially other primary schools were considered to be included in the research, but the timescales for when the schools planned to deliver the five week intervention for COGMED did not correspond with the timescales for the submission of this research. However the advantage of a single rather than a multi -case study design is that it has allowed for a more in depth exploration of the case (Yin, 2014). Furthermore the WMRS was not completed for the Year 6 pupils. Had this been completed it would have offered further information on the pupils selected in relation to their working memory. The WMRS was not completed because the research was initially planned to only include the Year 5 pupils but subsequently when the research focus changed due to a number of setbacks such as the lack of programme fidelity and the retention of participants (See Section 5.6 Research Journey) I chose to include the Year 6 pupils who had already participated in COGMED.

As a result of the challenges and changes in the research focus the three Year 6 pupils had left the primary school and therefore were interviewed at their secondary school. The three Year 5 pupils participated in the interviews immediately after completing the last session on COGMED, whereas COGMED was not available to access in the secondary school, therefore a limitation of this study is that the Year 6 pupils discussed COGMED

retrospectively and this could have affected their ability to remember aspects of the programme.

The effect of a participant's motivations, memory, language and communication abilities can also affect the research findings and their responses, particularly when considering the pupils who may have vocabulary deficits or difficulties in articulation (Breakwell, Smith, Wright, 2012). I became aware during the research process that one of the pupils had a diagnosis of autism and some of the other pupils may have had language difficulties. This is a limitation of my study as the pupils' language abilities could have affected their understanding of the interview questions and their engagement with the interview process. I tried to reduce this by following Booth & Booth's (1996) advice for interviewing individuals with learning difficulties which suggests using direct questioning without the use of abstract questions. Future research studies may wish to consider the use of visual mediums to help support pupils with language difficulties to understand and access the interview process. Lewis et al (2008, p.27) suggest that "the use of Cue Cards to facilitate eliciting views from a broad spectrum of children and providing 'a structure which, while scaffolding elicitation processes and responses, do not constrain or bias'". Lewis et al (2008) argue that this is a useful visual approach for participants with autism. It is also important to acknowledge that some pupils may have found it difficult to talk about COGMED, how they went about remembering things on the COGMED programme and their overall memory skills and capacity. Schneider (1998) argues that young children have been found to over estimate their memory capacity and may struggle to verbalise their thinking. Hence attempts were made to mitigate the difficulties the pupils may have experienced in discussing and reflecting on their ability to remember and their memory. This was through the use of memory tasks to prompt discussions with pupils during the interviews (See Appendix ix).

It is also important to reflect upon ethics. The BPS (2014, p5) define research ethics' as "the moral principles guiding research from its inception through to completion". Within this research study there was an adherence to obtaining valid consent, maintaining confidentiality and anonymity (see Chapter 3 for further detail). An ethical issue relating to researching the implementation of an intervention is that it is possible that it might be unclear if the pupils are benefitting from the programme. With consideration to this risk and the impact of participating in the programme on the pupils' overall school education the teachers should carefully select the lessons when COGMED takes place. The teachers also engineered the opportunity for the pupils to undertake any activities they missed as a result of participating in COGMED. Furthermore two of the Year 5 pupils completed four or less sessions on COGMED. This is because they were absent from school for a significant period of time. When the pupils returned to school it was decided that it would be ethically appropriate for the pupils to be withdrawn from COGMED so that they could focus on the lessons they had missed, rather than continuing their participation in COGMED. Another ethical issue was that the pupils took part in the research within the school context. This was a limitation of conducting research in a school as the pupils were aware that the school protocol was that they were expected to follow the agenda of the adults. Therefore I regularly emphasised to the pupils, their right to withdraw and that they could leave the room at any time and could discontinue from engaging in the interview.

It is argued the location of where the research was undertaken could have had an impact (Elwood and Martin, 2000). Some of the interviews with the pupils took place at the primary school whilst the others took place at the secondary school. The location where the interviews took place may have had an effect on the pupils' responses. Conducting the research in a different environment to where COGMED was delivered, such as the

secondary school, may have led to different results being obtained. Elwood and Martin (2000) argue that the setting may affect an interviewee's responses.

- Critique of COGMED monitoring system

The data collection mainly focused on gathering data which would be accessible to the school implementing the programme e.g. the data from COGMED monitoring system and participants' views. Overall the data from COGMED's monitoring system concurred with the teachers views on which pupil had made the most progress but nevertheless the two progress measures, the Training Index and the CPI can be argued as not being rigorous measures of progress. The Training Index is considered by COGMED not to be an objective measure of progress because it presents the difference between the pupil's score at the beginning of COGMED and that of the pupil's best score on one single session. Also "the CPI is an index of improvement in non-trained tasks, or generalization", (Roche and Johnson, 2014, p380) which is computed from the pupil's performance on three tasks administered six times during COGMED. The CPI is described as measuring working memory related gains that are not specifically targeted in COGMED training. However Roche and Johnson (2014, p380) argue

> "given the repeated exposure to the CPI tasks, it is quite possible that changes in CPI scores are at least partially the result of practice effects. While the CPI report attempts to estimate generalization, the potential for a practice effect confound is seen as a limitation. In addition, the CPI report needs more validation research before it should be considered a measure of generalization".

5.5: Implications of the research findings

The following section will discuss what could be taken into consideration for the COGMED structure and by the participating school and Educational Psychologists in the future.

5.5.1: Implications for COGMED structure

This research has identified a number of future considerations in relation to the structure of COGMED:

- To undertake a review utility of monitoring provision and consider developing rigorous measures of progress to demonstrate impact, based on the understanding that COGMED's existing measures are unreliable (as discussed in Section 5.4.1).

To review the use of COGMED coaches across other schools and to ensure the dissemination of advice on the selection of participants and offering a greater understanding of COGMED (as discussed in Section 5.3.2.3 and Section 5.3.2.4).

- To explore whether other schools also experience difficulty in delivering the recommended sessions on the programme.

5.5.2: Implications for the teachers in the school

There are a number of considerations for teachers that have arisen as a consequence of this particular case study. Teachers could consider whether they have a clear understanding of working memory and COGMED, also what they could expect as outcomes of the intervention and how these would manifest in the classroom. They could develop and utilise their skills in supporting and scaffolding pupils' awareness of the use of strategy. The teachers would need to give further consideration on which pupils to select for COGMED and how the programme can be delivered within the school context, including the time of year COGMED is implemented. To deliver COGMED there is a requirement for ICT facilities, including headphones, and staff need to allocate time to communicate together and review the impact of the implementation of COGMED.

The teachers need to be aware of the impact of the length of sessions on pupil responsiveness and to offer distributed learning through shorter sessions. The reward games at the end of each session should not be forfeited to reduce the session time as this may also affect pupil engagement with the programme. The teachers used COGMED monitoring provision to monitor the pupils' progress and it would therefore be appropriate

for the staff to be aware of the limitations of COGMED's monitoring provision and to consider how they can quantify the impact.

5.5.3: Implications for Educational Psychologists

This research offers further indication of the role of Educational Psychologists in researching and evaluating interventions in schools (Frederickson, 2002). Educational Psychologists can support schools to examine the literature taking into account the research from a number of sources, not just from the programme developers, to inform the implementation process. This research offers Educational Psychologists a critical review of the literature on COGMED working memory programme which can be drawn upon if any of their schools mention that they are considering implementing COGMED.

The research findings clearly highlighted that the school staff needed to deliver a working memory intervention as they had been told by their Educational Psychologist that some of the pupils who later participated in COGMED presented with working memory difficulties. It was indicated that the school need to provide interventions for these children within the school budget and as part of their SEN protocol. Working memory underpins learning (Alloway, 2007) and the staff were essentially implementing a programme that they may not have fully understood. Also the school struggled to select pupils and therefore there may be a role for the Educational Psychologist, in this particular school, to consider how the school would select pupils, deliver training on working memory, offer advice on supporting the children on the programme and evaluate the outcomes of COGMED and this may be a more general consideration to take account of in other schools.

This research could be utilised by Educational Psychologists to facilitate discussion with other schools. They would be able to ask a number of potential questions which have been explored within this research:

- What is the teacher's understanding of working memory?
- What is the teacher's understanding and expectations of COGMED?
- What are the available alternatives to COGMED?
- How do the staff identify children with working memory difficulties?
- How will the staff select the pupils for a working memory intervention?
- How do the staff measure the outcomes of a Working Memory intervention?
- Are staff aware of the duration of the COGMED programme, how feasible is it for the school to deliver at least 20 sessions?
- Considering Table 5.1 and 5.2 can the staff identify any similarities in the findings of this research on the facilitators and barriers of implementing COGMED and relate them to their own situation?.

5.5.4: Summary of implications

Overall when taking into consideration my epistemological stance, critical realism, the research has generated ‘context-dependant knowledge’ which may offer the opportunity for naturalistic generalisation; whereby other professionals, such as teachers and Educational Psychologists, may become aware of the facilitators and barriers in the implementation in this school and explore whether they are appropriate to consider in their own context when implementing the intervention.

5.6: Research Journey

There has been a recent emergence of research studies which evaluate whether COGMED leads to far transfer effects (e.g. Holmes and Gathercole, 2013). Randall and Tyldesley (2016 p34) argued that "further research will be required for us to better understand the mechanism through which working memory training may improve working memory and academic performance in children". This research initially proposed to

address this by exploring whether pupils transfer skills from the COGMED Working Memory Training Programme to the classroom and if so how and to what extent this occurs. However, once data collection commenced in June 2015, a number of setbacks occurred. There were three main setbacks; which were the lack of programme fidelity, the retention of participants and emerging questions around the success of the programme itself. Five Year 5 pupils initially agreed to participate in the study but two of these completed four sessions or less out of a possible 30 sessions and the remaining three participants often engaged in the programme in a massed as opposed to the required distributed approach. A distributed approach is when practice occurs in shorter sessions over a longer period of time, whereas a massed approach is where the practice consists of fewer, longer training sessions. Additionally the staff, who had previous experience of using COGMED in the school, were sceptical of the benefits of the programme. At this point I reflected upon the difficulties of implementing an intervention in a school and re–reviewed the literature on this topic. "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" (Rumble, 2014 p184). Subsequently the focus of the research was revised and evolved towards the focus of this current study on the implementation of COGMED in the primary school.

Reflecting on my research journey I have undertaken, I think that this research process will impact upon my future practice. I have gained an increased understanding of working memory which I can share with schools if required. I have also become aware of the potential complications and threats and how these may have an impact on the delivery of an intervention in a school and I have furthered my skills on qualitative research methods.

5.7: Concluding points and considerations for future research

Most school based interventions employed do not undergo implementation studies and COGMED is not an exception as it was marketed by Pearson whilst there was still a lack of research on the implementation of COGMED in the "real-life context" of schools. This case study occurred in a real-life circumstance similar to that which Educational Psychologists often experience and as such offers a useful account of the challenges faced in an under researched real life situation which can be argued as a strength of the research.

Overall the research has been successful as it has revealed a range of critical considerations for implementation of COGMED in school, addressed key research questions and achieved the initial aim which was:

- To explore the facilitators and barriers of implementing COGMED in a primary school.

It is evident that many of the key implementation themes which emerged from this research complement the literature on implementation, including those relating to Durlak and DuPre's (2008) meta–analysis. The most significant findings of this research are that the implementation of COGMED may have been undermined by the teachers' understanding of working memory and ability to implement the programme as it was designed. Overall the majority of the teachers reported that they would not use the programme again.

This research has simultaneously led to further questions and highlighted considerations for the COGMED programme itself, researchers, teachers within the school and more generally Educational Psychologists. Future research might investigate whether other

schools also experience similar facilitators and barriers in the implementation of COGMED. This research was exploratory in nature and may serve as a role to prelude subsequent studies on implementing COGMED. Suggestions to researchers in the future include considering implementation research with pupils with a range of characteristics, varying the number of sessions, consideration of delivery within different school terms and of teachers' understanding of working memory. Furthermore further research could explore COGMED explicitly teaching the pupils strategies and the scope of teachers scaffolding the pupils' use of strategies on COGMED and supporting them to utilise the strategies across the curriculum. Additionally research could be undertaken whereby an Educational Psychologist could explore supporting the implementation of COGMED. Questions such as "what difference could Educational Psychology support, consultation and intervention make?" Or future research may diverge from COGMED and explore the Educational Psychologist's role and more ways in which pupils' working memory can be supported by Educational Psychologists. Ultimately this study offers learning opportunities and an insight into an under-researched domain of how the implementation of a working memory programme translates into a real life school context.

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Appendices

Appendix i: Descriptions of the Measures of the visuospatial sketch pad

Gathercole, Pickering, Ambridge and Wearing (2004, p179) also refer to digit recall, word recall, and nonword recall as measures of the phonological loop and block recall and mazes and visual Patterns test as measures of the visuo-spatial sketch pad.

Scale	Test
Digit recall	The child hears a sequence of digits and has to recall each sequence in the correct order
Word recall	In the word recall task, the child hears a sequence of words and has to recall each sequence in the correct order.
Non word recall	In the nonword recall task, the child hears a sequence of nonwords and has to recall each sequence in the correct order
Mazes	In the mazes memory task, the child is shown a maze with a red path drawn through it for 3 s. She or he then has to trace in the same path on a blank maze presented on the computer screen. I
Visual Patterns	The participant is presented with a matrix of black and white squares and has to recall which squares were filled in (Della Sala et al., 1997)
Block recall	In the block recall task, the child views a video of a series of blocks being tapped, and reproduces the sequence in the correct order by tapping on a picture of the blocks.

