Pupil engagement in the questioning process during Numeracy problem-solving sessions

by

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ABSTRACT

Within the context of interactive Numeracy lessons, active participation of pupils is encouraged. For example, questioning may be used to stimulate thinking skills and pupils may explain their methods of calculation to the class. Problem-solving is an area of Numeracy that offers an opportunity for pupils to discuss their methods and it has been highlighted as an area for development in Key Stage 2 mathematics. However, despite an emphasis on interactive lessons, research has shown that lessons tend to be teacher-dominated, with the teacher as questioner and evaluator, and pupils as respondents. I feel that if pupils are to be regarded as active participants in Numeracy lessons, then they must be engaged participants who willingly contribute to discussions, perhaps by asking questions, reflecting or sharing misconceptions. Indeed, I believe that, given the opportunity, pupils are capable of engaging in the questioning process, both as questioner and respondent.

Consequently, I have examined the nature of interaction and discourse in the classroom, in order to determine when pupils are explicitly engaged during whole-class problem-solving sessions. I collected data primarily in the form of audio-tapes, which were transcribed in order to facilitate analysis. I applied models of discourse analysis developed by Sinclair and Coulthard (1975) and Archer (2005) in order to categorise speech. Additionally, I utilised Bloom's *Taxonomy of educational objectives* (1956) to highlight the range of thinking skills being used in response to questioning.

The key findings indicated that when pupils were encouraged to pose their own questions, they readily responded to this opportunity to act as questioners. Pupils demonstrated a willingness and capability to question methods of calculation. There were instances of pupils using sustained questioning to examine alternative methods or misconceptions. The findings signalled that pupils were capable of engaging in the questioning process by considering and questioning methods of problem-solving, and responding to questioning from their peers by providing explanations and comments.

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CHAPTER 1 INTRODUCTION

This thesis seeks to examine the nature and extent of pupil involvement in classroom discourse during Numeracy lessons. I question whether effective methods are being used to engage pupils in this activity. Such methods include pupil demonstration of calculation procedures and the provision of opportunities for questioning and querying by pupils. The research aims to explore whether pupils are effectively engaged in the questioning process applied during Numeracy problem-solving lessons and examines the significance of pupil contributions to discussions. The thesis draws on prior research including interpretations of interactive whole-class teaching and pupil engagement. It explores the development of questioning by pupils in Upper Key Stage 2 (Year 5 pupils, aged 9-10). The impetus to explore these areas is outlined in the following sub-section.

1.1 Rationale

An important element of teaching is the process of asking questions as a means of gauging knowledge and also as a means of signalling the expectation of a response from pupils. Research has shown that teachers ask a variety of questions and these can be categorised in a number of ways. Andrew Trott for instance, provided examples of lower, middle and higher order questions (Trott, 2002). These ranged from questions which require the recall of a fact, e.g. "when was the Battle of Hastings?" to questions involving analysis, e.g. "why is the job of a police officer an important one?" (Trott, 2002: 9).

The Handbook for Leading Mathematics Teachers (DfES, 2002) emphasises the development of the skills of questioning. The objectives indicate that questioning has an important role in the development of children's learning in maths and that there should be consideration of,

> the role of questioning within the planning, teaching and assessment of mathematics (DfES, 2002: Objectives, session 3).

It also makes clear that pupils should be involved in discussions or dialogue, regardless of ability, stimulated by the use of a variety of questioning styles. However, the *Handbook* does not clarify whether the questions were to be used by teachers and pupils or by one group. This is an important point because during their review of the importance of developing thinking skills in the classroom, the Qualifications, Curriculum and Assessment Authority for Wales (QCA for Wales, 2006) emphasise the importance of encouraging learners to ask questions. Unfortunately, there is insufficient time to fully examine what may be meant by "thinking skills" in detail. However, I would suggest that thinking skills could mean the ability to reason, sort, analyse or draw conclusions from information. That is to say, these skills are employed during activities such as problem-solving. The QCA for Wales concludes,

> There is well-documented and substantial qualitative and quantitative evidence to show that the use of [thinking skills and assessment for learning] with learners in the classroom raises their motivation and performance (QCA for Wales, 2006: 4).

In other words, in order to raise pupil motivation and standards, pupils should develop their thinking skills through, for example, questioning, talk and explanation. In spite of this, Baumfield and Mroz, (2002) acknowledge that there is a shortage of research which focuses on pupil responses. Consequently, there appears to be a need to research the importance of pupil contributions during classroom discourse. In light of the suggestion that pupil involvement in discourse is important and under-researched, I will seek to assess the effectiveness of methods used to engage pupils in dialogue during the questioning process in this thesis. In particular, I will focus on Numeracy problem-solving lessons.

1.2 Why Numeracy problem-solving?

During my career as a primary school teacher, I was introduced to two important changes:

(i) the introduction by the Department for Education and Employment (DfEE) of the *National Numeracy Strategy* (NNS) *Framework for Teaching Mathematics* (DfEE, 1999)

and

(ii) the opportunity to undertake school-based research.

The NNS emphasises the importance of a two-way interactive process of teaching, as indicated in the following extract from the *NNS Framework*,

> During each lesson you should aim to spend as much time as possible in direct teaching and questioning of the whole class, a group of pupils, or individuals. High-quality direct teaching is oral, interactive and lively. It is not achieved by adopting a simplistic formula of 'drill and practice' and lecturing the class, or by expecting pupils to teach themselves from books. It is a two-way process in which pupils are expected to play an active part by answering questions, contributing points to discussions, and explaining and demonstrating their methods to the class (DfEE, 1999: 11).

This suggests that pupils should actively participate in the teaching process and any activity should include the opportunity for pupils to share their ideas or methods. Notice that the quotation presupposes that teachers and pupils will understand the meaning of "interactive" and that pupils will not seek to ask questions. The former change led me towards a specific interest in the processes necessary to gain mathematical skills, while the latter introduced me to the concept of practising such interactive methods of discourse. I began to explore alternative methods of tackling neglected or unpopular areas of Numeracy such as problem-solving and, having realised that my teacher-talk often dominated the lessons, I gave pupils the opportunity to question their peers' methods and to demonstrate their own methods. Put simply, lessons became more pupil-centred. That is, pupils proposed alternative methods of solving problems and aired their doubts or queries. Misconceptions and various alternative methods were aired and proposed. Pupils were active learners who tackled problem-solving with more confidence than earlier in

the school year. Contextual knowledge indicated that pupils had become engaged problem-solvers. This situation was seemingly in contrast with findings from other research,

> While 'interaction' is promoted, it is found to be essentially teacher-centred; teacher-talk dominates. The whole class interaction exemplified in NNS video materials supplied to schools does not show examples of interaction that go beyond the teacher-centred Initiate-Respond-Evaluate/Feedback model (... Sinclair & Coulthard, 1975): significantly children are never seen to *explore* a misconception, develop their argument or engage in conflict and reflection which...are seen to be so productive for learning (Ryan, Kassem and Sarland, 2003: 1).

The research by Ryan et al. (2003), indicated that far from being a two-way process whereby pupils are engaged in sharing their ideas, pupils are simply respondents in a teacher-dominated lesson. I will aim to explore the form of pupil discourse during Numeracy lessons focusing specifically on problem-solving sessions. There are several reasons for this particular focus,

(i) Analysis of pupil performance following Standard Assessment Tasks (SATs) identified problem-solving as an area for development (QCA, 2005)

(ii) Problem-solving offers an opportunity for pupils to contribute and discuss their methods of thinking. This form of interaction is a requirement of the National Numeracy Strategy (NNS).

(iii) On 20 May 2003, the Secretary of State launched "*Excellence and Enjoyment - A Strategy for Primary Schools*" (DfES, 2003). The Department for Education and Skills (DfES, formally known as the DfEE) aimed for 85% of Key Stage 2 (KS2) pupils to reach the standard of level 4.

This level in maths expects that,

> Pupils are developing their own strategies for solving problems and are using these strategies ... They present information and results in a clear and organised way. They search for a solution by trying out ideas of their own (DfEE, 1999: 9).

These factors suggest that problem-solving is an area of Numeracy which is ripe for investigation and development, whilst at the same time offering an opportunity for encouraging pupils to develop their thinking skills during interactive engagement, including exploration and discussion of their methods of calculation. Consequently, there are valid reasons for selecting this area to research. However, it is important to consider a number of contextual factors when studying classroom discourse, for example, teaching and learning styles or curriculum pressures. They are all of significance but due to time constraints, I am unable to examine these in detail as part of this thesis. I do, however, examine them briefly here. Clearly, numerous and possibly wide-ranging mathematical and thinking skills are required in order to attain the expected level 4. Pupils need to possess the capability to express their thinking when sharing their mathematical ideas. The NNS publication *"Mathematical Vocabulary"* (DfEE, 2000) states that by utilising a breadth of question-types e.g. from those that recall knowledge to those that require analysis or interpretation of information, children could learn to understand mathematical ideas (DfEE, 2000: 4). The publication goes on to list examples of questions that may extend children's thinking. There is a particular point of interest however; the publication, which was circulated to schools mentions, "a higher level of thinking" (DfEE, 2000: 4), but does not explicitly define what is meant by this. Similarly, an on-line article aimed at teachers states,

> Everyone uses a range of thinking skills. Benjamin Bloom's *Taxonomy of educational objectives* (1956) has been widely used to define a hierarchy of these skills (QCA, 2006: 8).

This seems to be a cursory mention of taxonomy of skills and presupposes that it is familiar to the audience. It is questionable whether the DfEE assumption that the term "thinking skills" is a familiar and understandable term. Perhaps it would be beneficial to provide a clear and explicit definition of what is meant by "thinking skills" prior to

emphasising methods of developing such skills? This thesis will highlight the need for a clear definition of thinking skills, including higher levels. In fact it is my belief that there is a need to clearly define key vocabulary or terminology such as "interactive" or "thinking skills" so that teachers are able to consistently apply their professional capabilities when planning. With this in mind, I am seeking to define my understanding of "engaged" or "engagement" (based on contextual knowledge and reviews of literature which imply the meaning of engagement) and to review definitions of "interactive" and "interactivity". Additionally, the conditions necessary to stimulate dialogue between pupil and teacher or pupil and pupil may not be present in all classrooms. Such conditions may include an ethos of valuing and respecting contributions to discussions, or a willingness to transfer responsibility for posing questions from teacher to pupil. Regarding the latter, Skidmore (2004) concluded in his study of the Literacy Hour (i.e. daily primary school lesson to teach literacy skills) that the teacher dominated talk, asked questions where the answer was already known and decided the order of turn taking. Consequently, Skidmore argued for pupils to "play a more leading role in shaping the topic of conversation" (Skidmore: 2004, 1). If effective questioning is to take place during Numeracy problem solving sessions, then the teacher may need to review their control of the discussion and allow the child who is describing their methods to invite questions and queries. Also, it is necessary to consider additional curriculum and professional constraints to utilising interactive methods to engage pupils, for example, the pace of Numeracy lessons, timetable pressures, trust and confidence. Although these are considered in more detail in a later chapter, it is important to recognise that teachers are expected to meet prescribed objectives within a given time and to a given minimum standard. Equally pupils are expected to achieve in a potentially fraught atmosphere of time limits and boundaries. These factors may serve to constrain effective methods of engagement. Finally, it is important to note that there are various learning styles preferred by pupils and some may or may not involve overt, active participation. I have focused on active participation as an element of engagement because this can be more readily observed and noted, but I value the importance of concealed pupil engagement whereby pupils do not explicitly signal their engagement.

To summarise, within the context of interactivity during Numeracy problem-solving lessons, I will examine potential methods of engagement and question whether interactive methods necessarily promote engagement. Indeed, I will suggest that given the opportunity, capability and awareness of the importance or value of asking questions and therefore using a range of thinking skills, pupils will be engaged and active participants in the Numeracy problem-solving process. However, there are likely to be implications, such as training needs or changes in expectations or values of teachers and pupils. This hypothesis is explored in the following chapters which are outlined below.
The next chapter reviews literature associated with the research topic. It identifies common themes and contrasting ideas which helped to guide the direction of the research. This is followed by Chapter 3 "Methodology" which states the selected research methods.

Data is in the form of transcripts produced from ten sessions of audio-recording of whole-class problem-solving Numeracy lessons. Summaries of each lesson are provided in the appendices. The data is analysed using three systems of categorisation (including discourse analysis) in order to determine whether engagement was taking place and to determine the nature of the interactions. The application of and findings from each system are described in Chapter 4 "Application of and findings from Sinclair and Coulthard's system of discourse analysis", Chapter 5 "Application of and findings from Archer's systemic approach to context identification and analysis" and Chapter 6 "Application of and findings from Bloom's Taxonomy of Educational Objectives". Then, Chapter 7 discusses the advantages and disadvantages of each of the systems of analysis and emphasises their main findings. Finally, Chapter 8 discusses the strengths and weaknesses of the research process, clarifies the findings following interpretation and analysis of the data and suggests a proposed way forward regarding further research.

CHAPTER 2 A REVIEW OF LITERATURE

In this chapter, I examine literature relating to key elements of my work. In particular, I examine literature stemming from Government bodies that was circulated to teachers and Head teachers. This literature focuses on Numeracy standards and pupil achievement; I also examine literature in a bid to find a consistent description of engagement. Additionally, there is a review of literature concerning questioning and thinking skills. These reviews act as introductions to research findings. Subsequent chapters contain more detailed analyses and discussions where appropriate. The review of literature focuses on the following areas:

Recommendations of DfES and QCA

Interpretations of terminology regarding "interactivity" and "engagement"

Thinking skills

Developing questioning skills.

2.1 Recommendations of DfES and QCA

On 20 May 2003, the Secretary of State launched "*Excellence and Enjoyment - A Strategy for Primary Schools*". The Department for Education and Skills (DfES, formally known as the DfEE) set a target of 85% of Key Stage 2 (KS2) pupils to attain the standard of level 4. The expectation was that by this level, pupils were able to develop and use their own strategies for solving problems, as well as clearly organising their method of calculation. Supporting the DfES is the Qualifications and Curriculum Authority (QCA). The QCA has the responsibility of reviewing the National Curriculum, including pupil performance, and suggesting areas for development. For example, problem-solving was cited as an area for development during the 2005 *Implications for teaching and learning from the 2005 national curriculum tests* report (QCA, 2005). Additionally, a DfEE booklet *Mathematical Vocabulary* (DfEE, 2000: 4) stated that by

means of questions children can learn to understand mathematical ideas. Yet, in both publications, questioning by pupils was not explicitly suggested as a means to improve performance. The use of questioning was in line with the key aims of the *National Numeracy Strategy Framework for Teaching Mathematics* (DfEE, 1999) which emphasised interactivity, including pupils providing explanations and answers. Interestingly, this suggests that pupils are to be assigned an answering role rather than a questioning role, and so they are seemingly not expected to engage in the questioning process other than as a respondent. Similarly, the Basic Skills Agency (which works with Local Education Authorities to ensure good standards of literacy and numeracy teaching) emphasises the importance of pupil participation in the questioning process and has found that mathematical talk leads to raised achievement. That is, schools which combined thinking skills, questions and reflection with an ethos of valuing mathematical discussion, noted that pupils reinforce their ability to think and reason mathematically (Basic Skills Agency, cited in QCA, 2005: 9). However, it was unclear whether mathematical talk was to include pupils participating as questioner or respondent or both.

2.2 Interpretations of terminology regarding "interactivity" and "engagement"

The *National Numeracy Strategy* (DfEE, 1999) emphasises and encourages the use of interactive whole-class teaching in order to raise standards of achievement. However, teachers and pupils have sometimes interpreted the meaning of "interactive" teaching in different ways, for instance, listening is viewed as more important than talking, and this may have implications for the quality of learning (Pratt, 2003).

Indeed as a result of the implementation of the *National Numeracy Strategy*, Grainger (2000) was motivated to research examples of best practice in maths teaching from the Czech Republic and to implement the processes in selected Nottinghamshire schools. Reference was made to OFSTED (Office for Standards in Education: the inspectorate for children and learners in England) who had highlighted interactive whole class teaching as being important for effective learning (OFSTED, in Grainger, 2000: 2). This primarily involved sharing misconceptions and using effective questioning. These methods were employed in the Czech Republic. Pupil thinking was made explicit and students were used to presenting their working out to the rest of the class. Additionally pupils were

expected to fully participate in lessons and challenged to attempt difficult mathematical ideas with tasks at an appropriate level. This interpretation of "interactive whole class teaching" and its related effectiveness corresponds with my understanding of this method of teaching, in that pupils are encouraged to actively participate by showing their methods of calculation to the rest of the class and by sharing any misconceptions through discussion. However, Grainger's work is seemingly a rare practical example of effective whole class interactive teaching using explicit guidelines.

There has been much research regarding the nature of interactivity. Pratt (2003) explored children's perceptions of whole-class interactive teaching (as required by the NNS) and particularly their view of the roles of speaking and listening in the classroom. Pratt learned that children perceived listening to be more important than talking and talking was not seen by pupil or teacher as a tool for learning. Similarly, Hardman, Smith, Mroz and Wall (2003) concluded that teachers were unclear as to what constituted interactive whole class teaching and had received insignificant amounts of advice in respect to the latter e.g. less than a fifth of the sample of teachers said they had seen DfES training materials. Hardman et al. (2003) based their findings on teacher responses to questionnaires regarding their understanding of interactivity and compared these findings with observations of teachers in the classroom during "interactive" lessons. It was determined that there was a disparity between the findings. For instance, teachers suggested that they encouraged or extended pupil contributions, but in practice, this was a rarity. Burns and Myhill (2004) supported this belief that there were divergent interpretations of "interactive" teaching. They concluded that teachers had been left to interpret "interactive" and dominated the discourse in order to meet objectives documented in Government teaching frameworks. As a result, pupils played a generally passive role in the proceedings with few opportunities to explore their ideas. However, Thornborrow (2002) disputes that teachers have all the power in the classroom. That is, Thornborrow learned that pupils are capable of collaborating and of regulating discussions; thereby becoming engaged as participants and the teacher then becomes a less dominant regulator of the proceedings. I would agree with this conclusion, but I would suggest that pupils are more likely to actively participate or engage if they are given the opportunity by the teacher. Yet Anderson (2000) argues that pupils may

actually become disengaged if they felt that their peers or teacher were scornful of their contributions. Anderson explores whether pupils felt anxious during whole-class questioning and whether this impacted on their school-life. It transpired that pupils became anxious and withdrew from participating during periods of whole-class questioning if they felt they had made a mistake. Therefore, Anderson's work highlights potential implications regarding whole-class interactive teaching and engagement, including the need to be aware of pupil anxiety resulting from teacher questioning.

2.3 Thinking skills

Department for Education and Skills (DfES) literature, for example, *Mathematical Vocabulary* (2000), recognises the importance of stimulating thinking skills. As such, guidance was circulated to teachers regarding the use of questions to promote higher thinking skills. The Qualifications and Curriculum Authority for Wales (QCA for Wales), whose role it is to maintain and develop the national curriculum and regulate tests and standards, has researched the importance of developing pupils thinking skills, such as the ability to analyse information, problem-solve, evaluate and reflect. The QCA for Wales (2006) suggest that there is substantial evidence to show that the use of thinking skills and self-assessment could lead to increased motivation and achievement. The work features specific guidelines for developing thinking skills, including giving pupils time to talk, explain and/or question. Similarly, McGuinness (DfEE, 1999) has reviewed research into the role of thinking skills and suggests that a clear definition of what is meant by "thinking" is necessary. She further suggests that the development of thinking skills should not only equip pupils for better learning, but also necessitate a change in training for teachers due to the potentially more active role of the pupil.

It is worth noting that a taxonomy of thinking skills was developed by Bloom (1956). The aim of the taxonomy was to define thinking skills for educators and to categorise them in hierarchical order. The *Taxonomy* was cited on the QCA web-page *KS2: Mathematics optional tasks for the more able* (QCA, 2006: 7) and applied to examples of questions that could be used by teachers to stimulate higher level thinking skills. These examples include the following: what is the general rule? How would you change ...? What would happen if ...? (QCA, 2006: 9) However, the responsibility for

posing questions seems to belong to teachers rather than pupils. That is, the web-page focuses on questions to be used for assessment purposes in order to stimulate higher level thinking from pupils. This implicitly suggests that the teacher will be assessing by asking questions.

The development of questioning skills is explored in the following section.

2.4 Developing questioning skills

Classroom discourse was analysed during the 1970s using a system developed by Sinclair and Coulthard. The system is described further in the Methodology chapter and is evaluated in Chapter 7.

Talk is still regarded as important for engaging pupils in the process of learning. For example, the *National Numeracy Strategy Handbook for Leading Maths Teachers* (DfES, 2002) was intended to be used by leading maths teachers in order to clarify key points of good practice to classroom teachers: it makes clear that all abilities of pupils should be involved in discussions and that their involvement should be stimulated by the use of a variety of questioning styles. However, it can be assumed that the questions were to be used by teachers rather than pupils because an overt distinction was not apparent. That is, the Handbook emphasises the use of a variety of question types, but goes on to highlight the importance of giving pupils time to form their responses and then listening closely to their answers. Indeed this covert distinction of the teacher as questioner and the pupil as respondent seems to be a prevailing view in Government literature. Teacher-dominance of classroom discourse is identified by Skidmore (2004) who concludes that during dialogue, the teacher dominates talk, asks questions where the answer is already known and decides the order of turn taking. Although Skidmore's area of interest is related to the teaching of Literacy, his comments are applicable to Numeracy, particularly in the sense that he summarises the artificial nature of talk in classroom when compared with everyday conversations e.g. that pupils wait their turn and raise their hand to indicate their willingness to contribute. Skidmore also concludes that government guidance regarding teacher-led discussions (in the Literacy Hour) should be changed in order to give pupils the opportunity to develop their thoughts or ideas. This change may include giving pupils an opportunity to develop their questioning skills, but this is not

explicitly proposed by Skidmore. Another potential change to classroom dynamics is also proposed by Coles (2001), who studied different forms of "listening" used by teachers. The forms of listening described by the author are: (1) evaluative, whereby contributions are judged as either right or wrong; (2) interpretive, whereby the response is likely to be a check for clarification; (3) transformative, whereby ideas are considered and incorporated into responses. Coles (2000) determined that, when the teacher's type of listening changed, pupils began to ask their own questions about complex mathematical procedures. I felt that this was an interesting point because the form of listening may possibly act as a constraint to pupils wishing to engage and pose their own questions. Coles commented upon particular transcripts in his work. In respect to one transcript (3), he highlights how:

> The participatory nature of discussion is even more evident in Transcript 3 *[teacher and pupils discussing lines of symmetry in a rectangle]*... the listening is also transformative *[whereby ideas are considered and incorporated into responses]*. The teacher here is not running the discussion (e.g. posing questions for students to respond to). It is the students who are asking questions: e.g. 'What would just a straight line be?' Students are now talking directly to each other and extending each other's ideas (Coles, 2001: 5).

In other words, Coles is commenting on a change in classroom dynamics whereby pupils engaged in the questioning process (by asking their own questions), apparently as a result of the change in the form of listening undertaken by the teacher.

As indicated in the previous paragraphs, a review of literature has revealed common and sometimes complementary themes and views. It has served to extend my understanding, in that it is apparent that research has centred on the role of the teacher as the questioner and methods of interactive teaching have seemingly neglected to actively involve pupils as questioners. Also, the review has guided the direction of the thesis, in that there is an examination of the nature of interaction and discourse during Numeracy problem-solving sessions, in an effort to discern whether "interactive" teaching necessitates pupils to become questioners capable of developing their thinking skills.

CHAPTER 3 METHODOLOGY

This thesis aims to assess the most effective methods of engaging Key Stage 2 (in particular aged 9-10) pupils in the questioning process during Numeracy problem-solving lessons. I believe that, given the opportunity and recognising the value of asking questions, pupils would be engaged and active participants in the Numeracy problem-solving process. In turn, I believe that pupils would recognise that they are capable of posing questions which enable them to actively interact during the learning process.

Due to the context of the research, the strategies for data-collection have been carefully chosen. That is to say, the research focuses on the discourse and interaction between pupils and their teacher and so it was important that my presence as a researcher in the classroom caused minimal disruption and distraction. A class of 28 Year 5 pupils (aged 9-10) was chosen from a school which represented a wide range of ability and backgrounds. Parental permission for participation was sought and gained. I approached the Head teacher regarding my aims and agreed that I would collect data in the format of audio tapes and observations during the Spring Term, by which time the pupils had settled into their classroom routines. Initially, I made two visits to the class so that members would become familiar with my presence in the classroom as an observer. Similarly, I had met with the newly-qualified class teacher prior to becoming an observer, in order to allay any possible nervousness on her part and to reassure her of my motives.

During previous school-based research, I had used questionnaires as a means of gathering data effectively and time-efficiently. Macintyre (2000) identified the pros and cons of questionnaires. The "pros" included the speed of administration, anonymity of respondents, numerous replies, questions can be standardised, not necessary to interact face-to-face. The "cons" included the large amount of time required to design and redraft the questions, descriptive rather than explanatory responses, responses lacking detail, difficulty in following up note-worthy responses (Macintyre, 2000: 84). Pupil capability and willingness to respond can be problematical and I agree that some resultant responses might be deemed "superficial" (Macintyre, 2000: 84). Permission to use questionnaires as a means of collecting data was granted, but this method was not utilised during analysis

because there was sufficient applicable data collected from observation and audio-recording methods.

Regarding audio-recording, the major benefit according to Macintyre was that this method recorded not only what was being said, but also how it was being said. The author determined that such information captured on tape was invaluable, e.g. the main benefit of audio-recording was that tapes could be replayed and/or transcribed in order to access detailed data, or to enable participants to evaluate dialogue or behaviours. But it was necessary to be aware of procedural bias associated with the research method, e.g. teacher or pupil behaving differently than usual due to the presence of the recorder. However, I was also aware that clarity of recordings was critical and this point was emphasised by Macintyre (2000: 64). Furthermore, transcription of tapes could be a lengthy process and this would be prolonged if tapes were difficult to decipher.

In order to assess the nature of the classroom interaction, I made audio recordings (c. 45 minutes duration) of the interactions between the pupils, their peers and their teacher during weekly Numeracy problem-solving lessons over a period of 11 weeks. The tape recorder remained in the same position throughout the period of the lesson when all pupils were gathered together as a means of participating interactively during the teaching process ("whole-class" session). I focused on recording this part of the session because I wanted all pupils to be present in order to provide a fair basis for data collection. The teacher was not asked to position the pupils any differently than usual in order to maintain a sense of normality, which I felt was important for recording purposes. In order to allow for repeated close analysis of the content of the tapes, each session was transcribed. That is, all audible interaction taking place during the whole-class introductory session was transcribed. This stage of the Numeracy lesson involved the main teaching input and pupils were expected to be involved "interactively" by questioning and by contributing to discussions, e.g. by offering their methods and solutions to problems.

An audio device was used because the teacher preferred not to be video recorded. Unfortunately, the device was not sensitive enough to record all discussion, e.g. lower volume voices and voices from a certain distance away from the microphone. Presumably, a more sensitive recording device would have recorded asides and low

volume utterances. Also the tapes used were of variable quality and consequently the recognition of individual words during the lengthy transcription process was difficult at times. Yet, overall, audio recording was beneficial because I felt it provided improved accuracy over paper-based observation records, namely, because the tapes could be repeatedly checked after the session. However, I believe that video recordings could have proven useful for recording facial expressions and gestures which may have acted as potential indicators of enthusiasm or engagement.

Observation as a means of gathering data was explored by Macintyre. The author stressed that it was a difficult skill to master but was valuable for gaining objective information, e.g. "The recordings can tell "when" and "where" as well as "how often" and so provide a valuable source for reflection and evaluation" (Macintyre, 2000: 66). And "several [observation] schedules spaced sequentially...can show the progress that is being made..." (Macintyre, 2000: 66).

I agree that observation is probably necessary to "supplement" or support other forms of data-collection methods, mainly because notes taken during periods of observation can serve to highlight "small" details which may go unnoticed but may be relevant, such as facial expressions, peer responses or seating positions. In an attempt to avoid bias or false impressions during potentially subjective observations, it would be necessary to perhaps design a clear structure for recording notes or tallies. Such a framework for observation was designed and it focused on talk according to role (pupil or teacher) and form of interaction, e.g. questioning, answering, reflection. I observed the class while the audio tape was recording. I noted anything of interest that could not be audio recorded, e.g. facial expressions, seating organisation, use of easel or interactive board, general location of teacher, whether pupils took their whiteboards, pens, pencils and/or exercise books into the teaching area. I thought that these factors may have been of relevance during later analysis. (The key points arising from each session form Appendix 1).

Initially I was a non-participant observer. The reasoning behind this was that I wanted to be as unobtrusive as possible in order to encourage pupils and teacher to behave as normal and therefore to provide an accurate basis for data collection. For a similar reason, I chose to sit in the same seat each week. This was positioned near the front of the

classroom and therefore I was sitting amongst the pupils during the whole-class session. As pupils became familiar with my presence, individuals would ask for support during whole-class teaching time. I opted, at this point, to become a participant observer by supporting pupils during the whole-class session and circulating during the non-recorded individual or group activities so that I could assist pupils who requested support with their work.

From the outset of the data-collection period, the class-teacher was using interactive methods to engage pupils, for example the use of questioning to stimulate pupil responses, including descriptions of their methods of calculation. The whole class could view the chosen method as the teacher repeated the pupil's steps and recorded their working-out on a whiteboard easel. The question and the answer would then be erased in preparation for the next question/answer. Pupils did not seek to ask questions to clarify or to extend the possible method of calculation, nor were they encouraged to do so. However, in order to extend the potential opportunities for pupils to engage in the questioning process, I proposed the introduction of additional interactive methods. The class teacher responded positively and was willing to instigate gradual changes. Applicable to the whole-class section of the lesson, I suggested the following methods:

(1) The use of the interactive whiteboard to enable pupils to write and explain their methods of calculation to the whole of the class,

(2) The display of the questions on the interactive board so that pupils were able to physically underline the key points for example,

(3) The introduction of the opportunity for pupils to ask questions to their peers, for instance regarding methods of calculation.

The first two methods enable pupils to view the questions and refer to them where applicable, and allow pupils to view the steps involved in solving a problem and to potentially offer an opportunity for highlighting areas of difficulty for instance. The latter method enables pupils to participate in the process of problem-solving by addressing any misconceptions or by investigating alternative methods of calculation for example.

The characteristics of each lesson, including the introduced changes to pedagogy, are outlined in Appendix 1 and include the focus of the lesson, dominant voice and utilisation of resources. Importantly, the analysis of the nature of classroom interaction,

including the use of thinking skills for example, aims to show the effects of these changes/interventions on engaging pupils in the questioning process.

3.1 Methods of data analysis

The following models of discourse analysis offer a means of explaining the content of my sets of data and they contain elements which are applicable to my area of interest, e.g. the categorisation of thinking skills and speech in order to determine the nature of interaction during Numeracy problem-solving discourse.

Sinclair and Coulthard (1975) focused on the discourse taking place in primary schools during whole-class sessions, and between pupil and teacher. They developed a framework for analysis which was considered to be suitable for teacher/pupil interaction within the classroom. The framework included acts (the label given to categories of speech such as questions or replies) which helped to describe the detail of the discourse. It was expected that questions from pupils were generally regarding administration of tasks rather than to elicit explanations or to query methods of working out. Sinclair and Coulthard were aware of difficulties associated with language, such as the constantly changing topics within a conversation or when a question acted as an instruction. They chose to focus on,

> a more simple type of spoken discourse, one which has much more overt structure, where one participant has acknowledged responsibility for the direction of the discourse...and...a situation where all participants were genuinely trying to communicate and where potentially ambiguous utterances were likely to have one accepted meaning (Sinclair and Coulthard, 1975: 6).

Consequently, they were interested in analysing the discourse that took place in classrooms. Whereas Sinclair and Coulthard's system of discourse analysis examined teacher/pupil discourse, I am interested in investigating both teacher/pupil and pupil/pupil discourse. Nevertheless, the system is seemingly appropriate to employ because its categorisation of talk in the classroom can serve to highlight the nature of interaction.

Furthermore, their model of discourse analysis involved the designation and annotation of acts within a turn. The categories which were immediately applicable to classroom discourse included,

> Informative= a statement that provides information
> Elicitation = a question that requests a response
> Prompt= expecting a response
> Nomination= choosing someone to respond
> Reply= an answer appropriate to the question
> Accept= indicates that the response was appropriate but not necessarily correct
> Evaluate =a comment on the quality of a reply that lets someone know if they are "right"

Based on the above, Sinclair and Coulthard recognised a common pattern of initiation (e.g. a question or instruction) by the teacher (I), followed by a response from a pupil (R) and evaluative follow-up or feedback from the teacher (F). For example, a typical IRF pattern was,

> Teacher: A group of people used symbols to do their writing. They used pictures instead of words. Do you know who those people were? I'm sure you do. Billy?
>
> Pupil: The Egyptians
>
> Teacher: Yes. The Egyptians (Sinclair and Coulthard, 1975: 71).

Although this demonstrates a level of "interactivity", I do not feel that it necessarily indicates engagement, because the role of the pupil is passive. That is, the pupil participated by replying to a teacher-initiated question. However, the pupil did not go on to provide a supporting comment or to pose a question for instance. In other words, their role seemed to be that of a respondent replying to a question to which the teacher already knows the answer. The pupil's answer would enable the teacher to gauge recall of

knowledge but does not serve to develop a discussion point. This IRF pattern of interaction is nevertheless relevant in my view. Indeed, I reasoned that Sinclair and Coulthard's system would help me to highlight such patterns in my own data and therefore facilitate the interpretation of the nature of contemporary classroom discourse and interaction, including instances of pupils asking questions (to their peers) and occasionally providing feedback (to their peers). In fact, I want to determine whether Sinclair and Coulthard's system is as applicable when exploring such interaction between pupils. This necessitates an examination of each transcript and the annotation of every turn taken by a pupil or the teacher, in addition to the calculation of the total number of each act. This data is then analysed in order to determine the emphasis or under-emphasis of those acts which indicate participation or engagement during the learning process.

A similar system to Sinclair and Coulthard's has been devised by Archer (2005) to study discourse taking place in the courtroom. Archer's systemic approach to context identification and analysis classifies questions and answers according to their form, function and interactional intent, for instance who was the question directed towards, in what context and in what form, e.g. whether it was a request, an inquiry or a query. This level of detail potentially allows for more specific distinctions to be made, for example, were pupils engaged in the questioning process as questioners or as respondents or both? Archer's linguistic-based system contains the category of "Response-initiation" (Stenström, cited in Archer, 2005: 122-125) and this precisely relates to the instances when pupils respond to a question or instruction and then pose their own question or query for example. Archer's (2005) system relates to the speaker and hearer at the utterance level. As such, we can distinguish elicitations (e.g. questions, requests) and responses that are used by teachers and elicitations that are used by pupils to be categorised and counted. That is, Archer's system contains the "Interactional Intent" fields (Archer, 2005: 121) which categorise the organisation of talk. Using Archer's categories as a model (see below), I have added two categories which are compatible with classroom talk, in order to assist in the gathering of further applicable data. These categories are,

(1) "Re-initiate" categorises instances when appropriate responses were not forthcoming perhaps due to reinforcement of skills being required and so necessitated a change in the approach to questioning for example

(2) "Re-word" categorises occasions when the same intention was worded in a variety of ways in order to extend to differing ability levels.

Table 1 shows Archer's categories of Interactional Intent for use during analysis.

Table1 Categories of Interactional Intent

Archer's systemic approach to context identification and analysis	Brief definition of each category
Initiation	an eliciting device such as a question or query requiring a response
Report	an explanation or statement, not directly elicited
Follow-up initiation	feedback/evaluation plus an eliciting device
Follow up	feedback/evaluation
Response	a reply such as an answer
Response-initiation	a reply plus /or acting as an eliciting device

Archer's "Interactional Intent" terminology already captures interactivity and participation e.g. "Initiation", "Response", "Follow-up", but I am particularly interested in using the system to determine engagement. I believe that the category of "Response-initiation" can provide an important indication or feature of engagement. This is because it may signal that a pupil is not only listening to their peer's method of calculation, but also considering or analysing it in order to query or question it or occasionally to advise or make a request. Such an occasion may be when a pupil is disputing the reasoning behind a method or because they require more information.

Each transcript is then examined by initially assigning each teacher and pupil utterance a categorisation symbol e.g. INI (initiation), or RES (response). Totals for each category of teacher and pupil utterance are recorded and the data analysed (see Appendix 2).

Both of these systems highlight the nature of interaction between the teacher, pupils and their peers, and the data serves to indicate the dominance of certain forms of discourse, for example the teacher as the chief questioner or evaluator, or the pupils as active participants in the questioning process.

A third system of analysis to be utilised, is based on levels of thinking skills rather than discoursal analysis. I believe that engaged pupils demonstrate a range of thinking skills that involve explanations, interpretations and comparisons for example. When pupils respond to or ask questions, evaluate methods or query calculations, I reason that they are using a range of thinking skills which can be identified and categorised. I feel that *Bloom's Taxonomy* (1956) is a valuable tool for assisting my analysis because it focuses on the categorisation of thinking skills. Following categorisation, it may be apparent which level of skills are being used and to what extent. If pupils offered questions and comparisons for instance, I would suggest that they are actively engaged in the learning process. Alternatively, if they generally respond to teacher questioning with simple recall responses, then I would suggest that they are "participating" rather than "engaging".

The system is considered to be a useful tool for teachers because it enables them to identify learning goals that are disproportionately represented during a lesson; for example, asking the listener to recall facts, but rarely using question types that require interpretation of results. QCA cited *Bloom's taxonomy of Educational Objectives* (1956) in their web-page *KS2: Mathematics optional tasks for the more able* (QCA, 2006) and provided examples of questions based on Bloom's categorisation system, which could be used to develop higher thinking skills. The system is also used when planning assessments in order to encourage pupils to use the full range of thinking skills when answering questions. However, in theory, certain categories have proved difficult to understand or place in context, perhaps due to the taxonomy dating from the 1950's.
Based on Bloom's *Taxonomy*, I have produced a simplified list of categories of thinking skills (see Appendix 3). For instance, instead of dividing the skill of knowledge into nine sub-sections as Bloom did, I have simply categorised the skill as "remembering". In this way, I feel able to analyse the data in simpler terms.

It is worth noting that Buxkemper and Hartfiel (2003) state that,

> It has been observed that Bloom's taxonomy does not provide a good fit with mathematics. Analysis and synthesis are often done together and those, together with evaluation, are often used in application. So we reorganize these tasks, adding a bit of our own, for a better fit (Buxkemper and Hartfiel, 2003: 2).

I agree that it may be difficult to distinguish between thinking skills which, by necessity, may be combined in order to tackle problem-solving questions for instance. Unfortunately, Buxkemper and Hartfiel do not elaborate any further, but they do provide a useful summary of the *Taxonomy*:

(1) Knowledge—a student should be able to recall and recognise material from memory.
(2) Comprehension—a student should be able to give literal meanings of material.
(3) Application—a student should be able to apply general material to new situations.
(4) Analysis—a student should be able to break down material, identify significant pieces and their interrelationships to see how the pieces fit to form a whole.
(5) Synthesis—a student should be able to put material together in order to create new material.
(6) Evaluations—using a sense of the whole, a student should be able to make judgements about what is important and what is efficient.

The levels of thinking skills are hierarchical in nature and simpler behaviours form part of more difficult behaviours.

I use two methods of analysis utilising Bloom's *Taxonomy*. The initial analysis is qualitative and provides an overview of thinking skills used by the teacher and pupils during each weekly session of problem-solving. This initial method is followed by a more detailed examination of the transcripts using the major elements of Bloom's

categorisation system. From this data I make a qualitative analysis combined with a quantitative interpretation.