Appendix ii: Working Memory Rating Scale (Alloway, Gathercole and Kirkwood, 2008)

Appendix iii: Dehn (2008) Suggested Items for Classroom Observation of Working Memory (Dehn 2008 p152-153)

General Working Memory

- Classroom performance is poorer than would be predicted from standardized achievement test scores.
- Has difficulty staying focused during cognitively demanding activities but attends well when cognitive demands are minimal.
- Fails to complete complex activities.
- Has difficulty keeping track of place during challenging activities.
- Has difficulty retrieving information when engaged in another processing task.
- Has difficulty associating current situation with past experience.
- Has difficulty integrating new information with prior knowledge.
- Rarely contributes to class discussions.
- Make comments such as, ‘‘I forget everything.’’
- Has difficulty organizing information during written expression.
- Has difficulty retaining partial solutions during mental arithmetic.
- Has difficulty memorizing and retaining facts.
- Is very slow at arithmetic computation.
- Is slow to retrieve known facts.
- Confuses known facts.

Phonological Short-Term Memory

- Has difficulty remembering multistep oral directions.
- Has difficulty restating instructions.
- Has more difficulty remembering digits than words (indicative of mathematics disability).
- Makes many counting errors.
- Has difficulty blending phonemes into words when reading.
- Has difficulty with phonetic decoding of text.
- Has difficulty with phonetic recoding (spelling).
- Has difficulty learning new vocabulary.
- Has difficulty producing multiword utterances.

Visuospatial Working Memory

- Does not notice the signs (e.g., ‘‘þ’’) during arithmetic calculation.
- Has episodic memory lapses for the relatively recent past.
- Loses place when reading.

Verbal Working Memory

- Requires frequent reminders.
- When called on, forgets what was planning to say.
- Forgets the content of instruction.
- Has difficulty paraphrasing spoken information.
- Has difficulty comprehending syntactically complex sentences.
- Has difficulty taking meaningful notes.
- In third grade and above, continues to finger count during arithmetic calculation.
- Rereads text when there has not been a decoding problem.
- Has difficulty remembering the first part of the sentence or paragraph when reading.
- Has difficulty detecting targets in spoken or written language, such as identifying the rhyming words in a paragraph.
- Produces only short sentences during written expression.
- Has frequent subject-verb agreement errors in written expression.
- Omits some of the content when writing a sentence.
- Repeats words when writing a sentence.

Executive Working Memory

- Answers to oral comprehension questions are off-topic or irrelevant (has difficulty inhibiting irrelevant information).
- Has difficulty switching between operations (e.g., from addition to subtraction problems).
- Has difficulty taking notes and listening at the same time.
- Inaccurately estimates memory performance before, during, or after a task.
- Does not use learning strategies or does not use them on a consistent basis.
- Prefers to use simple instead of complex learning strategies.
- Does not use the most basic strategies, such as subvocal rehearsal
- Selects inefficient strategies during problem solving.

Appendix iv: Durlak and DuPre (2008) Framework For Effective Implementation

Durlak and DuPre's (2008) constructed a framework for effective implementation. The framework was comprised from Durlak and DuPre's (2008) meta- analysis of 500 studies of programmes implemented with children and young people in real world settings by non-researchers. The 500 studies identified barriers and enablers to implementation success. Within Chapter 5 this framework is compared to the findings on the implementation of COGMED in this study.

Twenty-three factors that affect the implementation process (Durlak and DuPre 2008 p337-338)

I. **Community Level Factors**
A. Prevention Theory and Research
B. Politics
C. Funding
D. Policy
II. Provider Characteristics
A. Perceived Need for Innovation
Extent to which the proposed innovation is relevant to local needs
B. Perceived Benefits of Innovation
Extent to which the innovation will achieve benefits desired at the local level
C. Self-efficacy
Extent to which providers feel they are able to do what is expected
D. Skill Proficiency
Possession of the skills necessary for implementation
III. Characteristics of the Innovation
A. Compatibility (contextual appropriateness, fit, congruence, match)
Extent to which the intervention fits with an organization's mission, priorities, and values.
B. Adaptability (program modification, reinvention)

The extent to which the proposed program can be modified to fit provider preferences, organizational practices, and community needs, values, and cultural norms
IV. Factors Relevant to the Prevention Delivery System: Organizational Capacity
A. General Organizational Factors
1. Positive Work Climate
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 insure 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.

Appendix v: Interview Schedule for Pupils

A) Introductory comments (explain the interview format)

B) Questions

1) Tell me about what you did at weekend?

2) Are you having a good day today?
3) Are you good at remembering things? Is there anything that helps you remember? How did you find out about these?

4) Do you find it easy to concentrate in class?

5) If you had to describe yourself what you say?

6) Tell me about COGMED?

Additional prompts for researcher

- Scale how much you like/ dislike it on a scale of 0-10.
- Why a ? out of 10.
- What is COGMED? Why were you doing COGMED?
- Has COGMED taught you anything?
-
- Where you good at doing the tasks on COGMED?
- Has COGMED taught you anything new you can use in the classroom?
- What new ways have you learnt that help you remember?
- Have you learnt any new ways to do things in the classroom?
- Has COGMED been helpful in the classroom? Why/ why not?
- Scale how good/ poor you are at remembering on a scale of 0-10

- What have you used in the classroom to help you remember numbers?

- What have you done in the classroom that helps you follow teachers' instructions?

- What have you done in the classroom that helps you remember what the teacher has said?

Do you have any questions you would like to ask me?

C) Debrief

Appendix vi: Interview Schedule for Teachers

A) Introductory comments (explain the interview format)

B) Questions

Concerns (about existing skills of SEN children and those who have been chosen for COGMED)

(Prompt questions if needed....

- What kinds of difficulties are the children on your SEN register experiencing?
- What kinds of interventions do you deliver in school with SEN pupils?
- What kinds of difficulties are the children who have been selected for COGMED experiencing in the classroom?
- What kinds of interventions can your school use to support the COGMED children's difficulties?
- What are the individual characteristics of the children that have participated in COGMED?
- Can you scale the pupils - self esteem,
  perseverance,
  motivation
  academic performance,
  attention and memory skills?

On a scale of 0-10 (10 = good 0= poor)

Hopes for the programme/ Selection of programme

(Prompt questions if needed....

- What is COGMED?
- What were you expecting before you used COGMED?
- Why did the school purchased this programme? What influenced them to do so? What was appealing about purchasing COGMED?
- What are that factors lead to in the decision making process in terms of using a computerised intervention such as COGMED?
- What is the general school staff's understanding of working memory? What is your understanding of working memory?
- What behaviours have you noticed that appear to be due to working memory difficulties/ attention difficulties?

Selection of pupils for the COGMED programme

(Prompt questions if needed....

- How does a school know which pupils to select for the COGMED Training? On what basis does your school select the pupils?
- How did you identify which pupils had working memory difficulties?
- What behaviours have you noticed that appear to be due to working memory difficulties/ attention difficulties?
- Did any other factors affect the decision making in whether the pupil should participate in the COGMED programme?
- What other factors if any, can affect the pupils progress on either COGMED or working memory in the classroom? Ie home factors, attendance at school, emotional health- anxiety, pupils participating in other interventions?
- What advice would you give to other schools / colleagues who are using COGMED on selecting pupils for the programme?

Implementation of programme

(Prompt questions if needed....

- What training did you receive on how to use the programme?
- What support, if any did you feel you need for using the programme?
- What are your thoughts on implementing the programme? What are the advantages/disadvantages of implementing COGMED?
- What have been the reactions of the other staff members to using COGMED?
- Did you need to adapt the implementation of COGMED?
- What are your perceptions on the design of COGMED?
- What are the threats to either; the adherence, dosage, quality of programme delivery?
- How can these be overcome? If so how?

Challenges

(Prompt questions if needed....

- What difficulties/ challenges have been encountered from using COGMED? Can these difficulties be over come?
- What factors affected the implementation and use of COGMED with the pupils?
- What are the barriers to using / implementing this programme in school? What is the teachers' experience of using COGMED?
- Can these barriers be overcome? If so how?
- What are the disadvantages/drawbacks of COGMED?

Benefits

(Prompt questions if needed....

- What were you told are the benefits of the programme? Who told you this?
- What benefits if any, do you think the children have got from COGMED?
- Are there any benefits of using this type of programme from the staff perspective?
- What do you think are the benefits of using this intervention?

Outcomes

(Prompt questions if needed....

- Were there any significant facilitators which affected the use of COGMED?
- What are your perceptions of the programme??
- What changes did you expect to arise from the programme? How would the staff identify/measure these changes? How could other users of COGMED measure if any changes have occurred?
- How quickly would the staff expect to see these changes occur?
- How far has the COGMED programme met your expectations? Can you scale on a scale of 0-10 how much COGMED has met your expectations? (10 = met their expectations, 0 = not met their expectation)
- How did the pupils respond to using COGMED? What do you think is their view of COGMED?
- Have you noticed any differences in the COGMED pupil's ability to concentrate following participation in the programme? For example has their ability to following instructions improved?
- Has any of the pupil's ability to remember improved, if so can you give any examples?
- Why do you think it has improved?
- Has there been any changes in your practice/ school's practise in the use of interventions as a result of you using COGMED?/Has the intervention had any impact on school's future use of interventions?
- Has there been any changes in your practice as a result of you using COGMED?
- Were there any unexpected outcomes of using COGMED?

Future Planning

(Prompt questions if needed....

- Would you change anything about the programme? If so what?
- How would you decide on whether to use the programme again?
- Will you use the programme again in school? Why / why not/ (Scaling question 0-10)
- If you were to use the programme again what could school do differently?
- What are the alternatives to using COGMED in the future?
- Would you adapt the programme? If so how?
- What do other schools need to take into consideration before using COGMED?
- Would you recommend the programme to other schools/ colleagues? Why / why not
- What advice would you give to other schools who were considering using the programme?/What would other schools need to consider if they were to use COGMED?

C) Debrief

Appendix vii: Working Memory Rating Scale Scores

Pupil User ID	WMRS Scores	Description of Scores
u1656	T score= 74 Centile 99	Above average range (red)
u1658	T score= 78 Centile 99	Above average range (red)
u1659	T score= 61 Centile 84	Above average range (amber)
u1660	T score= 65 Centile 89	Above average range (amber)
u1661	T score= 59 Centile 79	Average range (green)

Appendix viii: Myself as a Learner Rating Scale (Burden, 2012)

Appendix ix: Discussion Tasks with Pupils

Prompt Discussion activities

Activity One: Following verbal instructions: auditory memory. (Dehn, 2008)

Explain the task: I am going to give you some instructions to follow. I will only say them once, wait till I have given you the full instruction before you start.

- Draw a square
- Use the bigger pencil to draw a circle
- Give me the tray that is empty
- Pick up the book, rule pen and pencil but not the glue
- Touch the scissors, then pick up the blue and put them in the clear tray
- Give me two blue and four red shapes
- Give me two red, one green and three blue shapes
- Give me 2 red shapes, 1 blue shape, 3 yellow shapes and 1 green.
- Before you pick up the ruler get the book, pen and write your name
- Put all the yellow and red shapes in the pencil before your write your name on the paper and put the rest of the shapes in the tub.
- Pick up the clear tub, scissors, put the ruler in the tub and then get 2 blue 1 red 3 green shapes.
- Write today's date at the bottom of the page and then the numbers 2843

At the end of the task ask the pupil were you doing anything to help you remember?

Activity Two: Recalling digits backwards: auditory memory using numbers.
(Gathercole, Pickering, Ambridge and Wearing, 2004)

Digits	Digits Backwards
8 2	2 8
5 7	75
6 5	5 6
7 9 3	3 9 7
9 7 4	4 7 9
1 5 2	2 5 1
7 1 9 5	5 1 9 7
5 8 2 1	1 2 8 5
7 9 5 6	6 5 9 7
8 5 2 9 6	6 9 2 5 8
7 3 1 2 5	5 2 1 3 7
8 6 4 3 9	9 3 4 6 8

At the end of the task ask the pupil: were you doing anything to help you remember?

Activity Three: Kim's Game – Short term visual memory (Gathercole & Alloway, 2008)

Instructions:

I have a number of objects on the tray and I want them to remember as many items as possible. You will only have one minute to view them. Then take off the cover from the tray and start timing one minute. Check that the pupil is able to name all of the objects. After one minute, cover up the tray and ask the pupil how many they can remember.

Items in the tray:

- Padlock
- Balloon
- Chalk
- Key
- Teddy key ring
- Calculator
- Lolly pop
- String
- Scissors
- Battery
- Stamp
- Glue stick
- Spoon
- Cup
- Camera
- Bulldozer clip
- Torch
- Headphones
- Pen
- Pencil

At the end of the task ask the pupil: were you doing anything to help you remember?

Appendix x: School Recruitment Poster

Would you like free research to take place in your school??

If so there is a...

Researcher Looking For Schools To Participate In A Research Project That Looks At....

The impact of COGMED on your primary school pupils' working memory in the classroom?

Cost: Free

About the research project: The research will explore the impact of COGMED on primary school pupils' working and how the pupils use these skills in the classroom. It will involve both observing and interviewing six pupils, and a teacher completing a working memory questionnaire on each of the pupils and participating in an interview. It is expect that the research will take place between May to July 2015.

About the researcher: I am a Trainee Educational Psychologist currently on the DEdPsych at Sheffield University and as part of my training I currently work in a number of schools in Bradford. As part of my doctorate I am interested in researching COGMED and whether children transfer the skills they have been taught in COGMED sessions to the classroom.

If your school is already using COGMED in and your school is in the North West of England or Yorkshire and is interested in becoming involved or would like further information then please contact: Alexandra Smith, email aconnor1@sheffield.ac.uk

Appendix xi: Parent Information Sheet.