Each transcript of the taped Numeracy problem-solving lessons is analysed for examples or evidence of thinking skills and forms of questioning. This initial method aids recognition of forms of pupil and teacher thinking and their associated interaction. A framework based on Bloom's *Taxonomy* of thinking skills has been produced and is divided into two main sections: teacher as a model (e.g. providing questions that should lead to a variety of thinking skills being employed by the pupils) and pupil as an active participant (also demonstrating a variety of thinking skills). The sections are sub-divided into questioning style, skills and form of interaction (see Appendix 3). Examples of skills are matched to categories from Bloom's *Taxonomy*. For example:

Skill of **remembering**: did teacher make a summary?
Did teacher show a mathematical procedure (working out)?

Skill of **application**: did pupil solve problems using required skills?
Did pupil give reasons for their conclusion (I think this because...)?

It is envisaged that Sinclair and Coulthard's system, together with Archer's system, may indicate the nature of interaction taking place, and Bloom's *Taxonomy* may demonstrate the thinking skills being used at the time.

Another analysis system familiar to educationalists is Flanders Interaction Analysis Categories (FIAC). Indeed Croll (1986) cites FIAC as the most recognised systemic observation system. This system contrasts with the former systems, mainly because it involves a method of coding which classifies interactions between teacher and pupils. Interestingly, one category encompasses, "Talk by pupils which they initiate...freedom to develop opinions and a line of thought, like asking thoughtful questions..." (Croll, 1986: 40).

This is of interest because unlike Sinclair and Coulthard's system and unlike certain DfES and QCA literature, there is an assumption being made that pupils are likely to pose "thoughtful" questions rather than administrative questions. Importantly, Croll

highlighted that it was possible to note trends, for example the "two-thirds" rule which demonstrated that two-thirds of classroom-talk was dominated by the teacher. This system offers a potentially valuable method of categorisation, but due to time constraints, it is not used during this study.

I intend to analyse the data using both qualitative and quantitative methods involving observation and three data analysis models (Sinclair and Coulthard, Archer and Bloom). Observation aims to provide an initial, general and qualitative overview of each session. This includes noting potentially relevant points, such as, when are pupils enthusiastic or willing to voluntarily contribute points to the discussion, and who possesses the dominant "voice" throughout the discourse: teacher or pupils? The data resulting from the application of systems of categorisation is largely quantitative. It is hoped that one, some or a combination of categorisation systems produces findings that indicate occasions when pupils are engaged in the questioning process. In other words, data analysis aims to highlight which are the most effective methods for engaging pupils.

The following chapters explore the data using systems of analysis:

Chapter 4: Sinclair and Coulthard

Chapter 5: Archer

Chapter 6: Bloom

Each model is applied and the main findings are discussed.

CHAPTER 4 APPLICATION OF AND FINDINGS FROM SINCLAIR AND COULTHARD'S SYSTEM OF DISCOURSE ANALYSIS

In order to determine the nature of interaction taking place between teacher and pupils during Numeracy problem-solving sessions, I chose to utilise Sinclair and Coulthard's system of discourse analysis (1975). The application of their system is discussed in this chapter, along with findings.

4.1 Application of Sinclair and Coulthard's system of discourse analysis

I used Sinclair and Coulthard's terminology regarding the categorisation of acts, as these indicate interaction between pupils and teacher. That is to say, interaction could have taken various forms, including teacher as initiator of questions and pupil as respondent or perhaps as nominator of the next participant in the discussion and as initiator of questions. I determined that certain acts or categories indicated elements of active participation or engagement. For example, if pupils were asking their own questions (elicitation) or providing feedback (evaluate) then the likelihood was that they were motivated sufficiently to actively contribute to the discussion rather than by simply answering. Also, I limited my application of Sinclair and Coulthard's analysis system to the lowest level of discourse, e.g. acts, rather than attempting to apply their whole system of analysis. This was because the system is so fine-grained, it would be difficult to quantify data in a way that suggested meaningful results.

I examined each transcript according to my understanding of Sinclair and Coulthard's categories. I have produced a simplified list of definitions to assist my categorisation decisions. (Appendix 4) I annotated each turn taken by a pupil or teacher with a set of acts. For example, the following extract from transcript 2 (see Appendix 12: 203) demonstrates the IRF form of interaction recognised by Sinclair and Coulthard,

Teacher: C. how did you work it out then?	(n, el)
Pupil: I did 5 times £1.50 and then 4 times 50	(rep)
Teacher: so you've done 5 times £1.50 yes	(e)

It can be seen that the teacher initiated a question (*nomination and elicitation*), which was followed by a pupil response (*reply*) and ended with teacher-led feedback (*evaluate*). This process of categorising turns was continued for each whole-class session of each transcript/lesson.

I counted the total number of each act which took place during each session. Totals of acts were calculated according to gender and role (teacher or pupil) because this served to identify an emphasis or under-emphasis of those acts which indicate participation or engagement; for instance, reply (Rep), elicitation (El), comment (Com), evaluation (E). Table 2 "Data showing teacher and pupil acts from Transcript 6" shows an example of a table of data from lesson 6. Nineteen categories of acts have been utilised for both teacher and pupils, including those which indicate participation or engagement. The table also shows the percentages of acts within each turn. Similarly, I counted acts according to gender in order to ascertain whether engaged pupils were generally male or female. (However, at this point it is important to reiterate that pupils had various preferred learning styles and, although engaged, they may not have overtly appeared to demonstrate all the elements of engaged behaviour. For the purposes of this study, the learning styles were valued but only overt engagement has been identified). Appendix 5 contains data tables for each transcribed lesson and the symbols are explained in Appendix 4.

Clustered column charts and scatter charts were created from the data because they allowed the comparison of values across different categories. The reader will encounter these forms of graph in the Findings section 4.2 (nb the form was chosen according to its visual impact). It is important to note that there are varied maximum percentage levels for each chart (y axis) and the transcripts are numbered in chronological order (x axis). Also, regarding reliability of data, it was necessary to take into account that, due to the nature of Sinclair and Coulthard's fine-grained system, there were several acts per turn, so for example there could be 38 teacher turns in one session, with 195 corresponding acts. Finally, I had aimed to indicate the total number of turns taken by pupils by gender and by the teacher. Unfortunately, due to the similarity in the nature of certain pupil voices, a number of pupil turns were unable to be assigned as being either male or female voices (*m/f?*). This ranged from an additional 0.1% to 64%.

Table 2 Data showing teacher and pupil acts from Transcript 6

Transcript 6 6/3/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 71	Teacher	Marker=27 Starter= 5 Nomination= 31 Elicitation=33 Directive= 9 Accept=5 Comment= 29 Reply=2 Conclusion=5 Acknowledge=1 Cue=1 Clue= 1 Check=6 Prompt= 19 Evaluate= 36 Informative=4 Bid=0 Loop=4 Meta-statement=1 Total =219	M=12.3 S=2.3 N=14.2 El=15.1 D= 4.1 Acc=2.3 Com=13.2 Rep=0.9 Con=2.3 Ack=0.5 Cu=0.5 Cl= 0.5 Ch=2.7 P= 8.7 E= 16.4 I=1.8 B=0 L=1.8 M-s=0.5
Pupil Total= 82 (+25m/f?)	Male 47 Female 35	M=6 S= 0 N= 1 El=13 D= 0 Acc=2 Com=18 Rep=53 Con=0 Ack=1 Cu=0 Cl= 1 Ch=0 P= 0 E= 0 I=3 B=5 L=0 M-s=0 Total =103	M=5.8 S=0 N=1 El=12.6 D= 0 Acc=1.9 Com= 17.5 Rep=51.5 Con=0 Ack=1 Cu=0 Cl=1 Ch=0 P=0 E=0 I=2.9 B= 4.9 L=0 M-s=0

Therefore I categorised acts as "Pupil acts" rather than male or female when I made the

charts. Indeed, this difficulty highlighted why video recording would have been beneficial, however, the class teacher preferred the use of audio to video recording.

The charts were interpreted by searching for patterns and significant changes over time and the findings are described in the next section.

4.2 Findings

I employed elements of Sinclair and Coulthard's system of discourse analysis and scrutinised the resulting percentages of pupil and teacher acts. I focused on those acts which I felt were indicators of interaction and possibly could be interpreted as indicators of engagement. For example, I am interested in the nature of pupil participation and so I examined acts which indicated interaction e.g. elicitation, reply, evaluation and comment. As a result of counting according to act and role (i.e. teacher, pupil) using Sinclair and Coulthard's system of discourse analysis, a certain amount of "counter-evidence" was exposed. That is, during whole-class sessions, there was evidence of:

1. Pupil initiated questions
2. Pupil initiated feedback
3. Pupil:pupil interaction

To be fair, the latter forms of interaction were not intended to be highlighted by Sinclair and Coulthard, mainly because their system was designed to examine teacher/pupil interaction. However, each finding was an indication of the nature of contemporary classroom interaction and these were seemingly contrary to the pattern of discourse recognised by Sinclair and Coulthard. For example, their system of discourse analysis categorise questions requiring a reply as "elicitations" and I recorded the following examples of pupil talk as "elicitations,"

> How have you got 10 minus 3 equals 6? (Appendix 17: 249).
> How would you check your answer? (Appendix 17: 246).
> Why did you do subtraction when you could have done adding? (Appendix 17: 246).

How did you change metres into kilometres? (Appendix 16: 241).

It is apparent that these pupil "elicitations" are similar to those expected from a teacher, e.g.

OK, so how would you go about working this out? (Appendix 14: 226).

So how are you going to calculate it? (Appendix 15: 234).

Similarly, I categorised the following examples of feedback as "evaluation" acts (pupil category),

Well done! (Appendix 18: 253).

You've lost me D. (Appendix 18: 253).

D! D! Look at where it says 13 and it'll tell you! (Appendix 18: 254).

That's a weird method. There's a lot easier way... (Appendix 17: 250).

Again, these evaluations or offers of feedback are from pupils yet appear to be teacher-initiated, e.g.

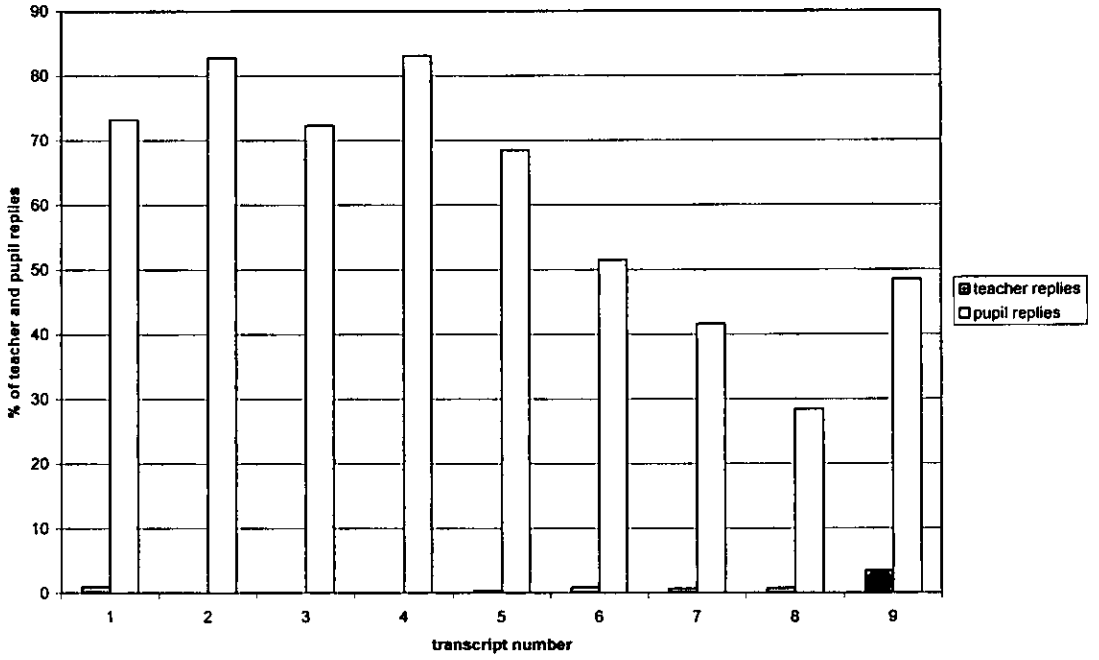
That's a good question (Appendix 16: 241).

OK so she's got 66 take away 43. That's a good way of doing it. (Appendix 14: 227).

It was necessary to refer back to the transcripts of the lessons in order to provide these word-for-word examples of acts, and findings indicated discourse that included questions ("elicitations") posed by pupils, plus occasional instances of evaluative comments ("evaluations") from pupils.

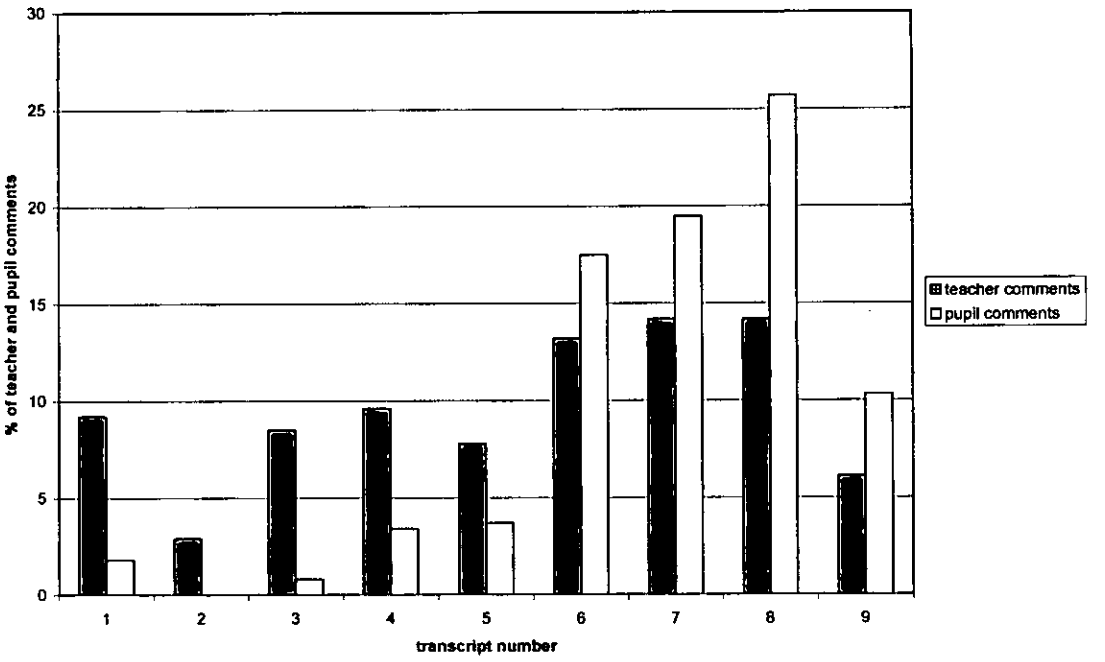
Regarding responses to "elicitations", the chart showing "Percentage of teacher and pupil replies" indicated that there were few teacher "replies" during the data-collection period. (see Figure 1)

Figure 1 Percentage of teacher and pupil replies



That is, the meaning of a "reply" according to Sinclair and Coulthard's system was a linguistic response to an elicitation such as a question. So the data suggested that few questions were directed to the teacher for her to respond to. Indeed, it is interesting to note that the overwhelming majority of pupil acts during the data-collection period were "replies" (c. 80%). That is to say, until lesson 5 onwards (with the exception of the final taped lesson 9) during which there was a steady reduction in the total percentage of pupil "replies". This suggests that, although up until lesson 5, there was interactive discourse taking place, e.g. pupils were providing "replies" to "elicitations", they were rarely participating using other linguistic devices such as evaluations, comments or questions. This may have been because they were not offered a clear opportunity to question their peers until lesson 6, at which stage we saw almost a 20% reduction in the number of pupil "replies" compared with the previous week. (At the point of lesson 6, the teacher introduced the opportunity for pupils to question their peers, in an effort to develop interactivity). At the same time, data shown in the chart "Percentage of teacher and pupil comments" mirrored the results of the "replies" chart (see Figure 2).

Figure 2 Percentage of teacher and pupil comments



A "comment" was described as a statement or question which adds to a response, such as "it's difficult isn't it?" Therefore, perhaps when the percentage of pupil "comments" overtook the percentage of teacher comments from lessons/transcripts 6 to 9 inclusive, this implied that pupils were providing additional information (e.g. reasoning) rather than a minimal response. For example, the following replies included a supporting evaluative comment:

> Pupil: you don't need to borrow because that doesn't work (Appendix 18: 257).
>
> Pupil: well she has the £3, then she takes away the 60 so it makes that easier (Appendix 17: 247).

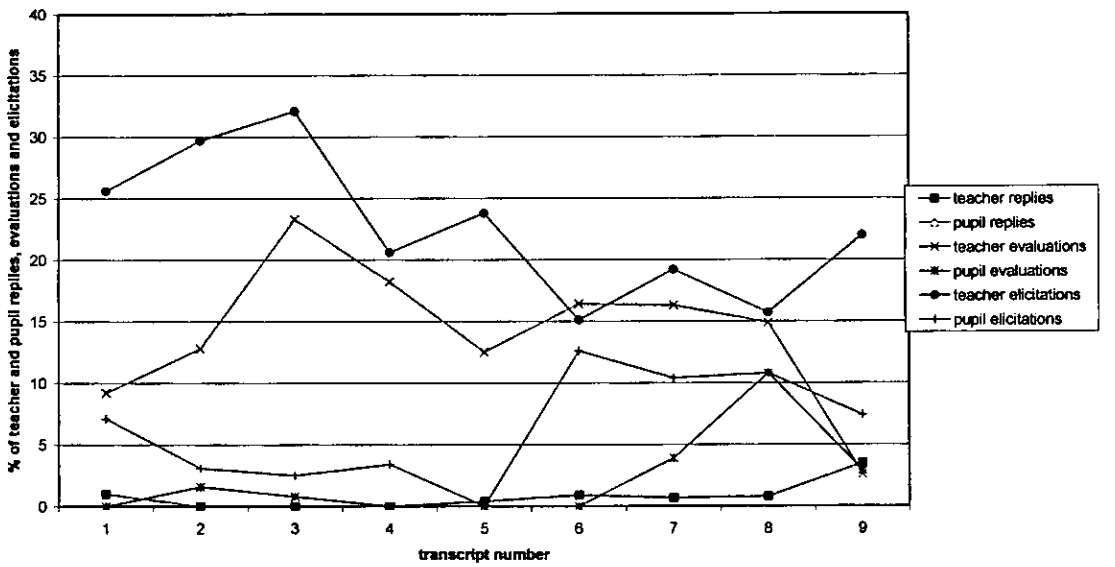
Sinclair and Coulthard's method of categorising these examples of talk as "comments", serves to highlight occasions when pupils were providing supplementary information to a reply. A more detailed review of transcript 8 reveals further signs of critical comment from pupils, as demonstrated by the following:

Pupil: she's too quiet I can't hear her (Appendix 18: 258).

It could be suggested that pupil "comments", including critical "comments", are indications of pupils who are keen to listen to methods of calculation and to provide their peers with more than a minimal "reply". I would argue that in such instances, this signals engagement.

Interestingly, the scatter charts with connected data-point lines often mirrored one another and so indicated parallel behaviours. For example, I produced a chart to compare acts and it indicated that (see Figure 3) transcript 8 contained the highest percentage of pupil "evaluations" (c. 10%) and the lowest percentage of pupil "replies" (c. 30%).

Figure 3 Comparison of percentages of teacher and pupil replies, evaluations and elicitations



A small number of pupil responses have been categorised as "evaluations." There were two reasons for this

1. The responses were evaluative in content
2. They did not follow on from a question. If they had done so they would have been categorised simply as "replies"

The following extract provides an example of an "evaluation" act from a pupil:

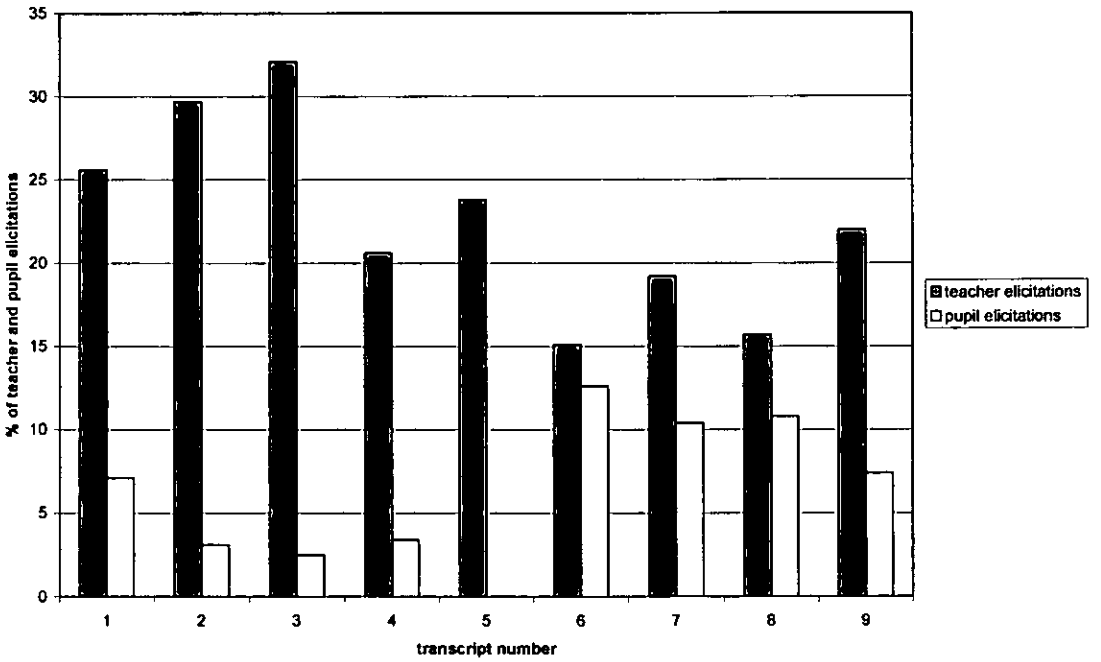
Teacher: *(nominates next contributor to discussion)*

Pupil: the method's alright but I wouldn't do that for time because, I don't know (Appendix 18: 257).

This interaction involving a pupil evaluation is interesting because it demonstrates that a pupil had been motivated to consider a peer's method and comment on it. Indeed, the pupil had participated by offering an opinion and feedback regarding the calculation of a problem involving time.

Regarding pupil elicitations, which potentially indicate engagement, the data showed an increase in the percentage of pupil elicitations and this corresponded to a general reduction in the percentage of teacher elicitations (see Figure 4). Similarly, the ratio of teacher:pupil elicitations changed from 26:7 during lesson or transcript 1, to 16:11 during lesson 8.

Figure 4 Percentage of teacher and pupil elicitations



The rise in the percentage of pupil elicitations was evident from the point of transcript 6 onwards. This change in the pattern of questioning coincided with the introduction of opportunities for pupils to question their peers. For example:

Teacher: any questions for E? (Appendix 18: 258).

Teacher: any questions about that? M was itching then. M? (Appendix 18: 256).

The data indicated that the teacher continued to ask questions (elicitations) and these included questions that acted as prompts or encouragement to respond with a question or query. This therefore signalled an opportunity for pupils to engage with their peers in the questioning process. Correspondingly, the data presented in Figure 1 (page 31), showed a significant rise in the percentage of pupil replies during transcript 9. This correlated with a rise in the number of teacher elicitations during the same period and possibly indicates interaction but not necessarily engagement.

4.3 Summary

Findings from the application of elements of Sinclair and Coulthard's system of discourse analysis indicated that interaction had taken place and this included elicitations from both pupils and teacher, in addition to feedback and comments. As Sinclair and Coulthard's system does not distinguish between the possible forms of elicitation, it was necessary to refer to the transcripts in order to check the discourse. For example, "elicitation" categorised questions ranging from administrative (e.g. can I sharpen my pencil please?) to queries concerning a method of calculation (e.g. how did you estimate it?). The latter form of pupil question is a likely indication of an engaged participant because it shows interest and an expectation of extended dialogue.

CHAPTER 5 APPLICATION OF AND FINDINGS FROM ARCHER'S SYSTEMIC APPROACH TO CONTEXT IDENTIFICATION AND ANALYSIS

Although Sinclair and Coulthard's system of discourse analysis highlights the forms of interaction taking place during Numeracy problem-solving, I decided to use a system which further categorises classroom discourse, in particular, questions and answers. Therefore, this chapter discusses the application of and findings from Archer's (2005) system.

5.1 Application of Archer's system of discourse analysis

In order to gauge the nature of pupil/teacher interaction occurring during Numeracy problem-solving sessions, it was necessary to closely examine the content of each transcribed lesson. Archer's "Interactional Intent" fields were applied to categorise the organisation of talk (see Appendix 2 for definition of terms). Categorisation symbols were assigned to each utterance. I counted the total number of times each type of utterance took place during each lesson and recorded the totals in a table (see Appendix 2). See example below (Table 3),

Table 3 Example of categorisation of utterances based on Archer

Transcript 6	**Utterance type**							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances =69	24 34.8%	1 1.5%	35 50.7%	0 0%	8 11.6%	0 0%	1 1.5%	2 2.9%
Pupils: Total number of utterances =78	5 6.4%	4 5.1%	0 0%	0 0%	0 0%	57 73.1%	12 15.4%	0 0%

Resultant data from each transcript was then used to form charts for ease of interpretation (see Appendix 6). Clustered column charts and scatter charts (with data points connected by lines) were formed where applicable, because they allowed the comparison of values across different categories. The charts were interpreted by, for example, searching for patterns and changes over time. The main findings from the interpretation of the data are described in the next section.

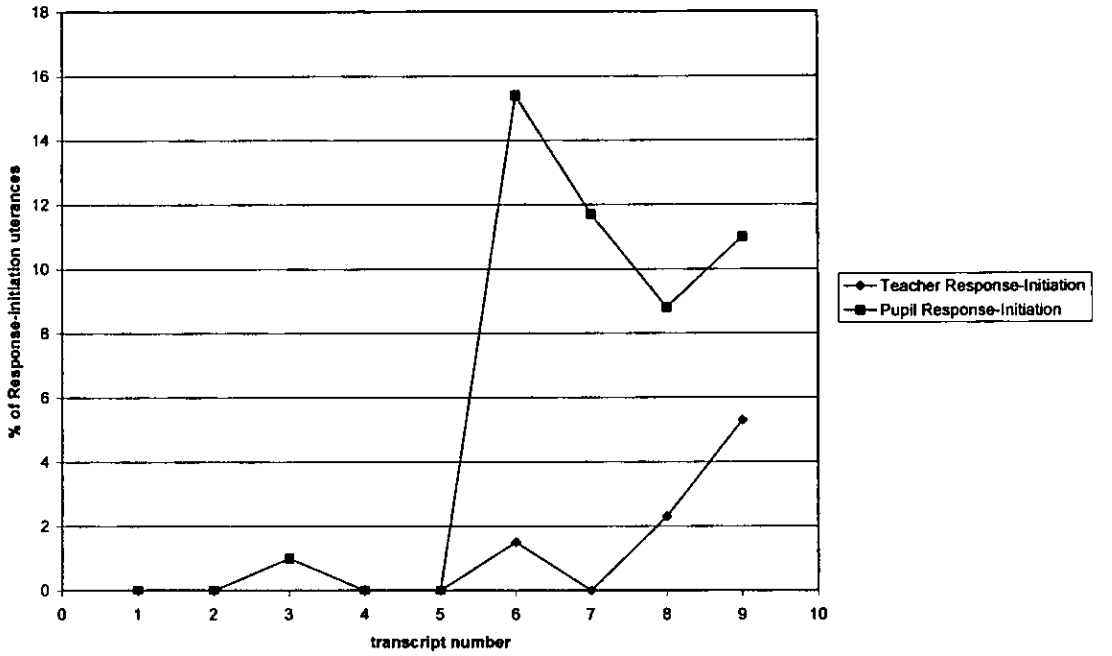
5.2 Findings: interpretation of charts

In this part of the chapter, I report on my attempts to indicate engagement, using Archer's (2005) systemic approach. In particular, I focus on her "Response-initiation" category (inspired by Stenström, 1984), which captures utterances that contain a reply immediately followed by a question, query, request or requirement. The two following examples of "Response-initiations" are noteworthy because the pupils are engaged in the questioning process,

> Pupil: why did you put 2 noughts because it's half...and you could have just put 4.5? (Appendix 16: 241).
>
> Pupil: how did you change metres into kilometres? (Appendix 16: 241).

These utterances were in response to an eliciting device such as a question or request from the teacher and yet initiated another response. It can be seen that these pupils are directly and actively involved in the analysis of peer methods of calculation and they are capable and willing to seek further information from their peers. Additionally, a striking feature of the "Percentage of teacher and pupil Response-initiation utterances" chart (see Figure 5) is the sharp increase in the percentage of pupil "Response-initiations" at the point of Transcript 6 (c.15%).

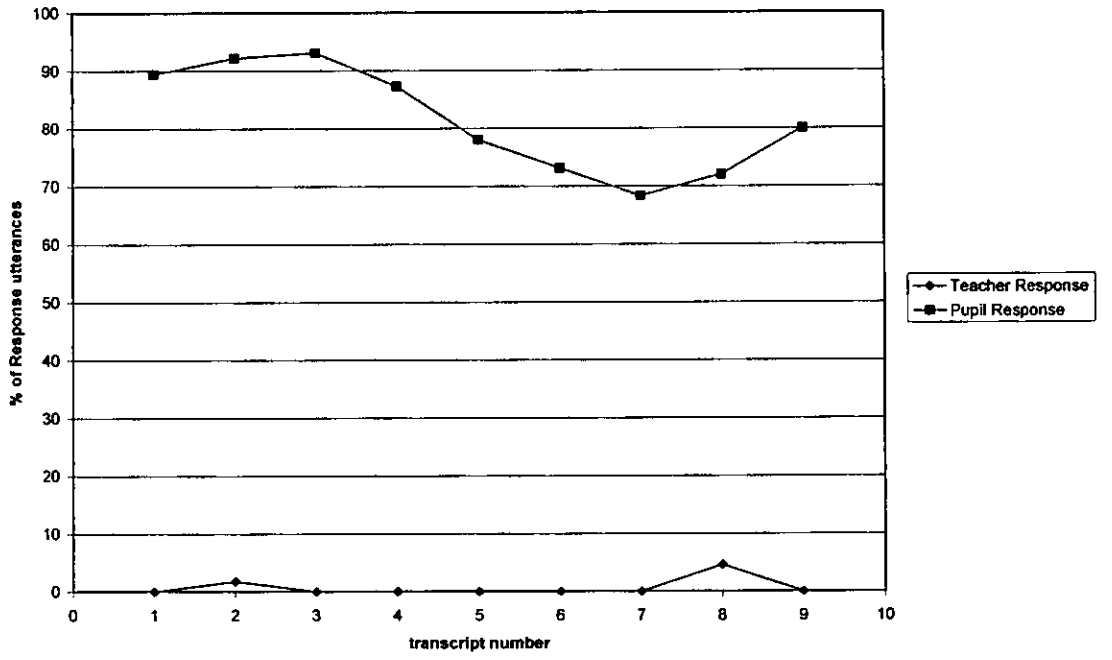
Figure 5 Percentage of teacher and pupil Response-Initiation utterances



At this stage, the teacher introduced pupils to the opportunity of questioning or querying their peers regarding methods of calculation. This was in an effort to encourage interactivity and was possibly precipitated by my presence and interest in the questioning process. Although there was a slight reduction in percentages following transcript 6, the figures remained much higher than pre-introduction (0-1%) of pupil-questioning of peers. Therefore the forms of the interactions during the questioning process were clear, that is to say, pupils were acting both as questioners and respondents.

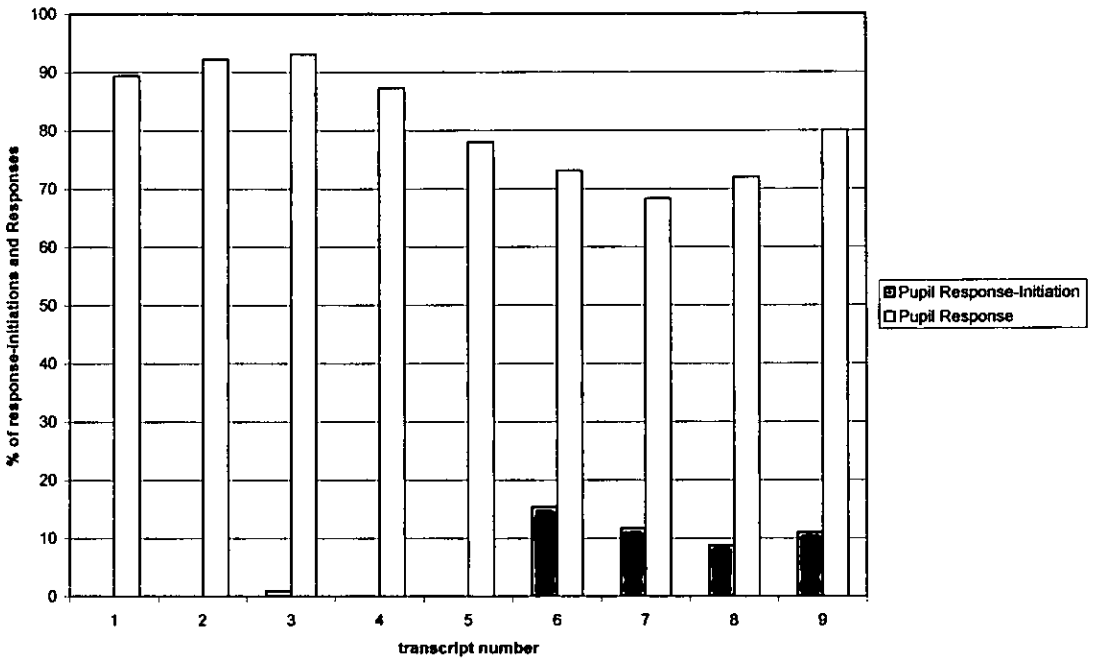
Interestingly, the Interactional Intent category of "Response" (e.g. a reply) also pointed towards interactive activity. This was presented in the "Percentage of teacher and pupil Response utterances" chart (see Figure 6).

Figure 6 Percentage of teacher and pupil Response utterances



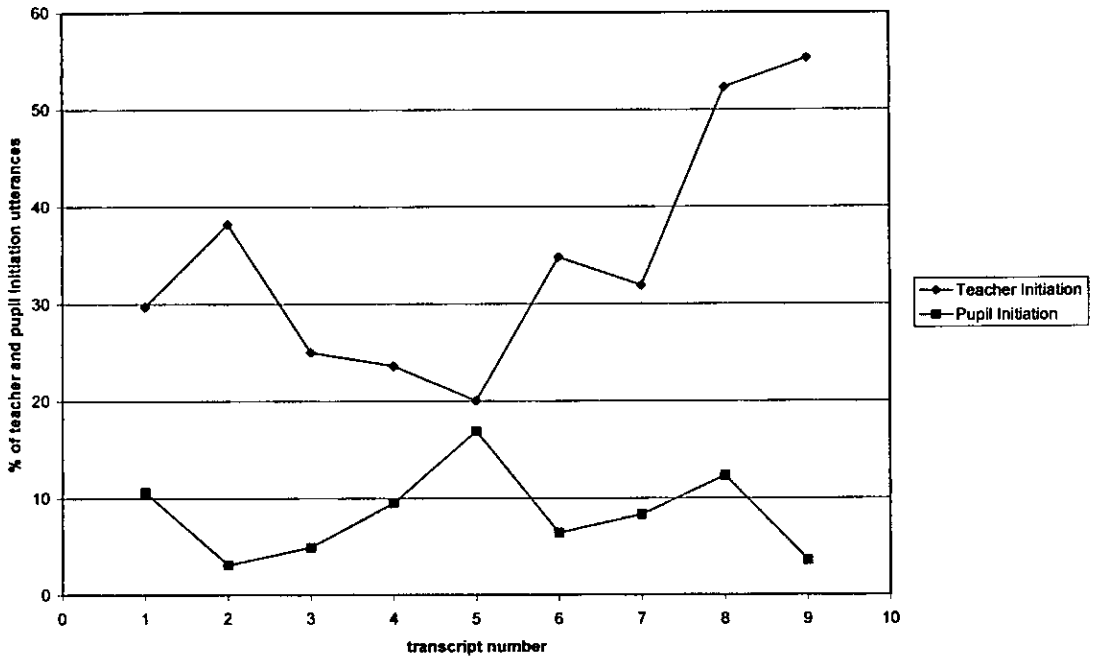
It was evident that the percentage of pupil "Responses" fell from over 90% (transcript 3) to 70% to 80% after transcript 6 and the associated introduction of questioning by pupils. So this suggested a continued response by pupils to eliciting devices such as questions, but at reduced levels, possibly because they were "extending" some of their responses into questions or queries, for instance, and therefore their utterances have been categorised as "Response-initiations". A comparison of data (see Figure 7) shows the proportion of pupil "Response-initiations" to pupil "Responses" was c. 1:5, and remained at c. 1:8 for the remainder of the data collection period. The data therefore suggests a changing pattern of pupil replies.

Figure 7 Comparison of percentages of pupil Response-Initiations and Responses



Additional important elements in a two-way process of interaction or engagement could be questions, requests or requirements and these constitute Archer's category of "Initiation" (Archer, 2005:122). The resulting percentages of "Initiations" were interesting because the connected data points in the scatter chart entitled "Percentage of teacher and pupil Initiation utterances" produced a mirror image of pupil and teacher "Initiations" (see Figure 8).

Figure 8 Percentage of teacher and pupil Initiation utterances



By lesson 5 (the mid-point of the data-collection period) teacher and pupil "Initiation" totals were almost equal at c.20%. Teacher "Initiations" reached their lowest level and conversely pupil "Initiations" reached their highest level. This may have been due to pupils "calling out" (e.g. they had not been directly elicited to participate). Examples of "called out" pupil "Initiations" were as follows:

> Pupil: underline the important bits (Appendix 15: 233).

> Pupil: I know! (Appendix 15: 231).

The former "Initiation" instructs or requests a peer to highlight key points in a problem-solving question. The latter supposes that the pupil will be asked to reveal or explain what they know and this would be likely to involve the use of the interactive whiteboard. Indeed, the rise in pupil "Initiations" from lesson 3 onwards coincided with the introduction of the use of the interactive whiteboard to describe their working out rather than the teacher acting as their scribe. This behaviour indicates engagement because the

pupils had been seemingly monitoring the progress of their peer's calculations and then felt the need to request the opportunity to show their own, perhaps more effective, methods of calculation. Additionally, data from transcript 6 and beyond showed a reduction in pupil "Initiations" at the same time as an increase in teacher "Initiations". This was likely to be due to a number of reasons. For example, the transcript provided evidence of the teacher regularly reminding pupils to ask questions and rephrasing pupil questions or queries and directing them to the pupil demonstrating their calculation, for example:

> Teacher: OK anybody else got a question about what K's done there? (Appendix 19: 261).

> Pupil: you've got the right answer, but if you didn't know that answer and you were working it out, how else would you do it?
> (*rephrased by Teacher*): have you got another way that you could have worked it out C? (Appendix 18: 256).

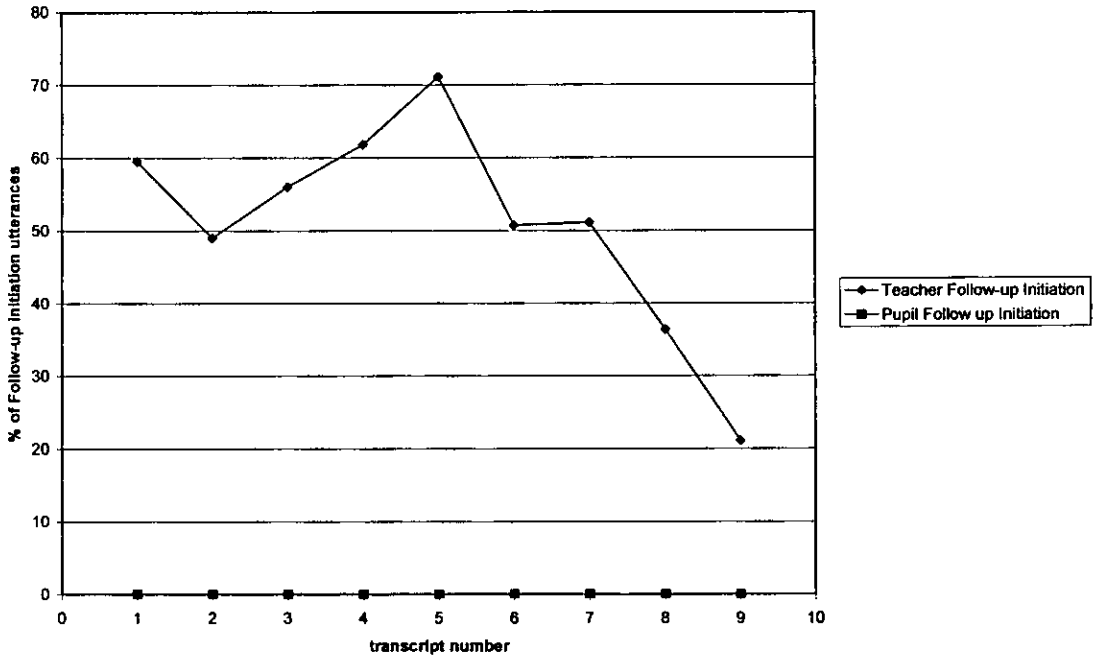
Both examples feature Archer's category of "Initiation" and serve to encourage interaction. That is, during the second example, the pupil evaluated their peer's answer and then directed the lesson by requesting further information. This was followed by the teacher re-phrasing the pupil's comment and seeking confirmation (teacher "Initiation"). Additionally there were examples of the teacher sustaining a pupil's explanation or description:

> Pupil: 2009...take away 75...what I would do first...
> Teacher *(interjects)*: where did you get 75 from? (Appendix 19: 264).

In my opinion, the likely reason for this "Initiation" was in order to continue the momentum of the calculation whilst dispelling any likely confusion from the outset. Later the teacher re-opened the discussion so that the remainder of the class were encouraged to question their peer.

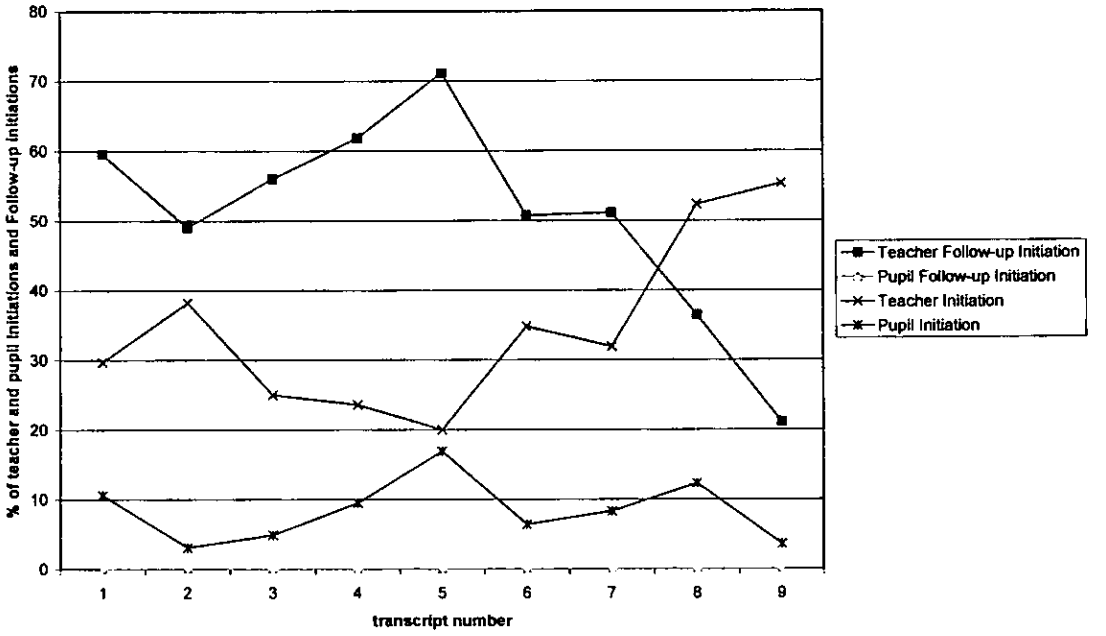
Interestingly, the data showed a marked reduction in the teacher's percentage of "Follow-up initiations" (i.e. an evaluative comment followed by an eliciting device) from c.70% during lesson 5 to c.20% by lesson 9 (see Figure 9).

Figure 9 Percentage of teacher and pupil Follow-up initiation utterances



The likely reason was that the form of interaction during discourse had altered because the teacher's role of initiator of questions followed by feedback and another question, was changing. Comparisons were consequently made between the data belonging to the categories of "Follow-up initiations" and "Initiations" (see Figure 10).

Figure 10 Comparison of percentages of teacher and pupil Initiations and Follow-up initiations

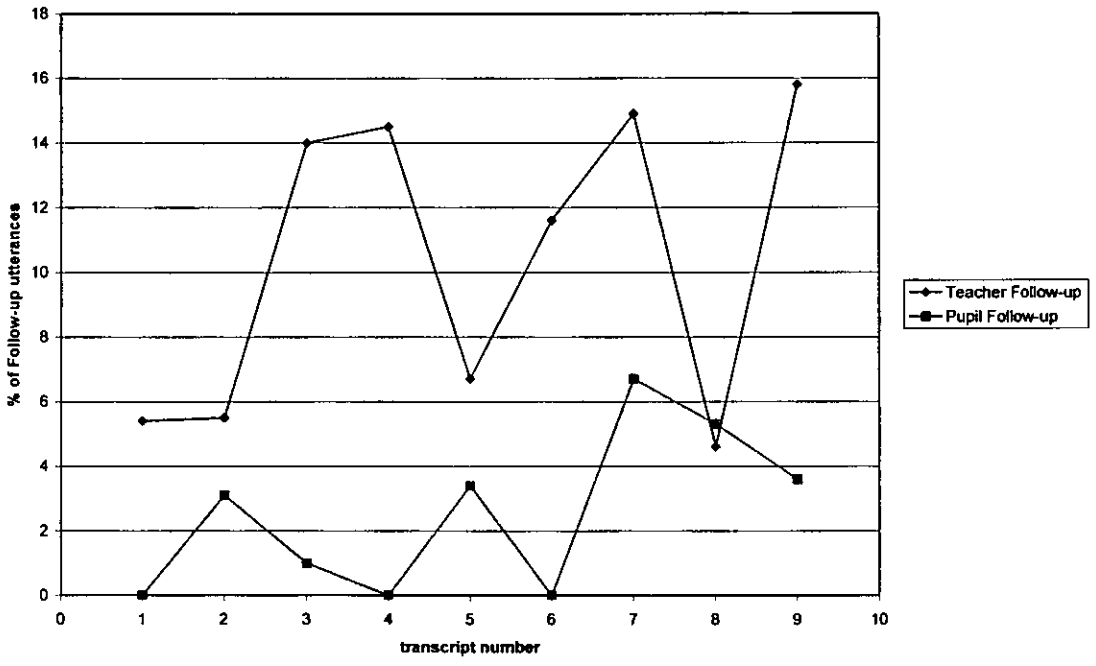


It was clear that the percentage of "Initiations" made by the teacher increased as the percentage of teacher "Follow-up initiations" decreased. This supported the altered state of interaction, whereby pupils were reminded by the teacher to pose questions (introduced at the point of lesson 6) and pupils seemingly responded to this opportunity by an increased percentage of "Initiations". Strangely, at the time of lesson 5, data indicated the highest percentage of teacher "Follow-up Initiations" and "Initiations", at the same time as the highest percentage of pupil "Initiations". Re-examination of the transcripts suggested that a number of "Initiations" were attributable to a pupil who regularly "called out" the following:

> Pupil: I know! (Appendix 15: 232).

Here the pupil bid or appealed to participate and so the utterance was not categorised as a "Report" because they were not providing a statement or explanation (Archer, 2005: 122). Similarly, patterns of feedback or evaluations ("Follow-up" fields) were problematic to interpret. That is, the "Percentage of teacher and pupil Follow-up utterances" chart (Figure 11) indicated a wide variation of percentages,

Figure 11 Percentage of teacher and pupil Follow-up utterances



Generally, it appeared that data from the pupil and teacher "Follow-up" category mirrored one another, with the exception of lesson 7. The data suggested that, as teacher evaluative comments increased, the reverse was true of pupil-initiated feedback and evaluations. At the point of lesson 7 there was a marked increase in pupil feedback, whilst at the time of lesson 8 there was a marked reduction in the percentage of teacher "Follow-up" utterances. This data may demonstrate shifts in the nature of classroom interaction, for instance, teacher retaining the responsibility of providing feedback, yet at times giving pupils the opportunity to dominate the role of evaluator.

Finally, regarding the additional category of "Re-initiate", the interpretations were also cautious. "Re-initiate" was an additional category created in order to be applicable to occasions during classroom discourse when a teaching point failed to lead to understanding, so a different approach was attempted (see Table 4 for percentages of teacher and pupil "Re-initiates" per transcript).

Table 4 Percentage of teacher and pupil Re-initiates

Lesson/transcript number	Teacher Re-initiate %	Pupil Re-initiate %
1	2.7	0
2	9.1	0
3	8	0
4	3.6	0
5	8.9	0
6	2.9	0
7	8.5	0
8	6.8	0
9	2.6	0

I felt that this was a potentially valuable category because it described an effort to sustain engagement when there was a likelihood of lost interest unless the point was approached differently. However, the resulting data was problematic because there were seemingly only instances of teacher "Re-initiates", despite several examples of pupils self-evaluating their method of calculation, then changing course. For instance, this was demonstrated by the pupil in the following extract:

> Pupil *(realises she is unable to use that method successfully)*: I'm not going to do that one! ...*(tries alternative method)* ...the reason I've done that is because I've...*(indistinct)* (Appendix 17: 247).

The pupil evaluated her own method of calculation and consequently changed course and altered her working-out. Whereas in the next extract, the teacher changed course:

> Teacher: now is there anything really, really important? She's calculated it, and knowing it's sensible ...we know it's kind of sensible, how do we know what is a sensible answer R? (Appendix 15: 232).

It can be seen that the teacher provides feedback and initiates a different course of action. On the whole, my use of this additional category proved to be problematic because I had chosen to make use of the level of categorisation that is similar to Sinclair and Coulthard's, rather than utilise Archer's sub-categorisation.

5.3 Summary

Generally, Archer's system highlighted features of discourse with sufficient applicable detail as to enable interpretation of the data. This resulted in indications of engagement. That is, pupils began to actively participate in the questioning process following the introduction of the opportunity to question or query methods of calculation. This change was highlighted by application of Archer's category of "Response-initiation". Ostensibly as a result of the changed state of classroom dynamics, pupils took a more active part in the process of learning whilst the teacher fluctuated between roles as an intermediary and a major provider of questions or feedback. The data also revealed a rise in pupil "Initiations" including requests to contribute to the learning process. This rise began at the time of the introduction of pupils' use of the interactive whiteboard to show their working-out (introduced at the time of lesson 3) as an alternative method to using the teacher as a scribe.

CHAPTER 6 APPLICATION OF AND FINDINGS FROM BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

I decided to apply both Sinclair and Coulthard's (1975) and Archer's (2005) systems of discourse analysis in order to identify interactions between teacher and pupils. I also needed to identify the thinking skills being stimulated as a result of questioning, in order to determine engagement. Consequently, this chapter discusses the application of Bloom's *Taxonomy* of thinking skills (1956) and the resultant findings.

6.1 Application of Bloom's Taxonomy

I felt that a categorisation system which related to thinking skills would be applicable to an examination of an area of Numeracy that requires the use of a variety of thinking skills. That is, Numeracy problem-solving regarding "real-life" problems, requires both the recall of mathematical knowledge and the application of mathematical skills. Pupils must understand what the question is asking them to do and decide which function to apply and how to apply it. They must choose the most effective and appropriate calculation method, for example 5x2 rather than 2+2+2+2+2. In other words, a wide range of thinking skills is required in order to tackle problems confidently and independently. Archer's (2005) system indicates the different functions of questions, but they are shaped by their usage in the courtroom. However, Bloom's *Taxonomy* is intended to be utilised in the context of educational rather than courtroom settings. Additionally, because I felt that engagement is partly signalled by the use of a range of thinking skills, I believed that a system of analysis which categorises them hierarchically, may serve to highlight the various levels of thinking being employed by pupils. Perhaps if it can be demonstrated that pupils were using a range of thinking skills, then this may indicate effective engagement?

Therefore for each transcribed lesson, I highlighted clearly heard examples of teacher-initiated questions or instructions which were used to stimulate pupils' thinking (Appendices 11-19). I categorised the thinking skills given in response to each example roughly according to Bloom's *Taxonomy.* The teacher questions were categorised according to the level of thinking stimulated as a response, e.g.

When do pupils give lower level replies? (knowledge, application, comprehension)

And

When do pupils give higher level replies? (analysis, synthesis, evaluation)

I utilised Archer's Interactional Intent categories (defined by Archer, 2005) for each utterance in order to provide a basis for further analysis if necessary. Additionally I highlighted and counted instances of "multiple" question types whereby the teacher maintained the same aim but re-worded the question in order to appeal to all ability groups. Similarly, I highlighted and counted instances of "fuzzy" questioning, whereby the teacher demonstrated unclear intentions. The reasoning was that I was interested to examine whether fuzzy or multiple questioning led to predominantly higher or lower thinking or a range of thinking skills.

The examples of teacher and pupil discourse from each lesson were recorded in tables (see Appendix 7). The tables include the following exchanges:

(1) when the teacher's question and pupil's response were clearly audible

(2) when the teacher Initiations/Follow-up initiations necessitated or received a verbal response

Interestingly, it became clear that teacher and pupils recognised that rather than reiterating the prompt to ask a question, a nomination could be used to initiate a question or query, e.g. "Go on E". Therefore, these examples have been included, together with those which requested a verbal explanation from a pupil. This is because there was the expectation of a thinking skill being stimulated in response, e.g.

> T: OK C, tell us what you're doing at the moment
>
> P: Well, I'm underlining. I'm going to approximate it (Appendix 16: 239)

However, I have omitted exchanges where the Initiation was acting as a prompt during a pupil's demonstration of their calculation, or the pupil was working silently whilst

demonstrating their method of working-out or simply following the instruction by reading the question aloud. The reasoning was that they did not stimulate a verbal higher/lower level thinking response.

Table 5, "Exchanges leading to higher or lower level thinking" provides an extract from a table recording data from lesson 6.

Table 5 Exchanges leading to higher or lower level thinking

Exchanges leading to higher or lower level thinking response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

TRANSCRIPT 6

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: 5 would, well done J. How many 5's would go into 15?	FOL/INI	3	RES	knowledge
T: 3. How many 5's into 100?	FOL/INI	20	RES	knowledge
T: so then what do you need to do K?	INI	change them into kg	RES	application
T: a 100g of butter. What would that be of a kg? a 100g	INI	is it an eighth?	RES	application
T: A 150g, how would you write that? who can help K with that one, a 150g... written as a kg? M? No? G	FOL-INI	is it one seventh?	RES	application
T: Would you need to change the next part K?...some people are saying you can't really have a fraction for that one. Now...J you think you can. Go on, what would you say?	FOL-INI	oh, I was just saying I don't think you can	RES	application

Using the data from the tables (Appendix 7), the total number of exchanges leading to higher and lower level thinking were counted. Included in these totals are the responses from multiple and fuzzy questioning. Table 6 shows the collated data following the application of Bloom's *Taxonomy*.

Table 6 Percentage of higher and lower level pupil responses

Lesson/ transcript number	Number of lower level pupil responses*	Number of higher level pupil responses*	Total number of teacher INI/FOL-INI leading to lower/higher level pupil responses*	% lower level pupil responses	% higher level pupil responses
1	28	0	28	100	0
2	28	0	28	100	0
3	30	3	33	91	9
4	12	1	13	92	8
5	23	2	25	92	8
6	14	11	25	56	44
7	16	11	27	59	41
8	9	14	23	39	61
9	11	5	16	69	31

*including pupil responses from fuzzy and multiple questioning

Clustered column charts and scatter charts were produced from the data (choice of chart dependent on their visual impact) because they allowed the comparison of values across different categories. The main findings from the application of this form of analysis are described in the next section.

6.2 Findings

A qualitative overview was formed following initial analysis using Bloom's *Taxonomy* (see Appendix 8). Transcripts one and two from the early stages of the data collection

period indicate that the teacher questioning style tended to be closed (only one correct answer possible), e.g.

> How much would it be, 6 packets at 40p? (Appendix 12: 205).

This acted to limit responses from the pupils. Pupils did not demonstrate the skill of evaluation, and the interaction was teacher-dominated whereby pupils respond to teacher-initiated questions or prompts, rather than opening the discourse with their own questions or queries.

Towards the middle stage of the data collection period, we can see some important changes to the range of thinking skills being actively employed. Pupils had been showing their own working-out, rather than the teacher acting as a scribe, since the time of lesson 3 when they were encouraged to use the interactive whiteboard to demonstrate their methods of calculation. From this point on, pupils sometimes added explanations as they described their calculations. For example, the transcript from lesson 6 contains,

> well, I'm underlining. I'm going to approximate it (Appendix 16: 239).

Consequently, the pupil is demonstrating application, which is a mid-level thinking skill. Also, initially pupils did not ask questions regarding the methodology or reasoning behind a calculation, but lesson 6 coincided with the introduction of the opportunity and encouragement of pupils to ask questions, and from this point, there was a noticeable change in the demonstrated thinking skills of pupils actively participating or engaging in the lesson. For instance, following a prompt from the teacher to ask questions to the pupil demonstrating their calculation, a peer posed this question directly to their peer,

> I wonder why you put 500 x 5? (Appendix 16: 239).

This indicated not only the skill of open questioning, but also perhaps the higher thinking skill of analysis by querying the method being demonstrated. The pupil being questioned directly responded with,

> because it's 450 approximately near 500 and then...(*indistinct*) (Appendix 16: 240).

And, as such, was also able to show the skill of comprehension, because they grasped the meaning of the question and summarised or explained their understanding of approximation. There were several more instances of pupils asking questions, both to the teacher and to their peer, in response to teacher prompts. According to Bloom's *Taxonomy*, the following thinking skills were required in response to the prompts and/or questions:

(1) application (e.g. pupil solves problem using required skills/gives reasons for their conclusion): "...but you could have just took away the 10 'cos you know 30 add 30 is 60 which is 1 hour" (Appendix 18: 254).

(2) analysis (e.g. pupil identifies a general rule): "say someone in Year 3 didn't know how much a kilogramme was and then you put 1500 grammes...(they) wouldn't understand" (Appendix 16: 244).

(3) evaluation (e.g. pupil looking for evidence/giving reasons making their decisions): "yes, but if I was doing it to younger...(*demonstrating their method*)" (Appendix 16: 244).

The teacher used a range of questioning styles (mainly open and some closed),

> Go on, what would you say? (Appendix 16: 238).
> How many 5's into a 100? (Appendix 16: 239).

This encouraged the use of a range of thinking skills from the pupils. For example, higher and lower order skills necessary to pose questions, respond, compare etc.

Generally, it was noticeable in lesson 6 that varied interaction was taking place; the teacher's voice was less dominant and the proportion of lower to higher thinking

skills was 9:4 (the previous week, it was 20:2). Regarding teacher dominance, the teacher acted as an intermediary and this allowed pupils to offer their analysis or understanding of methods, e.g.

> Teacher: ah, C recognised that he might have made a mistake. Can anyone else see it? E you're quite right. Go on E
> Pupil: well, because he's timesed (*multiplied*) by 5 he shouldn't have timesed by 5 because that would mean she would only go to school, but she has to go from school, so that's going to be x10, so it has to be... (Appendix 16: 240).

It was noticeable that the teacher regularly prompted the pupils to query or to ask questions, for example,

> oh, there are lots of people wanting to ask you a question this time, G you ask (Appendix 16: 243).
> some people might have a question about this part...anyone got any questions then, M? (Appendix 16: 241).

These encouraged a range of thinking skills to be used by pupils, ranging from comprehension to possibly evaluation.
Pupils also demonstrated the use of questioning in order to encourage explanation (comprehension) or recall (knowledge, remembering) for example:

> how did you change metres into kilometres? (Appendix 16: 241).

This not only indicated that pupils felt at ease when identifying and voicing their struggle in grasping a mathematical skill, but it also indicated the use of analysis for instance, as they identified the need to convert units of measure.

By the end of the data collection period, a pupil seemingly demonstrated the higher thinking skill of evaluation, e.g. made judgments about what was important or

efficient, (Buxkemper and Hartfiel, 2002). By way of illustration, lesson 8 contained the following pupil feedback,

> you've got the right answer, but if you didn't know that answer and you were working it out how else would you do it ...? (Appendix 18: 256).

I felt this showed that the pupil posing the question had recognised that there may have been an alternative, perhaps more effective, method of calculation and was keen to encourage his peer to think about alternatives.

Similarly, application of Bloom's *Taxonomy* of thinking skills indicated that the following example may involve the skills of application, analysis and evaluation because the pupil had used learned material (partitioning) but in a new situation (adding minutes),

> well instead of making that complicated you could have just done, if you think of 40 minutes and then knock off the 10 add it on to 3.30 then you get 4 o'clock and then you add on the next 10 (Appendix 18: 254).

The teacher regularly provided opportunities for the pupils to comment, query or question, which they readily did. Therefore, the pupils were regularly encouraged to actively participate by using a range of thinking skills rather than by simply responding to teacher-initiated questions requiring low level thinking, such as recall or comprehension.

Transcript 9 was the final complete transcript and was from the penultimate session. It is worth noting that the session began with a lengthy period of mental maths and many pupils were restless, possibly because the teacher had returned to the method of acting as a scribe or because the warm-up was longer than usual. However, the pupils settled quickly when the whole-class introductory session began and silence fell when a pupil began to explain their method on the interactive board. The teacher provided praise and encouragement regarding pupil questioning skills,

> Can I have a volunteer [Pupil: me!] who thinks they could come up to the front of the board and explain to everybody else and then the rest of the class are going to question you, you've got very good at that? (Appendix 19: 260).

I believe this served to encourage pupils to think about the question under scrutiny and to begin to tackle the question by using the skill of application (using the required skills or knowledge), as shown in the example below:

> Pupil: er, 2009 take away 27 *(pupil writing on interactive board; remainder of class almost silent)* (Appendix 19: 261).

This was followed by pupils offering alternative methods of calculation (analysis, application),

> Pupil: I would do 2009 take away just 8 which would be *(indistinct)*
> Pupil: why do you think 2009? I think 2006
> Pupil: what I did was ...take away Fred's age...(Appendix 19: 262).

The teacher often acted as a discreet intermediary who encouraged pupils to use Bloom's range of thinking skills, but at times stifled the questioning process by using closed questions which limited responses to low level recall. For example:

> Teacher: anybody agree with him there? *(pause)* Anybody think they've got something completely different?
> [background pupil: his age is 75!] [another background pupil: that's OK, that's OK]
> Teacher: OK keep going then J (Appendix 19: 264).

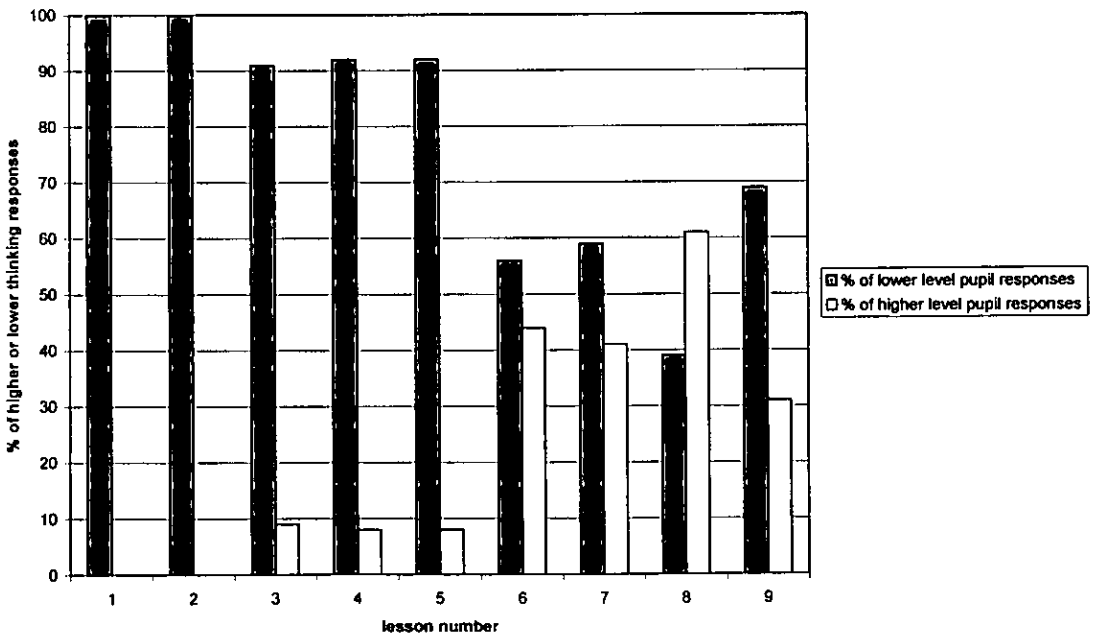
Initially analysing the transcripts using a simplified version of Bloom's *Taxonomy* provided valuable outcomes. It was possible to demonstrate that pupils used a range of thinking skills spanning low level skills such as recall or comprehension to higher level

skills such as analysis or forms of evaluation. They were utilising these skills in response to teacher questions and prompts, and to pupil questions and queries.

In order to facilitate the interpretation of the more detailed application of Bloom's *Taxonomy*, data has been presented in tables (see Appendix 7, leading to Table 6) and then as a column chart to display the percentages of higher and lower level responses to teacher questions and instructions throughout the data-collection period (Figure 12, see below). The reason for creating a chart containing this information was to provide a clear representation of forms of thinking stimulated by teacher-questioning. I believe that engaged pupils demonstrate a range of thinking skills that involves explanations, interpretations and comparisons for example. Whereas if pupils generally respond to teacher questioning with simple recall responses, then this indicates participation rather than engagement. Or rather, the use of lower level thinking skills does not exclude the possibility of engagement, but it does not explicitly show it.

Figure 12 shows the changing pattern of lower and higher thinking skills during the data-collection period.

Figure 12 Percentages of higher and lower thinking: pupil responses to teacher questions and instructions



What is evident from the column chart is that during the initial stages of data-collection, there was a disproportionately large number of lower level pupil responses. For example, during lessons 1 and 2, the following questions were posed,

> Teacher: three 10ps are?
> Pupil: 30 (Appendix 11: 199).
> Teacher: add the 6 and the 4. Is it important that some are boys and some are girls?
> Pupil: no (Appendix 12: 207).

According to Bloom's *Taxonomy*, knowledge and comprehension were the likely thinking skills used in response to the questions. (Lessons 1 and 2 contained no clear examples of higher level responses). Unfortunately, Bloom's categorisation of mid to higher level thinking skills was difficult to understand at times. In fact, it has been noted,

> no entirely clear lines can be drawn between analysis and comprehension at one end and evaluation at the other (Bloom, 1956: 23).

This suggests that certain thinking skills are sometimes used in combination with others making differentiation (other than a binary distinction) problematic. However, with this is mind, it is clear that the chart showed a shift in the pattern of thinking skills at the point of lesson 6 and the introduction of the opportunity for pupils to engage in the discourse as questioners. By lesson 8, the percentage of questions which stimulated higher thinking exceeded the percentage of those that led to lower level responses. Interestingly, during lesson 9 the percentage of responses categorised as higher level, was almost half that of the week before. Yet it was apparent that this amount was still considerably higher than earlier in the data-collection period, prior to the development of pupil questioning. Therefore, the data strongly suggested that a change in pedagogy had contributed to both a marked rise in higher level pupil responses and a more even range of thinking processes.

To restate, I have provided evidence indicating that engagement of pupils is more likely if they have been stimulated into responding to a range of levels of thinking, especially if higher thinking responses are proportionate to the number of lower level responses. Additionally, higher level thinking offers a challenge to pupils of all abilities to develop their mathematical knowledge and skills. For example, the DfEE publication *Mathematical Vocabulary* (DfEE, 2000) states that,

> it is easy to use certain types of questions - those that ask the listener to recall and apply facts - more often than those that require a higher level of thinking. If you can use the full range of question types you will find that children begin to give you more complex answers in which they explain their thinking (DfEE, 2000: 4).

This serves as "official" backing of the value of engaging the use of a range of thinking skills.

I also examined the usage of "multiple" (i.e. questions re-worded but have the same intention) and "fuzzy" (i.e. unclear intentions) questioning in order to further ascertain the general pattern of thinking indicated by pupils' responses. I recorded the percentages of responses which involved higher or lower level thinking in tables (see Tables 7 and 8).

Table 7 Percentages of multiple types of question

Lesson/ transcript number	Number of lower level pupil responses	Number of higher level pupil responses	Total number of multiple INI/FOL-INI leading to lower/higher level pupil responses	% leading to lower level pupil responses	% leading to higher level pupil responses
1	2	0	2	100	0
2	0	0	0	100	0
3	2	0	2	100	0
4	0	0	0	100	0
5	3	0	3	100	0
6	1	0	1	100	0
7	1	0	1	100	0
8	1	0	1	100	0
9	0	0	0	100	0

Table 8 Percentages of fuzzy types of question

Lesson/ transcript number	Number of lower level pupil responses	Number of higher level pupil responses	Total number of fuzzy type INI/FOL-INI leading to lower/higher level pupil responses	% leading to lower level pupil responses	% leading to higher level pupil responses
1	2	0	2	100	0
2	4	0	4	100	0
3	3	0	3	100	0
4	2	0	2	100	0
5	2	0	2	100	0
6	0	0	0	0	0
7	0	1	1	0	100
8	0	0	0	0	0
9	2	1	3	67	33

The quantity of responses was small (see Appendix 9 for categorisation), but application of Bloom's *Taxonomy* revealed that "multiple" teacher questions stimulated wholly lower level (knowledge and application) responses. "Fuzzy" questioning initiated mainly lower level responses and possibly two instances of higher level thinking.

6.3 Summary

Application of Bloom's *Taxonomy* highlighted which skills were being stimulated as a result of the teacher-led questioning process during Numeracy problem-solving sessions. The resultant responses included pupil questions and answers, e.g. pupils engaged in the questioning process as both questioners and respondents. During the initial stages of the data-collection period, there was a disproportionate percentage of teacher-initiated questions likely to stimulate lower-level thinking. Interestingly, the teacher stimulated a wider range of thinking skills following the introduction of the opportunity for pupils to ask their own questions. That is, when the teacher urged or reminded pupils to question or query, using questions such as, "does anyone have any questions for B?" This was demonstrated by an initial rise in the percentage of higher thinking skills and then a

general "evening out" of the responses involving higher and lower thinking skills. This wide ranging stimulation of thinking skills was indicative of challenge and engagement.

CHAPTER 7 EVALUATION OF THE MODELS OF CATEGORISATION AND A SUMMARY OF THEIR KEY FINDINGS

In order to assess methods used to engage pupils in the questioning process during Numeracy problem-solving sessions, it was necessary to analyse classroom discourse. That is, the discourse occurring between pupils and teacher during the whole-class session of Numeracy problem-solving. Three models of analysis were used: Sinclair and Coulthard's discourse analysis, Archer's systemic approach to context identification and analysis and Bloom's *Taxonomy of educational objectives*. Each model categorised the nature of the talk taking place and the resulting data could be interpreted in order to establish whether the interactive teaching process utilised by the teacher equated to engagement.

Each of the above systems had advantages and disadvantages and these are discussed in this chapter (see 7.1-7.3). Certain systems contained ambiguous terminology or cumbersome categorising features, e.g. an unwieldy number of categories; other systems contained categories which were difficult to apply to contemporary classroom discourse or they did not differentiate within categories, e.g. overly broad categorisation of questions. (For a summary of the key findings from the three models of categorisation, see 7.4). However, the overall advantage of applying the systems was that their combined usage resulted in a detailed qualitative and quantitative analysis of classroom discourse. That is, the data could often be transformed into charts from which emergent patterns signalled engagement. Subsequently, it was possible to determine at which points of the data-collection period the features of engagement were occurring and therefore which methods had been introduced or employed. Additionally, when data was being analysed, it was also necessary to consider potential constraints and variations, i.e. the importance of the ethos of trust within the classroom, teacher experience, learning styles, curriculum pressures, skills and capabilities. These are briefly discussed in Chapter 8.

7.1 Sinclair and Coulthard

This system of discourse analysis was particularly relevant because it focused on an educational setting and the interaction between pupils and the teacher. Following the

categorisation of the discourse from each session of Numeracy problem-solving according to Sinclair and Coulthard's speech acts, it was possible to count the number of acts and produce percentages for each act (it should be noted that there are often several acts per turn according to the model they use). Sinclair and Coulthard's model of discourse analysis highlighted the different elements of talk, therefore allowing interpretation of the discourse which was taking place. For example, during transcript 3, there were 95 teacher "elicitations" from a total of 102 teacher turns, leading to the figure of 32.1%, i.e. almost a third of teacher-initiated acts occurring during this session were "elicitations" (questions). If we then noted that during the same session, 72.3% of pupil-initiated acts were replies and 2.5% were "elicitations", then we could suppose that this was an interactive session involving many questions and answers (see Figure 3, Appendix 10). However, I would suggest that, in this scenario, the questioning process was one-sided and the pupil role was that of providing replies to teacher-initiated questions. If we compare this with evidence from transcript 8, whereby the percentage of teacher-initiated "elicitations" had reduced to 15.7% and pupil-initiated responses included 10.8% "elicitations", 25.7% "comments", 10.8% "evaluations" and 28.4% "replies", then we could speculate that this was still an interactive session, but it also included a wider range of pupil-initiated input that potentially signalled engagement (reference was made to the transcribed lessons in order to ascertain contextual evidence, such as the form of the reply or the elicitation, in order to gauge the likelihood of engagement taking place). The examples therefore indicated that Sinclair and Coulthard's system of discourse analysis provided data that could be readily interpreted.

However, I felt that Sinclair and Coulthard's method of categorising did not always differentiate sufficiently within the acts to indicate the depth of thought required to form a response. For instance, it was difficult to ascertain what form the replies had taken, e.g. recall of facts, explanations, and comparisons and so on. Unfortunately, it was difficult to consistently assign certain acts such as "meta-statement", "starter" and "comment" because, at times, Sinclair and Coulthard's definitions were unclear.

To summarise, although Sinclair and Coulthard's system categorised and highlighted the diverse elements of classroom discourse and in a form that precipitated counting and data analysis, it did not seem to possess the detail necessary to allow close

interpretation of the interaction. As a result, it was possible to use the system to determine the nature of interaction, but not to determine whether interaction involved engagement.

7.2 Archer

This system of categorisation was important because it contained categories which enabled a more detailed and applicable analysis of classroom discourse. The categorisation of utterances was more straightforward than the Sinclair and Coulthard system because the fields were clearly described, applicable and fewer in number. Importantly, the resulting data was often more meaningful in the context of determining interaction or engagement. That is, although it was originally devised for analysing discourse taking place in the courtroom, it contained features that were immediately relevant to the classroom. For instance, the category (Interactional Intent) of "Response-initiation" denoted a response that included a question or query i.e. a response that initiated another response. For example, in the following extract, pupil C responded to the teacher's prompt and followed by pointing out a problem,

> Teacher: ...put up your hand and ask a question if you're not sure...er, C
> Pupil: how would you check your answer? (Appendix 17: 246).

The category "Response-initiation" demonstrated that, in this case, the pupil was responding with an answer which was another question. In other words, it could be interpreted as a pupil being motivated to extend the point and perhaps draw further information from their peer, thereby showing that they were engaged in the questioning process. The following example of "Response-initiation" indicated another function,

> Teacher: any questions about that? M was itching then. M?
> Pupil 1: why did you need to that, well, you know on that how you put it...3 take away 2 doesn't equal 2 (Appendix 18: 257).

This exchange signalled to the pupil whose method was being queried (Pupil 2) that they were expected to respond, which they did,

Pupil 2: no but I've added that bit too (Appendix 18: 257)

These and similar examples supported the idea of a "Response-initiation" also serving to extend or elaborate on a point in question, perhaps for reinforcement or consolidation of a mathematical skill or knowledge. Referral to the transcripts in order to check wording or context aided the interpretation of the resulting data. Therefore, the importance of Archer's "Response-initiation" category was that it may have signalled motivation and a willingness to pursue a point of interest; something that I consider a key feature of engagement. Additionally, Archer's system provided for the possibility of different types of "responses", so facilitating data interpretation; for example, "responses" can include criticisms, answers, and praise.

Finally, Archer's system successfully served to highlight the moments when the teacher encouraged pupils to question their peers or to demonstrate their methods of calculation. Reference to the transcripts showed that, almost without exception, these interactive occasions led to motivated and enthusiastic pupils participating in the problem-solving process. These teacher initiations contributed towards an effective method of engagement. The following examples demonstrate the teacher's willingness to encourage pupil participation,

OK J tell me what happens (Appendix 12: 208).

...come and show us exactly what you mean... (Appendix 14: 227).

Put your hand up if you've got a question for her (Appendix 19: 261).

According to Archer's categorisation system, these utterances were counted as "Initiations" and would require a verbal response. (The category includes the intended purpose of the "Initiation", such as an order, a request, a query or a question). Also, it

was clear that a response was expected, unlike Sinclair and Coulthard's ambiguous category in which an instruction ("directive") was not followed by a linguistic response. Archer's system produced concurrent data that signalled a rise in pupil "Response-initiations" and a rise in teacher "Initiations" (see point of lesson 6, Figure 13, Appendix 6). Consequently, I felt that this signalled a change in the pattern of interaction and indicated engagement in the questioning process.

Further categories from the Archer system could have been used when identifying speech act function, in particular, question-function and answer-function. These have been tailored for the courtroom and so I thought it more appropriate to use a system for "thinking" that is promoted by government bodies and tailored for use in educational settings (see below).

7.3 Bloom

Bloom's *Taxonomy of Educational Objectives* (1964) classified educational outcomes and so facilitated the identification of areas which were over-represented and areas of thinking which required further emphasis when planning the curriculum. Therefore, it seemed appropriate to utilise this system in order to categorise the questions and responses presented during Numeracy problem-solving sessions. The categories divided the discourse into hierarchical levels of thinking skills used in order to provide a response. Consequently, the system could be used to categorise the questions or instructions given in order to initiate a response. The six levels were sub-divided, but I found the sub-divisions difficult to apply, so I focused on applying the main six hierarchical categories of thinking skills. By examining each transcript for examples of higher or lower level thinking skills, I was potentially able to use the *Taxonomy* to establish areas which were under- and over-represented during each problem-solving session. This was of importance because I believe that regular exposure to and development of the range of thinking skills and the associated challenges, extends pupil motivation and confidence. Therefore the *Taxonomy* offered the opportunity to gauge the extent of participation during the questioning process. For example, application of Bloom's *Taxonomy* led to the following utterances being categorised as lower level skills of knowledge and comprehension:

Teacher: three 10ps are?
Pupil: 30 (Appendix 11: 199).