The impact of COGMED in Schools

Your child is being invited to take part in a research project. Before you decide whether you would like your child to be involved, 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. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish you child to take part. Thank you for reading this.

What is the project's purpose? COGMED is a computerised programme that was used in your child's primary school. Participants who have been involved in COGMED may show improvements in memory skills. The aim of the research is to explore the use of COGMED in your child's school. The research will be completed by December 2015.

Why has my child been chosen? Your child has been selected as a pupil to be involved in COGMED research because they undertook COGMED programme in their primary school.

Does my child have to take part? It is up to you and your child to decide whether or not to take part. If you decide you would like your child to take part you will be given this information sheet to keep (and be asked to sign a consent form) and your child will also be given an information sheet.
After signing the consent form, you can still withdraw your consent at any time without any consequence and without having to give a reason.
If you do consent to your child participating in the research, consent will then be sought from your child. Even if you have agreed for your child to participate, they will only be involved in the research if they have also provided consent.

What will happen to my child if they take part? All pupils involved in the research will be interviewed by the researcher. In the interviews they will be asked what they think about COGMED, their views on themselves and as a learner.

What are the possible disadvantages and risks of taking part?
The children may miss part of one lesson to take part in COGMED.

What are the possible benefits of taking part? Your child's participant will contribute to the understanding of using COGMED in your child's primary school.

What if something goes wrong? If you or your child has a complaint, you may contact the researcher (Alexandra Smith) at any time during the research. Contact number of researcher: ….. If you feel your complaint has not been handled to your satisfaction, you are also entitled to contact: Lorraine Campbell, Research Supervisor, University of Sheffield.

Will my child be recorded, and how will the recorded media be used?
Participants who are interviewed will be recorded during the interview using a Dictaphone. The audio recordings will be used only for analysis. Transcripts will be

made from the audio recordings and will be anonymised. The audio recordings will be destroyed when the research is finished.

Will participants' involvement in this project be kept confidential? All the information that we collect about your child during the course of the research will be kept strictly confidential. Participants will not be able to be identified in any reports or publications. Participants will be given a unique identification code in order to anonymise data, and real names will not be used by the researcher during interviews. Any names used by participants will be removed from audio recordings. All electronic data will be kept on passworded systems, and audio recordings will be destroyed after completion and successful submission of this research (anticipated to be around July 2016). If for any reason a pupil happens to disclose information that gives cause for concern around the safety or wellbeing of the pupil or others. In this instance, the researcher will pass this information on to relevant parties, e.g. the school's Child Protection Officer.

What will happen to the results of the research project? The proposed research will be submitted as a Doctoral thesis to The University of Sheffield. It is possible that this thesis (or a summarised/amended version) may also be submitted for publishing within a journal and/or book.

Who has ethically reviewed the project? The research has been ethically approved via the ethics review procedure with the Department of Education, University of Sheffield. Contact for further information:

Alexandra Smith, Researcher, tel: email: aconnor1@sheffield.ac.uk
Lorraine Campbell, Research Supervisor, tel:
email: l.n.campbell@sheffield.ac.uk

A copy of this information sheet will be provided to parents of prospective participants, alongside, if appropriate, a signed consent form to keep.

Thank you for considering whether you would like your child to take part in this research study

Appendix xii: Pupil Information Sheet

My name is Alex,

The COGMED Project is a research project and I am a Trainee Educational Psychologist and I am hoping to be a researcher in your school. Researchers try to find out new things.

A researcher tries to find out the answers to questions. They watch how people do things and might ask them questions. 

I would like to find out about what you think of using COGMED computer programme. I would like to find out how you remember things. I would like to work with you and some other children in your school. If you agree to take part in my research project I will be talking to you and asking you questions about COGMED.

When I ask you questions there are no right or wrong answers. Just try to answer the questions honestly so I can get your views.

If you agree to talk to me you will be tape recorded so that I can write it down later, but no names with be used. The answers you give will be shared with my teacher at University. They will be available to be read in my University work which is called a thesis.

If you tell me anything that may put you at risk then I will have to tell a teacher what you told me so that they can make sure your safe.

You can stop taking part at any time. Nobody will tell you off if you decide to stop taking part.

You can also change your mind about taking part even when you have started to work with me. If you do change your mind then the information I have collected will be deleted.

Do you have any questions, if so you can tell me or your teacher?

Appendix xiii: Teacher Information Sheet

1. **Research Project Title:**

A Case Study On The Implementation Of A Working Memory Programme In A Primary School

2. **Invitation paragraph**

You are being invited to take part in a research project. Before you decide 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. Ask me 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.

3. **What is the project's purpose?**

The main purpose of this project is to find out how COGMED training has been implemented in school. COGMED Memory Training is a computerized programme combining software with coaching for children. The research project will run from April 2015 to July 2016

4. **Why have I been chosen?**

Your school has expressed interest in taking part in the research. The research involves Year 5 & 6 children and their class teachers. You have been asked to take part as you may have had some involvement with COGMED.

5. **Do I have to take part?**

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 and following which you can still withdraw at any time without it affecting any benefits that you are entitled to in any way. You do not have to give a reason.

6. **What will happen to me if I take part?**

The whole research project will last for nearly 14 months. However if you were to take part, you might be asked to be involved in an interview. The interview would last up to an hour..

The audio recordings of your interviews made during this research will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings.

7. **What do I have to do?**

- Complete a short rating scale on the working memory skills of each of the five pupils before they take part in COGMED. (Year 5 teacher only)

- Participate in an interview with the researcher to find out about your views of the COGMED programme.

8. **What are the possible disadvantages and risks of taking part?**

Following careful consideration there does not appear to be any reasonably foreseeable disadvantages or risks in taking part in this research other than setting aside some time to take part in the research activities explained above. Any unexpected disadvantages that arise would immediately be brought to the attention of participants.

9. **What are the possible benefits of taking part?**

It is possible the participant may find the tasks interesting and they may gain an increased understanding of children's working memory skills

10. **What happens if the research study stops earlier than expected?**

In the unlikely event that the research study stops earlier than expected, the participant will be informed and reasons will be provided.

11. **What if something goes wrong?**

If you have a complaint you wish to share at any time during the research it should be addressed to the supervising tutor via email: l.n.campbell@sheffield.ac.uk. However, should you feel that your complaint has not been handled to your satisfaction you can contact the University's Registrar and Secretary via email: registrar@sheffield.ac.uk.

12. **Will my taking part in this project be kept confidential?**

All the information that is collected from your involvement in the project will be kept strictly confidential. All data will be anonymised before being analysed. In signing the consent form you will be giving permission for members of the research team to have restricted access to your data once is has been anonymised.

During the research tasks, participants will be referred to by a code and may adopt a pseudonym if desired. No third parties or schools will be made recognisable by participants during research tasks.

13. **What will happen to the results of the research project?**

The results of the project will be drawn together to be included in a thesis and may be published in a journal. You and your school will not be identified in any reports or publications.

You will be informed of the research summary, once the thesis is completed and approved.

You will be informed if the data is published in a journal and asked if you would like a copy of the report.

14. **Who is organising and funding the research?**

The research project is part of the requirements for completion of the Doctorate in Educational and Child Psychology and does not have any direct sponsorship or funding.

15. **Who has ethically reviewed the project?**

This project has been ethically approved via the University of Sheffield's Education Department ethics review procedure.

Should you decide to take part, you will be given this information sheet and asked to sign a consent form.

Thank you for taking the time to read this information and if you decide to take part then thank you for your participation.

16. **Contact for further information**

If you have any further questions or concerns then please do not hesitate to contact Alexandra Smith (lead researcher).

Alexandra Smith

Aconnor1@sheffield.ac.uk

The supervising tutor for this project is Dr Lorraine Campbell and her contact details are as follows:

Dr Lorraine Campbell

The School of Education

University of Sheffield

Glossop Road

Sheffield

S10 2JA

Appendix xiv: Teacher Consent Form

Title of Project: A Case Study On The Implementation Of A Working Memory Programme In A Primary School

Name of Researcher: Alexandra Smith

Participant Identification Number for this project:

Please initial box

1. I confirm that I have read and understand the information sheet and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. (To withdraw please contact Alexandra Smith on …….). ☐

3. I understand that my responses will be anonymised before analysis. I give permission for members of the research team to have access to my anonymised responses. ☐

4. I agree to take part in the above research project. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Lead Researcher	Date	Signature

To be signed and dated in presence of the participant

Copies:
Once this has been signed by both parties the participant will receive a copy of the signed and dated participant consent form and information sheet. A copy for the signed and dated consent form will be placed in the project's main record, which will be kept in a secure location.

Appendix xv: Pupil Consent Form

Participant Identification Number for this project:

Tick the boxes next to the sentences you agree with. ✓
Cross the boxes next to the sentences that you do not agree with. X

1. I have been told about COGMED Project and I know I can speak to my class teacher if I have any questions. ☐
2. I understand that I can stop taking part in the COGMED research at anytime. I know that I do not have to give a reason and nobody will tell me off. ☐
3. I understand that all my work with Alex will be locked away. ☐
4. I understand that my work will have a code and my name will not be used. ☐
5. I understand that I will be doing activities with Alex and she will be asking me about those activities. ☐
6. I understand that these activities will be audio-recorded to help Alex remember what I have said. I understand that nobody except Alex will be able to listen to the recordings. I know that the recordings will be locked away and destroyed one year after the project is over. ☐
7. I would like to take part in COGMED training and the activities with Alex. ☐

My name is _____
Date_____

Appendix xvi: Parental Consent Form

Title of Research Project: A Case Study On The Implementation Of A Working Memory Programme In A Primary School

Name of Researcher: Alexandra Smith

Participant Identification Number for this project: **Please initial box**

1. I confirm that I have read and understand the information sheet which explains the research project and I have had the opportunity to ask questions about the project. ☐

2. I understand that my child's participation is voluntary and that I am free to withdraw my child from the research at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. *Contact number of lead researcher...* ☐

3. I understand that my child's responses will be kept strictly confidential. I give permission for members of the research team to have access to my child's anonymised responses. I understand that my child's name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. ☐

4. I agree for the anonymised data collected from my child to be used in future research ☐

5. I agree for my child to take part in the above research project. ☐

_____	_____	_____
Name of Participant (*or legal representative*)	Date	Signature
_____	_____	_____
Name of person taking consent (*if different from lead researcher*)	Date	Signature

To be signed and dated in presence of the participant

_____	_____	_____
Lead Researcher	Date	Signature

To be signed and dated in presence of the participant

Copies:
Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

Appendix xvii: Sample Segment of an Interview Transcript- Teacher

I: Interviewer

R: Respondent/ Interviewee

I – There are different areas that I want to explore with you around using COGMED, Initially wanted to start off by asking you questions about what kind of difficulties your children have, that you have put forward for COGMED?.

R – Things like retention of learning; we seem to be having to do a lot of over learning with them, but sometimes even that's not making it stick either, so with memory and retention.

I – So the pupils that you have chosen when you mentioned memory and retention are there other children that you may not have considered that have memory or retention difficulties or is it just a set number and they were the ones?

R – Er no we could of probably chosen more and had more pupils doing it but as we had not used it before we just wanted to try it on a small group, but in hindsight right now some the children we chose were the wrong children, because some of the children I chose had other difficulties, around concentration and attention things and it didn't work as well on them, erm so the ones who on the tracking data are not making great progress.

I – is that tracking data on COGMED?

R - No our school tracking data, so we looked at our school tracking data and we chose children but some of them had behavioural needs as well.

I – So when you were looking at the tracking data what were you looking for?.

R – To see how far behind they were really for age related expectations, and also from just chatting with the teachers and the ones they felt that even though they were doing the pre teaching and over learning were still struggling to retain facts, erm basic number of facts and things like that, and then, ./.. but then I did chose some other children who had other needs to do with round behaviour, in hindsight I wouldn't say it worked as well for them

I – So you said that when you chose the children some had memory retention difficulties some had behaviour difficulties, just as a whole what kind of interventions have these children had. Have they had a lot of other interventions as well as COGMED?

R – Yeh Some of them have been on the SEN Register for a long time, and others that gaps only got bigger once they have got into the juniors, so they were ok downstairs in the infants, once they have gone into the juniors the gaps got bigger, but lots of them have had, speaking and listening interventions in the infants, I'd say the majority of them had, things like Talk booths but when they were in the infants it would have been time to talk, black sheep speech programs, so they will of all I would say had most of those, and some of the ones that have been put forward had done other small group interventions like Silver Seal and things the ones with the behaviour problems and because they are behind in things like literacy and numeracy they will have had small group literacy and numeracy support, anyone who is on the SEN register gets 20 minutes a day 1 to 1 10 minutes literacy over learning sort of phonics and basic facts and the same for number. So they are getting other input but the reason why we tried COGMED as well is that even though we had tried other interventions and 1 to 1 every day that gap wasn't really closing.

I – That's answered a few questions I was going to ask, Were there any individual characteristics about the children that participated in the COGMED program? So to give you an example were there variations across the children, maybe in self-esteem, motivation, perseverance, academic performance, you know attention and memory skills you know individually were they quite different were they quite similar?

R – No there were some differences, there were definitely some of the children that were chosen, struggled with self-esteem and self-image because they are in year 5 and they know they can't do what a lot of their piers can do academically in school, some of them like I say have been going out in these small groups for a long time, and when they get to year 5 they do start to know and yet there is others, I can think of one in particular that's like water off a ducks back, that I wouldn't say its effected his self-esteem at all. But from looking at the data at the end I would say the ones, even then ones with self-esteem differences, low attainment all did well with it the ones that didn't are the ones with behavioural concentration.

I – What's your understanding on what COGMED is?

R – I think it helps train your working memory and I think the success of it depends on how well the child can then use those techniques they have used on COGMED in their academic subjects, so I think that for the ones on the wholes school tracking, weren't looking like they were making a lot of progress, ern, but they are not statemented and they are not going to a pupil referral unit, those children were then able to use those strategies that they learned in COGMED and take it back to the basic skills and try it in numeracy and literacy whereas the ones where there was more needs more going on than just working memory it didn't really have massive impact.

I –So are you saying you're getting a sense its having an impact for some of them but not for other ones?

R – The ones where the needs are more complex

I – So what do u mean by more complex?

R – Where there is more barriers to their learning. so maybe there's one boy I think of that goes to the pupil referral unit, that's being assessed for ADHD who has had some trauma at home recently for him it didn't have the same impact, because I feel like that there's that many barriers to learning he couldn't take what he's, even though he had progressed in COGMED, he couldn't take that and then implement into his learning in class probably because there is so much else going on.

I –So you are saying that other factors influence if they make progress or not?. So what were you expecting before you used COGMED, before you purchased it what outcomes were you expecting?

R – Well we only bought a small number of licences we only got 5., because I wanted to see how effective it was, but I had read the research that was behind it and what I was hoping to see was an improvement in the retention of those basic facts that they need, basic skills in numeracy and literacy really so I was hoping they would do COGMED and show progress on the app and then they would be able to take that back into class and use those strategies to retain facts.

I – what influenced you as a school to purchase this particular program, how did you find out about it and what made you?.

R – I go to area subject,…..what they called …. Support groups SENCO forums erm I go to them every term, and they have different people speaking about things and they had somebody from is it Pearson's COGMED, im not sure now, but they had somebody from there talking about it and we had a go of it and it seemed interesting erm then when I came back to school I had another little look. There weren't many schools around here using it, so I knew it was a bit of a risk, but as it wasn't that expensive and you could start with a small number I thought its worth a go.

I– What appealed to you about it?

R – I thought it seemed simple to use, I like the fact that there would be quantifiable data to show an improvement, so that I could justify why I spent money on it why I am using it, so after this small group, I liked the fact that if It worked for them and I got it for more children, there would be data from the start and data from the end.

I– Do you mean the COGMED scores?

R – Yeh, so I liked that and I thought it was attractive to the children and easy to use for the staff.

I – Is that

R – Sorry can I just say aswell another reason why I liked it is that there is not that much adult intervention needed.

I – What factors that led to the decision making process that led to using a computer based intervention?.

R – There are so many children in our school that staff will come to me and say they just not retaining it, they can't remember it, they knew it that day and they don't know it this day. Erm so because there is that many that seem to have the same need so be able to take them out of class and do it 1 to 1 we just couldn't do it so to be able to have 6 sat on ipads in one room in the school with one TA it seemed like we would be able to help more children

I – Ok what do u feel in general with staff in the school, what is their understanding of working memory? What's your understanding of the staffs understanding?

R - I don't know if they would call it working memory, they would call it sort of here today and gone tomorrow. The TAs do a lot of the 1 to 1 precision teaching so they will talk a lot about that, so especially things like phonic sounds or number facts they might do numbers 1 to 10 and the child's totally got it and they are replying it in class for that week and they will come back after the weekend and its gone. So they might not call it working memory but they understand it as here today gone tomorrow and we have used practical ways of trying to improve working memory but they are very staff intensive aren't they, when you're doing them on a 1 to 1 basis, so I think they would know a little bit.

I – This is a question I don't know because this was a thing I was looking at with COGMED, does it claim improve attention?

R – Again its similar the children who's main barrier to learning is the retention of these basic facts, so when they are going out and doing COGMED and they are progressing thought it they are managing to bring some of those strategies back into class, but when there is loads of other barriers to learning it's not really making a difference on attention no but then I think that's because their needs are more severe.

I – Ok erm

R – So for the children whose attention difficulties are quite minor it is having a positive impact but for the ones who's attention difficulties are massive barrier then.

I – So you think that the children who have had trauma, and stress is causing affect.

R – Yes there is a lot of children in our school who have attachment issues so for them COGMED is not going to fix that, but for those whose who's concentration difficulties are on the next tier, where it's not as severe as that then it's had a positive impact.

So its about choosing the right children, which I don't feel I did the first time round,

I – What behaviours have you noticed that appear due to working memory or attention difficulties? You mentioned here today gone tomorrow?

R - yes yes, they know it one minute don't know the next

I – How did you select the pupils for this training and what basis did you base the selection on?

R – I was looking at my SEN register to choose these children where as if I was to choose again they wouldn't necessarily be children on the SEN register they would be the ones on a more targeted intervention group. I think those children benefit better from COGMED then those who are SEN. So the ones on with educational health care plan or ones on school support level 2. I think there is so much going on there that COGMED doesn't have the most impact whereas if you pick the ones that are just sort of below where they should be but not way below, or they are on the SEN support register but at that earlier level

I – I don't know what you call the levels?

R – we call it school support level I, school support level 2, then either a statement or an educational healthcare plan, so our school support level 1 which is like the old school action,

I – Yeh

R – yeh they are, when I have done it before they have responded well, when its more like school support level 2, educational health care plan I have felt like no.

I – And what's made you come to that conclusion?

R – Not just the data from COGMED because some of them did well on the COGMED but didn't transfer it back to class, not just going on what I have seen from the COGMED data.

I – So some of them did well on the scores but didn't transfer?

R – On the App yeh

Appendix xviii: MALS Table of Scoring / Information on Scoring

Pupil ID	MALS Score	Description
u1656	74	Average range
u1658	63	Average range
u1659	56	Below Average range
u1660	61	Average range
u1661	73	Average range

Appendix xix: Sample of different segments from a number of coded transcripts

A – What made you choose those pupils over choosing possible other ones?

S –Erm, I think I probably chose the ones who were furthest behind, which is what I was saying about next time, I wouldn't necessarily choose the ones furthest behind. Pupil Selection

What they learnt

A - Are there any other factors that affected your decision making process to why you put the pupils on COGMED?

S – Mainly looking at the data and talking to the class teachers. How selected pupils

A - Or disadvantages

S – well obviously its technology so the teacher needs to be organised you need to keep those 6 ipads need to keep them separate, because they are the ones with it on, in a school of 200, you need to make sure no one else gets those ipads, you need to make sure the ipads are charged up, not that it's a disadvantage, but just errrr.

Barrier Programme Structure

A – Was there any unexpected outcomes from using COGMED

S – No nothing unexpected, I was impressed with the TA who's been doing it, I felt like she surprised me in how good shes been, you know she did the online training which I wouldn't say we have done over much online training as a school, the heads done online web, as a rule the majority of us don't get trained in that way, she handled that really well she found that uselful and cascade that down to other TAs so I think that was quite unexpected because that type of training we have not used in the past.

Staff engagement with Cogmed

training on cogmed

PUPIL CHARACTERISTICS

Barrier

IMPACT

S – Again its similar the children who's main barrier to learning is the retention of these basic facts, so when they are going out and doing COGMED and they are progressing thought it they are managing to bring some of those strategies back into class, but when there is loads of other barriers to learning its not really making a difference on attention no but then I think that's because their needs are more severe.

Not Suitable for Cogmed

A – Ok erm

S – So for the children whose attention difficulties are quite minor it is having a positive impact but for the ones who's attention difficulties are massive barrier then.

Impact

So they are getting other input but the reason why we tried COGMED as well is that even though we had tried other interventions and 1 to 1 every day that gap wasn't really closing.

Rationale for Cogmed

Appendix xx: Timeline of present study

The table below shows Research Plan / Time line of present study

Date/ Time Period	Activity	Research Stage/ Question
January 2015	• COGMED Pearson representative contacted to discuss how I as a researcher could identify schools that would be willing to participate in the research.	Participant recruitment
February/ March 2015	• Information on research aims sent to COGMED so they could ask in their newsletter the schools who are using COGMED whether they would be interested in the research (see Appendix x)	Participant recruitment
March 2015	• I became familiar with COGMED and its features. • I reviewed the literature on working memory, transfer and COGMED to consider what changes could be observed in the classroom after the pupils have participated in COGMED.	Design of study.
End of March 2015	• Electronic submission of Ethics Application.	Ethics approval
End of April 2015	• Ethical Approval received	Ethics approval
April 2015	• I met with the teachers to informally discuss the research and gauge the school's interest. • I met with the teacher who was participating in the research to identify what the teacher's current knowledge of working memory was and their understanding of how it translates into classroom activities. This teacher was given information on working memory. (This was prior to the focus of the research changing from	Participant recruitment

	exploring whether the pupils transfer skills from the COGMED Working Memory Training Programme to the classroom to the current focus of the implementation of COGMED in school)	
April 2015	• Interview schedule and data collection methods compiled.	Data collection
May 2015	• Pupils identified. Letters sent out to parents to request parental permission.	Participant recruitment
May 2015	• Pilot work undertaken with a pupil who has already undertaken the programme. This will consist of the piloting a semi-structured interview with the pupil.	Pilot work
May 2015	• Administration of the Working Memory Rating Scale for the teacher to complete for the Year 5 pupils. • Year 5 pupils complete the Myself as a Learner Rating Scale.	Pre-intervention data collected.
May 2015 / June 2015	• Year 5 pupils complete a 5 week programme of COGMED	Intervention
End of June 2015	• I identified that there were three problems/ setbacks with the existing research which were: • Programme fidelity • The retention of participants • Emerging questions around the success of the programme itself.	Changes made to the research focus/design
July 2015	• Literature re-reviewed • Research methods altered and comprised to complement the new research focus.	Design of study
July – November 2015	• Further consent was obtained from participants.	Participant recruitment
July -	• Conducting pupil and teacher and SENCO semi-	Design of study

November 2015	structured interviews.	
December 2015	• Collecting quantitative data from COGMED's monitoring system • Conducting semi-structured interviews with three Year 6 pupils in their secondary school.	Data Collection.

Appendix xxi: Information given to Teacher B on working memory

Working memory: An introduction (Alloway, Gathercole & Kirkwood, 2008, p1-2 & 5-6)

"Working memory is the term used by psychologists to refer to the ability we have to hold and manipulate information in the mind over short periods of time. It is a kind of mental workspace or jotting pad that is used to store important information in the course of our everyday lives.

On example of an activity that uses working memory is mental arithmetic. Imagine, for example that you are attempting to multiply together the numbers 43 and 67, in a situation where you are unable to use either a calculator or a pen and paper. To do this you would first need to store the two numbers in working memory. The next step would be to use the multiplication rules you have already learned to calculate the products of successive pairs of numbers, adding to working memory the products as you go. Finally you would need to add together the products held in working memory, arriving at a final solution.

This process imposes quite considerable burdens on working memory: several number combinations need to be kept in working memory for the amount of time it takes to make these calculations, and the contents of working memory have to be updated to include our number calculations as we proceed through the stages of the calculation. Without working memory we would not be able to carry out this kind of complex mental activity without having some means to make an external record of numbers and the calculations.

We usually experience mental activities that place significant demands on working memory as a kind of mental juggling in which we try to keep all elements of the task – in the case of mental arithmetic, the original numbers we are trying to multiply as well as the calculations we make as we proceed – going at the same time. Often, the juggling attempt will fail, either because the capacity of working memory is exceeded, or because we become distracted and our attention is diverted away from the task in hand. A minor distraction such as an unrelated thought springing to mind or an interruption by someone else is likely to result in complete loss of the stored information, and so in a failed calculation attempt. As no amount of effort will allow us to recall the lost information, the only course of action is to start the calculation afresh.

It is important to note that working memory is different from short –term memory. Psychologists use the term ‘short –term memory’ to refer to those situations in which the individual simply has to store some material without either mentally manipulating it in some way or doing something else at the same tie. Remembering a telephone number is therefore a good example of an activity that depends on short term memory.

Working memory in the classroom

We often have to hold information in mind whilst engaged in an effortful activity. The information to be remembered may, for example be the sentence that they intend to write while trying to spell the individual words. It could also be the list of instructions given by the teacher while carrying out individual steps in the task.

Individuals with small working memory capacity will struggle in these activities, simply because they are unable to hold in mind sufficient information to allow them to complete the task. Losing crucial information from working memory will cause them to forget many things: instructions they are attempting to follow: the details of what they are doing: where they have got to in a complicated task and so on. Because those with small working memory capacity fail in many different activities on many occasions die to these kinds of forgetting, they will struggle to achieve normal rates of learning and so typically will make poor general academic progress.