Teacher: add the 6 and the 4. Is it important that some are boys and some are girls?
Pupil: no (Appendix 12: 207).

The *Taxonomy* therefore highlighted the level of thinking utilised in response to a question. So whereas, at the level of categorisation applied in this study, Archer and Sinclair and Coulthard's models differentiated between the elements of the discourse, Bloom's system supported the resulting data by assigning levels of thinking. However, the lower level category of comprehension and the higher level category of analysis were at times problematical to apply. For instance, in the following example the pupil could have simply guessed or he could have understood and identified patterns (therefore an indication of a higher skill),

Teacher: how many combinations do you think that there are? Put your hand up if you think that you've worked it out. OK B how many do you think?
Pupil: 6 (Appendix 11: 200).

Consequently, it was necessary to be cautious at times when drawing conclusions from the data. However, much of the time the data seemed to present clear patterns of change. That is, at the beginning of the data-collection period, prior to the introduction of opportunities for pupils to show their methods of calculation or to query their peers' methods for example, >90% of the pupil responses involved lower thinking skills. By contrast, towards the end of the data-collection period, c.40% of responses involved higher level thinking, balanced with c.60% which required lower level thinking.

In summary, the use of Bloom's *Taxonomy* enabled the categorisation of many of the thinking skills used during the data-collection period. This categorisation system

facilitated the interpretation of patterns of thinking and the associated engagement of pupils.

7.4 A summary of the key findings from the three models of categorisation

Each model served to categorise talk in the classroom and the data that resulted from the application of the systems enabled conclusions to be drawn. Ideally a system of analysis which combined features of Bloom's *Taxonomy* and Archer's systemic approach would have been utilised because these systems provided the most appropriate and detailed results. However, a system that indicated the frequency of forms of discourse would have been useful for providing additional information regarding the nature of discourse, e.g. proportion of pupil time spent engaged in questioning peers' methods. Unfortunately, during this study limited time was available for data collection and analysis.

It was evident from applying Sinclair and Coulthard's system of discourse analysis, that pupils were capable of asking questions and providing feedback. These were elements of discourse that were seemingly contrary to the Initiation, Response, Feedback (I.R.F.) pattern that was dominated by the teacher and was the general pattern that was recognised by Sinclair and Coulthard during their research in the 1970s. Up until the promotion of peer-questioning (lesson 6), the major act of pupil discourse was the "reply". This indicated that, until this point, classroom discourse had been dominated by the teacher-voice and pupils participated mainly as respondents. However, after this point, there was a steady reduction in the total percentage of pupil "replies". This coincided with a gain in the percentage of pupil "comments" and suggested that pupils were expanding their responses to include additional information, including evaluative comments. This would suggest, in turn, that pupils were listening to methods of calculation and were able to provide their peers with more than a minimal "reply". Additionally, at the same time as the number of teacher "elicitations" was showing slight rises and falls, the number of pupil elicitations had doubled. These changes occurred following the introduction of peer questioning and suggest that pupils were more than willing to participate in the questioning process, not just as respondents but also as questioners.

Archer's category of "Response-initiation" was particularly useful in highlighting pupil involvement in the questioning process. That is, data indicated that pupils were capable of responding to teacher-initiated elicitations by either making requests for further information, questioning methods or by seeking advice, etc. So in response to the teacher's question or prompt, the pupils regularly responded by providing initiations that would, in turn, require a response. This was a change to earlier discourse because the pupils were effectively guiding the direction of the discussion or questioning, rather than being wholly guided by the teacher. It could be seen that this change in classroom discourse occurred at the point of transcript 6, when the teacher introduced the regular opportunity for pupils to question or query their peers. Prior to this introduction of an interactive method of engaging pupils, there were negligible instances of pupil initiated "Response-initiations". Data from the "Response" category also highlighted changes to classroom discourse around this time and thereafter. The percentage of pupil "Responses" decreased and this indicated that pupils were offering fewer responses to teacher initiations, possibly because they had "extended" their responses to include initiations of their own, e.g. "Response-initiations".

Interestingly, the pattern of teacher and pupil "Initiations" displayed rises and falls, but the most striking element was the mirroring of each other's form of discourse. This included a rise in pupil "Initiations" and indicated a willingness to actively participate by demonstrating methods of calculation using the interactive whiteboard. A later reduction in pupil "Initiations" and a rise in teacher "Initiations" came at a time when pupils where being urged to query and to question methods of solving problems. So, findings from the application of Archer's system of analysis suggest that both the introduction of the use of the interactive whiteboard and the emphasis on peer-questioning were key factors in promoting engagement of pupils.

The opportunity for pupils to demonstrate their working-out to the rest of the class by using the interactive whiteboard was introduced during the early stages of data-collection. The teacher had previously acted as a scribe who recorded the calculation method of a pupil. Up until this time, much time was spent repeating the calculation in order to record it and pupils described their method rather than adding reasons for their choices or additional comments. The teacher then introduced a change, in an effort to

develop more interactivity, which involved pupils being invited to describe their method. Not only did this change continue to generate enthusiastic responses to participate from many pupils throughout the duration of the data-collection period, but it also seemingly led to mid-level thinking skills being applied. For example, pupils would add reasons for their choices, when previously they would simply provide the calculation steps.

The application of Bloom's *Taxonomy* revealed the regular use of mid- and higher thinking skills, when previously they had been infrequently demonstrated. That is to say, from the point of lesson 6, the teacher encouraged pupils to ask their peers questions or to query any misunderstandings or request further information. The teacher regularly prompted and reminded pupils to ask their peers a question or to comment. The teacher's voice had become less dominant and the teacher regularly acted as an intermediary who facilitated pupil participation in the questioning process. Pupils were stimulated to respond using a range of thinking skills, e.g. comprehension, analysis and evaluation. Unfortunately, regarding the use of "fuzzy" and "multiple" questioning by the teacher, it was difficult to ascertain the effect, if any, on pupil responses or interaction. This was because the data comprised of very few examples of each type of questioning style and so I felt that it was unreasonable to draw conclusions from such scant data. However, there was a clear change evident at the point of lesson 8, two weeks after the introduction of clear questioning opportunities for pupils. That is, the percentage of lower level thinking skills was outweighed by the percentage of higher level thinking skills. Overall, the proportion of higher to lower level thinking skills had become more evenly balanced following the change in pedagogy, and the data demonstrated that a range of thinking skills was being stimulated. This was in contrast to the early stages of data-collection, when lower level skills predominated and higher skill usage was rare. The use of a range of thinking skills, as demonstrated by the application of Bloom's *Taxonomy*, corresponded with my interpretation of "engagement" and my understanding of "interactive" teaching plus "active participation". That is, engaged pupils are likely to be motivated and keen to participate. They would demonstrate a range of thinking skills and would enjoy participating. The encouragement or involvement of pupils in the questioning process not only invites the use of a range of thinking skills by the

respondent, but also necessitates a two-way process of interactive teaching/learning, with pupils as active, rather than passive, participants.

CHAPTER 8 DISCUSSION AND FUTURE RESEARCH

This chapter discusses the strengths of my approach and how, after reflection, I may have taken different approaches. This is followed by consideration of the implications of encouraging pupils to engage interactively. The chapter concludes with a brief discussion of proposed areas for further study.

8.1 A summary of the study's approach

Throughout the period of research I have reflected on the approaches and methods which have been employed in order to investigate the nature of classroom discourse. There have been approaches used which I would feel confident to use again, for example the chosen period for data-collection was seemingly ideal. This was because I used contextual knowledge to determine the most appropriate time of year to collect data in a Key Stage 2 classroom. In addition, there was time allocated to meet with the Head teacher, class teacher and pupils prior to beginning data-collection. As a result, there was an element of openness and trust regarding the purpose and nature of the work. This was necessary in order to become an observer and to be able to collect data with minimal disruption. Also, I felt that the use of a range of data-collection and analysis systems was appropriate because it enabled interpretations to be supported by the beneficial elements from each of the systems rather than a reliance on a single method or system. Finally, the work was based on prior school-based research and contextual knowledge, and so there were elements of familiarity and experience which formed the foundation for the work, especially during the initial stages.

However, after appraising the approaches I felt that, although the class teacher preferred the use of audio recording, I would have preferred to have collected data using video. That is, the use of video would have been preferable because it potentially would have captured gestures, facial expressions, seating arrangements, who was speaking and reactions for example. This additional data may have assisted in determining engagement and may have been a useful tool for evaluation purposes if viewed with the teacher and pupils. Instead I relied on notes taken during observations together with recollections of the session when transcribing the audio tapes. A timer device or counter would perhaps

have been useful for accurately determining duration of exchanges for instance and for marking points of time to assist with the location of key pieces of dialogue.

Regarding the use of questionnaires, I would aim to ensure anonymity by omitting the name of the pupil on the page and I would also request careful completion by the end of same day of data-collection. However, I realise that there are potential difficulties associated with many forms of data-collection, including the capability or willingness of participants to complete questionnaires to a standard that will provide reliable data.

8.2 Implications

The research has several immediate implications for classroom practice and the teaching of problem-solving. For example, pupils have demonstrated a willingness to share their methods of working out the solutions to problems. They have been given opportunities to share their misunderstandings and to support their peers by offering explanations. Therefore, pupils have taken responsibility for their learning by directing the discussion and by engaging in the questioning process as both questioners and respondents. Their questions have demonstrated their ability to elicit a range of responses, including explanation, analysis and application. They have responded to questioning not only from their teacher but from their peers, and so there has been a change in the roles of teacher and pupil. In fact, there has been an added change in the expectations of participants, as evidence has shown that a simple nomination became sufficient to encourage questioning and the demonstration of methods using the interactive whiteboard. In addition, pupils have developed their range of thinking skills as they formulated their questions and explanations. This, together with an enthusiastic and confident approach to tackling problems, soon became an expected and accepted part of Numeracy problem-solving.

Pupils engaged in discussion, corresponds with the *National Numeracy Strategy's* emphasis of the value of dialogue, e.g. the use of interactive, whole-class direct teaching involving questioning and pupil contributions. However, if pupils are to benefit from modes of interactive teaching which potentially promote dialogue, motivation, confidence, wide-ranging thinking skills and a willingness to learn, then teachers require information and training. If there is to be an effectual approach to encouraging pupil questioning, then teachers require examples of lessons that include effective methods of

engagement. In this way, they could use their professional skills to apply the methods within their own classroom. Similarly, pupils require modelling of question-types, encouragement to ask questions and, additionally, to explicitly know what interactive methods involve (Pratt, 2003). Indeed McGuinness (DfEE, 1999) recognised the need for the teacher to create a philosophy of thinking in the classroom. Pupils need to be assured that contributions are valued and that they are being trusted to take responsibility for their own learning by seeking reinforcement or extension of their mathematical skills. Equally, the teacher may need to alter their interpretation of an interactive Numeracy problem-solving lesson in order to appreciate the value of effective methods of pupil engagement. For instance, Hardman, Smith, Mroz and Wall (2003) were interested in determining how the official emphasis on "interactive" teaching had affected classroom discourse. Although many teachers affirmed that they promoted pupil participation in discourse, findings from classroom observations indicated, "that opportunities for sustained and extended dialogue by the pupil are rare" (Hardman et al. 2003: 16).

This suggests, then, that a number of teachers may be constrained from introducing active pupil participation in the questioning process, because they require more training or support in order to understand the meaning of interactive teaching and learning.

The importance of pupil contributions to discussions is supported by the work of Grainger (2000), who observed "interactive whole-class" teaching in schools in Prague and noted the respectful, supportive atmosphere where pupils were encouraged to share their thinking regarding the calculation of problems. However, even if teachers were made fully aware of the value of active participation, it may be that timetable pressures are acting as a constraint to encouraging interactivity and engagement. That is to say, possibly in an effort to meet many objectives stipulated by the National Curriculum, the pace of lessons is quick, leaving little time to explore misunderstandings or alternative calculations for example. This view is shared by Burns and Myhill (2004), who suggest that teachers may dominate discourse in order to meet objectives documented in Government subject frameworks. In other words, in order to "transmit" the intended objectives, teachers tended to dominate discourse by asking questions that demonstrated

recall of knowledge and by giving facts. Indeed, Basit (2003) recognised that Numeracy topics were,

> ...rarely developed and extended over several lessons. The National Numeracy Strategy framework seems to be over ambitious regarding what can be covered in the time allocated for each topic (Basit, in Kyriacou, 2005: 177).

So if teachers wished to promote engagement by encouraging pupil contributions, would the timetable be able to accommodate opportunities for sustained discussion or explanations? Curriculum pressures combined with teacher-domination of discourse could consequently be constraints to the development of engagement.

The necessity for planning and preparation in order to introduce effective methods of engaging pupils in the questioning process, is an additional implication. Teacher and pupils must be prepared to explore their perceptions of interactivity and the role of speaking and listening in the classroom. The teacher must be prepared to devolve more responsibility for learning to the pupils. That is, there is likely to be a change in classroom dynamics as pupils become more dominant questioners and demonstrators. Yet teacher and pupil perceptions of listening may be a potential constraint to the introduction of such effective methods of engagement. Indeed studies by Coles (2001) determined that pupils asked their own questions about complex mathematical procedures when their teacher's type of listening style changed from one form (listening whereby contributions were judged as either right or wrong) to another (listening whereby ideas were considered and incorporated into responses). So, by implication, it would be necessary for teachers and pupils to alter their perceptions regarding the importance of listening.

Interestingly, research by Pratt (2003) has shown that pupils may perceive listening to be more important than talking, but talking was not necessarily seen by pupil or teacher as a tool for learning. Pratt also recognised that teachers faced the conflicting responsibilities of requiring pupils to listen while facts are relayed to them, at the same time as requiring pupils to draw out knowledge interactively through discussion. So this suggests that pupil and teacher perceptions of speaking and listening may need to be

altered if methods of engagement involving pupil questioning or explanations are to be introduced.

Finally, if the method of engaging pupils by encouraging explanation, questioning and querying is to be effective, there needs to be an ethos of trust within the classroom. That is, it is necessary for pupils to trust their teacher or peers to accept and value their contribution to the discussion. Indeed, research by Anderson (2000) has indicated that some pupils become disengaged if they make a mistake or as a result of a negative reaction by a peer or their teacher. In other words, some pupils may feel that their contributions are not valued and so there may be a temporary or long-term withdrawal from participating in discussions as a result of their reduced self-confidence.

In summary, there are a number of important issues to consider regarding the implementation of effective methods of engagement, such as teacher and pupil perception of speaking and listening. In addition, there are implications regarding training and provision of information, for example, teachers' understanding of "interactive" teaching. Although these issues are of importance, it is not possible to fully examine their significance within the confines of this thesis.

8.3 Future research

As the research progressed, I became increasingly interested by the questioning of pupils by their peers, and in particular, those instances when pupils directly responded to a question or query and dialogue took place directly from one pupil to another, rather than via the teacher. The following example demonstrates a direct peer response to a pupil query,

> Teacher: is there a question there for C? Is there something that you think...*(immediate question from pupil)*
> Pupil 1: I wonder why you put 500 x 5?
> Pupil 2: because it's 450 approximately near 500 and then ...*(indistinct)*
> Teacher: anybody else see anything...that's a good question, well done for having a go E, house point for that...J? (Appendix 16: 240).

This situation is of interest to me because, during a whole-class session, it is not usual for a pupil to control the direction of the discourse by choosing when, who and how other pupils participate. However, as the example demonstrates, it is possible for pupils to direct the course of the discussion under the guidance or supervision of their teacher; thereby showing responsibility for their learning. Also, the data indicates that pupils are capable of sustained exchanges whereby areas of difficulty or alternative methods can be discussed or consolidated. Together with comments from pupils which are evaluative or supportive, I feel that Pupil:Pupil participation in the questioning process, as demonstrated earlier, signifies engagement. In order to capture these different instances of engagement, it would be necessary for me to further develop my system of analysis using a combination of Archer's system (2005) and Bloom's *Taxonomy* (1964). Therefore, I would be interested in furthering research into pupil involvement in the questioning process. Indeed, I would like to examine if there are peak times during primary school years when pupils are motivated or willing participants in the questioning process. Questions I would seek to address include: are Year 1 pupils more likely to ask questions than Year 5 pupils and if so, why? Regarding the practicalities of questioning, do pupils know how to ask questions of their peers? And finally, would pupils who were engaged in the questioning process during their years as upper juniors, continue to ask questions during their first year of secondary school?

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APPENDIX 1: KEY POINTS ARISING FROM EACH SESSION

Lesson 1

Focus: systematic methods of calculation; using a grid to organise and record combinations of coins to make a given total.

Much emphasis is placed on recording the combinations of coins in order to find a solution.

Questions temporarily displayed on whiteboard easel.

The teacher acts as a scribe and repeats pupil's working out as the she writes on the whiteboard easel.

There are no requests for clarification from the pupils, nor do pupils compare methods.

Almost the whole session is dominated by the teacher voice.

Although pupils are asked questions, they tend to be closed, recall questions.

A small number of pupils are invited to join in the discourse, but with one exception their responses are brief and without any elaboration.

Many pupils seem uninterested in the calculations being shown and there is some off-task behaviour.

Lesson 2

Focus: "real-life" problem-solving involving money

Teacher reinforces use of problem-solving acronym "QUACK" and therefore questions are mainly recall in order to reinforce meaning of each initial letter.

Teacher's voice is dominant.

Questions temporarily displayed on whiteboard easel.

Pupils are asked how they worked out the problems, but they are not asked to extend their responses by giving reasons.

Questions tend to be closed and teacher turns tend to be disproportionately lengthy.

The teacher acts as a scribe and repeats pupil's working out as the she writes on the whiteboard easel.

Many pupils seem uninterested in the calculations being shown and there is some off-task behaviour.

Lesson 3

Focus: problems involving multiplication and division

Teacher reinforces use of problem-solving acronym "QUACK" and therefore questions are mainly recall in order to reinforce meaning of each initial letter.

Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Teacher encourages pupils to show their working out and nominates participants.

Pupils are excited at the prospect of being chosen to show their working out and express disappointment if they are not chosen.

Pupils do not ask for clarification regarding calculations.

Pupils quiet and seemingly interested while peer shows working-out.

There is an immediate vocal response from the remainder of the class when a pupil reaches the solution.

Background murmuring indicates agreement or disagreement with methods of calculation/solutions.

Lesson 4

Focus: problems involving multiplication and division.

Teacher's voice is dominant.

Teacher reinforces use of problem-solving acronym "QUACK" and therefore initial questions are mainly recall in order to reinforce meaning of each initial letter.

Teacher controls the discourse.

Evidence of many open questions being used.

Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Pupils are extending some of their answers e.g. giving reasons for choice of method,

Background murmuring indicates agreement or disagreement with methods of calculation/solutions.

Lesson 5

Focus: mixed measures *(NB requires much embedded factual knowledge)*

Teacher reinforces use of problem-solving acronym "QUACK" and therefore questions are mainly recall in order to reinforce meaning of each initial letter.

Teacher's questioning style is mainly closed.

Explanations are not requested and pupils do not offer to elaborate.

Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Pupils seem quite restless.

Many pupils are struggling with conversion of units and knowledge of measurement facts.

Three pupils predominantly involved in discourse.

Lesson 6

Focus: problems involving mass.

Teacher introduces opportunity for pupils to question and query their peers' methods of calculation.

Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Several P:P exchanges.

Many teacher and pupil questions are open.

Teacher's voice is noticeably less dominant.

Pupils continue to show enthusiasm when chosen to use interactive board.

Noticeable sustained interest and participation from all ability levels.

Sustained dialogue.

Pupils given opportunity to nominate next participant on two occasions.

Teacher regularly reminds pupils to ask questions.

Pupils willing to say that they did not understand a point.

Spontaneous applause from pupils following a series of exchanges during a method of calculation..

Lesson 7

Focus: "real-life" problem-solving involving money

Teacher generally still has nominating role but is opening the discussion by providing an opportunity to ask questions. Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Teacher uses inclusive terms: "we" and "us".

Noticeable sustained interest and participation from all ability levels.

Some P:P interaction.

Background murmuring indicates agreement or disagreement with methods of calculation/solutions.

Pupils keen to attempt their methods and to persevere to overcome calculation difficulties.

Noticeable amount of pupil dialogue and questioning, often with longer pupil responses (>10 words) than those from the teacher.

Pupils show enthusiasm when chosen to use interactive board.

Lesson 8

Focus: problem-solving involving time

(NB teacher told me prior to the lesson, that pupils had demonstrated difficulties relating analogue to digital time during a science lesson requiring ability to read times)

Pupils expressed their thoughts regarding calculations.

One pupil provides a "running commentary" including an evaluative "well done" followed by a round of applause.

Several pupils refer back to methods used by peers.

Seems clear that pupils realise they are expected to participate by asking questions when one pupil says, "it's not really a question but..."

Questions displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Pupils keen to ask questions/offer comments.

Pupils continue to show enthusiasm when chosen to use interactive board.

Teacher regularly reminds pupils to ask questions.

Teacher tends to keep own turns brief.

Lesson 9

Focus: a single problem to determine ages from given clues.

(NB teacher reverted to being scribe during unusually long mental-maths warm-up; much restlessness from pupils)

Interest and discussion taking place, yet seemingly restless atmosphere.

Question displayed on the interactive whiteboard.

Pupils given opportunity to show their working-out on the interactive whiteboard.

Few examples of pupils' questions, but the exchanges are sustained, including a P:P exchange.

Pupil asks to "take over" from their peer when they recognise an alternative method.

When, for instance, there is a point of contention during the calculation, there are raised voices, background comments and acknowledgements.

APPENDIX 2: CATEGORISATION OF UTTERANCES BASED ON ARCHER (ARCHER, 2005: 122)

Key to symbols used in marking transcripts

Initiation (e.g. a question or a request) → Ini

Report (e.g. an explanation or statement)→ Rep

Follow-up initiation (e.g. feedback followed by a question)→ Fol-ini

Re-word→(e.g. asking the same question but using slightly different words) Re-word

Follow-up (e.g. a comment or an evaluation)→ Fol

Response (e.g. an answer)→Res

Response-initiation (e.g. an answer followed by a question)→Res-ini

Re-initiate→ (e.g. a question or statement posed again following misconception) Re-initiate

Transcript 1	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 37	11 29.7%	1 2.7%	22 59.5%	1 2.7%	2 5.4%	0 0%	0 0%	2 2.7%
Pupils: Total number of utterances 47	5 10.6%	0 0%	0 0%	0 0%	0 0%	42 89.4%	0 0%	0 0%

Transcript 2	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 55	21 38.2%	2 3.6%	27 49%	1 1.8%	3 5.5%	1 1.8%	0 0%	5 9.1%
Pupils: Total number of utterances 64	2 3.1%	1 1.6%	0 0%	0 0%	2 3.1%	59 92.2%	0 0%	0 0%

Transcript 3	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 100	25 25%	2 2%	56 56%	2 2%	14 14%	0 0%	1 1%	8 8%
Pupils: Total number of utterances 102	5 4.9%	0 0%	0 0%	0 0%	1 1%	95 93.1%	1 1%	0 0%

Transcript 4	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 55	13 23.6%	0 0%	34 61.8%	0 0%	8 14.5%	0 0%	0 0%	2 3.6%
Pupils: Total number of utterances 63	6 9.5%	2 3.2%	0 0%	0 0%	0 0%	55 87.3%	0 0%	0 0%

Transcript 5	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 45	9 20%	1 2.2%	32 71.1%	0 0%	3 6.7%	0 0%	0 0%	4 8.9%
Pupils: Total number of utterances 59	10 16.9%	1 1.7%	0 0%	0 0%	2 3.4%	46 78%	0 0%	0 0%

Transcript 6	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances =69	24 34.8%	1 1.5%	35 50.7%	0 0%	8 11.6%	0 0%	1 1.5%	2 2.9%
Pupils: Total number of utterances 78	5 6.4%	4 5.1%	0 0%	0 0%	0 0%	57 73.1%	12 15.4%	0 0%

Transcript 7	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 47	15 31.9%	1 2.1%	24 51.1%	0 0%	7 14.9%	0 0%	0 0%	4 8.5%
Pupils: Total number of utterances 60	5 8.3%	3 5%	0 0%	0 0%	4 6.7%	41 68.3%	7 11.7%	0 0%

Transcript 8	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 44	23 52.3%	0 0%	16 36.4%	0 0%	2 4.6%	2 4.6%	1 2.3%	3 6.8%
Pupils: Total number of utterances 57	7 12.3%	1 1.8%	0 0%	0 0%	3 5.3%	41 72%	5 8.8%	0 0%

Transcript 9	Utterance type							
	Initiation (total)	**Report** (total)	**Follow-up initiation** (total)	**Re-word** (total)	**Follow-up** (total)	**Response** (total)	**Response-initiation** (total)	**Re-initiate** (total)
Teacher: Total number of utterances 38	21 55.3%	1 2.6%	8 21.1%	0 0%	6 15.8%	0 0%	2 5.3%	1 2.6%
Pupils: Total number of utterances 55	2 3.6%	1 1.8%	0 0%	0 0%	2 3.6%	44 80%	6 11%	0 0%

APPENDIX 3: CATEGORISATION OF THINKING SKILLS BASED ON BLOOM

Teacher: as a model

Questioning style: open questions
closed questions
thinking time

Skill of remembering: did teacher make a summary
Did teacher show a mathematical procedure (working out)

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

Skill of application: did teacher solve problems using required skills
Did teacher give reasons for their conclusion (I think this because...)

Skill of analysis: did teacher identify a general rule

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

Skill of evaluation: did teacher look for evidence/give reasons when making their decisions

Pupil: as an active participant

Questioning style: open questions

closed questions

thinking time

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because...)

Skill of analysis: did pupil identify a general rule

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

Interaction

Pupil → pupil

Pupil → teacher

Teacher → pupil

APPENDIX 4: DESCRIPTIONS OF SINCLAIR AND COULTHARD ACTS, INCLUDING SYMBOLS

Marker(m)= indicates a change in direction of the discourse; often indicated by "so", "now", "OK"

Starter(s)= a statement or question that draws attention to an area so that it is more easily understood; "and what about this one?"

Nomination(n)= choosing someone to respond or contribute to the discourse (counted as an elicitation because a response is expected)

Elicitation(el)= usually a question (also interpreted as a nomination); a response is required

Directive(d)= a command or a clear expectation; a reaction not a reply is required

Accept(acc)= an evaluative word or comment that shows that the response was acceptable; usually expecting more; can show that the response was acceptable but not quite right

Comment(com)= statement or question which adds to a reply; could include "isn't it?"

Reply(rep)= a response to a question

Conclusion (con)= acts as a summary

Acknowledge (ack)= shows that an initiation has been understood

Cue(cu)= not expected to all respond, but is an opportunity to bid; "hands up"

Clue(cl)= additional information which acts as a clue to the expected answer

Check (ch)= a question where the answer is not known; "can everyone see the board?"

Prompt (p)= a response is urged and expected; "come on", "go on"

Evaluate(e)= commenting on the "quality" of a reply (is it right?), often shown by repeating the response or "yes"

Informative(i)= statement, not expecting a reply; but the statement initiates a response;

Bid (b)= a request to be chosen (by nomination) to contribute to the discourse; often indicated by a show of hands or "I know!"

Loop (l)= a statement that is repeated for emphasis or because it wasn't heard initially; not evaluative

Meta-statement (ms)= a statement that describes what will take place during the lesson (opposite to a conclusion)

APPENDIX 5: TURNS AND ACTS WITH PERCENTAGES

Transcript 1 23/1/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 38	Teacher 38	M=17 S= 9 N= 18 El=50 D= 12 Acc=17 Com= 18 Rep=2 Con=8 Ack=0 Cu=3 Cl= 2 Ch=4 P= 5 E= 18 I=3 B= 0 L=0 M-s=9 Total =195	M=8.7 S= 4.6 N= 9.2 El=25.6 D= 6.2 Acc=8.7 Com= 9.2 Rep=1 Con=4.1 Ack=0 Cu=1.5 Cl= 1 Ch=2 P= 2.6 E= 9.2 I=1.5 B= 0 L=0 M-s=4.6
Pupil Total= 41 (+10m/f?)	Male 32 Female 9	M=0 S= 0 N= 0 El=4 D= 4 Acc=0 Com=1 Rep=41 Con=0 Ack=3 Cu=0 Cl= 0 Ch=1 P= 0 E= 0 I=0 B=2 L=0 M-s=0 Total =56	M=0 S= 0 N= 0 El=7.1 D= 7.1 Acc=0 Com=1.8 Rep=73.2 Con=0 Ack=5.4 Cu=0 Cl= 0 Ch=1.8 P= 0 E= 0 I=0 B=3.6 L=0 M-s=0

Transcript 2 30/1/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 57	Teacher 57	M=10 S= 15 N= 26 El=51 D= 10 Acc=10 Com= 5 Rep=0 Con=10 Ack=2 Cu=2 Cl= 0 Ch=1 P= 0 E= 22 I=2 B=0 L=2 M-s=4 Total =172	M=5.8 S=8.7 N=15.1 El=29.7 D= 5.8 Acc=5.8 Com=2.9 Rep=0 Con=5.8 Ack=1.2 Cu=1.2 Cl= 0 Ch=0.6 P= 0 E= 12.8 I=1.2 B=0 L=1.2 M-s=2.3
Pupil Total= 48 (+14m/f?)	Male 30 Female 18	M=0 S= 0 N= 0 El=2 D= 0 Acc=0 Com=0 Rep=53 Con=0 Ack=2 Cu=0 Cl= 0 Ch=0 P= 0 E= 1 I=1 B=5 L=0 M-s=0 Total =64	M=0 S=0 N=0 El=3.1 D= 0 Acc=0 Com=0 Rep=82.8 Con=0 Ack=3.1 Cu=0 Cl=0 Ch=0 P= 0 E=1.6 I=1.6 B= 7.8 L=0 M-s=0

Transcript 3 6/2/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 102	Teacher	M=30 S= 24 N= 23 El=95 D= 32 Acc=12 Com= 25 Rep=0 Con=9 Ack=0 Cu=1 Cl= 7 Ch=0 P= 6 E= 69 I=12 B= 0 L=1 M-s=9 Total =296	M=10.1 S=8.1 N=7.8 El=32.1 D= 10.8 Acc=4.1 Com=8.5 Rep=0 Con=3 Ack=0 Cu=0.3 Cl= 2.4 Ch=0 P= 2 E= 23.3 I=4.1 B=0 L=0.3 M-s=3
Pupil Total= 105 (+5m/f?)	Male 67 Female 38	M=1 S= 0 N= 1 El=3 D= 2 Acc=0 Com=1 Rep=86 Con=0 Ack=9 Cu=0 Cl= 0 Ch=0 P= 0 E= 1 I=0 B=5 L=1 M-s=0 Rea=9 Total =119	M=0.8 S=0 N=0.8 El=2.5 D=1.7 Acc=0 Com=0.8 Rep=72.3 Con=0 Ack=7.6 Cu=0 Cl=0 Ch=0 P= 0 E=0.8 I=0 B=4.2 L=0.8 M-s=0 Rea=7.6

Transcript 4 13/2/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 62	Teacher	M=42 S= 8 N= 30 El=58 D= 20 Acc=3 Com=27 Rep=0 Con=8 Ack=0 Cu=1 Cl= 4 Ch=1 P= 11 E= 51 I=13 B= 0 L=0 M-s=4 Total =281	M=15 S=2.9 N=10.7 El=20.6 D= 7.1 Acc=1.1 Com=9.6 Rep=0 Con=2.9 Ack=0 Cu=0.4 Cl= 1.4 Ch=0.4 P= 3.9 E= 18.2 I=4.6 B=0 L=0 M-s=1.4
Pupil Total= 58 (+4m/f?)	Male 38 Female 20	M=0 S= 0 N= 0 El=2 D= 1 Acc=0 Com=2 Rep=49 Con=0 Ack=1 Cu=0 Cl= 0 Ch=0 P= 0 E= 0 I=1 B=3 L=0 M-s=0 Total =59	M=0 S=0 N=0 El=3.4 D= 1.7 Acc=0 Com=3.4 Rep=83.1 Con=0 Ack=1.7 Cu=0 Cl=0 Ch=0 P= 0 E=0 I=1.7 B= 5.1 L=0 M-s=0

Transcript 5 27/2/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 47	Teacher	M=28 S= 8 N= 34 El=61 D= 18 Acc=7 Com=20 Rep=1 Con=6 Ack=1 Cu=1 Cl= 5 Ch=6 P= 8 E= 32 I=11 B= 0 L=3 M-s=6 Total =256	M=10.9 S=3.1 N=13.3 El=23.8 D= 7 Acc=2.7 Com=7.8 Rep=0.4 Con=2.3 Ack=0.4 Cu=0.4 Cl= 2 Ch=2.3 P= 3.1 E= 12.5 I=4.3 B=0 L=1.2 M-s=2.3
Pupil Total= 57 (+17m/f?)	Male 30 Female 27	M=0 S= 0 N= 0 El=0 D= 0 Acc=0 Com= 2 Rep=37 Con=0 Ack=5 Cu=0 Cl= 0 Ch=0 P= 0 E= 0 I=0 B=10 L=0 M-s=0 Total =54	M=0 S=0 N=0 El=0 D= 0 Acc=0 Com=3.7 Rep=68.5 Con=0 Ack=9.3 Cu=0 Cl=0 Ch=0 P= 0 E=0 I=0 B=18.5 L=0 M-s=0

Transcript 6 6/3/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 71	Teacher	M=27 S= 5 N= 31 El=33 D= 9 Acc=5 Com= 29 Rep=2 Con=5 Ack=1 Cu=1 Cl= 1 Ch=6 P= 19 E= 36 I=4 B=0 L=4 M-s=1 Total =219	M=12.3 S=2.3 N=14.2 El=15.1 D= 4.1 Acc=2.3 Com=13.2 Rep=0.9 Con=2.3 Ack=0.5 Cu=0.5 Cl= 0.5 Ch=2.7 P= 8.7 E= 16.4 I=1.8 B=0 L=1.8 M-s=0.5
Pupil Total= 82 (+25m/f?)	Male 47 Female 35	M=6 S= 0 N= 1 El=13 D= 0 Acc=2 Com=18 Rep=53 Con=0 Ack=1 Cu=0 Cl= 1 Ch=0 P= 0 E= 0 I=3 B=5 L=0 M-s=0 Total =103	M=5.8 S=0 N=1 El=12.6 D= 0 Acc=1.9 Com= 17.5 Rep=51.5 Con=0 Ack=1 Cu=0 Cl=1 Ch=0 P=0 E=0 I=2.9 B= 4.9 L=0 M-s=0

Transcript 7 13/3/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 60	Teacher	M=8 S= 2 N= 17 El=27 D= 13 Acc=5 Com=20 Rep=1 Con=3 Ack=0 Cu=1 Cl= 1 Ch=2 P= 10 E= 23 I=5 B=0 L=2 M-s=1 Total =141	M=5.7 S=1.4 N=12.1 El=19.2 D= 9.2 Acc=3.6 Com=14.2 Rep=0.7 Con=2.1 Ack=0 Cu=0.7 Cl= 0.7 Ch=1.4 P= 7.1 E= 16.3 I=3.6 B=0 L=1.4 M-s=0.7
Pupil Total= 53 (+34m/f?)	Male 34 Female 19	M=1 S= 0 N= 0 El=8 D= 2 Acc=1 Com= 15 Rep=32 Con=0 Ack=7 Cu=0 Cl= 0 Ch=0 P= 1 E= 3 I=3 B=3 L=0 M-s=1 Total =77	M=1.3 S=0 N=0 El=10.4 D= 2.6 Acc=1.3 Com= 19.5 Rep=41.6 Con=0 Ack=9.1 Cu=0 Cl=0 Ch=0 P= 1.3 E=3.9 I=3.9 B= 3.9 L=0 M-s=1.3

Transcript 8 20/3/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 50	Teacher	M=10 S= 1 N= 29 El=21 D= 14 Acc=1 Com=19 Rep=1 Con=1 Ack=0 Cu=0 Cl= 5 Ch=1 P= 6 E= 20 I=3 B=0 L=1 M-s=1 Total =134	M=7.5 S=0.8 N=21.6 El=15.7 D= 10.4 Acc=0.8 Com=14.2 Rep=0.8 Con=0.8 Ack=0 Cu=0 Cl= 3.7 Ch=0.8 P= 4.5 E= 14.9 I=2.2 B=0 L=0.8 M-s=0.8
Pupil Total= 53 (14m/f?)	Male 25 Female 28	M=2 S= 0 N= 0 El=8 D= 0 Acc=4 Com= 19 Rep=21 Con=0 Ack=6 Cu=0 Cl= 1 Ch=0 P= 0 E= 8 I=0 B=5 L=0 M-s=0 Total =74	M=2.7 S=0 N=0 El=10.8 D= 0 Acc=5.4 Com= 25.7 Rep=28.4 Con=0 Ack=8.1 Cu=0 Cl=1.4 Ch=0 P= 0 E=10.8 I=0 B=6.8 L=0 M-s=0

Transcript 9 27/3/06	Total number of Turns	Total number of Acts	% of each Act
Teacher Total= 39	Teacher	M=12 S= 7 N= 16 El=25 D= 12 Acc=5 Com=7 Rep=4 Con=2 Ack=0 Cu=2 Cl= 0 Ch=3 P= 9 E= 3 I=4 B=0 L=1 M-s=2 Total =114	M=10.5 S=6.1 N=14 El=22 D= 10.5 Acc=4.4 Com=6.1 Rep=3.5 Con=1.8 Ack=0 Cu=1.8 Cl= 0 Ch=2.6 P= 7.9 E= 2.6 I=3.5 B=0 L=0.9 M-s=1.8
Pupil Total= 41 (+12m/f?)	Male 24 Female 17	M=1 S= 0 N= 0 El=5 D= 0 Acc=1 Com= 7 Rep=33 Con=0 Ack=9 Cu=0 Cl= 1 Ch=0 P= 0 E= 2 I=4 B=4 L=0 M-s=1 Total =68	M=1.5 S=0 N=0 El=7.4 D= 0 Acc=1.5 Com= 10.3 Rep=48.5 Con=0 Ack=13.2 Cu=0 Cl=1.5 Ch=0 P= 0 E=2.9 I=5.9 B= 5.9 L=0 M-s=1.5