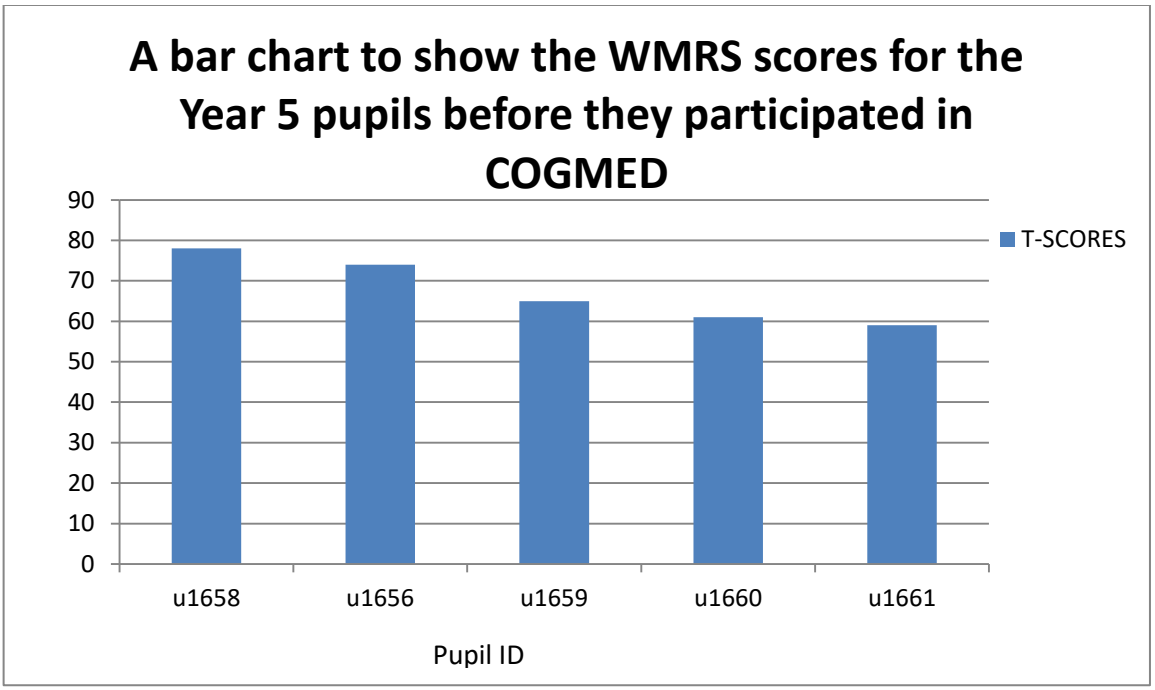
Here are some characteristics that are warning signs of poor working memory. The children typically:

- Are well-adjusted socially
- Are reserved in group activities in the classroom, rarely volunteering answers and sometimes not answering direct questions.
- Have short attention spans and high levels of distractibility, often forgetting part or all of instructions or messages
- Fail to adequately monitor the quality of their work, and show a lock of creativity in solving complex problems.
- Frequently lose their place in complicated tasks which they may eventually abandon
- Forget the content of messages and instructions

- Are rated by their teachers at school entry as having relatively poor skills in areas such as reading, language and mathematics
- Show poor academic progress, particularly in literacy and mathematics
- Have low levels of attainment at English, mathematics and science".

Appendix xxii: A Bar Chart to Show the Pupils T-Scores on the Working Memory Rating Scale

The Working Memory Rating Scale (WMRS) was completed by one teacher, Teacher B, prior to the pupils undertaking COGMED. As mentioned in Chapter 3 it was not possible for the WRMS to be completed for the Year 6 pupils. The WMRS indicated that four out of the five Year 5 pupils selected for the programme had working memory difficulties (see appendix vii for a table of the pupils' individual scores). The bar chart below shows the pupils' T-scores from the WMRS.

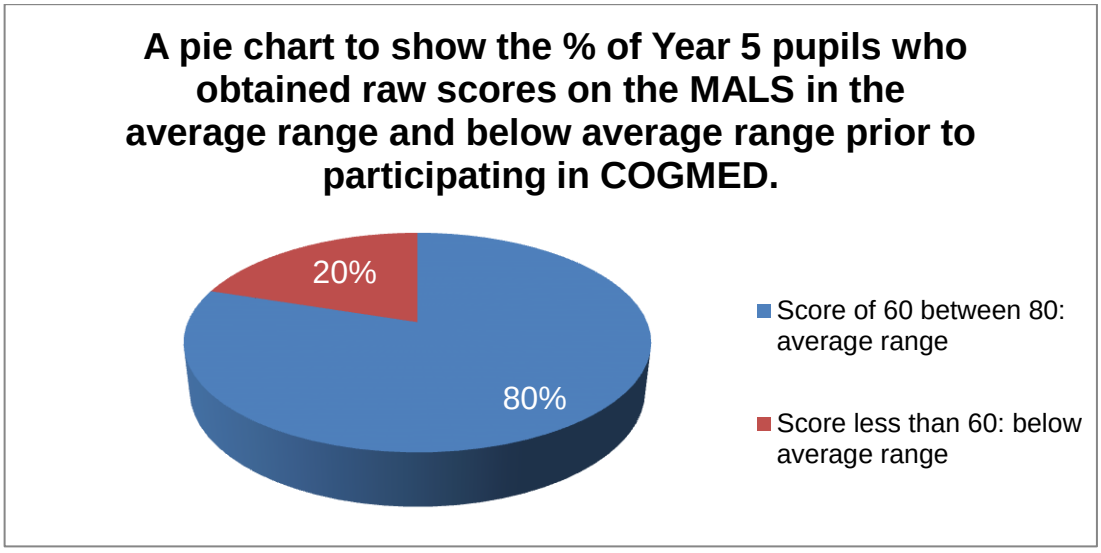


(A child who obtains a T-score of < 60 is considered to have typical working memory behaviours for their age group and therefore is considered as having a score in the average range. Scores that are 1sd above the mean T score > 60 may indicate moderate working memory deficits. Scores that are 2sd above the mean T score > 70 may indicate marked working memory impairments). Two pupils, u1656 and u1658 obtained scores

2sd above the mean indicating marked working memory impairments, u1659 and u1660 obtained scores 1sd above the mean indicating moderate working memory deficits whilst u1661 obtained a score in the average range.

Appendix xxiii: A Pie Chart to Show the Scores on Myself as a Learner Scale

Myself-As-a-Learner Scale (MALS) measures a pupil's perceptions of their learning abilities (Burden, 1998). The five Year 5 pupils completed the MALS prior to participating in COGMED and the results are displayed in the pie chart below.



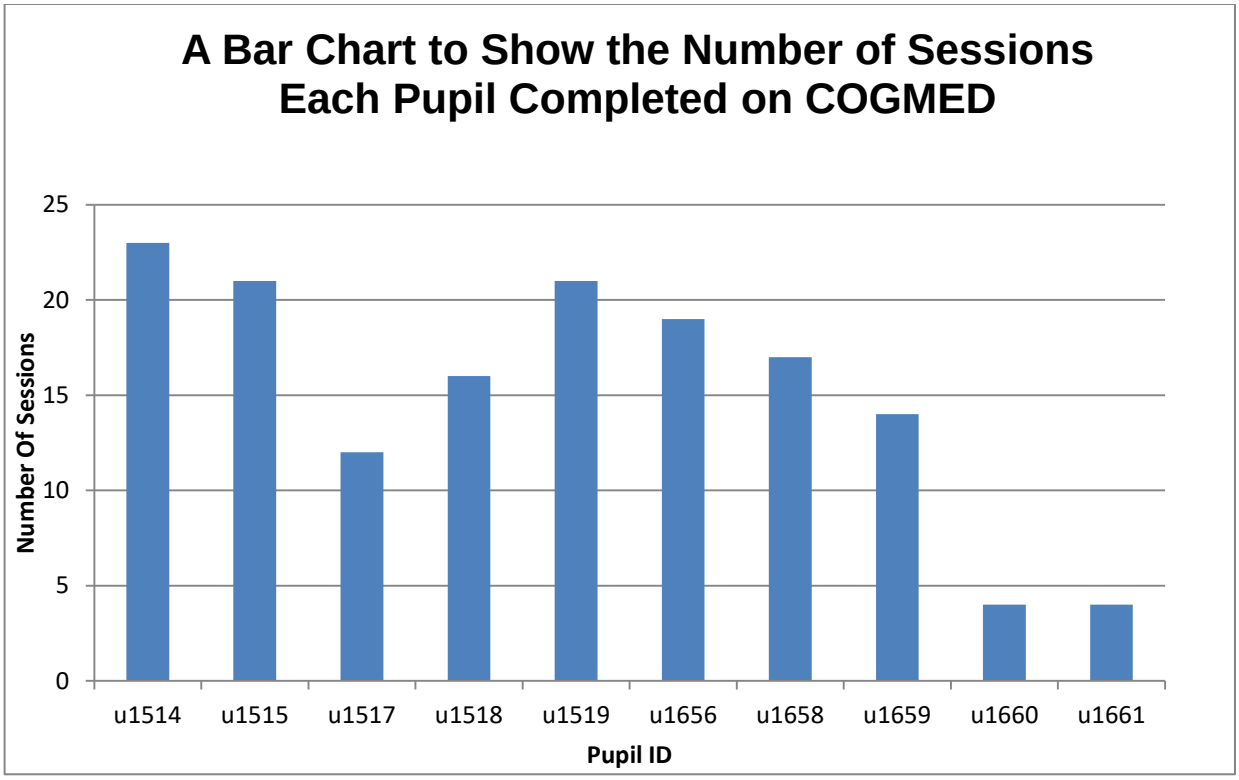
The above pie chart indicates that 80% of the pupils which equates to four out of the five pupils, obtained a self concept score within the average range when compared to a standard sample of pupils of a similar age. Pupil u1659 obtained a score in the below average range.

Appendix xxiv: COGMED Data

The following sections describe the data obtained from COGMED.

- **Dosage**

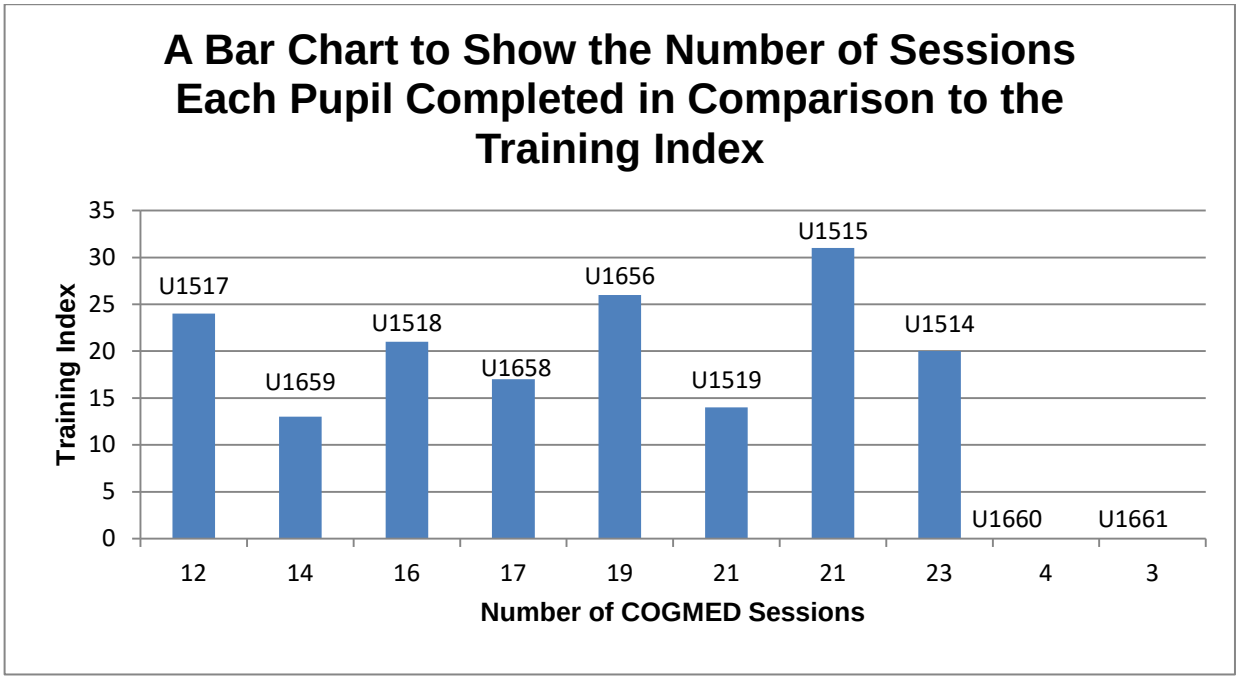
Programme dosage can be understood as the number of sessions delivered. The chart below shows the number of sessions each child received according to the COGMED data.



The COGMED Integral Data programme indicated that only 30% of the pupils received 20 or more sessions on COGMED. None of the pupils received the minimum of 25 sessions as recommended by COGMED. The bar chart indicates that u1660 and u1661 completed four sessions or less and for this reason they were not included in the semi-structured interviews. Also u1518 did not take part in a semi-structured interview as she was absent from school when the interviews took place.

- **Improvement: Training Index**

Improvement on the COGMED tasks is measured using the Training Index. A pupil's best scores from selected exercises create the Training Index. According to the COGMED Coaching Manual UK (2010 p17) "The Index Improvement is calculated by subtracting the Start Index from the Max Index". The Start Index is calculated using the results from days two and three, while the Max Index is calculated using the results from the two best days during the training period". The graph below shows the number of COGMED training sessions each pupil completed in comparison to the progress made by the pupil.