APPENDIX 6: CHARTS SHOWING PERCENTAGES OF TEACHER AND PUPIL UTTERANCES

Figure 5 Percentage of teacher and pupil Response-Initiation utterances

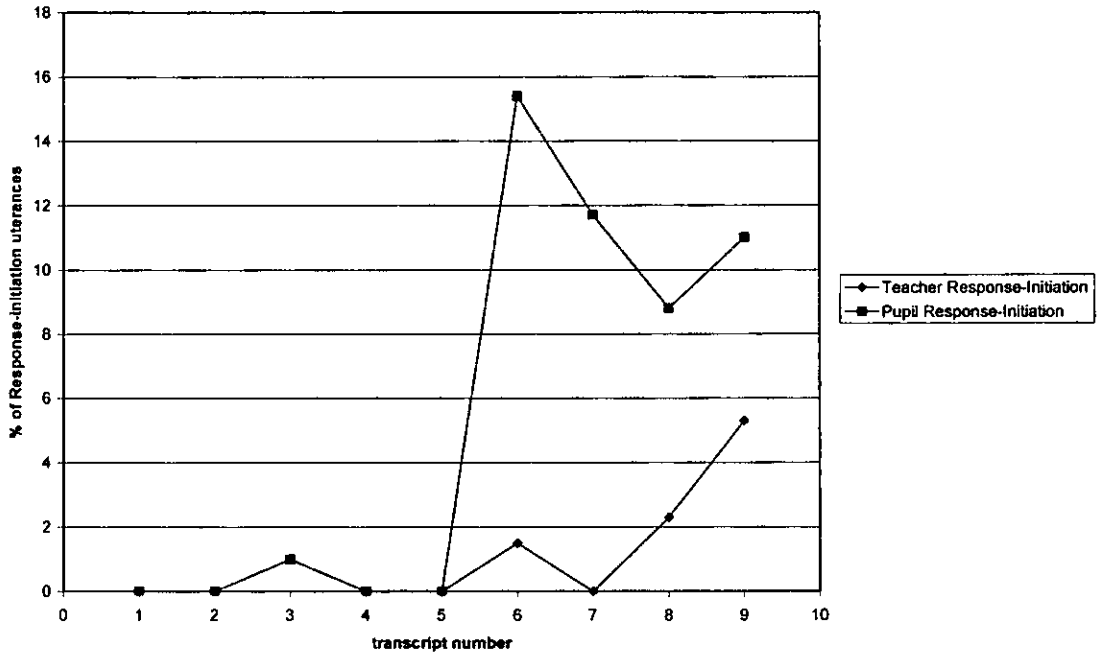


Figure 6 Percentage of teacher and pupil Response utterances

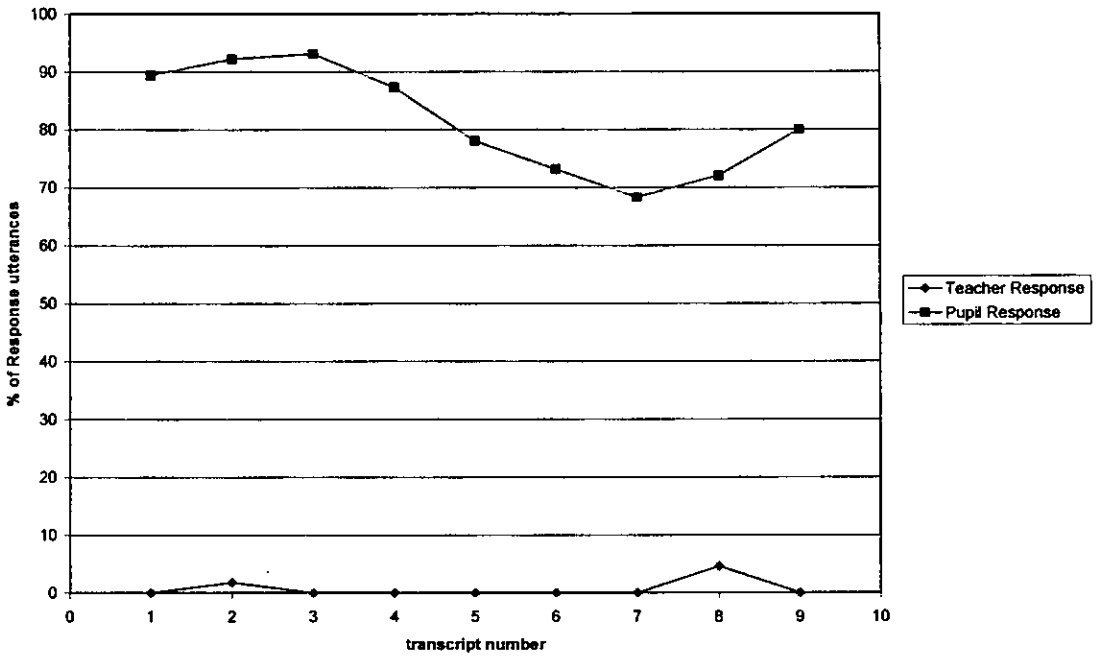


Figure 7 Comparison of percentages of pupil Response-initiations and Responses

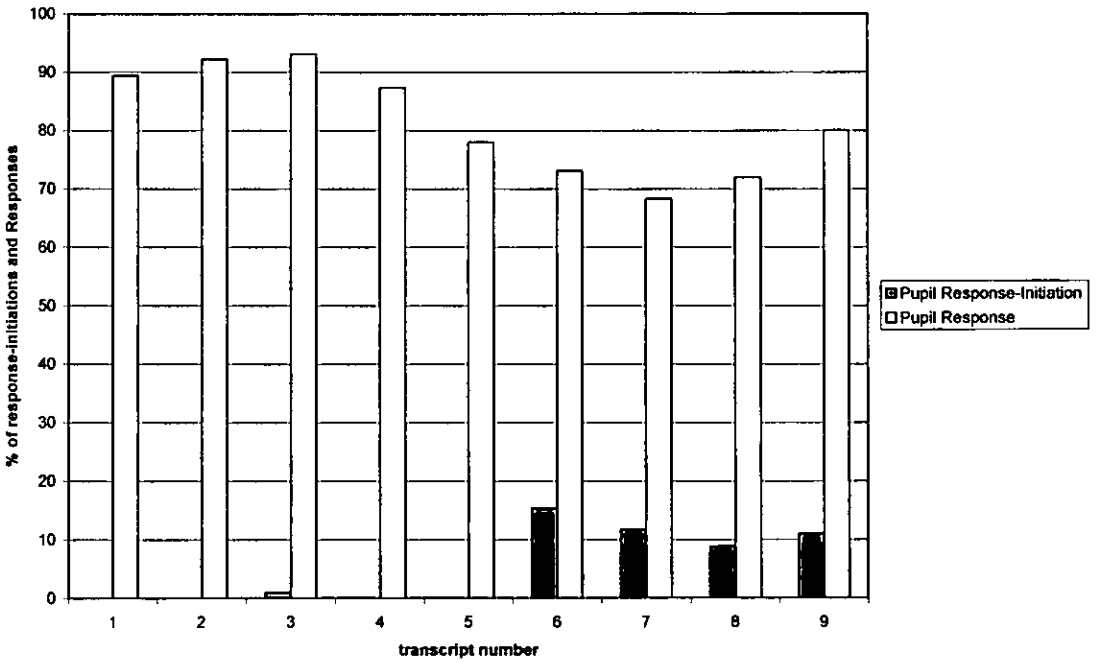


Figure 8 Percentage of teacher and pupil initiation utterances

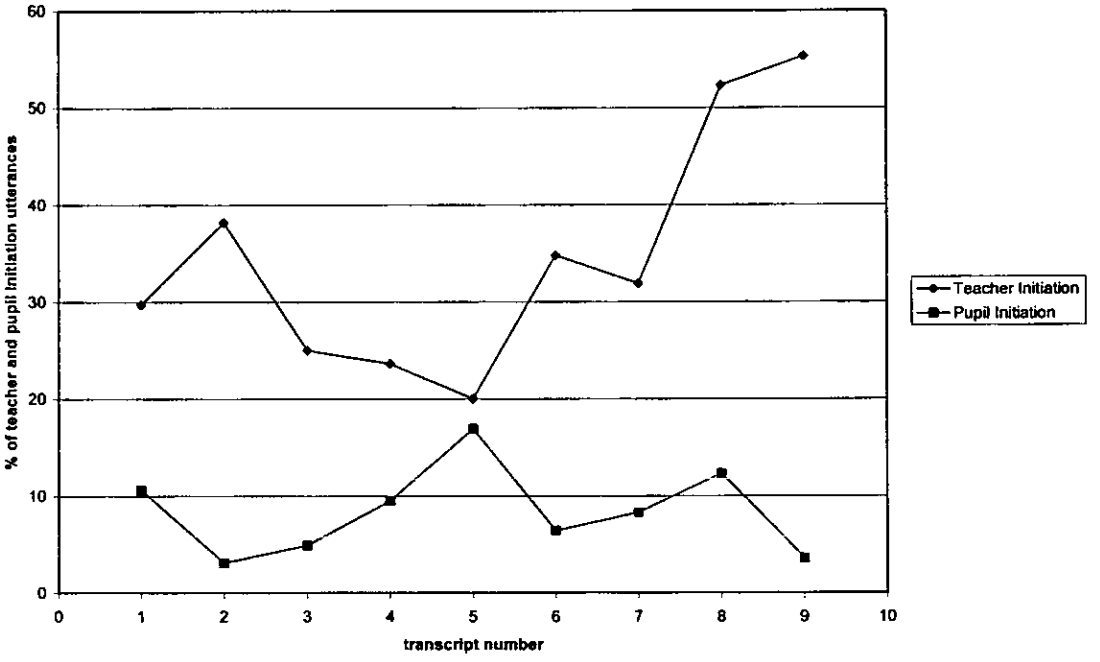


Figure 9 Percentage of teacher and pupil Follow-up initiation utterances

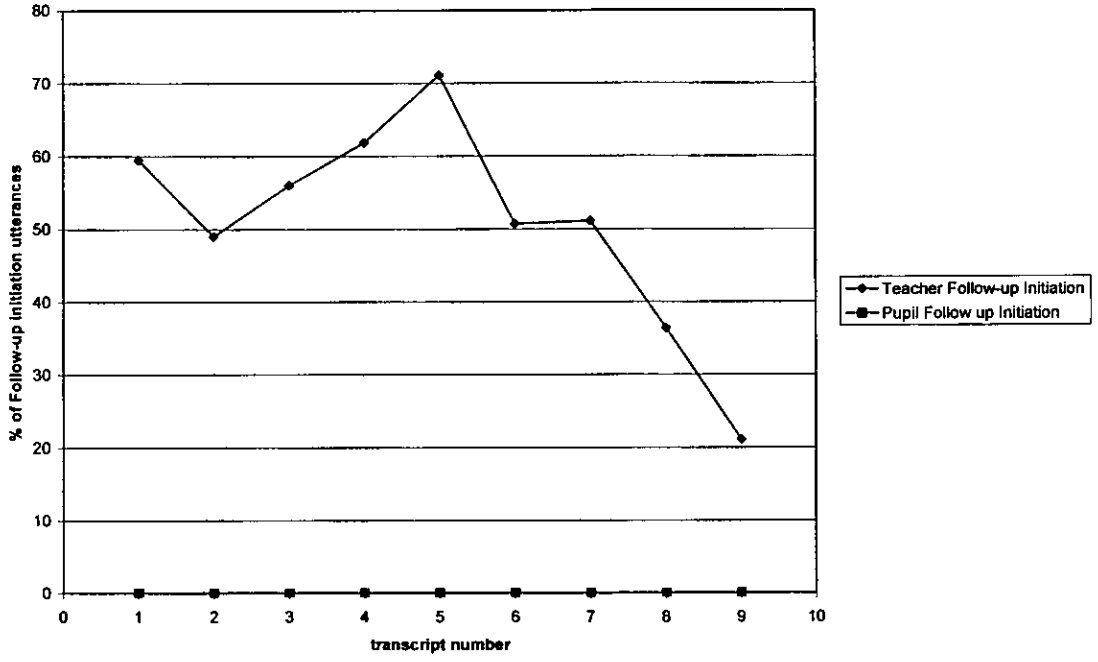


Figure 10 Comparison of percentages of teacher and pupil initiations and Follow-up initiations

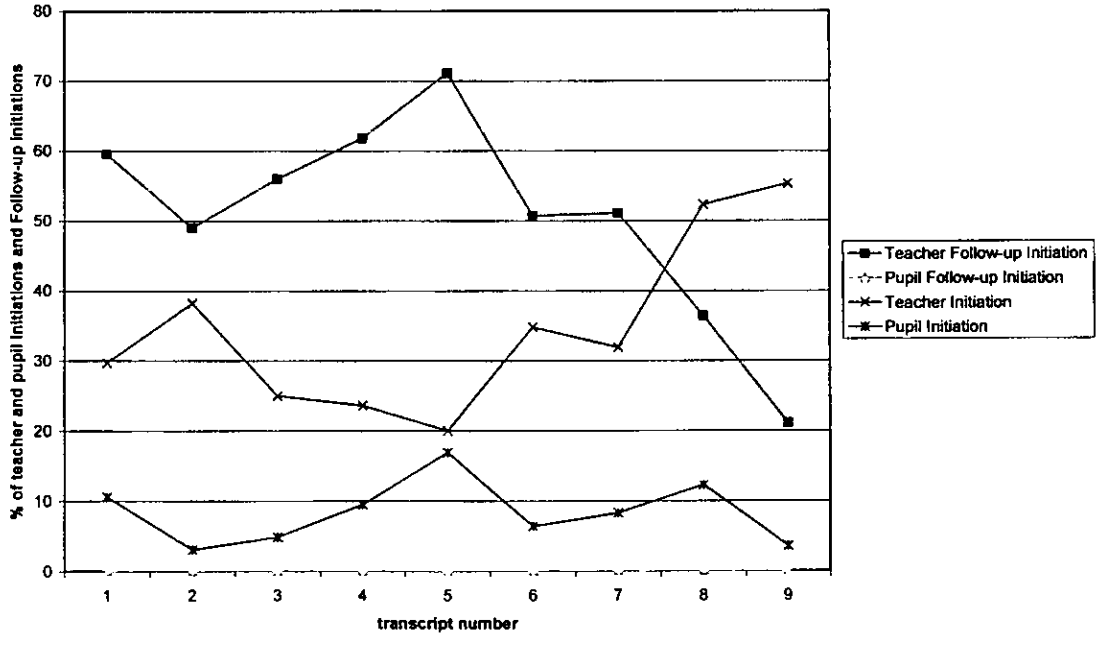


Figure 11 Percentage of teacher and pupil Follow-up utterances

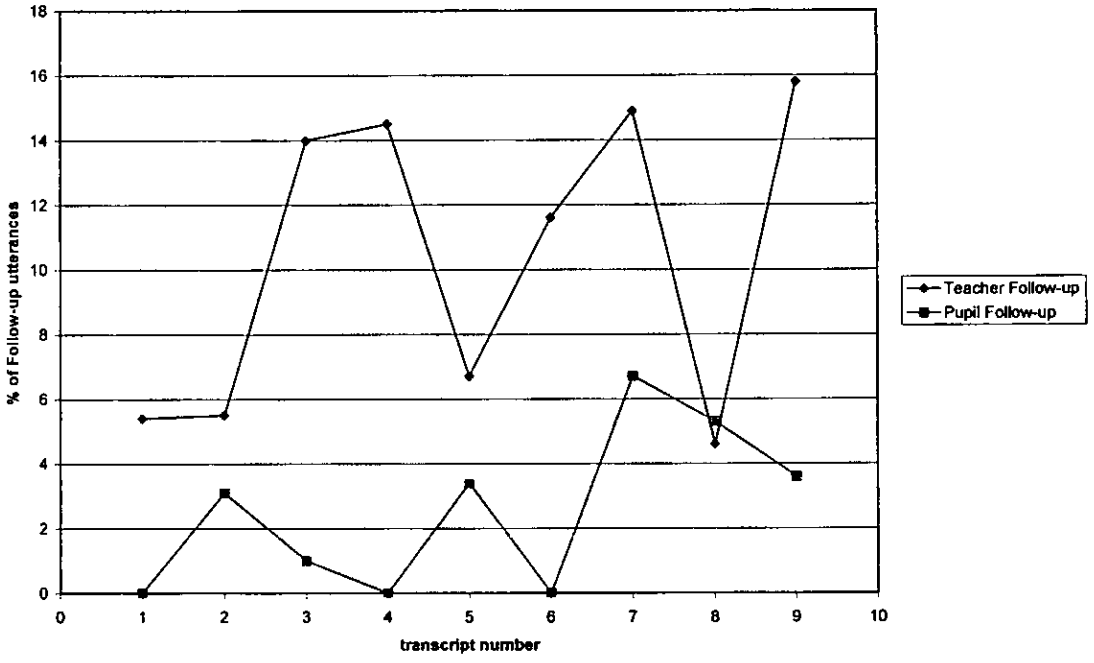
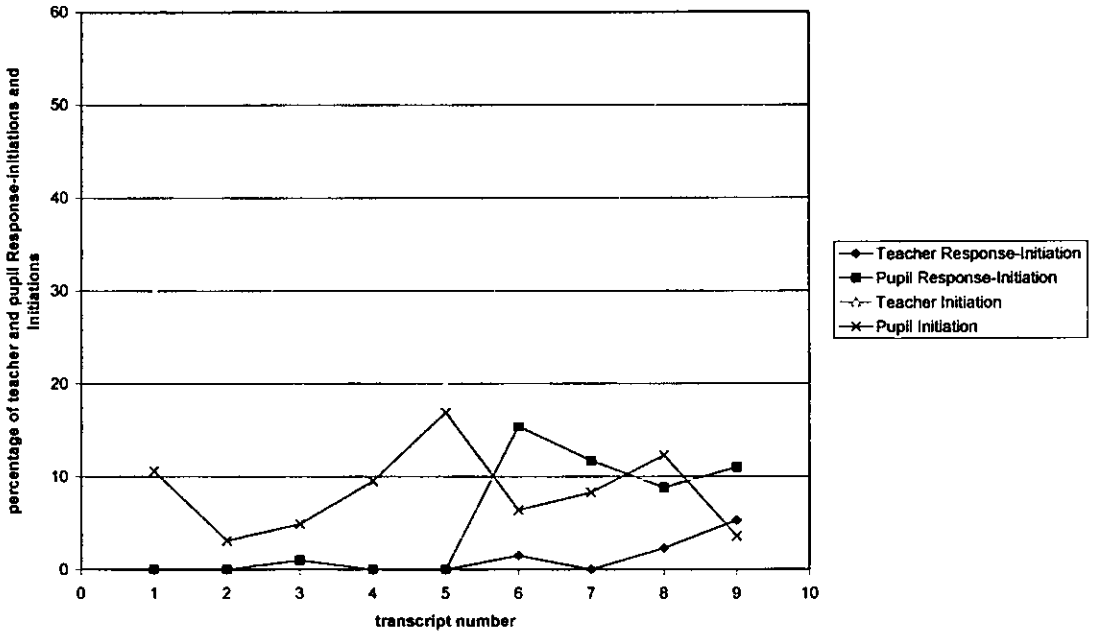


Figure 13 Comparison of percentages of teacher and pupil Response-Initiations and Initiations



APPENDIX 7: EXCHANGES FROM TRANSCRIPTS 1 TO 9 LEADING TO HIGHER OR LOWER LEVEL THINKING, BASED ON BLOOM'S *TAXONOMY*

Exchanges leading to higher or lower level thinking **TRANSCRIPT 1**

Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: Now the biggest thing that we're going to focus on today in our problem solving is, is to be what? What do I always say?	INI	be systematic!	RES	knowledge
T: OK. If I use six 10ps, how many 5ps will I use? If I have six 10ps, how many 5ps will I need to make 60? H	FOL-INI	none	RES	application
T: yes, good. So now you've got five 10ps, so five 10ps are	FOL-INI	50	RES	knowledge
T: 50, but we need 60 so how many 5ps would we need then?	FOL-INI	2	RES	application
T: . OK so we've still got 60 haven't we? Anybody else tell me what's going to be next? E	FOL-INI	four 10ps	RES	application
T: four 10ps. How many 5ps M?	FOL-INI	4	RES	application
T: 4? *(pause)*	INI as FOL	8	RES	knowledge
T: 40 and we need 60 so how much more do we need?	FOL-INI	20	RES	application

T: our 5ps. Next one, let's see who's wide awake. C what do we do next?	FOL-INI	er, take three 10ps	RES	application
T: how many?	INI	six 5ps	RES	knowledge
T: six 5ps. Shall we check? So we've got three 10ps are how much R?...30, three 10ps are	FOL-INI	30	RES	knowledge
T: 30, six 5ps are	FOL-INI	er, 30	RES	knowledge
T: can you see what's happening? We've used 6, 5, 4, 3 *(pause)* what else could we have a look at?	INI	2	RES	application
T: 2 OK. So we've got two 10ps and how many 5ps would we need? J.	FOL-INI	8	RES	application
T: 8 *(pause)* OK. And, do we need to go anymore? *(pause)* JW what would be next?	FOL-INI	er, one in 10 and ten in 5	RES	application
T: 1x10 is 10 and how many?	FOL-INI	ten times 5	RES	application
T: 10x5, do we need to go any further? ...*(pause)* D	FOL-INI	you could do, no tens	RES	application
T: ...Ok, J so how many different combinations do you think there that is?	FOL-INI	5	RES	application
T: how many combinations do you think that there are? *(pause)* Put your hand up if you think that you've worked it out. OK B how many do you think?	INI	6	RES	application
T: ...What's the score	INI	35	RES	knowledge

of the beanbag throwers target? Some people are very quick there. Well done D for listening. Go on D				
T: OK let's look at yours. So G got, you could have six 10ps, you could have twelve 5ps, three 10ps and six 5ps, she's used multiplication OK. Anyone used any other ways? C how did you do yours?	FOL-INI	six 10ps,	RES	application
T: we need another 20p but we need to do it in the 5ps	FOL-INI	4	RES	application
T: none good girl. The six 10ps are 60 altogether aren't they, so then no 5ps. What would be the sensible to do next *(pause)* if we're doing it systematically in a table?	FOL-INI	would you take one off the 6 and then you would add one to the nought? *(pause)* Take *(indistinct)* 5 and then	RES	application
T: B thinks 6. Is he right?	FOL-INI	(background pupils: yes)	RES	knowledge?

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear examples found in text)				

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S	Interactional Intent	Category of thinking

		UTTERANCE		skill used in response
T: a table, so can you use a table? Think about it yourself. Would you use a table? What else did you do when we did our table? Go on J. J doesn't think we can use a table for this one. Go on.	FOL-INI	I think *(indistinct)* it's like you've got to put the 3 dots, you've got to add them all up so I don't think you can use a table to do it.	RES	application
T: eight 5ps. Who thinks he's not right? What did you need to do M? You know that you've got 10ps which is how much? How much is four 10ps?	FOL-INI	40	RES	knowledge

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: superb. So what were you using to do that? It's a brilliant answer, good boy. *(indistinct)* That was a brilliant answer B OK. So, you could actually draw yourself a table, then you could have, a number of 10ps and a number of 5ps. Now B said a really good idea, now what's the most number of 10ps that you could have? *(pause)* What's the biggest number of 10ps that you could have? *(pause)* If we	FOL-INI	6	RES	application

want to buy a monster at 60p, what's the biggest number of 10ps that we could use?				
T: You could do. What did we do on our last one that might help us to be systematic? What did we do then to make sure that we got all the different amounts G?	FOL-INI	er, a table	RES	knowledge

Exchanges leading to higher or lower level thinking **TRANSCRIPT 2**

Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: times, 6 times by 35. So you. did 6 times by 30 is how many?	FOL-INI	£1.80	RES	knowledge
T: what is the 30? Is it £30?	INI	er 30p	RES	knowledge
T: how do I know that it's right 42p G?	INI	you can add on 34	RES	application
T: excellent, because girls and boys are the same price, it's just to trick you a little bit. You need to read the question, so we have 6 girls and 4 boys; so we've got how many all together R?	FOL-INI	10	RES	knowledge
T: C how did you work it out then?	INI	I did 5 times £1.50 and then 4 times 50	RES	application
T: so you've done 5 times £1.50 yes	FOL	equals 3.50 and you add them together	RES	application
T: Did everybody get the answer of £7.50?	INI	yes	RES	application
T: Read the question OK. So Q is for the question. What's the U for? JB	FOL-INI	U is for understand the question	RES	knowledge
T: understand the	FOL-INI	underline	RES	knowledge

question, or it could be for what? *(2 second pause)* B?				
T: brilliant. Underline the important information. What about the A? A? M	FOL-INI	is it answer?	RES-INI	knowledge
T: not answer. *(2 second pause)* S	FOL-INI	approximate	RES	knowledge
T: approximate OK so if this one says "5 times £1.50" well even if you did 5 times £1, you know the answer's roughly going to be, a bit more than the £5. If you get the answer £50 then you know somewhere along the line that your decimal points gone wrong. *(indistinct)* The C, what can we do for the C? K	FOL-INI	calculate	RES	knowledge
T: calculate. OK and the K is for what? J	FOL-INI	equivalent	RES	knowledge
T: for what sorry?	INI	equivalent	RES	knowledge
T: no. G	FOL-INI	knowing if it's sensible	RES	knowledge
T: B approximated first (*2 second pause*) J	FOL-INI	£1.50	RES	application
T: you thought it might be	INI	£1.50	RES	knowledge
T: ...Calculate it. How do people calculate it? E how did you do it?	FOL-INI	I got 6 times by 35	RES	application
T: add the 6 and the 4. Is it important that some are boys and some are girls?	FOL-INI	no	RES	comprehension
T: why not?	INI	er, because it doesn't really	RES	incomplete answer leading

T:(implicit evaluation of incorrect answer) G?	(FOL) INI	matter they're all the same price	RES	to re-initiation, followed by comprehension
T: we know that we've got 10, what do I do with the numbers? J	INI	(background pupil: I know! I know!) put a nought on	RES	knowledge
T: put a nought on. Put up your hand up if you think he's right, if you just put a nought on. OK, J tell me what happens	FOL-INI	(background pupil: no, no!) you can put a nought on the end *(indistinct)* I can't remember	RES	knowledge
T: when you say I put the dot in the middle, where am I putting my dot?	INI	in front of the 6	RES	application

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear example in the text)				

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: If you didn't know what to do, what could the acronym QUACK stand for?...who can remember what the Q is for? E	INI	read the question	RES	knowledge
T: how much do we need for all of them to get in? So what's the first thing that you will do (n)?	INI	add the 6 and the 4	RES	application

T: mmm... what will 6 packs at 40p be? How will I do that? ... 6 times 40, what will that be R?	INI	er, £2.40	RES	knowledge
T: well done. So you've got to make sure that you've got the right information to start off with. Sometimes it might give you some information that's right and some that's wrong. But you have to make sure that you have the right information in the *(indistinct)* well done *(indistinct)*. But if K bought, let's say, let's say she had 6 sweets, K had 6 sweets for herself and her friends and she's buying 6 packets altogether. Each packet costs 35p how much would she spend? Can you work that out for me? She buys 6 packets. *(pause) (indistinct)* read the question, well I know you've read the question because you've already noticed that something was missing from it. You did understand the question, because otherwise you wouldn't have known that important information was missing. Now, approximate. What's it going to be roughly? How am I going to know that one?	FOL-INI	it's going to be roughly about one or two pounds	RES	application

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear example in text)				

NB it has been difficult to provide examples due to the indistinct nature of many utterances

Exchanges leading to higher or lower level thinking **TRANSCRIPT 3**

Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: J	INI	understand	RES	knowledge
T: understand the question or H	FOL-INI	underline	RES	knowledge
T: know your answer is	INI	sensible	RES	knowledge
T: no, no, no, what do you have to do first? What's the Q?	FOL-INI	read the question	RES	knowledge
T: OK so then what do you have to do G?	INI	Erm, underline	RES	knowledge
T: good boy, in two classes, super. There's two lots of 28 would be... how many K?	FOL-INI	56	RES	knowledge
T: yeah, yeah...lean on it M...OK...do you know what you've done there? We had 62 didn't we?...so how many does that mean M, you've done some super calculating	FOL-INI	6	RES	application
T: she's right. She's underlining the right thing, but why are you underlining it?	FOL-INI	because it's important	RES	knowledge
T: a 118 divided by 12, OK then K, can you work with that?	FOL-INI	what's 12 twelves, a 120, 10 twelves a 120, er, just take	RES	application

T: fantastic. What did you do then?	FOL-INI	I rubbed this one out	RES	application
T: you tell me M...Does anyone not agree with M?	RES-INI	I know what it equals now!	RES	application
T: approximate OK, you don't have to do a big long calculation to approximate	FOL-INI	18	RES	application
T: just do the *(indistinct)* we've done the underlining, what's next?	INI	approximate	RES	knowledge
T: underline the important parts that's the main one. A for, R	FOL-INI	approximate	RES	knowledge
T: approximate. OK, so roughly what should your answer be? C for, M	FOL-INI	calculate	RES	knowledge
T: she's forgotten...good girl. Approximate. So what do think it would be roughly the answer?	FOL-INI	around 30	RES	application
T: what's that special word that begins with an "i"? She knows that a take away is the	INI	inverse	RES	knowledge,
T: brilliant yes, so he's got a 112, so how many boxes have you got there then M?	FOL-INI	so far I've got 16	RES	application
T: so R thinks you could have made a mistake M, so we're just going to have to listen to R. could you explain to us what you calculated?	FOL-INI	well, 18, 18 is er near to 20 which is a 120, no a 118 is near to 20	RES	application
T: OK so he's got a	FOL-INI	er, it can't be 10	RES	application

rough estimate already. So how many boxes were you thinking it will be roughly then R, that was a good idea		boxes because that's, its two eggs off, so it would have to put it down 12 which would be a 108 which is 9 times		
T: OK so you're thinking that there's 9 boxes of eggs	FOL-INI	[background pupil:yes!] yes	RES	application
T: which are a 108 so how many eggs would be left in the *(indistinct)* then?	INI	how many eggs would be left, 10	RES	application
T: *)* Don't worry there are more...OK so what have you got to do first, remembering your QUACK?	FOL-INI	read the question	RES	knowledge
T: What operation has he used for that? *(1 second pause)* He's halved them, but what has he done J?	FOL-INI	has he divided?	(INI as)RES	application
T: That was a good way of doing it M. brilliant idea that was, superb. So he started at 18, and what's he done with his 18 to make it easier for him? C	FOL-INI	he's cut it down	RES	application

WHEN DO PUPILS GIVE <u>HIGHER LEVEL</u> REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used

				in response
How did M go wrong? Did any body spot what he actually did? He's smiling now because the penny's dropped. C you tell him what he did?	INI	instead of doing 12s he started doing kind of 7s	RES	analysis
T: a division OK so just explain to K what you think she should do	FOL-INI	er, a 118 divided by 12	RES	analysis
T: why do you think he did that? Why do you think he started to do?	INI	(is it) because he was using the 7 boxes?	RES	analysis

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: he's cut it down. What's that for? What's the special word for it T? *(pause)* G?	FOL-INI	partitioned	RES	knowledge
T: ssh... that's really good thinking good boy M keep going *(pause).* Now, he's got 34, so what do you know about that calculation that you've done there M so far, *(pause)* how many classes has that told you?	FOL-INI	one	RES	application
T: if you times 118 by 7 would that get you the right answer? *(pause)* What sort of operation are we looking at C? T: how many boxes would 118 eggs fill? T: we've got 118 boxes	INI	er er, do a division	? RES	? application

and 12 eggs in each box				

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: OK. So what you're going to do then M, you've got to...for that first part we've got to approximate the answer, haven't we, so what will it be roughly?...what will it be roughly?	FOL-INI	about 17	RES	application
T: roughly, you're trying to work it out *(indistinct)* before you do that, how would you do it roughly E? how would you approximate that one?	Re-word (Re-initiate?)	er	RES	application

NB it has been difficult to provide examples due to the indistinct nature of many utterances

Exchanges leading to higher or lower level thinking **TRANSCRIPT 4**
Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: so how are you going to work out how many biscuits she has left?	INI	well if you add 5 and 8 together *(pause)* that's 13 and then take, and you've only got 35 *(pause)* take *(indistinct)*	RES	application
T: 54 divided by 6 = 9. brilliant. How many of you got that one right?	FOL-INI	me!	RES	knowledge
T: did anyone get one a little bit different? Anyone got anything slightly different to that? J what have you got?	INI	I've got 9x6=54	RES	knowledge
T: How could you make 2 multiplications? *(indistinct) (pause) (indistinct)* 4 facts on their board. Go on then B, you tell us	FOL-INI	erm, 9 times 4 equals 36	RES	application
T: superb. House point for that. He managed to get 4 different facts *(indistinct)* how	FOL-INI	me! Me!	RES	knowledge

many other people got that one?				
T: approximate. OK work out roughly what it should be. The "C" for, go on C	FOL-INI	calculate	RES	knowledge
T: understand it. Good the U stands for "understand the question" and J?	FOL-INI	underline	RES	knowledge
T: underline, brilliant. The A. Go on. H, help him out	FOL-INI	(called out: I know! Mrs!) approximate	RES	knowledge
T: calculate, excellent and the K for, go on J today you're *(indistinct)*	FOL-INI	knowing the answer is sensible	RES	knowledge
T: OK *(indistinct)* 48 divided by 6 equals 8, so what does that tell you then J?	FOL-INI	er well that one, er that 6, no, 8 six ah! Yeah, 8 sixes are 48. work out er that one sixth of that	RES	application

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: you're right J, because that's the actual question isn't it? "how many biscuits did she have left?" so it's very important the last one. OK so how many parts is this calculation going to be do you think J? *(pause)*	FOL-INI	3	RES	analysis

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: does anyone agree with him there? Now I know he didn't approximate it when he came up did he? He did all the right things, he read the question and he underlined it, but he didn't quite approximate it, what would it be if we approximated the answer? Roughly, what do you think? What numbers would he use? If we've got 29, what's that nearly?	FOL-INI	30	RES	knowledge
T: 30 OK, and then 37 is near to what? *(pause)* We could add 30 and 37 couldn't we? So it's about 67and we need to take away the 43. Roughly. Now, could anyone suggest how he might have made that a little bit easier? I could see what he'd done. He'd had a great idea, he ended up with 66 and knew that he had to take away 43, do you think he could have started with 66? Go	FOL-INI	I would have done 66 take 43 *(indistinct)*	RES	application?

on G				

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear examples in text)				

NB it has been difficult to provide examples due to the indistinct nature of many utterances

Exchanges leading to higher or lower level thinking **TRANSCRIPT 5**

Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: now, who can tell Z, you know all about *(indistinct)* when we're solving a problem, you have to try and remember a word QUACK. I'm going to pick on people today. S, what does Q stand for?	INI	read the question	RES	knowledge
T: calculate, work it out. And the K is for, R?	FOL-INI	know if your answer is sensible	RES	knowledge
T: good girl...so you're going to change them into the same units aren't you? Do you know how many grammes there are in a kilogramme? Oh, go on G	FOL-INI	A 1000	RES	knowledge
T: so what else is important that you've not quite underlined then? What else is important?	INI	how much taller	RES	comprehension

T: read the question, OK. The U is for? H	FOL-INI	understand and underline	RES	knowledge
T: understand the question and underline the important bit. The A is for? K	FOL-INI	approximate	RES	knowledge
T: approximate, work out roughly what you think the answer is going to be. And C, T	FOL-INI	calculate	RES	knowledge
T: in metres, OK, so, now, what do we have to do?	FOL-INI	underline it	RES	knowledge
T: you've got to approximate it in metres. You said it was cm, that's OK you could say it's about 160cm. If it was a 160cm what would that be in m? what's a 160 in m?	FOL-INI	1.6	RES	application
T: who can show me how they are going to calculate that one?...come on, will you tell everybody how you are doing it?	INI	well in a 1000...take away ....which equals 650	RES	application
T: So you've underlined the important bits, what are you going to do now? What are you going to do now?	FOL-INI	approximate	RES	knowledge
T: And C was very wise, he knew that 2m was how many?	FOL-INI	200	RES	knowledge

T: OK, cm good. How much taller is Sally's sunflower than J?	FOL-INI	it's 64	RES	application
T: J said there was a much easier way. J what would you have done?	FOL-INI	just have 200 take away a 100...(*indistinct)* answer straight away	RES	application
T: good but what's that 174? "174 what" have you worked out?	FOL-INI	cm	RES	knowledge
T: has it actually answered the question? How tall is Sinita in m? how many would it be in m?	FOL-INI	*(indistinct)* 1m and 74cm	RES	application
T: good you could say 1m and 74cm....what else could you say? Can you think of anything else?...R's got her hand up	FOL-INI	could you say 1.74?	RES	application
T: everybody understand that? When you've got 2 different, what we call mixed measurements, you need to swap it for being the same...so everybody ok with that?	FOL-INI	yes	RES	comprehension

WHEN DO PUPILS GIVE <u>HIGHER LEVEL</u> REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: is there anything else that's important? You've found some important bits. E what do think could be important there? Do want to tell J?	FOL-INI	a bag holds 1kg of sugar underline *...(indistinct) (audible "no" from some pupils)*	RES	analysis?
T: OK some people are saying no. S why are you saying no	INI	er I don't really think it's that important	RES	analysis

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

(e.g. unclear intentions) TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: so how do you think that you will tackle that one? What do you need to do first? How are you going to make that one a lot easier J?	INI	find out how much a gram is...a kilogramme is	RES	application
T: now is there anything really, really important? she's calculated it, and knowing its sensible...we know its kind of sensible, how do we know what's a sensible answer R?	INI	mmm cos if there's 400g...no...if there's a kg which is a 1000g and 400 has been used...	RES	application

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response	Interactional Intent	Category of thinking

		PUPIL'S UTTERANCE		skill used in response
T: ...he's not approximated it has he? Think about how you're going to approximate first OK...what will it be roughly?	FOL-INI	about 600	RES	application
T: 1000. OK. So there are a 1000g in 1kg. And if 400g have been used, how much is going to have been left in the bag? Now approximate the answer. Who thinks that they know roughly what they think it's going to be? E?	FOL-INI	about 600	RES	application
T: approximate, so what do you think it's going to be roughly?	FOL-INI	70	RES	application

NB it has been difficult to provide examples due to the indistinct nature of many utterances.

Exchanges leading to higher or lower level thinking **TRANSCRIPT 6**
Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: 5 would, well done J. How many 5's would go into 15?	FOL-INI	3	RES	knowledge
T: 3. How many 5's into 100?	FOL-INI	20	RES	knowledge
T: so then what do you need to do K?	INI	change them into kg	RES	application
T: a 100g of butter. What would that be of a kg? a 100g	INI	is it an eighth?	RES	application
T: A 150g, how would you write that? who can help K with that one, a 150g... written as a kg? M? No? G	FOL-INI	is it one seventh?	RES	application
T: Would you need to change the next part K?...some people are saying you can't really have a fraction for that one. Now...J you think you can. Go on, what would you say?	FOL-INI	oh, I was just saying I don't think you can	RES	application
T: it is a remainder. Good girl for asking. Well done G. anybody else? K... what would you	FOL-INI	...just do 10x450	RES	application

have done?				
T: do you understand the 5x99 part J? So he does need to explain it from the beginning does he? OK come on then C. Listen carefully	INI	right, to get to school each day...in a week she will go....900m each day...	RES	application
T: which part? Try and be specific	INI	all the noughts	RES	application
T: what might somebody do by mistake if they got that? That's what I think about it when I see it. What might somebody do, E?	INI	when they think *(indistinct)* they might not know it's thousands, so *(indistinct)*	RES	application
T: go on G *(indistinct)*	INI	er, I wouldn't put it like that but I'd put it like I did, but if people were only just coming on and they didn't know what a kg was, I might put a 1000g and in brackets, a kg	RES	application
T: yes, did you think about doing that C?	FOL-INI	er no I just...	RES	application
T: so what are you going to do then G?	INI	right if they're using 500g ...I'd do 1000g...	RES	application

WHEN DO PUPILS GIVE <u>HIGHER LEVEL</u> REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: ah, C recognised	FOL-INI	well, because he's	RES	analysis?

that he might have made a mistake. Can anyone else see it? E you're quite right. Go on E		timesed by 5 he shouldn't have timesed by 5 because that would mean she would only go to school, but she has to go from school, so that's going to be x10, so it has to be...		
T: anybody else see anything... that's a good , well done for having a go E, house point for that...J?	FOL-INI	why did you do it as 450 because..?	RES-INI	analysis? (pupil understands teacher's question and expects an explanation in response?)
T: why did you do it that way G?	INI	to make it easier	RES	analysis
T: OK so was there a reason that you did it that way G?	INI	yes it's because, I did it that way because people who good at maths...but the people who are bad....	RES	evaluation
T: some people might have a question about this part...anyone got any Qs then, M?	INI	why did you put 2 noughts because it's half...and you could just put 4.5	RES-INI	analysis (pupil understands the teacher's question and has evaluated the method; they possibly expect an explanation in response?)
T: Ok anybody else got a question about that? That's a good explanation...go	FOL-INI	what if you had 4km and you only had 5 m, if you did that...*(indistinct)*	RES-INI	analysis

on J				
T: that's a tricky question ...that's a good way of thinking about it though...J?	FOL-INI	I don't understand	RES	analysis (just the nomination is now sufficient to prompt pupils to analyse and respond)
T: good that's important isn't it? Well done. Has that helped you a little bit J? (*spontaneous ripple of applause*) that's very kind of you. G?	FOL-INI	I don't get what excess means	RES (as RES-INI?)	analysis
T: ok yes alright. M?	FOL-INI	you know you put a 1000, why did you...	RES-INI	analysis
T: could do. But does it actually ask you for that?...but on this occasion, it didn't actually ask you for that part so it's not necessarily wrong. L	FOL-INI	why did you do it as an add, you could have ...	RES-INI	analysis
T: Is there a Q there for C? Is there something that you think... (*immediate Q from pupil)*	INI	I wonder why you put 500x5?	RES-INI	analysis (pupil understands the teacher's question and expects application in response)

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S	Interactional	Response	Interactional	Category of

UTTERANCE	Intent	PUPIL'S UTTERANCE	Intent	thinking skill used in response
(no clear examples in text)				

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: *(indistinct)* 15/100. How else could I make that smaller? Are there any multiples that can go into 15 and a 100? Any numbers that will go into both? [*2 multiples called out]*	INI	5	RES	application

Exchanges leading to higher or lower level thinking **TRANSCRIPT 7**

Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: this time I've got a £10 note...put your hand down. Who's not had a go at showing? Listen very carefully to L explanation and see if you can think of any good questions to ask her...OK L what would you do?	INI	OK I'm going to start with my £10. I'm going to take away £3.34	RES	application
T: OK C what are you going to do?	INI	convert it into pence	RES	application
T: so now we've got 10 take 7 is	INI	3	RES	knowledge
T:...J is saying it's the wrong answer, go on then J	INI	if you do 54 add 56 that would equal 110 that's like saying 73 add 37 is going to be a 110 so you take off the 10 on the 673...663	RES	application
T: OK so she's got the £5-£3, she's stuck on the next bit. What did you do then?	FOL-INI	you take away the 60 and then ...equals...	RES	application
T: add what? You're	FOL-INI	£2.68	RES	application

right...add which number to it?...that's a good question C. Which would you add to it				
T: OK so what's she got then?	INI	£2.30	RES	application
T: now you're starting there with the thousands and the hundreds aren't you, where do you usually start for a take away? C	INI	you start at the units?	RES	knowledge
T: I'm not sure why you'd end up with a minus number though J. Why would you...I'm asking B. Come on B. ...you were actually, you got to the right answer but some people were confused. OK B. listen	FOL-INI	and then, what we've got to do is, you can safely say that it's a take-away, that which would be £7	RES	application
T: OK so you're taking off the £3, yes?	INI	and then take off this one which would be 3. So, but, yes, and then, we er, so we've taken away, but the £10 is not a £10 anymore (*pupils laugh*)...	RES	application
T: 3, then I would have 9 take away 3 is	FOL-INI	6	RES	knowledge
T: and then I've got 9 take away 3 is	INI	6	RES	knowledge

T: and if I added them together would it make £10?	INI	yes	RES	knowledge
T: can I just ask G er C is that ok? Have you got a question or did you want to show us something G?	FOL-INI	show something ...a 1000 pence take away *(becomes confused by method)*		application
T: what would you have done J? ...go on then. I know what you mean about that being a bit confusing, it was good way to go about it though M	INI FOL-INI	can I show?...I would just take that into 10...	RES-INI RES	application (focus is application of skill of subtraction, rather than alternative strategy)

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: I wanted to know ....as well R. Go on then A. Can you explain that one? We know how you got your £3 but then you did something.....we're a bit confused as to how you got your answer from that bit *(pause)*....can anybody explain? J you were helping A at the beginning. How did she get this bit?	INI	because a pound's a 100, so you just take off 68 ...which gives you 32	RES	analysis (because pupil is explaining how *a peer* seemingly applied their calculation skills)
T: but she's got take away 60 , then take away 8...J?	FOL-INI	well she has the £3, then she takes away the 60 so it makes	RES	analysis (see above)

		that easier		
T:...does anybody have any questions?	INI	it's the wrong answer!	RES/FOL	evaluation
T: shhh, don't distract him. I know....the only thing I would say there B is I can see what you are trying to do...let's just go back to the question for A and what she's actually written down. I know I'd like to ask her a question but I bet someone's going to ask before me. Go on T	FOL-INI	why did you do subtraction when you could have done adding, cos...68 add 2 which is 70...	RES-INI	evaluation
T: shh, don't forget to put up your hand and ask a question if you're not sure...er, C	INI	how would you check your answer?	RES-INI	analysis
T: would you mind that L?...(*M asks teacher something as he erases L's working out*) it's up to you how you're going to explain it, the best way for everybody to understand	INI	pretend you had £1 and ...it doesn't work as easy sometimes because when you take away the 7 it's normal and equals 3, yeah, oh I'm going to start again... *(struggling with exchanging)*	RES (SELF-EVAL?)	application, evaluation
T: go on C you tackle him	INI	how've you got 10 minus 3 equals 6?	RES-INI	analysis
T: anyone got any questions for A that they'd like to ask? Go on A, you choose	INI	I don't get how, why you've done the last bit where take 60 take 8 so you	RES-INI	analysis (& evaluation?)

		could just have done mmm 60 take 8, 68 instead of ...separate ways...		
T: that's it! Good girl, well done. £2....makes £5...OK we'll just have a couple more. R	FOL-INI	know where you took away the 60 and the 8 , but how did you get 32?	RES-INI	analysis
T: *(teacher asks J to ask him a question)*	INI	that's a weird method...there is a lot easier way, you've just taken it the hard way	RES	evaluation

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: can you see what you've done L?...this column here...7 add 3 but you've got one on the doorstep haven't you, so you've ended up with something too much...but how would you explain that to her T?	FOL-INI	er, can I show my method...?	INI	analysis

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S	Interactional Intent	Category of thinking skill used in

		UTTERANCE		response
T: good question, go on A how would you check your answer? How do you know if you're right?...	FOL-INI	add	RES	application

Exchanges leading to higher or lower level thinking **TRANSCRIPT 8**
Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: how did you get it with all your calculations that you have there?	INI	what you do is you start off with the 30 and you add 40 on to the 30 which adds 70 and then 60 minutes you know is 1 hour so ...so you've got 70 so you add 1 more hour onto that and...*(indistinct)*	RES	application
T: OK so what've we got then...? We've got *(pause)* you explain to us what you've worked out then	INI	er, well I've got 10.20...	RES	application
T: can you see what you've done Ch? *(pause)*You had 10.20 and then you've added on 25 more minutes but because you've wrote 1.45 that means what time, what's 1.45 JB?	INI	er, *(pause)* what do you mean?	RES-INI	comprehension
T: how else can	INI	quarter to 2	RES	knowledge

we say 1.45?				
T: past midday, OK, so its not necessarily night time it could just be afternoon couldn't it? What does am mean? *(pause)* am, think about it, am, are we in am or are we in pm now? J.	FOL-INI	after midnight,	RES	knowledge
T: did you have a different way L?	INI	yes (response from pupil other than L)	RES	application (or could teacher be expecting an evaluative response?)
T: there's something else...What else is strange about it?	INI (Re-initiate)	you don't need to borrow because that doesn't work	RES	application
T: well done E, that was a good explanation. R.	FOL-INI	...1pm take away 60 minutes, that's an hour mmm which would be 12 o clock and then you add 10 back on which would be 12.10	RES	application

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: er some one else, er G?	INI	well instead of making that complicated you could have just done, if you think of 40 minutes and	RES(as FOL)	evaluation

		then knock off the 10 add it on to 3.30 then you get 4 o clock and then you add on the next 10		
T: I've got the clocks, yes, don't worry…E	RES-INI	the way D did it, to make it slightly a bit easier he could have just done 3.30, put 3.30 down and …3.30 plus 30 which would make 4 o' clock and you've still got your extra 10, to make it 10 past 4	RES(FOL)	evaluation
T: that's what G said wasn't it? Well done. K. (*sounds distracted*): go on tell, say exactly what you mean, I think I know what you mean but go on	FOL-INI p	mmm I know he got 70 and I know he did that but …you know that 60 is an hour… (*continues*) ….but you could have just took away the 10 cos you know 30 add 30 is 60 which is 1 hour	RES(as FOL)	evaluation
T: what's important? L	INI	is it pm or am	RES	analysis
T: anyone got a question back about that one? K?	INI	well you've got the working out right but 1.45 its not really 1.45 because 20 add 25 is 10	RES(as FOL)	evaluation
T: quarter to 2. So if we were on 20 past 10 Ch and we added on 25 minutes we wouldn't have got to quarter to 2, so can you see? *[realises]* You've missed off your nought, good girl.	FOL-INI	you've got the right answer, but if you didn't know that answer and you were working it out how else would you do it …?	RES-INI	evaluation

You've got your answer right but that's why people were confused. Anymore questions for Ch? *(Pause)* L?				
T: any questions about that? M was itching then. M?	INI	why did you need to that, well, you know on that, how you put it, 3 take away 2 doesn't equal 2	RES-INI	analysis
T: good, so why did you borrow one L?	FOL-INI	to make it more difficult	RES	evaluation
T: any questions for E?	INI	how did you do it so quickly?	RES-INI	analysis
T: I can hear people whispering the answer, but you've got to get your question ready, you might want to ask... is he absolutely and absolutely correct? You might need to ask him something	INI	*[(calls out)* Mrs B I didn't do it that way though *(pauses while teacher chooses someone else)* I did an easy way] I have the answer but I don't understand how he got it	RES (as FOL) RES	analysis
T: anyone got any questions?	INI	*(calls out quietly)* yes she's right at the answer though	FOL	analysis
T: yeah that's a good point though K you've, because, you've got the answer right C, you've got your 25 minutes but go on K carry on with what you're saying	FOL-INI	er, but 20 add 25 , you've got that bit right, but in the hour it's 10 not *(indistinct)*	RES (as FOL)	evaluation
T: can you not think of a time when that	INI (Re-initiate)	right, say if it was 10.20 and you were	RES	analysis

would be tricky to do that though? Quite a hard question this one, C?		minusing 9.45 the... minutes that you're minusing away in the minutes column is like		
T: she'd worked it out before. It was honest! J	FOL-INI	I'm not sure how she got it	RES	analysis

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear examples found in text)				

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: what does pm mean? *(someone calls out)* no it doesn't mean per minute. T? (pause) pm, what does the p and the m stand for? Hang on, there are some people shouting out and its not good today...K?	FOL-INI	past midday?	RES	knowledge

Note pupil RES acting as FOL following an INI

Exchanges leading to higher or lower level thinking **TRANSCRIPT 9**
Response:
"lower level": knowledge, application, comprehension
"higher level": analysis, synthesis, evaluation

WHEN DO PUPILS GIVE LOWER LEVEL REPLIES? (SEE BLUE HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: OK so what are you working out there K?	INI	er I'm working out the year she was born	RES	application
T: so "what year was his mum born?" Does it answer that?	INI	yes	RES	application
T: anybody else? Go on L, carry on	INI	I would do 2009 take away just 8 which would be *(indistinct)*	RES	application
T: put up your hand if you think that K is right so far, do you think that he was born in 1982? Anybody agree? [*several voices at once*] OK K, could L just take over from you from now and then she can show you what she's got OK?	FOL-INI (Re-initiate)	what I did was ...take away Fred's age	RES	application
T: So what year was his mum born? That's what we've got to establish now. How would you do that?	FOL-INI	2009...take away 75...[*quiet whisper in background]* what I would do first	RES	application

T: OK. How old is she this year then J?	INI	In 2009?	RES-INI	application?(pupil checks meaning of teacher's question)
T: in 2006, how old is she *this* year?	RES-INI	if she's 75, take away 3 *(interrupted by teacher)*	RES	application
T: *(interrupts)* If you think she was born in 1934, how old is she this year?*(pause)*	INI (Re-initiate)	background pupil: 72, 72	RES	application
T: go on G how old is she?	INI	72	RES	application

WHEN DO PUPILS GIVE HIGHER LEVEL REPLIES? (SEE GREEN HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: when was he born? 19…80...2. Anyone got a question about that one? K thinks, K thinks that he was born in 1982. Anybody got a question about that? M	FOL-INI	er read the question again, it was "what year was mum born?"	RES	analysis
T: come on C	INI	why do you think 2009? I think 2006	RES-INI	analysis
T: ah, so something, has gone wrong with the taking away part. Mmm M would you tell her what's gone wrong? Would you show her? You've got the right idea	FOL-INI	you start off, like L did but not with the 2 *(indistinct)* altogether	RES	analysis

L, you've done well there but Ssh. Just write it at the side M.				
T: the year she was born... put your hand up if you've got a question for her. *(pause)* L	FOL-INI	er, well, you're doing that...year but ...*will be* 48 in 2009	RES	analysis

FUZZY (E.G. UNCLEAR INTENTIONS) (SEE YELLOW HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
T: anybody agree with him there? *(pause)* Anybody think they've got something completely different?	INI	[background pupil: his age is 75!] [another background pupil: that's OK, that's OK]	RES	application evaluation
T: OK. Just put your lid on your pen where you're up to. I was very impressed to hear you discussing with each another and correcting each another as well because you looked at it in a different way. Can I have a volunteer who thinks they could come up to the front of the board and explain to everybody else and then the rest of the class are going to question you, you've got very good at that? Well I think at this moment I'm going to ask KR. (pause) Now, be ready to ask her a	FOL-INI	er, 2009 take away 27	RES	application

question or two. [*background murmuring] (pause)* We'll come to that in a minute C. OK K so where are you going to start? Sshh please put your lid on your pen and be looking at K, be looking at your answer now, D lid on the pen. How're you going to start K?				

MULTIPLE (E.G. RE-WORDED BUT SAME INTENTION) (SEE PINK HIGHLIGHTING IN TRANSCRIPTS)

TEACHER'S UTTERANCE	Interactional Intent	Response PUPIL'S UTTERANCE	Interactional Intent	Category of thinking skill used in response
(no clear examples in text)				

NB it has been difficult to provide examples due to the indistinct nature of many utterances
Note P:P interaction

APPENDIX 8: INITIAL ANALYSIS OF TRANSCRIPTS USING LEVELS OF THINKING FRAMEWORK BASED ON BLOOM'S *TAXONOMY*

Tape 1

Teacher: as a model

- Questioning style- closed and little to no thinking time given- everybody happy with that? Did anyone draw the coins?
- Skill of remembering: 4?
- Mathematical procedure: used grid to organise data
- Skill of comprehension: *rephrases* answers- So we've still got 60 haven't we?
- Skill of comprehension: *comparing* info/methods/ideas- no overt comparison, but implicit reference to variety of methods given: there are lots of different ways that you could do it and they are all right
- Skill of application: teacher used grid to organise data, but no clear reasons given
- Skill of analysis: have you got all the combinations? This was seemingly the focus, but there didn't seem to be a flagged up as a rule
- Skill of synthesis: did anyone draw the coins? there are lots of different ways that you could do it and they are all right
- Skill of evaluation: so we can see how it has gone up but made a pattern
- Opportunity for questions from pupils? Everyone understands that bit? Anyone struggling? (no pause between q)
- Interaction: teacher→ pupils

Pupil: as an active participant

- Questioning style: closed: (one instance during lesson) how many ways can she pay for it?
- Skill of remembering: read aloud working out from their whiteboards
- Mathematical procedure: various listing methods used
- Skill of application: various methods used- no reasons given and evident that not many had used a grid, again no reasons given or requested
- Skill of analysis: none evident
- Skill of synthesis: none evident

- Skill of evaluation: none evident
- Interaction: pupils answered teachers questions

Tape 2

Teacher: as a model

Questioning style

- closed questions

Skill of remembering: did teacher make a summary

- So you added the pounds up first?
- Repeats pupil working out whilst acting as a scribe

Did teacher show a mathematical procedure (working out)

- Writes pupils working out on the easel

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- Rephrases
- There are lots of different ways you could have done it and its not always important

Skill of application: did teacher solve problems using required skills

- ?

Did teacher give reasons for their conclusion (I think this because...)

- none evident

Skill of analysis: did teacher identify a general rule

- none evident

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- There are lots of different ways you could have done it and its not always important

Skill of evaluation: did teacher look for evidence/give reasons when making their decisions

- None evident

Teacher dominated lesson

Pupil: as an active participant

Questioning style

- None evident

Skill of remembering: did pupil make a summary

- Recalled definitions for QUACK acronym

Did pupil show a mathematical procedure (working out)

- Teacher acted as scribe

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- None evident

Skill of application: did pupil solve problems using required skills

- Yes

Did pupil give reasons for their conclusion (I think this because...)

- T: how did you know that?
- P: because... (check)

Skill of analysis: did pupil identify a general rule

- You can just put a nought on the end

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- He's got the answer right but it's just a weird method

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- None evident

Interaction

Teacher → pupil

- Teacher dominated

Tape 3

Teacher: as a model

Questioning style

- Mixture of open and closed

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- Teacher has handed over more control of lesson to pupils

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- 18s nearly 20 so 80 take away 20 is about 60
- Come on M show her what else you could do for that one

Skill of application: did teacher solve problems using required skills

- Comments on pupil methods

Did teacher give reasons for their conclusion (I think this because...)

- None evident

Skill of analysis: did teacher identify a general rule

- What's he done with his 18 to make it easier for him? (referring to partitioning)

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Teacher invites further pupils to show their methods

Skill of evaluation: did teacher look for evidence/give reasons when making their decisions

- None evident

Pupil: as an active participant

Questioning style

- Is it like how you are going to work out which method you are going to use?

Skill of remembering: did pupil make a summary

- He's cut it down (means partitioning)

Did pupil show a mathematical procedure (working out)

- Several examples of own working out

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- ?

Skill of application: did pupil solve problems using required skills

- yes

Did pupil give reasons for their conclusion (I think this because...)

- ..well that told me that this was too much so I need to put it down

Skill of analysis: did pupil identify a general rule

- Not explicitly

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- Evidence of interjection when a different interpretation of the *question* was offered

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- I know 12x7 equals 84 and then I tried to estimate what round about how much more it would be to get 184, so I said

about 5x7 equals 35 and then I added them two together and that equals 119. well that told me that this was too much so I need to put it down.

Interaction

Pupil → pupil

Teacher → pupil

Pupils showed more interest and were keen to show their methods

Tape 4

Teacher: as a model

Questioning style- open outweighs closed

- Open: how do you know if an answer is sensible?
- Closed: who thinks they would like to come and show us this one?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- 54 divided by 6 = 9 have you got that one right?
- Pupils showed their own working out

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- Good girl, finding the...that's really, really good
- Could anyone suggest how he might have made that a little bit easier?

Skill of application: did teacher solve problems using required skills

- Guided pupils through questioning e.g. how can you tell if the answer is sensible?

Did teacher give reasons for their conclusion (I think this because...)

- None evident

Skill of analysis: did teacher identify a general rule

- So not only has she worked out the answer, she has used the inverse to see if she was right

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Implicitly: anyone got anything different to that?

Skill of evaluation: did teacher look for evidence/give reasons when making the decisions

- None evident

Pupil: as an active participant

Questioning style

- No questions evident, but examples of statements acting as questions: I don't know where he got 40 – 1 from

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- Pupils showed their own methods of working out

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- I would have done...
- No evidence of rephrasing

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because...)

- Well, I had to have an estimate...half of 60 is 30 so...
- Explanation of how a pupil partitioned a number

Skill of analysis: did pupil identify a general rule

- None evident

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- I would have done...

- Pupils called out if they disagreed with or confirmed their methods of working out

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- Well, I had to have an estimate...half of 60 is 30 so…

Interaction

- Mixture of interaction evident
- Teacher dominates dialogue and directs the order of interaction

Tape 5

first day back after half term – mixed measures requires a lot of factual knowledge to be embedded

Teacher: as a model

Questioning style- mainly closed

- So everybody ok with that?
- Everybody understand that?
- who'd like to have a go?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- Reinforced the QUACK procedure but not an individual aspect of this method

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- 600 add the 400 ok

Skill of application: did teacher solve problems using required skills

Did teacher give reasons for their conclusion (I think this because...)

- Non evident

Skill of analysis: did teacher identify a general rule

- implicitly
- So what else is important that you've not quite underlined?
- He's not approximated it has he?
- Explicitly: ...mixed measurements, you need to swap it for being the same

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- None evident

Skill of evaluation: did teacher look for evidence/give reasons when making their decisions

- None evident

Pupil: as an active participant

Questioning style- one example of a q: hesitant: could you say 1.74?

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- Pupils showed own working out

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

-?

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because...)

- Used estimation and conversion of units

Skill of analysis: did pupil identify a general rule

- None evident

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- Pupil responses tended to be short or descriptive rather than explanatory

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- ?

Interaction

- Teacher tended to dominate the session
- pupils were given opportunity to use interactive board during whole class introduction and not the plenary
- Teacher → pupil
- Pupils restless
- Many pupils were struggling with conversion of units and knowledge of measurement facts

Tape 6

Focus was again measure (mass)

Teacher: as a model

Questioning style- open questions

- closed questions
- mixture of types e.g. who can help K with that one? Go on, what would you say? What sort of units are we going to talk about?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- I can see what you're going to write M, you're going to put 1kg...take away 500g...
- Pupils showed their own working out

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- You're going to double all the ingredients. Ok let me see you do that then
- Now I read that q a different way, did anyone else read that slightly differently to what C did...?
- Rephrases explanation of "excess" with an example

Skill of application: did teacher solve problems using required skills

Did teacher give reasons for their conclusion (I think this because...)

- Teacher facilitated the discussion of methods

Skill of analysis: did teacher identify a general rule

- None evident

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Implicitly by asking other pupils to contribute their q and ideas?

Skill of evaluation: did teacher look for evidence/give reasons when making the decisions

- Good boy actually because otherwise you are calculating it not approximating it are you?

Pupil: as an active participant

Noticeable change in number of pupils actively participating in lesson – when use of interactive board was introduced, pupils showed (and continued to show) enthusiasm and willingness to be chosen, however, interest is not always sustained

Questioning style- open questions

- closed questions
- thinking time
- why did you do it 450 cos...?
- I wonder why you put 500x5
- How did you get actually get the answer 2500?
- Is it an eighth?
- How many millilitres in a litre?

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- Pupils showed own methods of working out

- You know you put a 1000, why did you...?
- Why did you put 2 noughts because it's a half ...and you could just put 4.5
- When you...what measurement did you use?

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- So it's the remainder?
- You could have done it...
- Why did you do it as an add, you could have...?

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because...)

- I got the first bit 2x10 but where did you get 750 from?
- Yes it's because, I did it that way because people who good at maths...but the people who are bad...
- Yes but if I was doing it to a younger [demonstrating their method]
- So...
- Right, to get to school each day...in a week she will go...900m each day [justifying reasoning behind calculation?]

Skill of analysis: did pupil identify a general rule

- Say someone in Year 3 didn't know how much a kilogramme was and then you put 1500g...[they] wouldn't understand
- Well there's ten hundreds in a thousand so it's a tenth

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- Well you could do that but it doesn't matter because...
- What if you had 4km and you only had 5m, if you did that...[regarding mixed measures]
- You could have done it...
- Why did you do it as an add, you could have...?

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- Yes it's because, I did it that way because people who good at maths...but the people who are bad...
- Yes but if I was doing it to a younger [demonstrating their method]

Interaction

Varied interaction taking place

Noticeable that teacher's "voice" is much less dominant

At times, pupils were directing questions/answers directly to their peers

Volunteers showed enthusiasm for using interactive board to show their own methods

Sustained dialogue

Sustained interest and participation from all abilities

Pupil → pupil

Pupil → teacher

Teacher → pupil

Tape 7

Teacher: as a model

Questioning style- open questions

- closed questions
- mainly questions to prompt further questioning or posed to peer teachers e.g. ok C what are you going to do? How did you get that M? now there's a problem there C, why are you not starting with the units, that's my question? what would you have done J?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- what I would have done ...looked at that number as being a hundred...

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- R just asked you a question, where did you get 10 from?
- Teacher reminded pupils to ask questions if they had a query or had an alternative method

Skill of application: did teacher solve problems using required skills

Did teacher give reasons for their conclusion (I think this because...)

- Pupils solved the problems

Skill of analysis: did teacher identify a general rule

- When you do a take away, normally you start with the units end don't you which would be...

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Indirectly by asking other children to offer their ideas/methods e.g. come on C...come and show us how you would have done that bit

Skill of evaluation: did teacher look for evidence/give reasons when making the decisions

- None evident

Pupil: as an active participant

Questioning style- open questions

- closed questions
- generally open e.g. why did you...?
- Can I show my method?
- How would you check your answer?
- How've you got 10 minus 3 equals 6?

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- Pupils showed own methods of working out

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- I don't get how, why you've done the last bit where 60 take 8, so you could just have done... 60 take 8, 68 instead of...

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because...)

- A lot of effort from several pupils went into trying to solve a subtraction calculation using the exchanging method

Skill of analysis: did pupil identify a general rule

- Convert it into pence...because that's 337p or £3.37

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- Why did you double...you could have just gone 10 x 4 which equals 40...?
- Can I show my method?
- That's a weird method...there is a lot easier way, you've just taken it the hard way

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- So I'm taking this away first because that's 9 so that gives 1 from10...

Interaction

Pupil → pupil

Pupil → teacher

Teacher → pupil

- Variety of interaction, mainly teacher acting as go-between and controlling turn-taking
- Noticeable amount of pupil dialogue and questioning, with often longer (>10 words) responses from pupils than teacher's utterances

- Majority of pupils actively participating (evidence of multiple expressions, mouthing figures, whispering responses) for sustained periods
- Volume rises and falls e.g. more vociferous when pupils realise there is a problem with the method of working out, near silence while pupil writing/explaining/describing their method
- Pupils keen to show their methods and to provide questions or alternative ideas

Tape 8

Teacher: as a model

Questioning style- open questions

- closed questions
- thinking time
- is there anything...about time that you find a little difficult?
- What's important L?
- A bit like partitioning wasn't it?
- anyone got a question back about that one?
- Did you have a different way L?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- Pupils showed own working out
- A bit like partitioning wasn't it?

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- Is it pm or is it am D?
- Indirectly makes comparisons by encouraging pupils to share their ideas e.g. have you got another way that you could have worked it out C?

Skill of application: did teacher solve problems using required skills

Did teacher give reasons for their conclusion (I think this because...)

- None evident

Skill of analysis: did teacher identify a general rule

- Past midday ok, so its not necessarily night time it could just be afternoon couldn't it?

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Implicitly: Have you got another way that you could have worked it out C?
- Did you have a different way L?

Skill of evaluation: did teacher look for evidence/give reasons when making their decisions

- None evident

Pupil: as an active participant

Questioning style- open questions

- closed questions
- e.g. why are you going the wrong way?
- Why did you need to do that?
- Why does it include...?
- How else would you do it?
- how did you do it so quickly?
- How did you get that 11?

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- pupils showed own working out
- the way D did it, to make it slightly a bit easier, he could have just done 3.30, put 3.30 down and ...3.30 plus 30 which would make 4 o'clock and you've still got your extra 10 to make it 10 past 4
- well you've got the working out right but ...it's not really 1.45 because...

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- there's an easy way, you just need to do the 45 and take away the 20, it's easy
- Mrs B I didn't do it that way though...I did an easy way

Skill of application: did pupil solve problems using required skills
Did pupil give reasons for their conclusion (I think this because...)

- Knowledge and understanding of measurement of time, addition and subtraction necessary
- Because I'm a bit unsure about digital time I found it hard...

Skill of analysis: did pupil identify a general rule

- None evident

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- Indirectly e.g. by continuing to volunteer comments and questions, as well as offering to show their methods
- Well instead of making that complicated you could have just done....

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- I know he got 70 and ...you know that 60 is an hour ..but you could have just...

Interaction

- Examples of Pupil → pupil e.g. why did you need to do that ..3 take away 2 doesn't equal 2 [interjection] no but I've added that bit too
- E.g. how did you get that 11?

- Well...because I'd worked out 7 and...

Pupil → teacher

Teacher → pupil

- Focus of problem solving was time and this can be problematic if children do not have a secure understanding
- Sustained responses from pupils
- Keen to ask question/offer comments
- Excitement when it was time to choose next volunteer to use interactive board
- One child asked a question related to science topic

Tape 9

Teacher: as a model

Questioning style- open questions

- closed questions
- what did you do after your 9 times 10?
- What numbers did you add?
- How did you work that one out?
- Where are you going to start?
- Anyone agree with him there?

Skill of remembering: did teacher make a summary

Did teacher show a mathematical procedure (working out)

- Pupils showed own working out
- Well I think she's starting from the beginning bit aren't you K, is that right?

Skill of comprehension: did teacher demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- Indirectly by asking pupils to comment/ask questions to the pupil at the interactive board

Skill of application: did teacher solve problems using required skills

Did teacher give reasons for their conclusion (I think this because...)

- None evident

Skill of analysis: did teacher identify a general rule

- None evident

Skill of synthesis: did teacher identify that there may be other ways of solving the problem

- Indirectly by asking pupils to comment/ask questions to the pupil at the interactive board

Skill of evaluation: did teacher look for evidence/give reasons when making the decisions

- [interjects] Where did you get 75 from?

Pupil: as an active participant

Questioning style- not many questions or comments, possibly due to nature of the problem which was particularly difficult e.g. determining ages of parents and children when only certain facts are known

- how does she know…?
- In 2009?
- Can I take over?

Skill of remembering: did pupil make a summary

Did pupil show a mathematical procedure (working out)

- Pupils showed own working out
- …what I would do first…

Skill of comprehension: did pupil demonstrate understanding by rephrasing (lower order skill) or by comparing information/methods/ideas

- You start off like L did…

Skill of application: did pupil solve problems using required skills

Did pupil give reasons for their conclusion (I think this because…)

- Used skills of subtraction and addition

Skill of analysis: did pupil identify a general rule

- None evident

Skill of synthesis: did pupil identify that there may be other ways of solving the problem

- No, you take 2009 take...can I take over? (J higher achiever)
- Indirectly e.g. what I did was...
- And e.g. You start off like L did...

Skill of evaluation: did pupil look for evidence/give reasons when making their decisions

- Check tape: well instead of doing that first I would do 75 take away...so that would leave that with...

Interaction

Teacher → pupil

- Although teacher asked for volunteers and reminded pupils to ask questions, many pupils seemed reluctant to query the working out
- Many pupils seemed restless, yet there was interest and discussion taking place
- Enthusiastic confirmation of answer
- Longer warm up than usual: teacher repeated answers and wrote them on the easel
- Many pupils keen to describe their calculation during warm up
- Teacher asks for "hands up" twice e.g. hands up if you've got a question for...L; put up your hand if you think that K is right so far; and asked for agreement 3 times e.g. anybody agree?; anybody agree with him there?; who agrees that his mum was born in1934? →I think that these stifle questioning or comments and act that closed questions

- Teacher was controlling turn taking and was asking the peer teacher questions; this therefore may have reduced there likelihood of pupils asking questions/raising ideas?

APPENDIX 9: CATEGORISATION OF RESPONSES TO MULTIPLE AND FUZZY QUESTIONING

Number of pupil responses to multiple types of question

lesson/ transcript number	knowledge	application	comprehension	analysis	synthesis	evaluation
1	1	1	0	0	0	0
2	0	0	0	0	0	0
3	0	2	0	0	0	0
4	0	0	0	0	0	0
5	0	3	0	0	0	0
6	0	1	0	0	0	0
7	0	1	0	0	0	0
8	1	0	0	0	0	0
9	0	0	0	0	0	0

Number of pupil responses to fuzzy types of question

lesson/ transcript number	knowledge	application	comprehension	analysis	synthesis	evaluation
1	1	1	0	0	0	0
2	2	2	0	0	0	0
3	1	2	0	0	0	0
4	1	1	0	0	0	0
5	0	2	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	1	0	0
8	0	0	0	0	0	0
9	0	2	0	0	0	1

APPENDIX 10: CHARTS SHOWING PERCENTAGES OF TEACHER AND PUPIL REPLIES, COMMENTS AND ELICITATIONS

CHART SHOWING COMPARISON OF REPLIES, EVALUATIONS AND ELICITATIONS

Figure 1 Percentage of teacher and pupil replies

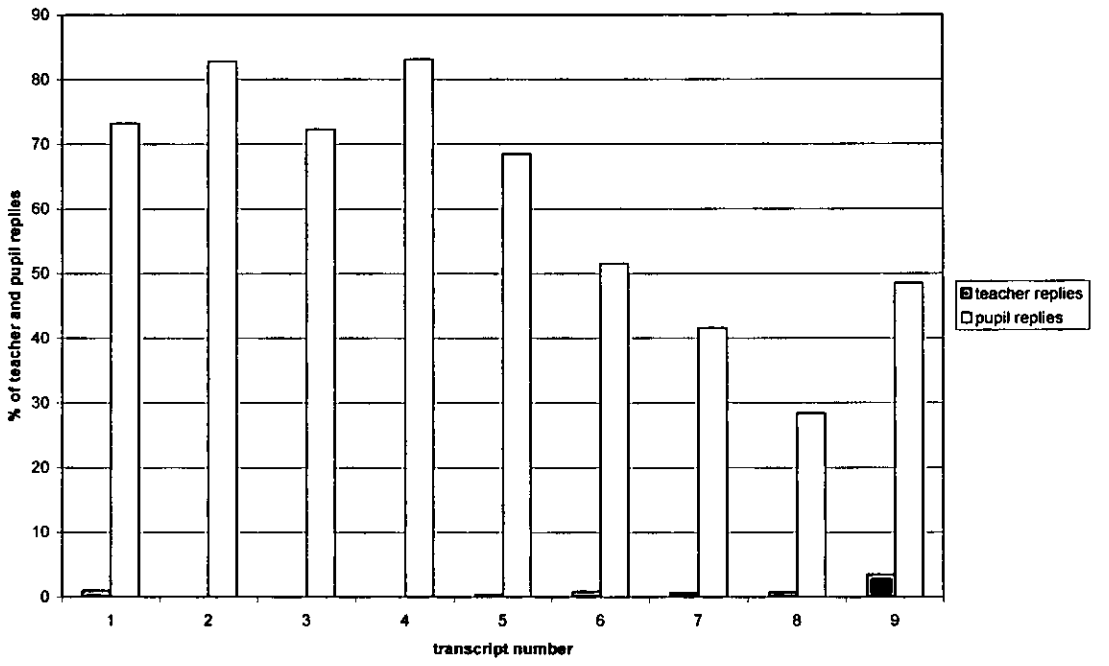


Figure 2 Percentage of teacher and pupil comments

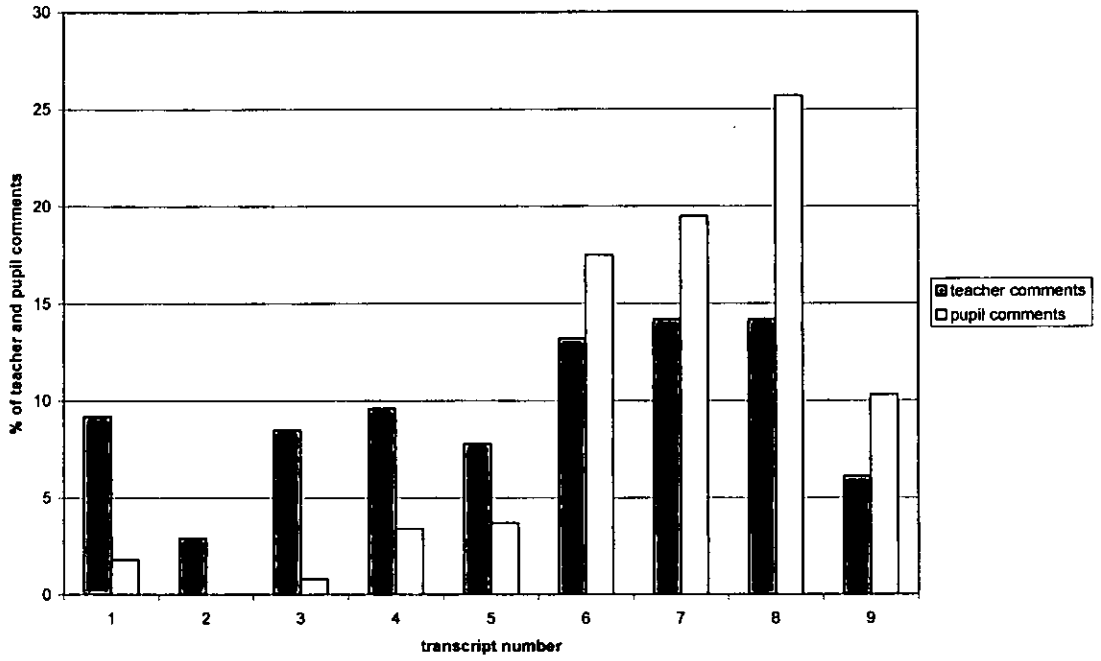


Figure 3 Comparison of percentages of teacher and pupil replies, evaluations and elicitations

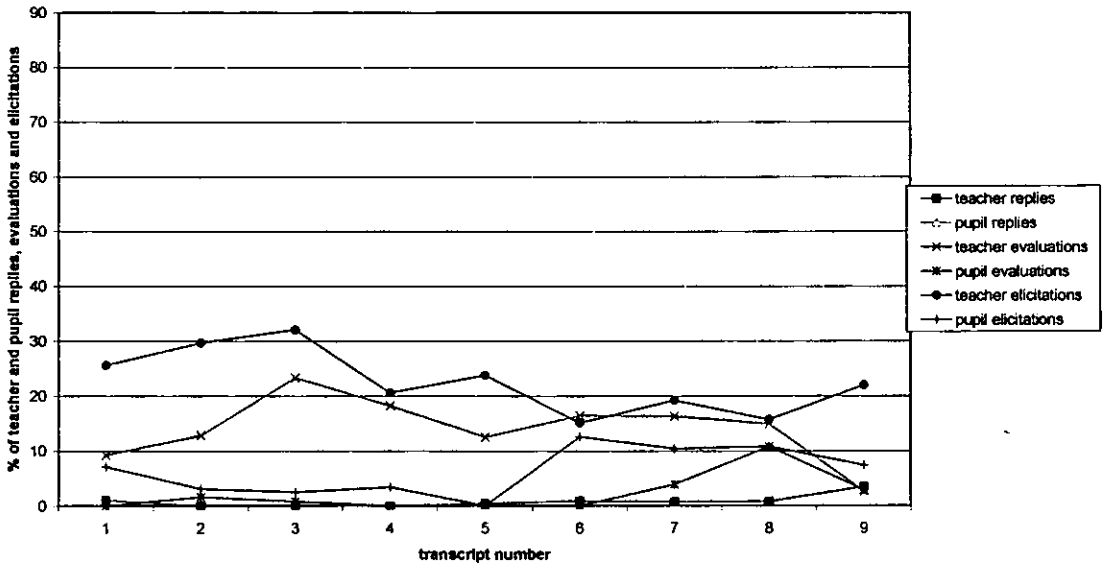
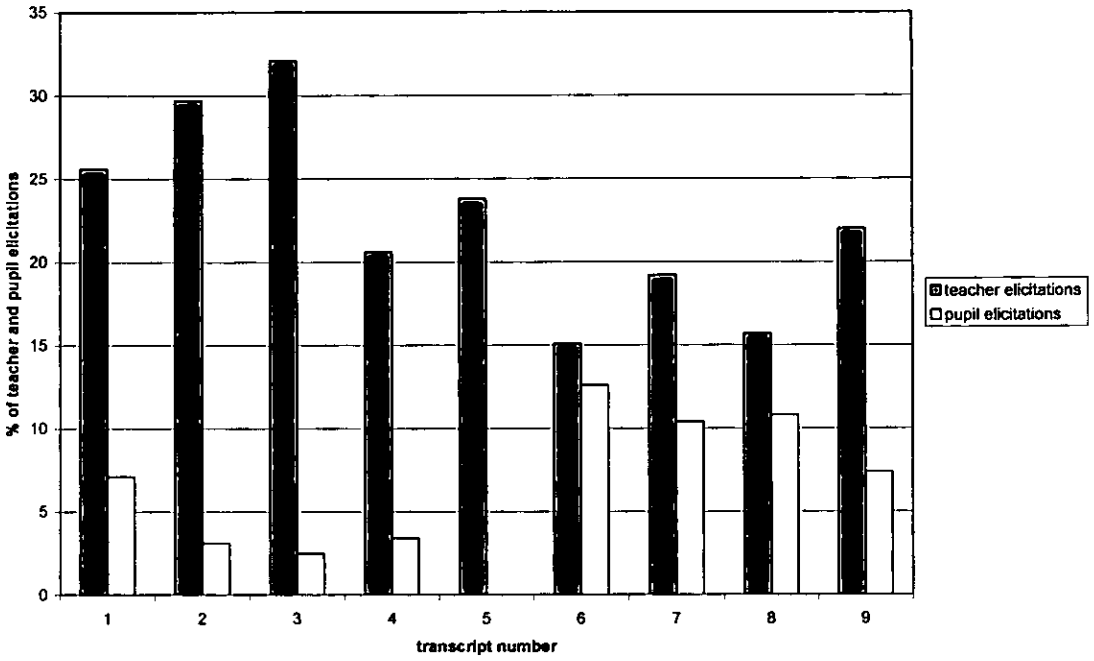


Figure 4 Percentage of teacher and pupil elicitations



LIST OF APPENDICES 11 – 19: PAGE

APPENDIX 11: ANNOTATED TRANSCRIPT 1

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session:

NB: mental maths warm-up and whole class introduction seem to have been combined

T: (INI) OK, now, today, is anybody's whiteboard pen not working before we start? Just try your whiteboard pens. Put your hand up if your whiteboard pen doesn't work. [background murmuring and movement as pupils organise themselves]. We're having terrible trouble with our whiteboard pens, I don't know what. Put up your hand if, C there a few more, there's M, there's... Right today, were going to be looking at problem solving, H who's not really listening, learning to solve problems that investigate number, we're going to know subtraction and addition facts to 20, which I'm sure we can all do and add and subtract multiples of 5 and 10. Now the biggest thing that we're going to focus on today in our problem solving is, is to be what? What do I always say? [background pupil: be systematic!] to be systematic. So here's the first one, problem. *(pause)* OK, I hope, its not too clear actually sometimes, is that OK for you J over there, can you still see? So a plastic monster in a toy shop costs 60p. but Kate's only got 5 and 10p coins in her purse, she's got lots of them, lots and lots of them, how many different ways can she pay for it? Have a go on your whiteboards to see how many ways she, could pay, costs 60p. Can you think of a way JB, can you think of any? Give you another minute to think of as many as you can. [background pupil: (INI) how many?] As many as you can think of! [background pupil: (RES) random]. *(pause)* [quiet background noise]. Just a few more seconds. *(pause)* Finish the one you're on. *(pause)* And I'd just like you to have a look at the persons board next to you. There's lots and lots of very interesting and different ways to record, C could I borrow yours a minute, right how many people have done what C done? C done, she could have 10+10+10+10+10+10=60p. how many people have done it that way? OK well done. Anyone done it a different way? G how did you do it?