The Training Index is used by the teachers to observe progress, however it is considered by COGMED not to be an objective measure of progress because it presents the difference between the pupils score at the beginning of COGMED and that of the pupil's best score on one single session. This chart shows the improvement on COGMED tasks as measured by the Training Index. The data indicate that a greater number of sessions may not always lead to a greater improvement on the Training Index. For example the chart shows that u1517 completed twelve sessions and obtained a training index score of

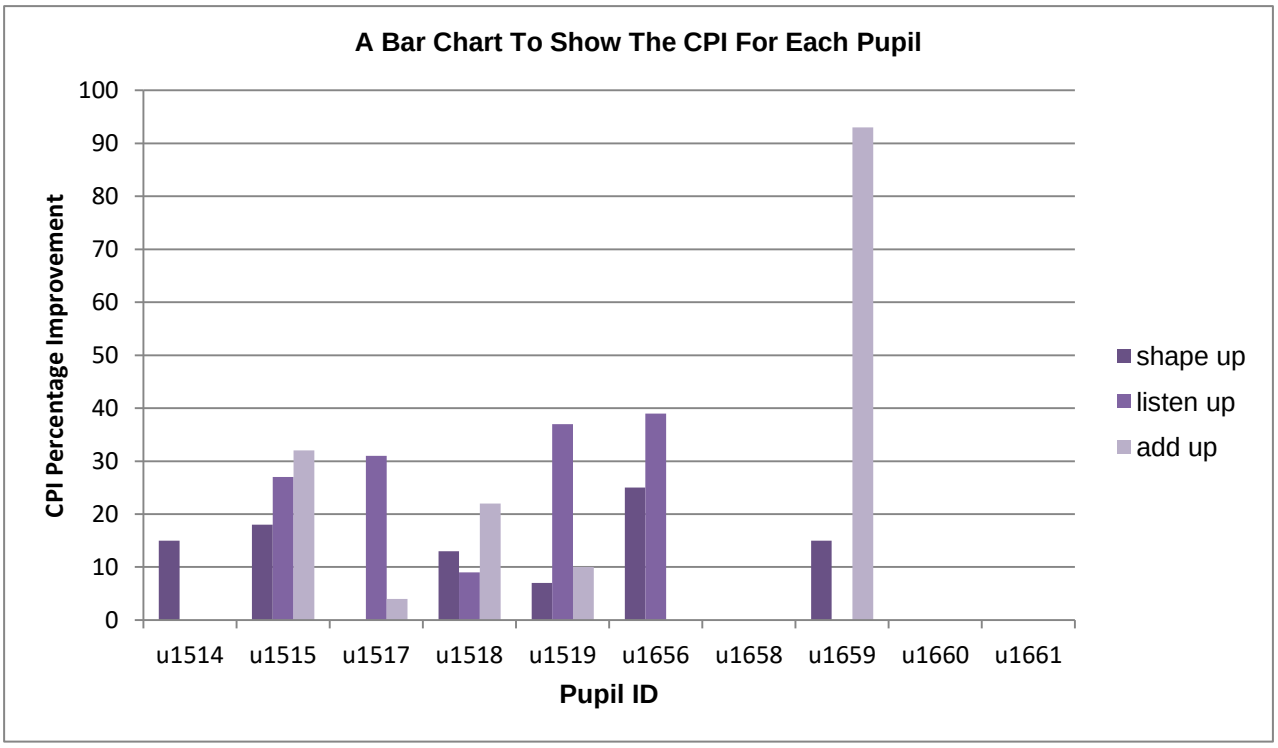
24, in comparison to u1519 who completed twenty-one sessions and obtained a training index score of 14.

- **COGMED Progress Indicators**

The COGMED Progress Indicator (CPI) is described by COGMED as illustrating

> *"the effects obtained from the training in a more direct and objective way than the Training Index. It consists of a set of tasks to be performed several times distributed throughout the training (the first block being on the first day). The outcome will be referred to as progress and will provide feedback to the trainee on how well training effects have transferred to non-trained tasks. It will be measured in % where the baseline obtained will be 0% and all subsequent measurement points will be compared to the baseline ....Therefore, the CPI will appear both on block one and two and the baseline will be the highest score on each task from the two blocks. This baseline will then be compared to all the subsequent blocks in which the peak performance will be reported as the improvement"* (COGMED, 2010 p18).

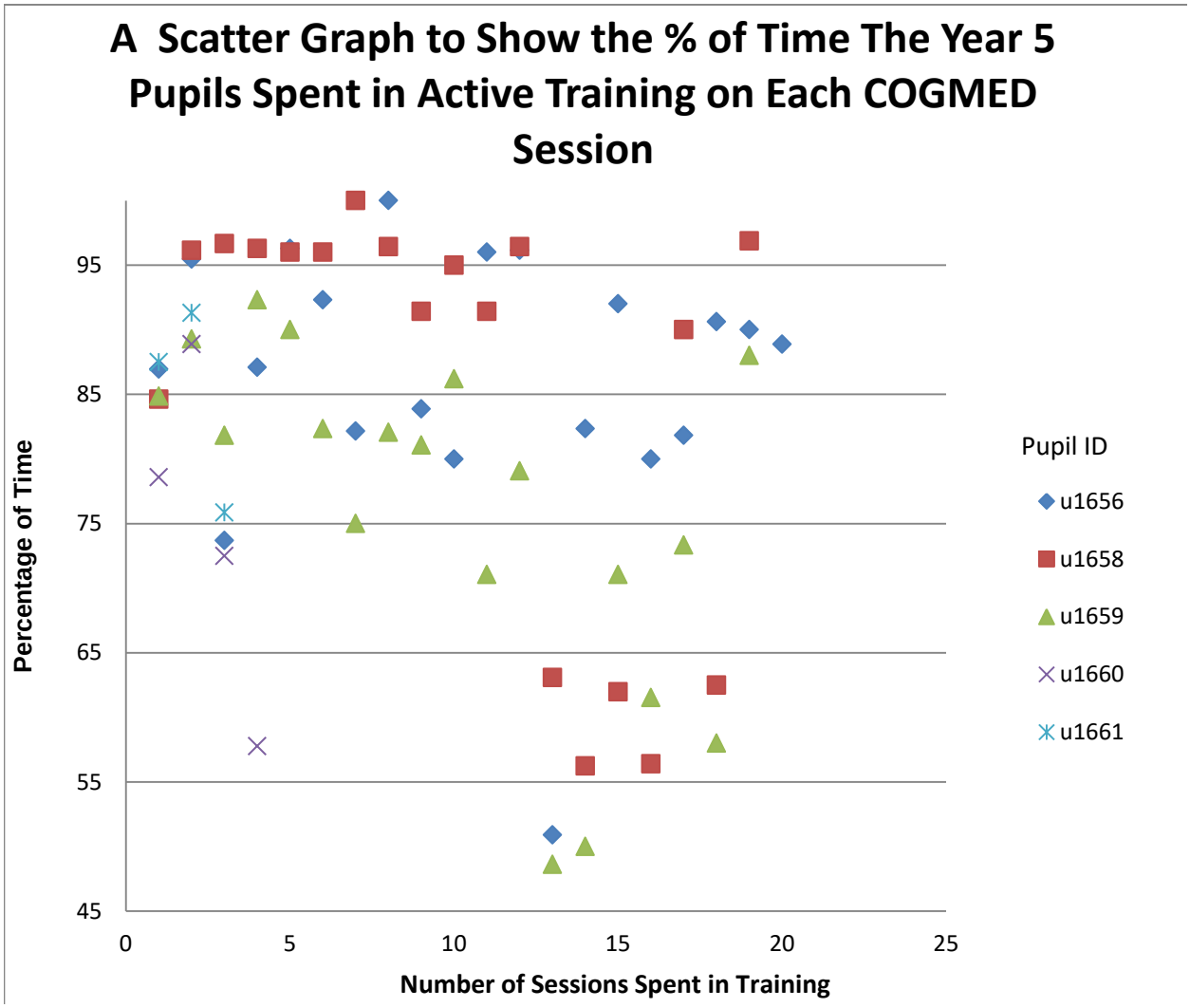
The CPI tasks are Shape Up, Listen Up and Add Up. Shape Up requires a pupil to remember the location of shapes in a correct order. Listen Up requires a pupil to listen to a set of instructions and then to undertake the instruction. Add Up requires a pupil to undertake a task of adding numbers by using their working memory. The results are shown in the following bar chart,



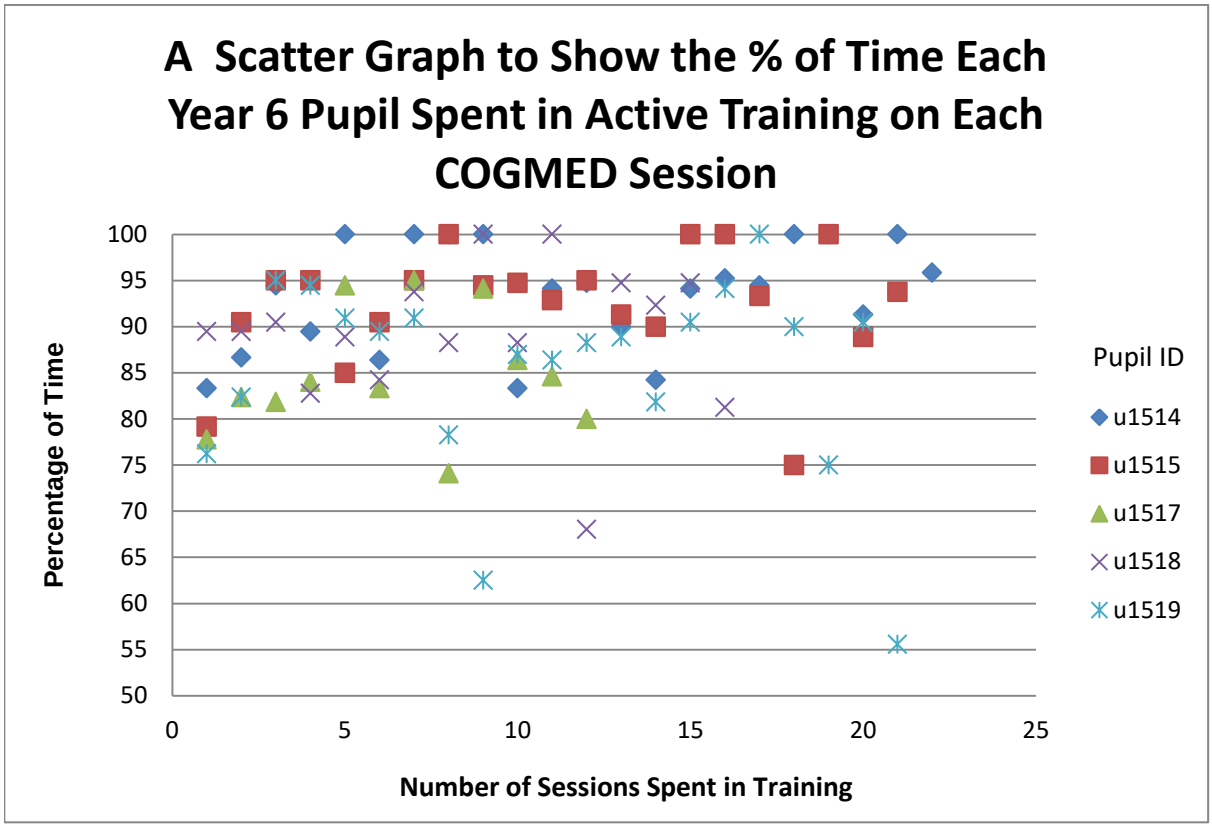
The chart indicates that three pupils, u1658, u1660 and u1661 did not make any improvement on the CPI tasks. Six pupils made an improvement on ‘shape up’, five pupils made an improvement on listen up and five pupils made an improvement on add up. As shown in the bar chart above three out of the ten pupils made an improvement on all 3 CPI tasks.

- **Participant responsiveness**

Participant responsiveness according to Durlak and DuPre, (2008) is the degree to which the intervention maintains the interest of the participants. COGMED records the total time the pupils spent on COGMED and how much of that time was in active training. The following line charts illustrate the percentage of time the Year 5 and Year 6 pupils spent in active training.

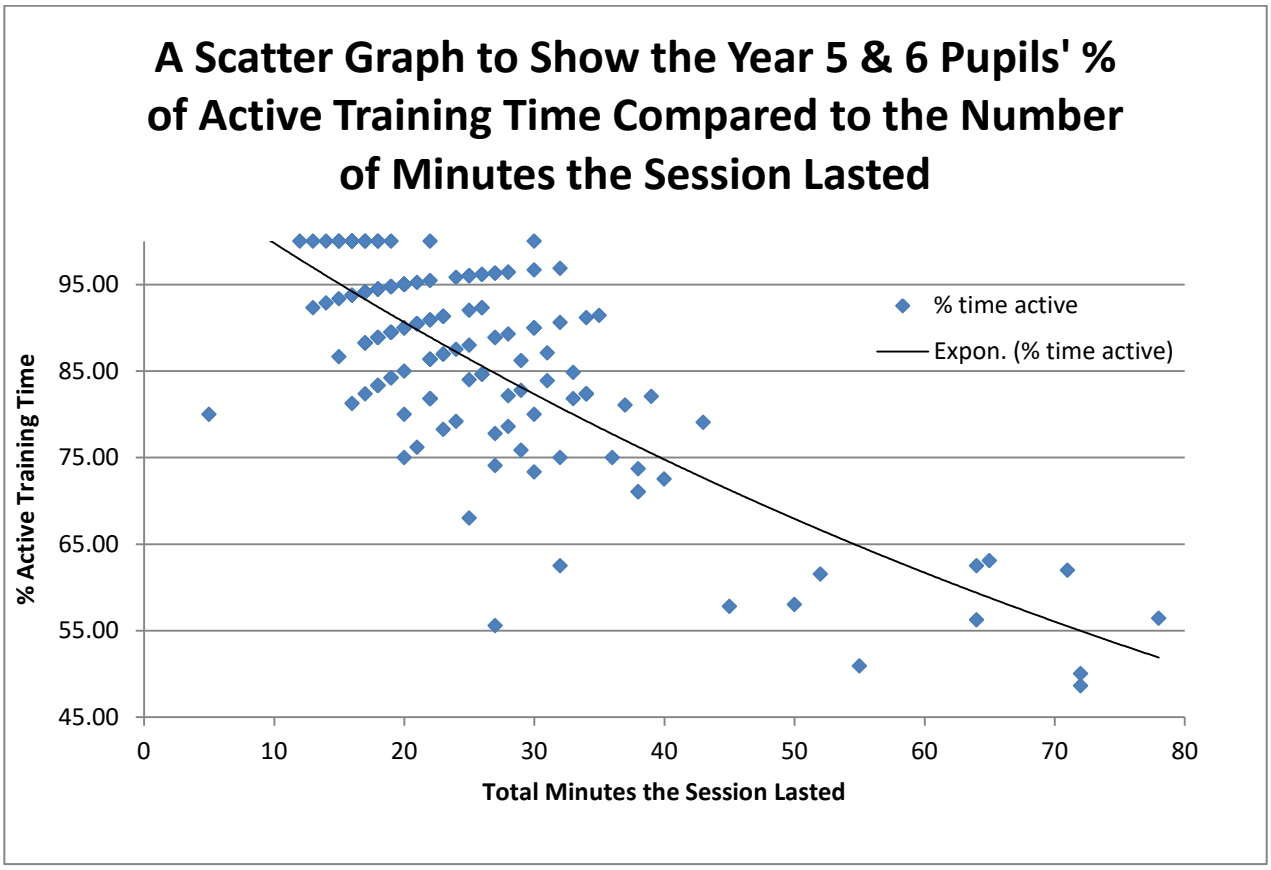


The above line graph appears to show that the three Year 5 pupils who engaged in at least 19 sessions were engaged in sessions 1-12 for approximately 75 to 100 percent of the time. On session 13 the session training time was significantly increased from approximately 30 minutes to 60 minutes, hence the above graph indicates that when the training time was increased the percentage of time in active training appeared to decrease for all the pupils.