Comment [MSOffice1]: m,el, d, cu,

Comment [MSOffice2]: com, cu, s

Comment [MSOffice3]: m, m-s

Comment [MSOffice4]: n, d, m-s, com

Comment [MSOffice5]: m, m-s

Comment [MSOffice6]: el

Comment [MSOffice7]: rep

Comment [MSOffice8]: s, m, ch

Comment [MSOffice9]: m, i, com, el, d

Comment [MSOffice10]: el, n, m-s?

Comment [MSOffice11]: el, rep,

Comment [MSOffice12]: rep?

Comment [MSOffice13]: m-s?

Comment [MSOffice14]: d, i,

Comment [MSOffice15]: n, el, m, el

Comment [MSOffice16]: s, el

Comment [MSOffice17]: e, el, n

P: (RES) I did...

T: (INI) OK let's look at yours. So G got, you could have six 10ps, you could have twelve 5ps, three 10ps and six 5ps, she's used multiplication OK. Anyone used any other ways? C how did you do yours?

P: six 10ps.

T: (REP) he's got six 10ps, that's a bit like G one that one, but five 10ps *(pause)* twenty five 1ps?

P: (RES) no and two 5ps!

T: (FOL-INI) oh, two 5ps, I beg your pardon, I can see what you've done now. Anybody draw the coins? *(pause)* No? Nobody think of drawing the coins? There are lots and lots of different ways that you could do it, but they're all right, but what if I said to you "have you got all of the combinations?" How do you know if you've got every single, combination that you can think of? *(pause)* Have another look on your board, anybody think that they've got all the combinations that they could have? G do you think?

P: (RES) I don't think I've got all *(indistinct)*

T: (FOL-INI) you could do yes, so we could have six times 10 and then you could swap them round *(indistinct)*

Would that make it very thorough so that we've got every single combination? Anyone think of a way that we could do it? B

P: (RES) you could do 10p then *(indistinct)*

T: (FOL-INI) superb. So what were you using to do that? It's a brilliant answer, good boy. *(indistinct)*

That was a brilliant answer B OK. So, you could actually draw yourself a table, then you could have, a number of 10ps and a number of 5ps. Now B said a really good idea, now what's the most number of 10ps that you could have? *(pause)* What's the biggest number of 10ps that you could have? *(pause)* If we want to buy a monster at 60p, what's the biggest number of 10ps that we could use?

P: (RES) 6

T: (FOL-INI) 6, OK. If I use six 10ps, how many 5ps will I use? Ah if I have six 10ps, how many 5ps will I need to make 60? H

P: (RES) none

Comment [MSOffice18]: rep

Comment [MSOffice19]: m, s, con, el, n, el

Comment [MSOffice20]: rep

Comment [MSOffice21]: acc, com

Comment [MSOffice22]: rep

Comment [MSOffice23]: e, com, el, el,

Comment [MSOffice24]: com ?, s, el,

Comment [MSOffice25]: s, el, n,

Comment [MSOffice26]: rep

Comment [MSOffice27]: acc

Comment [MSOffice28]: el, el, n

Comment [MSOffice29]: rep

Comment [MSOffice30]: e, el, e, con, el, el, el,

Comment [MSOffice31]: rep

Comment [MSOffice32]: acc, el, el, n

Comment [MSOffice33]: rep

T: (FOL-INI) none good girl. The six 10ps are 60 altogether aren't they, so then no 5ps. What would be the sensible to do next *(pause)* if we're doing it systematically in a table? S

P: (RES) (as INI) would you take one off the 6 and then you would add one to the nought? *(pause)* Take *(indistinct)* 5 and then

T: (FOL-INI) yes, good. So now you've got five 10ps, so five 10ps are

P: (RES) 50

T: (FOL-INI) 50, but we need 60 so how many 5ps would we need then?

P: (RES) 2

T: (FOL-INI) good girl, 2. OK so we've still got 60 haven't we? Anybody else tell me what's going to be next? E

P: (RES) four 10ps

T: (FOL-INI) four 10ps. How many 5ps M?

P: (RES) 4

T: (INI)(as FOL) 4? *(pause)*

P: (RES) 8

T: (FOL-INI) eight 5ps. [background pupil: (RES) 8?] Who thinks he's not right? What did you need to do M? You know that you've got 10ps [background pupil: (RES?or INI?) (b)] which is how much? How much is four 10ps?

P: (RES) 40

T: (FOL-INI) 40 and we need 60 so how much more do we need?

P: (RES) 20

T: (FOL-INI) we need another 20p but we need to do it in the 5ps

P: (RES) 4

T: f(FOL-INI) our 5ps. Next one, let's see who's wide awake. C what do we do next?

P: (RES) er, take three 10ps

T: (FOL) three 10ps

P: (RES) three 10ps and *(indistinct)* 5ps

T: (INI) how many?

Comment [MSOffice34]: e, com, el, n

Comment [MSOffice35]: rep

Comment [MSOffice36]: e, con, el

Comment [MSOffice37]: rep

Comment [MSOffice38]: acc, el

Comment [MSOffice39]: rep

Comment [MSOffice40]: e, com, el, n

Comment [MSOffice41]: rep

Comment [MSOffice42]: e, el, n

Comment [MSOffice43]: rep

Comment [MSOffice44]: el?

Comment [MSOffice45]: rep

Comment [MSOffice46]: acc

Comment [MSOffice47]: el?

Comment [MSOffice48]: el, el, n, el, el

Comment [MSOffice49]: b

Comment [MSOffice50]: rep

Comment [MSOffice51]: acc el

Comment [MSOffice52]: rep

Comment [MSOffice53]: acc, s?

Comment [MSOffice54]: rep

Comment [MSOffice55]: acc, d, n, el

Comment [MSOffice56]: rep

Comment [MSOffice57]: acc

Comment [MSOffice58]: rep

Comment [MSOffice59]: el

P: (RES) six 5ps

T: (FOL-INI) six 5ps. Shall we check? So we've got three 10ps are how much R?

[background pupil: (INI) can I tell you the next one?]

T: (continued) (INI) three 10ps are

P: (RES) 30

T: (FOL-INI) 30, six 5ps are

P: (RES) er, 30

T: (FOL-INI) 30, so 30 and 30 are 60p. JW what are we going to do next?

P: (RES) er

T: (INI) (Re-initiate)can you see what's happening? We've used 6, 5, 4, 3 *(pause)* what else could we have a look at?

P: (RES) 2

T: (FOL-INI) 2 OK. So we've got two 10ps and how many 5ps would we need? J.

P: (RES) 3

T: (FOL-INI) 3 *(pause)* OK. And, do we need to go anymore? *(pause)* JW what would be next?

P: (RES) er, one in 10 and ten in 5

T: (FOL-INI) 1x10 is 10 and how many?

P: (RES) ten times 5

T: (FOL-INI) 10x5, do we need to go any further? [background pupil: (RES) no] *(pause)* D

P: (RES) you could do, no tens

T: (FOL) brilliant good boy, no tens

P: (RES) and 12 *(indistinct)*

T: (FOL-INI) and 12 *(indistinct)*. Superb. So, we can see how it's gone up and how it's made a pattern? *(pause)* Everybody happy with that? We started with the biggest possible number of 10ps that we could use and we went right down to the smallest number of 10ps. OK *(indistinct)* been systematic to make sure we got every single one. Everybody understand that bit? Anybody struggling? OK then, *(pause)* what if the monster had only cost us 50p? *(pause)* How many different ways would there be of doing it then? If it only cost 50p? How many different ways would there be? *(pause)* Have a go on your board.

Comment [MSOffice60]: rep

Comment [MSOffice61]: acc, s, el, n

Comment [MSOffice62]: el

Comment [MSOffice63]: el

Comment [MSOffice64]: rep

Comment [MSOffice65]: acc, el

Comment [MSOffice66]: rep

Comment [MSOffice67]: acc, con, n, el

Comment [MSOffice68]: ack ?

Comment [MSOffice69]: ch, el

Comment [MSOffice70]: rep

Comment [MSOffice71]: e, el, n

Comment [MSOffice72]: rep

Comment [MSOffice73]: e, el, n, el

Comment [MSOffice74]: rep

Comment [MSOffice75]: el

Comment [MSOffice76]: rep

Comment [MSOffice77]: acc, el

Comment [MSOffice78]: rep

Comment [MSOffice79]: n

Comment [MSOffice80]: rep

Comment [MSOffice81]: e

Comment [MSOffice82]: rep

Comment [MSOffice83]: e, con, ch, con, ch, ch

Comment [MSOffice84]: m, s, el, el, d, el

How many different ways [background pupil: (INI) the same 10ps and 5ps?]. The same 10ps and 5ps, but it only costs this time, 50p.

[slight background working noise] OK how would you do it if it only cost 50p? *(pause)* Seen some people are using a really, really good way. E what could C do? She's got a good idea, it only costs 50p but how can we make sure that we've got every single combination? I can see some brilliant answers. *(pause)* See how many different combinations you could have. *(pause)* I'll give you one more minute. You're working really hard. *(pause)* Ok, J so how many different combinations do you think there that is?

P: (RES) §

T: (INI) (but implicit feedback re. incorrect answer) how many combinations do you think that there are? *(pause)* Put your hand up if you think that you've worked it out. OK B how many do you think?

P: (RES) 6

T: (FOL-INI) B thinks 6. Is he right? [background pupils: (RES) yes] What would the biggest amount be? *(pause)* B

P: (RES) er, *(indistinct)*

[NB at this point, observation showed that most children had not used a grid to record their combinations

One child was asked: what could C have done?

But clear opportunity to explain was not given]

T: (FOL-INI) brilliant, so we could have five 10ps, then we could do four 10ps, three 10ps, two 10ps, ten 1ps, and no 10ps and sort out the 5ps at the same time. So well done if you've got a table and you've worked it out systematically [background pupil: (RES) yes!] give yourself a pat on the back. Go on, well done. Now got something a little bit trickier here on the board and, it's a "toss the beanbag" game. [audible voices in background] So the idea of the game is that somebody would toss three beanbags. If any of these bean bags miss the square, like it does when Mrs B throws *(indistinct)* direction, you have another go, so that all 3 of them are somewhere on the board OK. To get this score you've got to add all 3 numbers. So I'm going to call upon EH who's going to put a

Comment [MSOffice85]: el, rep, com

Comment [MSOffice86]: m, el, e?, n, el, com, el,

Comment [MSOffice87]: e?, s, m-s, e,

Comment [MSOffice88]: m, n, el

Comment [MSOffice89]: rep

Comment [MSOffice90]: el, cu, m, n, el

Comment [MSOffice91]: rep

Comment [MSOffice92]: acc, el

Comment [MSOffice93]: rep

Comment [MSOffice94]: el, n

Comment [MSOffice95]: rep

Comment [MSOffice96]: e, con, e, com

Comment [MSOffice97]: ack ?

Comment [MSOffice98]: d, p, m, s,

Comment [MSOffice99]: i,

Comment [MSOffice100]: m, m-s, n, d

nice big dot on there for us on the number 15. You choose one of our pens there. *(pause)* OK [background pupil: (INI) have black] Any colour, on the 15 yes. [background pupil: yes!] OK and A you could do me another one on the 15 [background pupil: (INI) yes, make it more noticeable] Yes, make it a bit bigger perhaps. *(pause)* Oh its going all over the show now, it looks like it's been shot now doesn't it? Who can sort it out? [background pupils: (RES) me!] R, can you sort it out? It looks like it's been shot at the moment. [background pupil: (INI) use the rubber!] OK so we need two on the 15. OK [several pupils continue to call out instructions and prompts to the pupil who is standing at the whiteboard] *(indistinct)* very small. What's the score of the beanbag throwers target? Some people are very quick there. Well done D for listening. Go on D

P: (RES) 35

T: (FOL-INI) 35. how do you know? What have you done?

P: (RES) *(indistinct)*

T: (FOL-INI) absolutely brilliant, you're working hard today. So 35 is the score. But what you are going to do is this; you're going to go back to your place for me and were going to see, not yet, oh, were going to see what other scores you could possibly get, but we've got to be systematic. I want to make sure that you've got all possible scores that you could get by playing this game. Ok, so how do you think you might go about it? *(pause)*

L

P: (RES) *(indistinct)*

T: (FOL-INI) (Re-initiate)you could do. What did we do on our last one that might help us to be systematic? What did we do then to make sure that we got all the different amounts G?

P: (RES) er, a table

T: (FOL-INI) a table, so can you use a table? Think about it yourself. Would you use a table? What else did you do when we did our table?

[background pupil: (RES) *(indistinct)*]

Go on J. J doesn't think we can use a table for this one. Go on.

P: (RES) I think *(indistinct)* it's like you've got to put the 3 dots, you've got to add them all up so I don't think you can use a table to do it.

Comment [MSOffice101]: d

Comment [MSOffice102]: p? s?

Comment [MSOffice103]: ack

Comment [MSOffice104]: m, n, d,

Comment [MSOffice105]: d

Comment [MSOffice106]: d, com, el,

Comment [MSOffice107]: b

Comment [MSOffice108]: n, el(d), com

Comment [MSOffice109]: d

Comment [MSOffice110]: m, s?

Comment [MSOffice111]: el, com, e, p, n

Comment [MSOffice112]: rep

Comment [MSOffice113]: acc, el, el

Comment [MSOffice114]: rep

Comment [MSOffice115]: e, com, con, m-s, com,

Comment [MSOffice116]: m, el, n

Comment [MSOffice117]: rep

Comment [MSOffice118]: acc, el (cl), el, n

Comment [MSOffice119]: rep

Comment [MSOffice120]: acc, el, d, el, el,

Comment [MSOffice121]: rep

Comment [MSOffice122]: p, n, com, p,

Comment [MSOffice123]: rep, com

T: OK, anyone think that you can? Bit of a challenge *(indistinct)* having a go. I'll let you have a few minutes and then we'll come back, so very quietly move back to your place with our chairs…

Comment [MSOffice124]: m, el, com, m-s, d

[Children not focussed on listening to explanations- eye contact and full attention not given by majority of children during explanations.
Teacher does not insist on full attention or participation.
Children do not write on the easel whiteboard.
No record of methods e.g. whiteboard wiped/ interactive board used to project questions, not for working out/ key points.]

APPENDIX 12: ANNOTATED TRANSCRIPT 2

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session:

T: (INI) C *(male lower achiever)* how did you work it out then?

P: (RES) I did 5 times £1.50 and then 4 times 50

T: (FOL) so you've done 5 times £1.50 yes

P: (RES) equals 3.50 and you add them together

T: (FOL-INI) *(indistinct)* the £1…yes, say the next bit again *(indistinct)* you did 5 times

T: times 1 equals £5

T: yes, we got that one

P: (RES) then times the 5 times 50 *(indistinct)* then the answer of seven pounds and fifty

T: (INI) then you added them together. Did everybody get the answer of £7.50?

[background pupils: yes]…there are lots and lots of different ways you could have done it and it's not always important, but if you've got the right answer that's the main thing or if you know the important information, but some ways are obviously quicker than others…OK so we're going to see if we can try and find some of the quicker ones, well done if you got £7.50 *(2 second pause)*. If you didn't know what to do, what could the acronym QUACK stand for?…who can remember what the Q is for? E

P: (RES) read the question

T: (FOL-INI) Read the question OK. So Q is for the question. What's the U for? J

P: (RES) U is for understand the question

T: (FOL-INI) understand the question, or it could be for what? (2 second pause) B?

P: (RES) underline

T: (FOL-INI) brilliant. Underline the important information. What about the A? A? M

P: (RES) is it answer?

T: (FOL-INI) not answer. *(2 second pause)* S

P: (RES) approximate

Comment [MSOffice1]: n, el

Comment [MSOffice2]: rep

Comment [MSOffice3]: e

Comment [MSOffice4]: rep

Comment [MSOffice5]: e, s?(d), el

Comment [MSOffice6]: rep

Comment [MSOffice7]: e

Comment [MSOffice8]: rep

Comment [MSOffice9]: s?, ch,

Comment [MSOffice10]: rep

Comment [MSOffice11]: i,

Comment [MSOffice12]: m, m-s, e, el, n

Comment [MSOffice13]: rep

Comment [MSOffice14]: e, con, el, n

Comment [MSOffice15]: rep

Comment [MSOffice16]: e, el, n

Comment [MSOffice17]: rep

Comment [MSOffice18]: e, el, n

Comment [MSOffice19]: rep (el)

Comment [MSOffice20]: e, n

Comment [MSOffice21]: rep

T: (FOL-INI) approximate OK so if this one says "5 times £1.50" well even if you did 5 times £1, you know the answer's roughly going to be, a bit more than the £5. If you get the answer £50 then you know somewhere along the line that your decimal points gone wrong, *(indistinct)* The C, what can we do for the C? K

P: (RES) calculate

T: (FOL-INI) calculate. OK and the K is for what J?

P: (RES) equivalent

T: (INI) for what sorry?

P: (equivalent

T: (FOL-INI) no, C

P: (RES) knowing if it's sensible

T: (RES-INI) good girl, knowing if its sensible, so if I said "5 times £1.50 is £205" it's not really sensible is it? Because you know that 5 lots of £1 is £5. So if you're really stuck, that's what you need to think about doing. Let's try number 2. I'm not even going to read this one for you I'm going to let you read it.

P: (INI) Mrs B, how many pence is there?

T: (REP) ssh

P: (INI) it doesn't say how many pence

T: (RES) Oh!

P: (INI) just say 2!

T: (INI) (Re-initiate)OK. Put your hand up if you think there's something wrong with it...er, we might have, JW, what's wrong with it?

P: (RES) it doesn't have *(indistinct)*

T: (FOL-INI) well done. So you've got to make sure that you've got the right information to start off with. Sometimes it might give you some information that's right and some that's wrong. But you have to make sure that you have the right information in the *(indistinct)* well done *(indistinct)*. But if K bought, let's say, let's say she had 6 sweets, K had 6 sweets for herself and her friends and she's buying 6 packets altogether. Each packet costs 35p how much would she spend?

[background pupil: (RES) £2.10]. Can you work that out for me? She buys 6 packets.

[background pupil: (RES) £2.10!] *(pause)* *(indistinct)* read the question, well I know

Comment [MSOffice22]: e, m, com, el, n

Comment [MSOffice23]: rep

Comment [MSOffice24]: e, el, n

Comment [MSOffice25]: rep

Comment [MSOffice26]: l,

Comment [MSOffice27]: rep

Comment [MSOffice28]: e, n

Comment [MSOffice29]: e, com, con?,

Comment [MSOffice30]: s

Comment [MSOffice31]: el

Comment [MSOffice32]: d

Comment [MSOffice33]: i

Comment [MSOffice34]: ack

Comment [MSOffice35]: com ?

Comment [MSOffice36]: m, cu, n, el

Comment [MSOffice37]: rep

Comment [MSOffice38]: e, con,

Comment [MSOffice39]: el,

Comment [MSOffice40]: rep

Comment [MSOffice41]: el,

Comment [MSOffice42]: rep

Comment [MSOffice43]: i, m, el, el

you've read the question because you've already noticed that something was missing from it. You did understand the question, because otherwise you wouldn't have known that important information was missing. Now, approximate. What's it going to be roughly? How am I going to know that one?

P: (RES) it's going to be roughly about one or two pounds

T: (FOL-INI) *(interrupts before child finishes)* one or two pounds. How would you know that?

P: (RES) because it *(indistinct)*

T: (FOL-INI) £2.30 how *(indistinct)* that answer?

P: (RES) *(indistinct)* I just thought maybe *(indistinct)*

T: (FOL-INI) B approximated first *(2 second pause)* J.

P: £1.50

T: (INI) you thought it might be

P: £1.50

T: (FOL-INI) £1.50. So why did you think £1.50

P: (RES) because it was *(indistinct)*

[teacher acts as scribe and continues to repeat pupil's working-out whilst recording it on the whiteboard easel]

T: (FOL-INI) it was *(indistinct)*. What you need to do is you need to look at, we've got 6 packets and they're 35p, so you either need to think about 6 packets at 30p or 6 packets at 40p...OK, so 6 packets at 40p would be, how many? Let's have a look, er J, how much would it be, 6 packets at 40p?

P: (RES) 6 packets at 40p?

T: (INI) mmm... what will 6 packs at 40p be? how will I do that? [background pupil: (RES) £2.10] ... 6 times 40, what will that be R?

P: (RES) er, £2.40

T: (FOL-INI) £2.40p, so 6 fours are 24, add the nought back on, £2.40, so it should be roughly £2.40. So if your answer is something like that, you know you're on track. Calculate it, How do people calculate it? B how did you do it?

Comment [MSOffice44]: rep

Comment [MSOffice45]: acc, el

Comment [MSOffice46]: rep

Comment [MSOffice47]: acc, el

Comment [MSOffice48]: rep

Comment [MSOffice49]: con, n

Comment [MSOffice50]: rep

Comment [MSOffice51]: el

Comment [MSOffice52]: rep

Comment [MSOffice53]: acc, el

Comment [MSOffice54]: rep

Comment [MSOffice55]: acc, s, el, n, el

Comment [MSOffice56]: el

Comment [MSOffice57]: el, el NB these are questions with different intended outcomes

Comment [MSOffice58]: rep

Comment [MSOffice59]: el, n

Comment [MSOffice60]: rep

Comment [MSOffice61]: e, con, el, n, el

P: (RES) I got 6 times by 35

T: (FOL-INI) times, 6 times by 35. So you did 6 times by 30 is how many?

P: (RES) £1.80

T: (FOL-INI) £1.80, E

P: (RES) 6 times 5

T: (INI) is?

P: (RES) is 30 and then

T: (INI) what is the 30? Is it £30?

P: (RES) er 30p, add £1.80

T: (FOL-INI) you've got £2 and10 pence…put your hand up if you also got £2 and 10 pence (*background sound of agreement from pupils*) Oh! OK. So if you've calculated it, you should have been able to know if your answer was sensible. If you've got £210, and you've approximated it and you said "well perhaps maybe it should be £2.40" if you end up with 210 pence, or £210 should have said, you know that your answer is wrong. OK this time, I want you to look at number 3…and

I'm going to give you just 2 minutes to work out number 3 then you are going to explain to the person next to you…you need to be able to explain to the person sitting next to you very shortly D OK…I'm going to give you one minute. [background pupil: (RES) done it!] Ssh, you don't need to say you've done it, you just need to look at me and then I know that you're ready. Don't show anyone your board. Everyone looking at me, I'd like you now to explain the person sat next to you, how you got your answer. Compare answers and explain what you did for it. [appropriate discussion volume]. OK, if you stop there…ssh. H what did your partner tell you how they did it? What did he tell you?

P: (RES) (*indistinct) 76 (indistinct)*

T: (FOL-INI) so the important information was that he's got 76p in his pocket. OK. We know 34p is important, but what does he do with it?

P: (RES) *(indistinct <5 words)*

T: (FOL-INI) so the important information is the 76 and the 34 and also to know that it's a take away. OK. Show me your board, what have you got? [background P: (RES) *(indistinct)]* OK, don't rub it off until I say. 42p. how can I check MH that you're right? *(1 second pause)* Lots of people have said 42p how do I check that it's right?

Comment [MSOffice62]: rep

Comment [MSOffice63]: e, el
NB teacher has proceeded to next step of partitioning and has assumed this is how pupil calculated the answer

Comment [MSOffice64]: rep

Comment [MSOffice65]: e, n

Comment [MSOffice66]: rep

Comment [MSOffice67]: el

Comment [MSOffice68]: rep

Comment [MSOffice69]: el, el

Comment [MSOffice70]: rep

Comment [MSOffice71]: com (indirect evaluative feedback?), el, ack, con,

Comment [MSOffice72]: rep

Comment [MSOffice73]: m, s, m-s

Comment [MSOffice74]: m-s

Comment [MSOffice75]: b

Comment [MSOffice76]: d, d

Comment [MSOffice77]: d, s, s

Comment [MSOffice78]: m, d, n, el, el

Comment [MSOffice79]: rep

Comment [MSOffice80]: con, m, el

Comment [MSOffice81]: rep

Comment [MSOffice82]: con, m, d, el

Comment [MSOffice83]: rep

Comment [MSOffice84]: d, acc, el, (n), el

P: (RES) er, (*indistinct)*

T: (INI) how do I know that it's right 42p G?

P: (RES) you can add on 34

T: (FOL-INI) well done, add on the 34p if you get 76 you're right. *(no pause)* Now that hopefully, is quite easy …Oh, OK. Just try, one of these. We're going to try the one that says number 1… "*(indistinct)* to visit a museum, there are 4 boys and 6 girls, how much does it cost for all of them to get in?" OK, do it on your own for just 1 minute. *(5 second pause)* I don't need to see your boards at the moment. [background P: (RES) £6] Keep it to yourself. *(c. 20 second pause)* Show me… I don't want to know the answer just at the minute but L, which is the important information do you think?

P: (RES) I think the (*indistinct)*

T: (FOL) yes

P: (RES) and er

T: (INI) T

P: (RES) 4 boys, 6 girls

T: (FOL-INI) the 4 boys and the 6 girls. Now, what do we need to do? How do we know what sort of operation it is going to be? Is it going to be an add, a take away, or is it a times, a divide? [background P: (RES) times] G.

P: (RES) *(indistinct <5 words)*

T: (INI) how will I know how much, how do I know how to work that out? G

P: (RES) (*indistinct c. 20 words)*

T: (INI) how much do we need for all of them to get in? So what's the first thing that you will do (n)?

P: (RES) add the 6 and the 4

T: (FOL-INI) add the 6 and the 4. Is it important that some are boys and some are girls?

P: (RES) no

T: (INI) why not?

P: (RES) er because it doesn't really matter

T: (INI) [redacted] G

P: (RES) they're all the same price

Comment [MSOffice85]: rep

Comment [MSOffice86]: el, n

Comment [MSOffice87]: rep

Comment [MSOffice88]: e, com,

Comment [MSOffice89]: s, i, d

Comment [MSOffice90]: d

Comment [MSOffice91]: b

Comment [MSOffice92]: d

Comment [MSOffice93]: d, n, el

Comment [MSOffice94]: rep

Comment [MSOffice95]: e

Comment [MSOffice96]: ack

Comment [MSOffice97]: n

Comment [MSOffice98]: rep

Comment [MSOffice99]: acc, m, el, el, el, n

Comment [MSOffice100]: rep

Comment [MSOffice101]: rep

Comment [MSOffice102]: el, n

Comment [MSOffice103]: rep

Comment [MSOffice104]: el, s, n

Comment [MSOffice105]: rep

Comment [MSOffice106]: e, el

Comment [MSOffice107]: rep

Comment [MSOffice108]: el

Comment [MSOffice109]: rep

Comment [MSOffice110]: n

Comment [MSOffice111]: rep

T: (FOL-INI) excellent, because girls and boys are the same price, it's just to trick you a little bit. You need to read the question, so we have 6 girls and 4 boys; so we've got how many all together R?

P: (RES) 10

T: (FOL-INI) 10 and then what do I do? I know that 65 is important and 10, er JT what do I do with my 65 and my 10?

P: (RES) er

T: (INI) (Re-initiate?)we've got *(indistinct)* we know that we've got 10, what do I do with the numbers?

[background P: (RES) I know! I know!]

T: (INI) I

P: (RES) put a nought on

[background P: (FOL) no!... no!] [another background P: (FOL) yeah!... Yeah!]

T: (FOL-INI) (Re-initiate?)put a nought on. Put up your hand up if you think he's right, if you just put a nought on

[background P: (RES) no, no!]

T: (INI) OK, J tell me what happens

P: (RES) you can put the nought on the end *(indistinct)* I can't remember

[background P: (RES) I've got it!]

T: (INI) tell me again, you can put the nought on the end

P: (RES) yeah,

T: (REP?) I've got £60, I put my nought on the end

P: (RES) yes, but

T: (INI) (Re-initiate?)when you say I put the dot in the middle, where am I putting my dot?

P: (RES) in front of the 6

T: (FOL-INI) in front of the 6. How do you know its there? *(pause)* How do you know it is?

P: (RES) *(indistinct)*

Comment [MSOffice112]: e, com, s, el, n

Comment [MSOffice113]: rep

Comment [MSOffice114]: acc, el, n, el

Comment [MSOffice115]: ack

Comment [MSOffice116]: el

Comment [MSOffice117]: b

Comment [MSOffice118]: n

Comment [MSOffice119]: rep

Comment [MSOffice120]: e?

Comment [MSOffice121]: acc, cu,

Comment [MSOffice122]: b

Comment [MSOffice123]: n, s? (d)

Comment [MSOffice124]: rep

Comment [MSOffice125]: b

Comment [MSOffice126]: s, l

Comment [MSOffice127]: rep

Comment [MSOffice128]: s?

Comment [MSOffice129]: rep

Comment [MSOffice130]: s, el

Comment [MSOffice131]: rep

Comment [MSOffice132]: acc, el, el

Comment [MSOffice133]: rep

T: (INI) (Re-initiate?)how do you know it is? how do you know it's £6.50?

P: (RES) I just know *(indistinct)*

T: (INI) J

P: (RES) well *(indistinct c. 20 words)*

T: (FOL) (REP) That's it. It's a times isn't it? *(indistinct)* It's a times, yes? So you know that 65 times by 10 is going to be about £6.50. *(no pause)* Now, the other thing that's important is, if it asks you how much its going to cost, you need to be talking about money don't you? If it asks you how many blue sweets there are, you need to say there are so many blue sweets. Make sure that you have answered, answered the question that you have been given. Now, on your table...

NB pupils not given chance to point out what they think is important

Teacher goes straight onto giving instructions for independent task

15 minutes "for as many as you can do", "I would like to see your working out",
Teacher says that she will expect children "to explain to me how you worked it out, not just the answer"

Comment [MSOffice134]: el, el

Comment [MSOffice135]: rep

Comment [MSOffice136]: n

Comment [MSOffice137]: rep

Comment [MSOffice138]: acc, com, cl?, con,

Comment [MSOffice139]: m, s, s, d

APPENDIX 13: ANNOTATED TRANSCRIPT 3

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session:

T: (INI) Now what we're going to do today...OK, now, I'm going to get you very shortly to see if you can come out to the board and show us the working out, but you have to think about, I don't want your answer J, its not the answer that's always, always important *(in response to child showing answer only)* it's a good thing to know the right answer but, sometimes when you do tests or we're looking at something from *(indistinct)* sometimes they show your working out and some people might have got the right idea, they've got all the working out but might have got the answer part at the bottom wrong. But you might get points for the working out. OK so what I want you to do is to think about this acronym QUACK. So JT what does Q stand for in QUACK?

P: (RES) *(indistinct)*
T: (FOL-INI) read the question, good boy. Anything else J? what about the U?
P: (RES) mmm,
T: (INI) I
P: (RES) understand
T: (FOL-INI) understand the question or H
P: (RES) underline
T: (FOL-INI) underline the important parts that's the main one. A for, R
P: (RES) approximate
T: (FOL-INI) approximate, OK, so roughly what should your answer be? C for, M
P: (RES) calculate
T: (FOL-INI) calculate. And finally, K for what R
P: (RES) erm
T: (INI) know your answer is

Comment [MSOffice1]: m, s, m, m-s, d, n, com,
Comment [J2]: i, com, m, d, m, s, n, el
Comment [J3]: rep
Comment [J4]: e, el (n), el
Comment [J5]: ack?
Comment [J6]: n
Comment [J7]: rep
Comment [J8]: e, n(el)
Comment [J9]: rep
Comment [J10]: e, com, el, n
Comment [J11]: rep
Comment [J12]: e, m, el, el, n
Comment [J13]: rep
Comment [J14]: e, el, n
Comment [J15]: ack?
Comment [J16]: el,

P: (RES) sensible

T: (FOL-INI) sensible, good. OK. Know your answer is sensible so you're going back to the approximate one aren't you? So what we're going to do is we're going to have a look at this one and I want you to go through each of those points. I don't just want the answer. I want you, if I choose you, go through each of the points and first of all you're going to be thinking about the question. Then you're going to underline the important bits, you're going to approximate the answer, then you're going to calculate it and show us how you calculated it. And then, knowing your answer is sensible. So, we're going to start off with some fairly easy ones I think. Who would like to have a go coming to the front to show us? Erm, G OK. Right, first of all G what do you have to do?

P: (RES) erm

T: (INI) what do you have to do G?

P: (RES) *(indistinct)*

T: (FOL-INI) (Re-initiate) no, no, no what do you have to do first? What's the Q?

P: (RES) read the question

T: (FOL-INI) read the question. OK so out loud can you read us the question?

P: (RES) *reads question aloud*

T: (INI) OK so then what do you have to do G?

P: (RES) erm, underline

T: (FOL-INI) underline the important bit, so can you underline the important bit *(indistinct)* OK what's important there G?

P: (RES) 16

T: (INI) now you put what you think. Who's tapping?

[background P: (RES) D] don't tap. 16 is important G thinks...right, subtract ...and the answer is 14, OK so that's the important bit that G thinks. Now what do *(indistinct)*

P: (RES) *(indistinct)*

T: (FOL-INI) she's forgotten...good girl. Approximate. So what do think it would be roughly the answer?

P: (RES) around 30

T: (FOL-INI) So what do, so you think it's going to be around 30 ok

Comment [J17]: rep

Comment [J18]: e, m, com, m, m-s, d, d, d, m-s, m-s, m-s, m-s, com,

Comment [MSOffice19]: m, s?, el, n, m, el

Comment [J20]: ack?

Comment [J21]: el, (n)

Comment [J22]: rep

Comment [J23]: e, el, el

Comment [J24]: rep

Comment [J25]: e, m, el? (d)

Comment [J26]: rep

Comment [J27]: m, el, (n)

Comment [J28]: rep

Comment [J29]: e, m, el (d)

Comment [J30]: m, el, n

Comment [J31]: rep

Comment [J32]: d, el

Comment [J33]: rep

Comment [J34]: d

Comment [J35]: acc, acc, acc, m, com, m, el

Comment [J36]: rep

Comment [J37]: i, e, m, el

Comment [J38]: rep

Comment [J39]: m, acc, d, s? (d)

Calculate, show us what you're going to do. So you have to tell everyone what you're doing first of all

P: (RES) well, *(indistinct)*

T: (FOL-INI) OK so you've already decided that your operation is an add OK. Equals

P: (RES) *(indistinct)* and then *(indistinct)* check it

T: (RES-INI) to check it? Yes you could do that, good girl. That's a good way to check it isn't it? How does G know to check it with the take away? How does (indistinct) check it with a take away E?

P: (RES) because

T: (FOL-INI) what's that special word [P: (RES) oh] that begins with an "i"? she knows that a take away is the [P: oh]

P: (RES) inverse

T: (FOL-INI) well done B, good one, a house point for that. It's the inverse of that isn't it? Brilliant. OK thanks G that's super. Do want to (indistinct) then we'll choose someone else for the next one... [P: (RES) me!] Now OK have a read of the question first of all before you decide to volunteer for me...[P: (RES) J! P: (INI) what? Which J? That doesn't make sense! P: (RES) yeah it does!] Right, who would like to have a go at going through each of the points the same as G did and explain how you got it? T *(pupils excited and disappointed if not chosen)* Don't worry there are more...OK so what have you got to do first, remembering your QUACK?

P: (RES) read the question

T: (FOL-INI) read the question OK. Big loud voice.

P: (RES) *(reads question aloud)*

T: (INI) I've put J not J. OK erm so what've we got to now T?

P: (RES) *(indistinct)*

T: (FOL-INI) underline the important bits...OK, 52...OK. Then what have we got to do?

P: (RES) *(indistinct)*

T: (FOL-INI) OK. What would it be roughly then T?

P: (RES) *(indistinct)*

T: (FOL-INI) (Re-initiate?)roughly? Roughly 26. I would say roughly 25 really K. why would you say that?

Comment [940]: m, rep

Comment [941]: m, con, el

Comment [MSOffice42]: rep

Comment [MSOffice43]: el(acc), e, com, el, el, n

Comment [MSOffice44]: rep (ack?)