The above line graph appears to show that all the Year 6 pupils engaged in the programme for approximately 75 to 100 percent of the time. Pupil u1517 was withdrawn by the teachers from the programme after the 12th session, hence there is no further data after this point.

The scatter graph below indicates that as the time spent on a COGMED training session increased the pupil's active engagement tended to decrease.



Appendix xxv: The Data Analysis Process

Stages of thematic analysis, taken from Braun and Clarke, 2006, p.87.

Phase	Description of the process
1. Familiarising yourself with your data:	Transcribe data(if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the Coded extracts (Level 1) and entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid compelling extract examples, final analysis of selected extracts, relating back the analysis to the research question and literature, producing a scholarly report of the analysis.

Braun and Clarke (2006) stages (illustrated in the above table) were applied to this data analysis. The data from the pupil interviews was analysed separately from the data from the teacher interviews. The first step I undertook in the semi-structured interview data analysis was the transcription of the data (See Appendix xvii Sample interview transcript). Once the data had been transcribed each section or a small segment of data was assigned a code. Initial codes were identified throughout the data set as shown and Appendix xix illustrates a sample of coded segments of different transcripts. A code was a brief description of the segment of data. The segment of data with the assigned code was then cut out of the transcript by hand and collated with other similar codes (See Table 1 below). The collated codes then were assigned a category. As shown in Appendix xxvi the categories were collected into sub themes and themes. During the data analysis naming and substantial renaming of the categories and themes occurred as the data was collated.

The thematic analysis was undertaken by using an inductive (Frith and Gleeson, 2004) and deductive (eg Hayes,1997) approach. I undertook a deductive and inductive approach simultaneously. There were five main themes identified in the teacher interviews which were Facilitators, Barriers, Outcomes, Implementation and Recommendations. Braun and

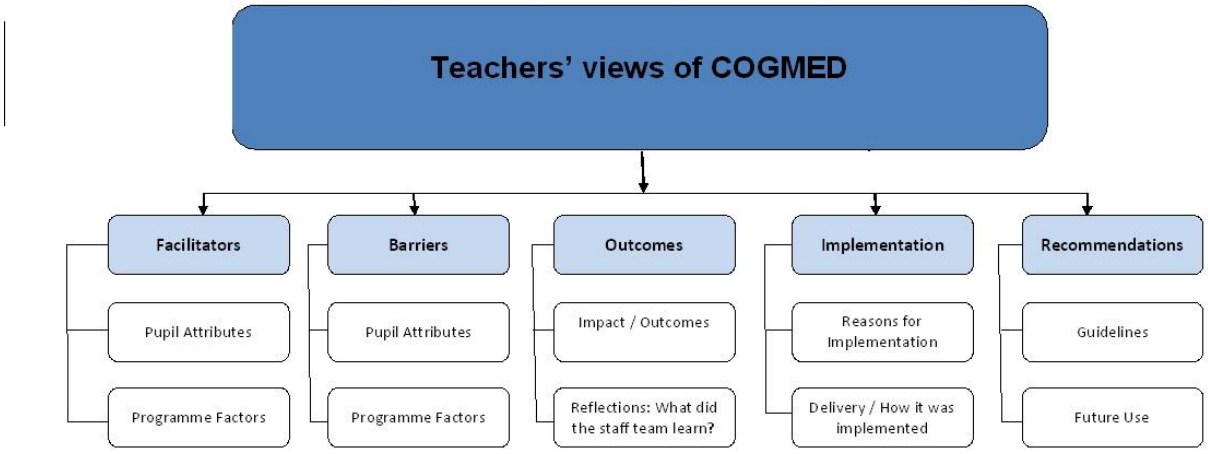
Clarke (2006) suggest that during thematic analysis the researcher has an active involvement in the analysis. The use of a deductive approach was apparent in the occurrence of main themes,: Facilitators, Barriers and this was a result of my awareness throughout the data analysis of the research questions. However as I also used an inductive approach, two unexpected main themes emerged from the data (which were not linked to any of the research questions or aims) these were Implementation and Recommendations. Overall the sublevel themes and categories mainly emerged from the data using an inductive approach. The use of both an inductive and deductive approach has been endorsed by Joffe and Yardley (2004); Fereday and Muir- Cochrane, (2006).

The use of an inductive and deductive approach was also used within the data analysis of the pupil interviews. There were three main themes from the pupil data, these were Facilitators and Barriers, Pupil Perceptions and Implementing COGMED. The theme Facilitators and Barriers was derived from a deductive approach as I was aware of the research questions whilst the themes of Pupil Perceptions (which incorporates the sub themes of strategy use and pupils' perception of their ability) and Implementing COGMED were unexpected themes derived from an inductive approach. Braun and Clarke (2006, p82) argue that importantly the prevalence of a theme across the data set does not determine its "keyness". However what was important was that the theme captured something of relevance in relation to the research questions.

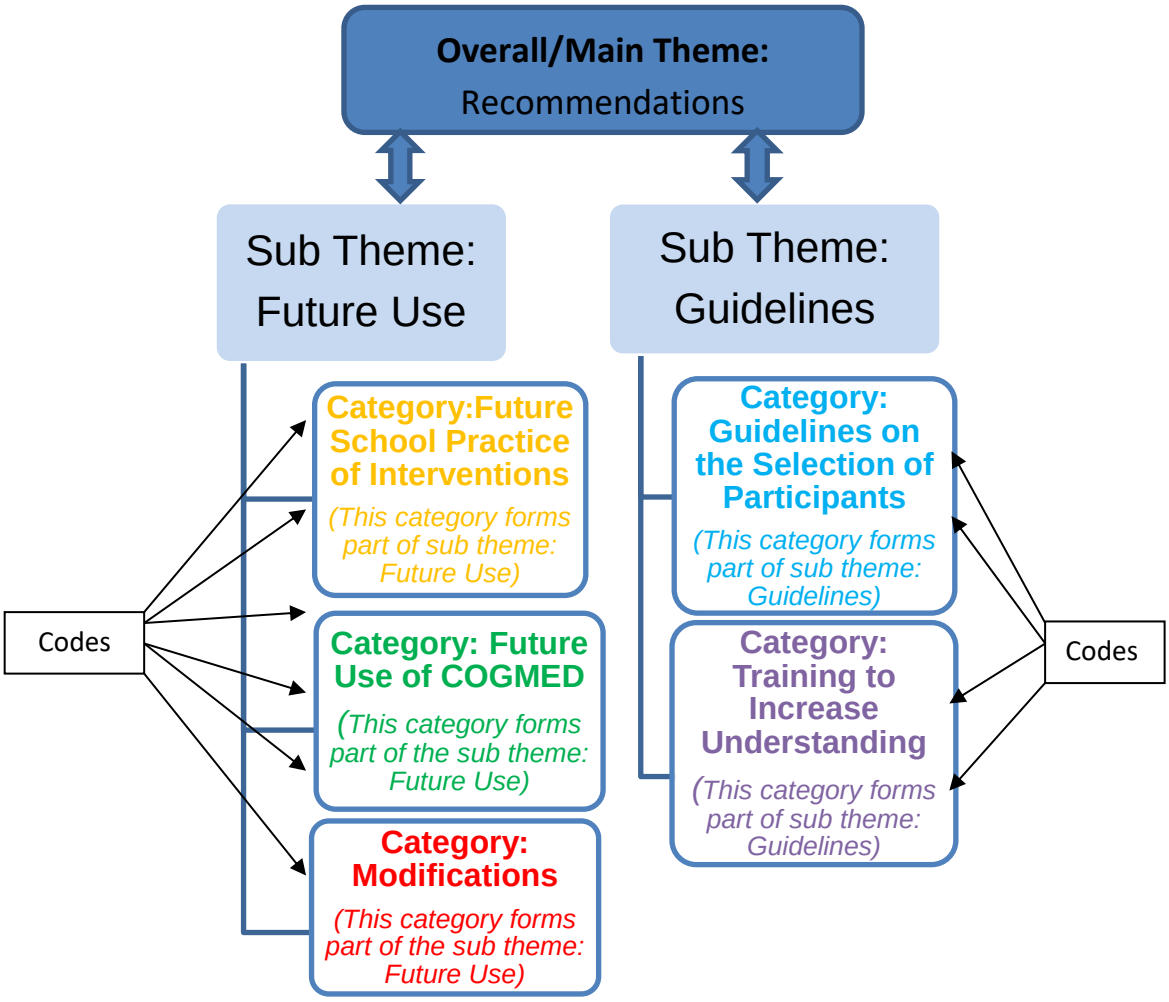
Once the data had been analysed a report was produced (see Chapter 4). The report followed Braun and Clarke's (2006) recommendation of selecting extracts or quotes to produce the report and hence did not include all the quotes as examples.

Appendix xxvi: An Example of the Data Analysis Process.

The following diagrams show the data analysis process. The overarching theme "Recommendations" has been used as an example to illustrate the process.



Example of data analysis using the overarching theme "Recommendations":



The following table, Table 1 shows an detailed example of the process of data analysis from quotations to codes to categories for the theme Recommendations. The codes with the quotes attached were placed by hand into a pile of other similar codes and these then formed categories. The categories were composed as a result of collating codes from all the teachers' interviews.

Table 1: Codes to Category

CATEGORY: Future School Practice of Interventions		
Participant/ Line Number	Quote	Code
Teacher D: LN 563	I: Has it changed your practice as a result of using COGMED? R: No	Not affected use of interventions
Teacher C LN 135	R: So it's about choosing the right children which I don't feel I did the first time round	Reflection on future selection
Teacher A: LN 283- 287	A: Has the intervention had any impact on your or the staff's future consideration for types of intervention N: er I wouldn't say it's really had in impact either way on that we are very open to try different interventions to try and find what suits our children so if something else different came out that possibly focused on something else and we knew there was a particular group of children that really needed It then we would try it, we are very open to try things like that.	Reflection on future interventions
Teacher A: LN 294-295	I – Are you aware of any other alternatives to COGMED? R- I'm don't personally know of any	Alternative interventions
Teacher C LN 420- 422	R: It is because it's on the educational psychologists' report they need an intervention in that area, so until somebody says this has been brought out why don't you try this or this, there isn't really much of an alternative for us that's manageable.	Lack of alternatives for future use

CATEGORY: Future Use of COGMED		
Participant/ Line Number	Quote	Code
Teacher C: LN 431- 440	I – Do you think you will use it again/? R – Yes, I – Ok why were you not sure when we talked before? R – No but from talking to staff,…. teachers were getting up children and the recommendations in the reports were that the children needed to work on working memory or had poor working memory, as we are just teachers they panicked, and they they want something like COGMED to know they are addressing that need.	Future use of COGMED. Future use of COGMED will address a need.
Teacher D: LN558 - 591	I: how would you decide on whether to use the programme again? R: I would like more input from them, more information, about what type of children it would be suited to	Future use will depend on more information on selecting participants
Teacher C LN222- 225	R – so the teacher needs to be on board so it's not a disadvantage, but if you didn't have a teacher that was on board and you didn't have teachers that's interested in it or taking, … taking it into account when she was trying to help students then I don't think it would really work	In future use of COGMED there needs to be a teacher engaging with the programme.
Teacher D: LN: 626 - 627	I : Okay would you recommend it to another school or colleague? R: Not until you knew they would be able to tell you who to deliver it to	Recommending future use of COGMED only once staff knew which select pupils
Teacher A: LN 252	R: It's just making sure you have dedicated time erm to help it work that the programme	Recommendation: time allocated to delivery
Teacher A: LN298-299	I: Would you recommend it to other schools? R: Personally I probably wouldn't recommend it just because of the erm it's not really negatives but just the sort of issues arising outweigh the benefits.	No future use/ wouldn't recommend to schools.

Teacher C: LN 464 -471	I – What would other schools or colleagues need to consider if they wanted to use COGMED? R – Erm I would ask them how they, how they address if it, who who they are going to do it for is it because they have been told they need to put some provision in place for a child you know by an Ed Psych or somebody, if they have been told it, why would they be choosing it?	Future use of COGMED/ need to understand the programme
Teacher C: LN 449 -467	R – Oh yeh I would definitely try it, if they brought something out with the research to back it up I would definitely try it. So on a scale 0 – 10 10 = would I try something else well/……. Erm I'd say 7 I – What makes you say 7? R – Erm if the research was there like it was for COGMED and it was as, and it looked as attractive and it was in the same, I think….. price obviously, if it was competitively priced against COGMED I would try it because budget is an issue. I: so what would make you stop using COGMED and use an alternative intervention? R: Budget would be a big one, so price would be a big one, just because it's always hard ermm I: If they were the same price? R: erm Recommendations off other schools maybe or errm, COGMED is all I found, COGMED is the best I've seen in terms of one teaching assistant to that many children and that kind of thing, but ermm, ….. I would be willing to try something different I'd probably keep COGMED going in one class and try something new in another class to compare them, yeh I would try something.	Future use of COGMED will be affected by price etc.
Teacher D: LN 595- 600	I: Will the school use the programme again? R: Possibly I: How likely would that be on a scale of 0-10, 10 being really likely, 0 being not at all R: I think it's, with their input they probably would.	Future use of COGMED.
Teacher C: LN:383 -	I would use it again because I don't really feel like I have other….. so it's kind of even though	Future use of COGMED

386	I'm not 100% sure it's just that I'm going to carry on with my precision teaching and my COGMED	
Teacher D: LN 621-622	I: Is there anything else that needs to be considered in the future? R: How you are going to manage it	Future use of COGMED / Managing the programme.
Teacher D: LN: 442	they are making progress so do we need COGMED?	Future use of COGMED/ Not going to use it.
Teacher C LN 500- 501	R – If an Ed Psych is telling you, you need to do something for working, … then yeh it's a fair enough option, I – Otherwise? R – Yeh I think there is probably other things you can do for a bigger impact	Future use of COGMED or alternative programmes
Teacher D: LN : 602-607	I: If school were to use the programme what would you do differently? R: you would probably set it up as it were , but if you knew it was for the right children it wouldn't matter it was taking 15 mins out of the day, or half an hour, what I mean if it was shorter.	Engaging with the programme in the future.
Teacher A: LN 288-291	I – Would the programme be used again R – Not sure I can really sort of comment on that because it wouldn't be my decision and with me not being over in the main school as well, erm and I think in my personal opinion it wouldn't be used again because of the cost and the number of children you are required to have to do it	Future use – cost may be a deciding factor in use.
Teacher D: LN441	R: They are making progress so do we need COGMED?	Future use of COGMED, unlikely.
Teacher D: LN:570	R: we certainly haven't thought oooo yes! Let's use it , it will solve all the problems	Using COGMED in the future
Teacher D LN 571- 582	R: Let's just go down computer, those children probably would have made, he would of I think any way, it would have just taken a bit longer ,cause we just tuned them into learning as well didn't we? I: Okay erm R: and its so structured in here anyway , by the time you get to January. I: Yeah R: They know exactly what to expect , don't	Future Use of Computerised Intervention, Don't need it as will pupils will make progress without it.

	they so they are on full alert learning I: Okay R: so you don't know, he probably would have improved without any of it, you don't know , erm,we are very structured and very much you know they are not allowed to switch off and not listen cause, it's not allowed	
CATEGORY: Modifications		
Participant/ Line Number	Quote	Code
Teacher A: LN 292-293	I: Is it a minimum of 5? R: I think there is a minimum if you could do it pupil by pupil then that would be a lot more appealing.	Modify use with one pupil
Teacher D: LN: 342-346	R: but it would have been useful if some of it was word base, literacy I: Okay. R: because you know that would of helped them if it was stringing sentences together and things, you know the literacy the word processing part of your brain would have been helpful.	Modifications- literacy based
Teacher D: LN587- 588	I; Erm would you change anything about the programme? R: Make it shorter.	Modify –shorter programme
Teacher A LN293	it was essential that we had headphones erm because erm mainly for the children that we had they couldn't process what was going on and have any outside noise.	Modification- use of headphones
Teacher C: LN 264 - 270	I think in other schools I know in some apps and things you can buy you can access it at home, erm with other things that I have seen before, I don't think that would be a benefit in my school because although we try very hard we don't always have the best parent involvement or support so I don't think an app that you could also access at home would be of useful in my school, where as in other schools where parent involvement is really high I imagine parents would be on board with getting to children having a go during the holidays and have a go when they are off, but	Modify to use COGMED at home

	that wouldn't happen here.	
Teacher D: LN 617-619	I: Erm would you adapt the programme? R: Well you can't it doesn't allow to be adapted.	Can't modify the programme
Teacher C: LN: 431-438	I – So future planning thinking ahead, would you change anything about the programme if so what? R – No I'm happy with the programme the children like it, it's engaging it's easy for us to use so in that respect I wouldn't. I – Is there anything you would like to add to that? R – I think for other schools it would be good if it was cloud based so that people could access it from home, not particularly in our school where we struggle with parental involvement.	Change the programme. Cloud based, modify programme.
Teacher D: LN 362-363	yeah it would have been better if it had been three times a week and shorter I: shorter okay	Modify by making it shorter

CATEGORY: Guidelines on the selection of participants		
Participant/ Line Number	Quote	Code
Teacher C: LN 137	R: So it's about choosing the right children which I don't feel I did the first time round	Selection of pupils
Teacher D: LN 430 -431	I: If another school was to use it again, what type of child could they select? R: well you wouldn't want your lows	Recommendations from teachers on which pupils to select.
Teacher C: LN143 -149	R: I was looking at my SEN register to choose these children whereas if I was to choose again they wouldn't necessarily be children on the SEN register they would be the ones on a more targeted intervention group. I think those children benefit better from COGMED than those who are SEN, so the ones on with educational health care plan or ones on school support	Recommendations from teachers on which pupils to select

	level 2. I think there is so much going on there that COGMED doesn't have the most impact whereas if you pick the ones that are just sort of below where they should be but not way below, or they are on the SEN support register but at that earlier level	
Teacher D: LN 398- 409	R: It's one we might actually go with your lowest, you might go with slightly higher than the, you might go with the ..that kind rather than ya .. I: Okay. R: Maybe the children , that not being so, so low I; yeh, R: so like one child who used it last year who's in here now, she'd started it next door, but I've our SENCo's tested her for processing and she's got a processing problem, now I've wonder if that's a problem, so there is no point putting them on that thing she struggles to remember what someone has said two seconds ago.	Recommendations from teachers on which pupils to select
Teacher C: LN 182- 185	I – If any other schools or colleagues asked about using COGMED, what things would you suggest when selecting pupils to use for the program? R – If there are loads of other barriers I wouldn't use COGMED	Recommendations from teachers
Teacher C: LN154-159	I: Yeh R: .when it's more like school support level 2, educational health care plan, I have felt like no". I: And what's made you come to that conclusion? R: Not just the data from COGMED because some of them did well on the COGMED but didn't transfer it back to class, not just going on what I have seen from the COGMED data	Recommendations from teachers on which pupils to select
Teacher D:	R: advice on who you choose,	Recommendations from

LN 114 -117	so children..... who have got a bit of an attention span already	teachers on which pupils to select
Teacher D: LN417	R: : and that's probably that's the advice you could do getting from them, who is it actually for, because it isn't , it isn't actually for everybody	Advice from COGMED on selection
CATEGORY: Training to increase understanding		
Participant/ Line Number	Quote	Code
Teacher D: LN 412	R: She's not processing anything and that's probably that's the advice you could do getting from them, who is it actually for?	More advice/ Training
Teacher D: LN 114	Well maybe you need more advice on who you choose	Advice/ training on selection
Teacher A LN 296- 297	I– Do you think staff and TA's have an awareness of working memory and what it is? N – no I think that's an area where people would need some training?	Training on COGMED
Teacher D: LN 423-425	R: Yeah but what would have been useful was if they said, well test their reading age, test their spelling age if they are so much behind , do you know, test the processing cause we all have tests for processing , if there's a problem there and if it is, if you're below a certain level	Training/ Guidelines from COGMED on who to select to participate in the programme.
Teacher A: LN 187-188	R: so it you know it would be good to have some sort of advice as to say you're better off if your children have headphones and you know little sort of hints and tips what to do.	Guidelines / Training
Teacher A ; LN 177-179	Just some sort of just like a web you know like a webinar or something just some brief training that you can	Brief training on COGMED

	access as a purchasing school that's there you just basically say right you're going to do this with this group here, watch this this will just take, yeh	
Teacher D: LN 236- 243	I: You did some online training tell me more about that? R: Ah it was four hours of hell I: Right okay M: Seriously was a waste of four hours of my life I: What did they, what did you get? R: Nothing, it basically talked you through the programme so it actually wasn't training there was no benefit for me where I could help the children. It was this is the programme and this is how it works	Training from COGMED not useful
Teacher A: LN 180 -181	I: So what would that include? Would that be what it's about? R: Yeh the reasons behind it I think that's important for whoever is doing it with the children	Training on the reasons for using COGMED
Teacher A: LN 150-156	R: Staff members could probably do with a bit more training of how they could support the children, erm because erm I mean obviously with me they were doing it and I'm a teacher but if they were doing it with a teaching assistant then you know the teaching assistant might need a bit of sort of an understanding of what the programme is about and the reasons doing it and how to support the children while doing it,	Training on COGMED
Teacher D LN: 245-257	R: Like guidelines er, if they are not making any improvement because obviously you can go in and check is there somethings you need to change? Are the there things you need to do differently? erm if a child is getting frustrated? What can you do? erm things like guidelines really I: Erm and did you get any er interaction with COGMED throughout? R: It was a live training so you could ask questions	Training to support the staff.

	I: So did you talk to them during the implementation at any point or did you just get the initial training? R: No that was it, they didn't contact at all during after that I: Is there anything that the company could of done R: Making sure who you're going to put on it, who about the candidates like the right kind.	

Appendix xxvii: Teacher Interviews: Qualitative Results of Sub Themes and Categories.

The following tables offer a description of the categories within each sub theme of the qualitative data results from all the teacher interviews.

Overarching Theme: Facilitators

Sub Theme	Category	Description/ Brief outline of the Category
Pupil Attributes	Pupil Characteristics	Factors such as attendance, perseverance and following instructions.
	Pupil engagement	Pupil motivation and engagement with the programme.
Programme Factors	Logistical Factors	Factors such as accessibility and easy to implement in the school context.
	Design/ Content.	Considers factors such as the programme being computerised, programme support and content and the design of the monitoring system.

Overarching Theme: Barriers

Sub Theme	Category	Description/ Brief outline of the Category
Pupil Attributes	Pupil Characteristics	Factors such as pupil processing difficulties, pupil anxiety, pupil motor skills, pupil concentration, pupil behaviour and perseverance.
	Pupil engagement	Factors related to engagement; attendance and difficulty of tasks on the programme.
Programme Factors	Knowing which pupils to select	Pupil suitability for COGMED and knowing which pupils to select.
	Design /Content	Factors such as COGMED can be time consuming and lack of apparent transfer from COGMED to the classroom. Also cost of COGMED, content of COGMED, teacher understanding the programme design and lack of the scope to measure pupil progress

Overarching Theme: Implementation

Sub Theme	Category	Description/ Brief outline of the Category
Reason for Implementing COGMED	Rationale for use of COGMED: Research presented on COGMED	Existing research available influenced the teachers decision to use the programme
	Understanding Working Memory and COGMED	Teachers understanding of working memory and understanding of COGMED
	Expected outcomes from implementing COGMED	Teachers expectations from implementing COGMED including expected time frame for change and outcomes, and expected improvement in working memory, processing, concentration and perseverance.
Delivery	Who they selected to participate in COGMED	Pupils who the teachers selected for the programme.
	Pupil and staff engagement	Pupil engagement with COGMED and staff engaging with the pupils during COGMED

Nb: The overarching theme of Recommendations and its subtheme and categories are detailed in Appendix xxvii

Appendix xxviii: Pupil Interviews: Qualitative Results of Sub Themes and Categories.

Overarching Theme: Facilitators and Barriers

Sub Theme	Category	Description/ Brief outline of the Category
Positive/ Advantages	Programme Structure	Factors included pupils enjoyed COGMED structure, it was fun and the pupils found the activities easy to complete.
	Engages Pupils and helps the Pupils' Memory	The programme engaged the pupils and the pupils thought that COGMED helped their memory .
Negative/ Barriers	Programme Structure	Factors included are that the programme was boring and frustrating and difficult**.**
	Computerised	COGMED was computerised when IT failed the pupils could not access the programme.
	Absence from lessons	Pupils report that missing lessons due to participating in COGMED was problematic.

Overarching Theme: Pupil Perceptions

Sub Theme	Category	Description/ Brief outline of the Category
Pupils' perception of their ability	Pupil perception of their ability on COGMED	Factors include pupils thought that they were either good or poor at undertaking COGMED
	Ability to remember	Pupils described their ability to remember information.
Strategy use	General Strategy Use	Whether pupils were aware that they used strategies to help them remember.
	Strategy Use On COGMED	Whether pupils use strategies while undertaking COGMED. How the pupils completed the COGMED tasks.
	Strategy Use In Class	Whether pupils use strategies to aid their memory in the classroom.

Overarching Theme: Implementing COGMED

Sub Theme	Category	Description/ Brief outline of the Category
Delivery of COGMED	Programme Fidelity	Pupils not adhering to the programme
	What is COGMED and its purpose?	Pupils understanding of COGMED and its purpose.
Outcomes of Delivery	What Pupils Learnt	Whether the pupils learnt anything, whether it improved their memory.
	Staff Engagement	Staff engaging with the pupils during the delivery of the programme
Alternatives/ Recommendations for Future Use.	ICT	Pupils would improve the ICT issues.
	Lessons when COGMED is delivered	To consider when COGMED is delivered.
	Content	More games as part of the programme content.
	Future Use	Whether or not pupils would participate in COGMED in the future.