Comment [MSOffice45]: el,

Comment [MSOffice46]: ack

Comment [MSOffice47]: el

Comment [MSOffice48]: ack

Comment [MSOffice49]: rep

Comment [MSOffice50]: e, com, e, m, n, e, d, s, b, m, d,

Comment [MSOffice51]: n, el, com, rep

Comment [MSOffice52]: el, n

Comment [MSOffice53]: i, m, el, el

Comment [MSOffice54]: rep

Comment [MSOffice55]: e, d

Comment [MSOffice56]: rep

Comment [MSOffice57]: i, m, el, n

Comment [MSOffice58]: rep

Comment [MSOffice59]: e, e, el

Comment [MSOffice60]: rep

Comment [MSOffice61]: e, el, n

Comment [MSOffice62]: rep

Comment [MSOffice63]: acc, com, (n), el

P: (RES) because *(indistinct)*

T: (FOL-INI) because half of it is 25. yes, plus T knows what the answer would be. Calculate, tell me what to show to the rest of the class and explain what your working out is

P: (RES) *(indistinct)* you have *(indistinct)*

T: (REP) some people are chattering which is a bit rude

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant. Can you see how T has managed, to find his half of 52? He's not sure about half of 52, he's partitioned the number which was a really, really good idea. What operation has he used for that? *(1 second pause)* He's halved them, but what has he done J?

P: (RES) has he divided?

T: (FOL-INI) he's divided them. Brilliant. OK. Well done T, superb. Let's try a slightly harder one *(indistinct)* Now, have a read of the question first of all yourself...oh bit harder this type. Few different steps to it this one...Who would like to have a go? M let's have you this time.

If you are not sure how to do it, have a little go on your white board see if you're going to get the same answer as M. OK M what you going to do for us? What do you do first?

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant, read the question. Read it out for us.

P: (RES) *(reads question aloud)* [T: (REP) *(assistance)* how many pence]

T: (INI) right, so quite a tricky one this one. So what are you going to do then M?

P: (RES) *(indistinct)*

T: (FOL) underline the important bits

P: (RES) *(underlines)*

T: (FOL-INI) OK. A could you move back slightly so that M...what's important there then M?

P: (RES) *(indistinct/pupil underlining silently)*

T: (FOL-INI) the first part definitely...OK a box holds 80 pens, OK, anything else?...got lots of different parts to this one, what's the next important part M?

[background P: (RES) 18]

Comment [MSOffice64]: rep

Comment [MSOffice65]: e, com, s, this is an instruction and a linguistic response is required

Comment [MSOffice66]: rep

Comment [MSOffice67]: d

Comment [MSOffice68]: rep

Comment [MSOffice69]: e, el, com, e, el, cl, el, n

Comment [MSOffice70]: rep

Comment [MSOffice71]: e, e, s, m, d, i,

Comment [MSOffice72]: s, el, n, d, el, cl

Comment [MSOffice73]: rep

Comment [MSOffice74]: e, s? or d?

Comment [MSOffice75]: rep

Comment [MSOffice76]: i

Comment [MSOffice77]: m, i, el, (n)

Comment [MSOffice78]: rep

Comment [MSOffice79]: e

Comment [MSOffice80]: rea

Comment [MSOffice81]: acc, d, el, (n)

Comment [MSOffice82]: rea

Comment [MSOffice83]: e, el, i, el, (n)

Comment [MSOffice84]: rep

T: (FOL-INI) OK. So what you're going to do then M, you've got to...for that first part we've got to approximate the answer, haven't we, so what will it be roughly?...what will it be roughly?

P: (RES) about 17

T: (FOL-INI) about 17. do you think he's right? *(pause)* G what do you think?

P: (RES) er, 17

T: (Re-word) (Re-initiate?)roughly, you're trying to work it out *(indistinct)* before you do that, how would you do it roughly E? how would you approximate that one?

P: (RES) er

T: (FOL-INI) he's doing 80 and then 18 of them don't work, how would you approximate it?

P: (RES) *(indistinct)*

T: (FOL-INI) about 60. good girl how did you work that out?

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant, superb. 18's nearly 20 so 80 take away 20 is about 60. so M we've got to calculate it, so I want you to tell everyone what you're doing

P: (RES) *(indistinct)*

T: (FOL-INI) yes *(indistinct)*... B can you move away please?

(pupil continues to silently show his working out on the whiteboard) if you lean on the board M, it *(indistinct)*...I can see lots of people are trying to work it out, see if you've got the same idea as M. yes 80...yes...ssh, you don't know what he's doing yet...

Ssh let him show us. That was a good way of doing it M. brilliant idea that was, superb. So he started at 18, and what's he done with his 18 to make it easier for him? C

P: (RES) he's cut it down

T: (FOL-INI) he's cut it down. What's that for? what's the special word for it T? *(pause)* G?

P: (RES) partitioned

T: (FOL-INI) partitioned it hasn't he, so he's done 80 take away 10 is 70, then we've got 70 take away 8 is 62, so, "know that your answer was sensible", when we approximated it E, what did we say it would be roughly?

P: (RES) *(indistinct)*

Comment [MSOffice85]: e, el, (n), com, el

Comment [MSOffice86]: rep

Comment [MSOffice87]: acc, el, n

Comment [MSOffice88]: rep

Comment [MSOffice89]: s, el, (n), el

Comment [MSOffice90]: ack ?

Comment [MSOffice91]: s, el

Comment [MSOffice92]: rep

Comment [MSOffice93]: e, el

Comment [MSOffice94]: rep

Comment [MSOffice95]: e, con, m, s

Comment [MSOffice96]: rep

Comment [MSOffice97]: e, d

Comment [MSOffice98]: rea, d, (n), i, e, d, com

Comment [MSOffice99]: d, e, el, n

Comment [MSOffice100]: rep

Comment [MSOffice101]: e, el, el, n

Comment [MSOffice102]: rep

Comment [MSOffice103]: e, con, n, el

Comment [MSOffice104]: rep

T: (FOL-INI) about 60 and he's got 62, so that's really good, but now we've got another step. We've got, what s the next part M?

P: (RES) *(indistinct/reads out question)*

T: (INI) OK so, how many whole classes, could have, if there are 28, go on M show us how you would work that one out

P: (silent RES) *(pupil continues to silently show working out on the whiteboard)*

T: (INI) how many whole classes could have a pen if there are 28 children in each class? So he's got 62 *(pause)* here he goes

[background P: (RES) *(indistinct)]*

T: (FOL-INI) ssh...[*pupil works silently*] that's really good thinking [*remainder of class almost silent, one pupil supportively comments as work progresses]* good boy M keep going *(pause)* now he's got 34, so what do you know about that calculation that you've done there M so far. *(pause)* how many classes has that told you?

P: (RES) one

T: (FOL-INI) so we know one class and we've still got 34 left, so how many classes can have a pen if there are 28 children in each class, (pause) so how many classes would there be M?

P: (RES) *(indistinct)*

T: (FOL-INI) good boy, in two classes, super. There's two lots of 28 would be... how many K?

P: (RES) 56

T: (FOL-INI) 56, OK we have 56 pens there and it says "how many pens would be left" then M? we've got 56 and we've worked out that there's 62 in a class

P: (silent RES) *[pupil works silently]*

T: (FOL-INI) yeah, yeah...lean on it M...OK...do you know what you've done there? We had 62 didn't we?...so how many does that mean M, you've done some super calculating

P: (RES) 6

T: (FOL-INI) 6 brilliant there'd be 6 pens left. Give him a round of applause for that

(NB from observation, teacher remains away from whiteboard when rephrasing or interpreting, so unclear which part of the method is being questioned)

Comment [MSOffice105]: e, s, el, n

Comment [MSOffice106]: rep

Comment [MSOffice107]: m, el, p, d

Comment [MSOffice108]: rea

Comment [MSOffice109]: el, s?

Comment [MSOffice110]: d, e,

Comment [MSOffice111]: s?, el, (n), el

Comment [MSOffice112]: rep

Comment [MSOffice113]: co n, el, el, (n)

Comment [MSOffice114]: rep

Comment [MSOffice115]: e, el, n

Comment [MSOffice116]: rep

Comment [MSOffice117]: e, el, (n), cl

Comment [MSOffice118]: rea

Comment [MSOffice119]: e, d, el, com, el, e

Comment [MSOffice120]: rep

Comment [MSOffice121]: e, d

[Round of applause]

T: I particularly like, before you rub it off M, I particularly like the way...JW you're not listening to me, that he's taken away 18 and he wasn't sure at first how to do that so he partitioned his number and he's done a lot of partitioning work to get there, well done M *(indistinct)* very impressed with that one. OK one last one...let's have a look...whoops, now have a read of this one...some people have put their hand up and they can't have read it yet (*indicates enthusiastic willingness to work on whiteboard?)* now again, lots of different stages is for this problem. Who thinks they like to have a go at it? Come on K you've been bursting. You need to *(indistinct)*

P: (RES) (*reads question aloud)*

T: (FOL-INI) so there are lots of different parts, what have you got to do for the first part then?

P: (silent RES) *[works silently]*

T: (INI) so what you doing there then when you do that?

P: (RES) *(indistinct)*

T: (INI) what you doing there then, yeah, why "12 eggs in the box"? what are you underlining when you underline that J?

P: (RES) *(indistinct)*

T: (FOL-INI) she's right. She's underlining the right thing, but why are you underlining it? *(pause)*

[background P whispers: (RES because it's important]

T: (FOL-INI) its important information, I can hear M whispering to you. OK yes, come on then

P: (silent RES) [*works silently]*

T: (FOL-INI) superb, so that's the first part isn't it, so what are we going to do next K?

P: (RES) (*indistinct)*

T: (INI) (Re-initiate?) just do the *(indistinct)* we've done the underlining, what's next?

P: (RES) approximate

T: (FOL-INI) approximate OK, you don't have to do a big long calculation to approximate

P: (RES) 18

Comment [MSOffice122]: e, d, con, e

Comment [MSOffice123]: m, s, com,

Comment [MSOffice124]: i, el, p, (n), m-s?

Comment [MSOffice125]: rep

Comment [MSOffice126]: i, el

Comment [MSOffice127]: rea

Comment [MSOffice128]: el

Comment [MSOffice129]: rep

Comment [MSOffice130]: el, el, (n)

Comment [MSOffice131]: rep

Comment [MSOffice132]: e, com, el

Comment [MSOffice133]: rep

Comment [MSOffice134]: e, i, p

Comment [MSOffice135]: rea

Comment [MSOffice136]: e, com, el, (n)

Comment [MSOffice137]: rep

Comment [MSOffice138]: el

Comment [MSOffice139]: rep

Comment [MSOffice140]: e, el

Comment [MSOffice141]: rep

T: (FOL-INI) about 18, OK fair enough. Next it's "calculate" but we need to know what you're doing.

P: (silent RES) *[pupil works silently]*

T: (FOL) OK

P: (silent RES) [*continues silently]*

T: (FOL-INI) (Re-initiate?)L are you trying to calculate the answer?...OK have a look what K got first of all, we've got 7 times by 10 is 70 OK keep going (pause) tell everybody what you're doing

P: (RES) *(indistinct/working silently)*

T: (INI) if you are talking, please stop because K is trying to explain to you what she's doing. I know she's quiet. OK K what have we got there

P: (RES) *(indistinct)* take away *(indistinct)* and *(indistinct)*

T: (FOL) OK

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant OK, so that's the first part that's brilliant we've got 84 pence so what's the next part?

P: (RES) how many *(indistinct)*

T: (FOL-INI) how many boxes does 118 eggs fill? How can you do that one?

P: (RES) *(indistinct)*

T: (INI) ah, say what you think again T

P: (RES) *(indistinct)* 118 times by 7

T: (INI) if you times 118 by 7 would that get you the right answer? *(pause)* What sort of operation are we looking at C?

P: (RES) er

T: (INI) how many boxes would 118 eggs fill?

[background P: (INI) what a 118 boxes?]

T: (Re-word) we've got 118 boxes and 12 eggs in each box

[background P: (RES) *(indistinct)* boxes?]

P: (RES) er, do a division

T: (FOL-INI) a division Ok so just explain to K what you think she should do

P: (RES) er a 118 divided by 12

Comment [MSOffice142]: e, s

Comment [MSOffice143]: rea

Comment [MSOffice144]: e

Comment [MSOffice145]: rea

Comment [MSOffice146]: n, el, s, p,

Comment [MSOffice147]: rep

Comment [MSOffice148]: d, com, m, (n), el

Comment [MSOffice149]: rep

Comment [MSOffice150]: e

Comment [MSOffice151]: rep

Comment [MSOffice152]: e, el

Comment [MSOffice153]:

Comment [MSOffice154]: el, el

Comment [MSOffice155]: rep

Comment [MSOffice156]: l

Comment [MSOffice157]: rep

Comment [MSOffice158]: el, el

Comment [MSOffice159]: ack?

Comment [MSOffice160]: el

Comment [MSOffice161]: el

Comment [MSOffice162]: cl

Comment [MSOffice163]: rep

Comment [MSOffice164]: rep

Comment [MSOffice165]: e, s?

Comment [MSOffice166]: rep

T: (FOL-INI) a 118 divided by 12, OK then K, can you work with that? *(background murmuring from remainder of pupils)*

[background pupil: (RES) what's 12 twelves, a 120, 10 twelves a 120, er, just take]

T: (INI) I may be asking you to take over if K gets stuck...[*remainder of pupils very quiet; just audible whispering heard*]...group 5 people be looking, we may need, you to come and help K out, OK so what have we got so far K? you're not explaining it to us too much

P: (RES) er, *(indistinct)*

T: (INI) M's looking puzzled at you K... are you stuck with that part, with the dividing? OK, M do you think *(indistinct)*

P: (RES) *(interrupts)* I thought I could do er,

T: (FOL-INI) I can see what you're trying to do, trying to partition your 12 aren't you? Come on ML come and show her what else you could do for that one

P: (RES) This is *(indistinct)* know the tables

T: (FOL-INI) OK you know the tables, you can bring your board

P: (RES) well er, first of all

T: (INI) Come up, come up and show us.

P: (RES) you know 12 times

T: (FOL-INI) come and watch K, Let's see if he knows, he was pulling lots of strange faces. Do want to rub that part off M and then we can get...I can see what you were trying to do K that was a really good idea you tried to partition it didn't you to make your 12? That was good thinking but then you got stuck, so let's see what M's solution would be

P: (RES) well I know 12x7equals 84, and then I tried to estimate what round about how much more it would be to get to 184,

T: (FOL) good, yes

P: (RES) so I said about 5x7

T: (FOL) brilliant

P: (RES) equals 35

T: (FOL) good

P: (RES) and then I added them 2 together

Comment [MSOffice167]: e, (n), el

Comment [MSOffice168]: rep

Comment [MSOffice169]: m-s, el, (n), com

Comment [MSOffice170]: i, el, (n), el, (n)

Comment [MSOffice171]: rep

Comment [MSOffice172]: ac c, com, p, (n)

Comment [MSOffice173]: rep

Comment [MSOffice174]: e, d

Comment [MSOffice175]: rep

Comment [MSOffice176]: p

Comment [MSOffice177]: rep

Comment [MSOffice178]: d, (n), s, com, d, (n), e, com, s, (n)

Comment [MSOffice179]: rep

Comment [MSOffice180]: e

Comment [MSOffice181]: rep

Comment [MSOffice182]: e,

Comment [MSOffice183]: rep

Comment [MSOffice184]: e

Comment [MSOffice185]: rep

T: (FOL) good

P: (RES) and that equals 119.

T: (FOL-INI) OK, what did that tell you?

P: (RES) er, well that told me that this is too much so I need to put it down.

T: (FOL-INI) fantastic. What did you do then?

P: I rubbed this one out

T: (FOL) good

P: (RES) and this, so we put 4x7

T: (FOL) got a good idea there

P: (RES) and that equals 28,

T: (FOL) good

P: (RES-INI) and I add them together and it equals 102 I think, does it?

T: (RES-INI) you tell me Mark. *[background pupils have been almost silent and now give a quiet laugh and murmur]* Does anyone not agree with M? [M: I know what it equals now! I know what it equals now!] *[increased murmuring from remainder of pupils]* J what do you think for that one? A 112 M. How do you know J?

P: (RES) er, cos 8 add 4 is 12, add 28 is a 100 *(indistinct)*

T: (FOL-INI) brilliant yes, so he's got a 112, so how many boxes have you got there then M?

P: (RES) so far I've got 16

T: (FOL) OK

P: (RES) yes. So I've got 16 boxes so far, and er, I counted on to a 118 and it equals er 6 so I think the answer's 16 remainder 6.

T: (FOL-INI) 16 remainder 6. [*When M provides answer, there is an immediate vocal response from remainder of class*] Put your hand up if you think that he could have made a mistake there.

Comment [MSOffice186]: e

Comment [MSOffice187]: rep

Comment [MSOffice188]: acc, com

Comment [MSOffice189]: rep,

Comment [MSOffice190]: e, el

Comment [MSOffice191]: rep

Comment [MSOffice192]: e,

Comment [MSOffice193]: rep

Comment [MSOffice194]: e

Comment [MSOffice195]: rep

Comment [MSOffice196]: e

Comment [MSOffice197]: rep, el

Comment [MSOffice198]: acc?, el,

Comment [MSOffice199]: rep/b

Comment [MSOffice200]: rep

Comment [MSOffice201]: e, el, (n)

Comment [MSOffice202]: rep

Comment [MSOffice203]: e

Comment [MSOffice204]: I?, (pupil repeats his answer and this links with the remaining part of his answer?), rep, (con)

Comment [MSOffice205]: acc, cu

[pupils bidding] Er R let's try you. OK Put your pen down M, that was a really, really good start. There was some really good working out there but R thinks he's spotted something that's not quite right M. [background pupil: (INI) rub it out] OK rub *(indistinct)* it all out R, quick as you can R, rub that bit out as well [background pupil: (INI) just use your hand R] OK so R thinks you could have made a mistake M, so we're just going to have to listen to R. Could you explain to us what you calculated?

P: (RES) well, 18 , 18 is er near to 20 which is a 120, no a 118 is near to 20

T: (FOL) a 120

P: (RES) yes, a hundred and 20, which is er 10 times 12

T: (FOL-INI) OK, so he's got a rough estimate already. So how many boxes were you thinking it will be roughly then R, that was a good idea

P: (RES) er, it can't be 10 boxes because that's, its two eggs off, so it would have to put it down 12 which would be a 108 which is 9 times

T: (FOL-INI) OK so you're thinking that there's 9 boxes of eggs [background pupil: yes!]

P: (RES) yes

T: (INI) which are a 108 so how many eggs would be left in the *(indistinct)* then?

P: (RES) how many eggs would be left, 10

T: (INI) so *(indistinct)*. R can you tell M what actually went wrong with his?

P: (RES) er, er

T: (INI) how did M go wrong? Did any body spot what he actually did? He's smiling now because the penny's dropped. C you tell him what he did

[another pupil is allowed to explain, R needs to be excluded to explain]

P: (RES) instead of doing 2s he started doing kind of 3s

T: (INI) why do you think he did that? Why do you think he started to do?

P: (Is it) (RES) because he was using the 3 boxes

Comment [MSOffice206]: b

Comment [MSOffice207]: n, d, e, i,

Comment [MSOffice208]: d

Comment [MSOffice209]: d,

Comment [MSOffice210]: d

Comment [MSOffice211]: i, m-s, el

Comment [MSOffice212]: rep

Comment [MSOffice213]: i

Comment [MSOffice214]: rep

Comment [MSOffice215]: con, el, (n), e

Comment [MSOffice216]: rep

Comment [MSOffice217]: con

Comment [MSOffice218]: ack

Comment [MSOffice219]: rep

Comment [MSOffice220]: el

Comment [MSOffice221]: rep

Comment [MSOffice222]: el

Comment [MSOffice223]: ack?

Comment [MSOffice224]: el, el, com,, d (el)

Comment [MSOffice225]: rep

Comment [MSOffice226]: el, el

Comment [MSOffice227]: rep

T: (FOL-INI) yes, he looked at eggs and 7 boxes and he's thought there were 7 eggs in a box so he went that way, yes, rather than thinking there were 12 eggs in a box [background pupil: (INI) Mrs B! Mrs B!] [*increased murmuring*] you counted up in 12s yes, because there's 12 eggs in the box (*2 second pause; pupil may have responded indistinctly*) OK, *(indistinct)* each part you've got to underline the appropriate information, that's just where you went wrong. Right, listen very carefully [background pupil: (FOL) Mrs B! I like it the way R did it] Good boy. Right this is your chance to prove what you understand for your problem solving. In the middle...[instructions for independent task given]

Comment [MSOffice228]: c, con,

Comment [MSOffice229]: b

Comment [MSOffice230]: con, i,

Comment [MSOffice231]: m, d

Comment [MSOffice232]: b, e

Comment [MSOffice233]: c, m, s

(real-life problems given for independent task, write on sheet, underline on sheet etc
NB: Limited time of 15 minutes and limit of 3 problems)

APPENDIX 14: ANNOTATED TRANSCRIPT 4

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session

T: (INI) What do I mean by operations H? what do I mean by "recognise the inverse of the operation"...?

P: (RES) *(indistinct)*

T: (FOL-INI) good girl, finding the inverse that's really, really good *(indistinct)* so you're going to check the answer using the inverse operation, good girl. Does anybody know what an operation is, anybody remember what we said, L

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant OK. So if I happen to put this on the ...if I put that calculation up on the board, *(indistinct)* you can work out the answer and also show me also show me what the inverse of that calculation is...so we have 48 and 53 *(indistinct)* calculate the answer and then show me what the inverse of that will be. Anyone think they know the answer to that question? Give people a little bit more time. OK show me your boards, what have you got? OK R, you were very fast, can you tell us what you did?

P: (RES) well I added *(indistinct)*

T: (FOL-INI) a 101. How did you *(indistinct)*

P: (RES) *(indistinct)*

T: (FOL) good

P: (RES) *(indistinct)*

T: (FOL) good

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant. Can you see how she managed to do it? A 101 take away 53 = 48. how did other people manage to get that one all correct? (pause) brilliant, well done, OK. Let's try a different one, C, can you *(indistinct)?* This time, were going to try a slightly different one. Lets try...this one...got to know multiplication for this one. So not only do I

Comment [MSOffice1]: el, n, el

Comment [MSOffice2]: rep

Comment [MSOffice3]: e, com, m, m-s, e, el(n), el(n), n

Comment [MSOffice4]: rep

Comment [MSOffice5]: e, m, s, m, i, d, el (n), d, m, d, el, n, com, el

Comment [MSOffice6]: rep

Comment [MSOffice7]: e, el

Comment [MSOffice8]: rep

Comment [MSOffice9]: e

Comment [MSOffice10]: rep

Comment [MSOffice11]: e

Comment [MSOffice12]: rep

Comment [MSOffice13]: e, el, i, el, e, m, d, n, el, d, el,

Comment [MSOffice14]: m, d, n, d, el, com, com, e, com

want the answer A. I want you to show me the inverse operation. How do I *(indistinct)*. Wow. I can see some good answers going up, there are some boards going up there. I can't see your calculations though, that's good, you've got the answers right

P: (RES) *(indistinct)*

T: (INI) oh, you need to write this one out first of all, don't you? *(indistinct)* at the end.

Background P: (RES) *(indistinct)*

T: (INI) *(indistinct)* those people thought of something? G tell me what you've done

P: (RES) well I *(indistinct)*

T: (FOL) good

P: (RES) and *(indistinct)* divided by*(indistinct)*

T: (FOL-INI) 54 divided by 6 – 9, brilliant. How many of you got that one right?

Chorus of P: (RES) me!

T: (INI) did anyone get one a little bit different, anyone got anything slightly different to that? J what have you got?

P: (RES) I've got 9x6=54

T: (FOL) yeah

P: (RES) and then, 54 divided by 6 equals 9

T: (FOL-INI) wonderful. Did anyone get anything slightly different? E

P: (RES) *(indistinct)*

T: (FOL-INI) good. 54 divided by 9 = 6. OK. This time, well try one more. I'm going to put a multiplication on the board and I want you to tell me the two multiplications facts that I could have from that number sentence and also, the two division ones that I could get from it, so, try…so 9 times 4, you want 2 multiplications and 2 divisions. How could you make 2 multiplications? *(indistinct)* *(pause)* *(indistinct)* 4 facts on their board. Go on then B, you tell us

P: (RES) erm, 9 times 4 equals 36

T: (FOL) brilliant, yes

P: (RES) 4 times 9 equals 36

T: (INI) go on

P: (RES) 36 divided by 4 equals 9, and 36 divided by 9 equals 4

Comment [MSOffice15]: rep

Comment [MSOffice16]: com

Comment [MSOffice17]: n, el

Comment [MSOffice18]: rep

Comment [MSOffice19]: e

Comment [MSOffice20]: rep

Comment [MSOffice21]: e, el

Comment [MSOffice22]: rep

Comment [MSOffice23]: el(n), el(n), n, el

Comment [MSOffice24]: acc

Comment [MSOffice25]: rep

Comment [MSOffice26]: e, el, n

Comment [MSOffice27]: rep

Comment [MSOffice28]: e, m, s, m-s,

Comment [MSOffice29]: m, i, cl, el, com, p, n

Comment [MSOffice30]: rep

Comment [MSOffice31]: e

Comment [MSOffice32]: rep

Comment [MSOffice33]: p

Comment [MSOffice34]: rep

T: (FOL-INI) superb. House point for that. He managed to get 4 different facts *(indistinct)* how many other people got that one?

P: (RES) me! Me!

T: (FOL-INI) excellent. Well done. So when you are, working out your problems, when you check the answers, sometimes *(indistinct)* inverse operation. Now before we start, to work out our problem solving, let's have a little peep at *(indistinct)*. J what's a Q for?

P: (RES) *(indistinct)*

T: (FOL-INI) read the question, well done. J, what about the U?

P: (RES) *(indistinct)*

T: (FOL-INI) understand it. Good the U stands for "understand the question" and J:

P: (RES) underline

T: (FOL-INI) underline, brilliant. The A

P: (RES) I know! Mrs!

T: (INI) go on H, help him out

P: (RES) approximate

T: (FOL-INI) approximate. OK work out roughly what it should be. The C for, go on C

P: (RES) calculate

T: (FOL-INI) calculate, excellent and the K for, go on J today you're *(indistinct)*

P: (RES) knowing the answer is [background P: (INI) stop looking at the *(indistinct)*] sensible

T: (FOL-INI) he is looking at the board. "Knowing it's sensible" so how do you know if an answer is sensible? What would you look at? How do you know if it's going to counted right? J

P: (RES) because if

T: (FOL-INI) what would you look at *(indistinct, plus* (RES) *response from pupil)* look back to your approximation and if it's something like it, if it's very close, you know that's its sensible. OK let's have a look at this one. Some people last week did have their hand up to answer, some of these questions, and to come up and show us all how they worked out the answer

P: (INI) *(called out but indistinct)* if you didn't get a chance

Comment [MSOffice35]: e, com, con, el

Comment [MSOffice36]: b

Comment [MSOffice37]: e, m, con, m, s, n, el

Comment [MSOffice38]: rep

Comment [MSOffice39]: e, n, el

Comment [MSOffice40]: rep

Comment [MSOffice41]: e, com, n

Comment [MSOffice42]: rep

Comment [MSOffice43]: e, el

Comment [MSOffice44]: b

Comment [MSOffice45]: p, n, d

Comment [MSOffice46]: rep

Comment [MSOffice47]: e, m, com, el, p, n

Comment [MSOffice48]: rep

Comment [MSOffice49]: e, el, p, n, com

Comment [MSOffice50]: rep

Comment [MSOffice51]: d

Comment [MSOffice52]: i(e?), el, el, el, n

Comment [J53]: rep

Comment [J54]: el, e, com, m, d, h,

Comment [J55]: el

T: (RES-INI) *(reply initially directed to this pupil)* I'll be looking very carefully at some different people, so lets have, who thinks they would like to come and show us this one? Go on C.

(Supported child offers to demonstrate his thinking)

Do want to read it for us?

P: (RES) *(reads out question)*

T: (FOL-INI) brilliant OK. So where's the important information then C? show us what's important

T: (FOL) yes, 29 books, that looks good

[pupil underlines silently]

T: (INI) OK so how would you go about working this out? There's more than one part to this so what do you think you will do first?

(child shows working out but does not explain to class as he is writing- no-one asks for clarification) some of you saying "I know", try working it out on your whiteboard see if you get the same as C. *(pause)* he's got the calculation sorted. *(pause)* OK. You're right C. can you explain to everybody how you know that you've got *(indistinct)*

P: (RES) *(indistinct)*

T: (FOL-INI) OK so you took your 25 *(indistinct)* what will be the answer to that then?

P: (RES) *(indistinct)*

T: (FOL-INI) it would be 66, he's right. Well done C. and now have you got to do? *(pause)* he's got his 66, now *(indistinct)* got to do with it ?

P: (RES) *(indistinct)*

T: (FOL) 66, yes

P: (RES) *(indistinct)*

[remainder of class almost silent]

T: (INI) OK so how many *(indistinct)*

P: (RES) *(indistinct)equals 24*

[background murmur of disagreement : (RES) 23! 24!]

T: (INI) (Re-initiate?) does anyone agree with him there? Now I know he didn't approximate it when he came up did he? he did all the right things, he read the question and he underlined it, but he didn't quite approximate it, what would it be if we

Comment [J56]: m-s, m, el, p, n, d

Comment [J57]: rep

Comment [J58]: e, m, el, n, d

Comment [J59]: e

Comment [J60]: m, el, cl, el, i, d

Comment [J61]: i, m, e, d?

Comment [J62]: rep

Comment [J63]: m, e, el

Comment [J64]: rep

Comment [J65]: e, com, el, i, el

Comment [J66]: rep

Comment [J67]: e

Comment [J68]: rep

Comment [J69]: m, el

Comment [J70]: rep

Comment [J71]: n(el), m, com, con, el, ei,

approximated the answer? Roughly, what do you think? [background pupil bidding (INI)] what numbers would he use? If we've got 29, what's that nearly?

P: (RES) 30

I: (FOL-INI) 30 OK, and then 37 is near to what? *(pause)* We could add 30 and 37 couldn't we? So it's about 67and we need to take away the 43. roughly. Now, could anyone suggest how he might have made that a little bit easier? I could see what he'd done. He'd had a great idea, he ended up with 66 and knew that he had to take away 43, do you think he could have started with 66? Go on G

P: (RES) I would have done 66 take 43 *(indistinct)*

I: (FOL-INI) OK just come and show us exactly what you mean (G to whiteboard) OK C good boy, you've had a really good go there. Let's just see *(indistinct)* So it's not 66 G are you happy with that part? *(pause)* Yes. OK. So.

Background P: (INI) it's hard isn't it?

(pause)

I: (FOL-INI) now, that was the first time I've seen anybody, use it that way. That's very good G. go on keep going.

(pause)

I: *(continued)* OK so she's got 66 take away 43. that's a good way of doing it.

P: (RES) *(indistinct)* take away *(indistinct)* and then I did

I: (FOL-INI) brilliant, superb, so not only has she worked out the answer she has used the inverse to see, if she was right. Excellent, house point for that G. and one for C as well because he tried very hard *(indistinct)* it was a slightly easier way to just work out what that bit was. Let's try, OK, *(indistinct)* volunteer. OK who thinks that they'd like to come to the front and follow QUACK routine and tell us what you think? Go on J you can, you've been very quiet so far. Can you read out the question for us?

P: (RES) *(reads question aloud)*

I: (INI) OK so, what's the important information then? *(pupil underlining*(silent RES) OK . how can you approximate it then J without sort of working it out accurately in your head? What will you *(indistinct)*

P: (RES) *(indistinct)*

I: (FOL-INI) about 40. so if you've got 4 stacks and they've got 12

Comment [J72]: b

Comment [J73]: el, cl, el

Comment [J74]: rep

Comment [J75]: e, el, com, m, i, m, ch, com, e, con, el, p, n

Comment [J76]: m, d

Comment [J77]: e, com, m, i, n, el, acc, m

Comment [J78]: com

Comment [J79]: m, i, e, n, p

Comment [J80]: m, con, e

Comment [J81]: rep

Comment [J82]: e, m, com, e, i,

Comment [J83]: com, d, m, el(n), p, n, com, el (d)

Comment [J84]: rep

Comment [J85]: m, el, m, el, (n), el

Comment [J86]: rep

Comment [J87]: e, el

P: (RES) *(indistinct)*

T: (FOL-INI) that is 48 OK, that's working it out though, not roughly. And 2 stacks have 15*(pause)*

T: *(continued)* so we have 30 now and then you said 48. [P: (RES) *(indistinct)*] around 80, OK. So you've done an approximate, now we need to calculate it J*(indistinct)*

[remainder of class very quiet]

T: (FOL-INI) sshh, some people are chattering, no need to chatter. *(Pupil continues to calculate her answer* (silent RES)) OK…78. So how can you tell if the answer is sensible J? So that was a really, really good way of going about it. She said it was going to be roughly 80 and she did 4 lots of, she just actually did 4 lots of 12. she did 2 lots of 12 *(indistinct)* then she did another 2 lots of 12 so she did another 24, is 48 so she knew it was 48 and then what did you do?

P: (RES) *(indistinct)*

T: (INI) you did your 2 stacks of

P: (RES) *(indistinct)*

T: (FOL-INI) yes, which was 78, you knew that your estimation was about 80 didn't you so you must know that your answer is quite sensible. D, D can you sit on your chair properly? Well done J… OK I'm looking for some *(indistinct)*. Not many volunteers yet. Mr M saying "it's easy".

Hands up if you're going to volunteer to have a go at this one [*background pupil discussing his signature with peer] (pause)*. Come on Mr W, you've been working very hard there. OK, so you need to read it out for us then J

P: (RES) *(clearly reads question aloud)*

T: (INI) OK so let's find what you need basically

(pupil works without explanation (silent RES), *remainder of class quiet)*

[background P: (INI) what about the *(indistinct)?*]

T: (FOL-INI) you're right … because that's the actual question isn't it? "how many biscuits did she have to?" so it's very important the last one. OK so how many parts is this calculation going to be do you think? *(pause)*

P: (RES) §

Comment [J88]: rep

Comment [J89]: e, com, el

Comment [J90]: m, con, m, s, m-s? or d?, (n)

Comment [J91]: d, e, m, el, (n), m, e, con, el

Comment [J92]: rep

Comment [J93]: el

Comment [J94]: rep

Comment [J95]: e, com, d, e, m, s, com, i, cu

Comment [J96]: p, n, com, m, d, (n)

Comment [J97]: rep

Comment [J98]: m, s

Comment [J99]: el

Comment [J100]: e, (n), com, m, el, n

Comment [J101]: rep

T: (FOL-INI) 3 parts OK, tell us how you're going to go about it then. J and C have already worked it out so they're going to try and see if they get the same as you. *(pause)*

P: (RES) 48 divided by 6

[background pupil: (REP) he's used to leaning on something]

T: (FOL-INI) OK *(indistinct)* 48 divided by 6 equals 8, so what does that tell you then J?

P: (RES) er well that one, er that 6, no, 8 six ah! Yeah, 8 sixes are 48, work out er that one sixth of that

T: (FOL-INI) OK. so you've got 48 divided by 6 equals 8, what are we going to do with that 8 now?

P: (RES) *(indistinct)*

T: (FOL-INI) brilliant OK. I hope people are listening, K. *(pause)*

T: OK. So on Wednesday she's got 40 biscuits so what *(indistinct)* next?

P: (RES) well *(indistinct)*

T: (FOL) one fifth will be 35, erm, OK *(indistinct)*

(pupil continues to work out silently (silent RES))

T: Yes *(indistinct)* equals... 8, OK

P: (RES) that's one *(indistinct)*

T: (INI) so how are you going to work out how many biscuits she has left?

P: (RES) well if you add 5 and 8 together *(pause)* that's 13 and then take, and you've only got 35 *(pause)* take *(indistinct)*

T: (FOL-INI) OK, before he thinks he's done it all wrong, somebody in Group 5 like J, no, no *(indistinct)* [background P: (INI) Mrs B, Mrs B!] come on J. He'd done really, really well right up to the very ending, wasn't quite sure what to do with it. Just watch where he got up to *(indistinct)*

P: (RES) 48 divided by 6..is 8..8...14... *(indistinct)*

T: (FOL) OK. so by Wednesday, she'd got 14, that's good, that's what you'd did

P: (RES) then *(indistinct)*

T: (FOL) (Re-initiate?) that's what you did, yes, but then, this is the bit you didn't get

P: (RES) take away *(indistinct)*

P: (REP) I did that

[background P: (RES) yes!]

Comment [J102]: e, d (el), i,
Comment [J103]: rep
Comment [J104]: i,
Comment [J105]: e, m, el, n
Comment [J106]: rep
Comment [J107]: e, el
Comment [J108]: rep
Comment [J109]: e, d, n
Comment [J110]: e, m, s, el
Comment [J111]: rep
Comment [J112]: acc
Comment [J113]: e
Comment [J114]: rep
Comment [J115]: m, el
Comment [J116]: rep
Comment [J117]: m, s, p, n, e, com, d
Comment [J118]: rep
Comment [J119]: m, con, e, com
Comment [J120]: rep
Comment [J121]: e, com
Comment [J122]: rep
Comment [J123]: com
Comment [J124]: ack

T: (FOL-INI) well done *(indistinct)* work that one out *[lots of murmuring e.g. comments called out if they disagreed with or confirmed their method of working out]* Now, *[quietness returns]* in the middle of your table…

Comment [J125]: e + instructions for independent task

APPENDIX 15: ANNOTATED TRANSCRIPT 5

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

(1st day back after Half Term)

Whole-class introductory session

T: (INI) now, who can tell Z, you know all about (indistinct) when we're solving a problem, you have to try and remember a word QUACK. I'm going to pick on people today. S, what does Q stand for?

P: (RES) read the question

T: (FOL-INI) read the question, OK [P: (INI) I know!] the U is for, H

P: (RES) understand and underline

T: (FOL-INI) understand the question and underline the important bit. The A is for, K

P: (RES) approximate

T: (FOL-INI) approximate, work out roughly what you think the answer is going to be. And C, T

P: (RES) calculate

T: (FOL-INI) calculate, work it out. And the K [P: (INI) I know] is for, R

P: (RES) know if your answer is sensible

T: (FOL-INI) brilliant. Know if it's sensible. OK, going back to the approximation, is it something like it? I've noticed as well how many of you are now putting your hands up to answer. You've obviously remembered some of those because more hands are going up, which is really, really good. They could be a little bit tricky, but we'll have a look. Let's have a look at the first one. Who would like to read that for me? Go on M.

P: (RES) *(reads question)*

T: (INI) so we've read the question. what's the important information that we're going to underline? [background pupil: (RES) I've got it]

T: J come and underline the important information for me first

(Supported child underlines information(silent RES)*)*

Comment [MSOffice1]: m,n, s, ms, n, el

Comment [MSOffice2]: rep

Comment [MSOffice3]: e,

Comment [MSOffice4]: b

Comment [MSOffice5]: el, n

Comment [MSOffice6]: rep

Comment [MSOffice7]: e, el, n

Comment [MSOffice8]: rep

Comment [MSOffice9]: e, com, el, n

Comment [MSOffice10]: rep

Comment [MSOffice11]: e, com, el

Comment [MSOffice12]: b

Comment [MSOffice13]: n

Comment [MSOffice14]: rep

Comment [MSOffice15]: e, m, com, i, com, e, cl, d, el, p, n

Comment [MSOffice16]: rep

Comment [MSOffice17]: s, el,

Comment [MSOffice18]: b

Comment [MSOffice19]: n, d

[T: (FOL-INI) is there anything else that's important? [P: (INI) (b)] You've found some important bits. [P: (INI) (b)] I what do think could be important there? Do want to tell J?

P: (RES) I bag holds 1kg of sugar under the *(indistinct)* *(audible "no" from some pupils)*

[T: (FOL-INI) ok some people are saying no. S why are you saying no

P: (RES) er I don't really think it's that important

T: (INI) so how do you think that you will tackle that one? What do you need to do first? How are you going to make that one a lot easier J?

P: (RES) find out how much a gram is…[T: (REP) how much a gram] a kilogramme is

[T: (FOL-INI) good girl…so you're going to change them into the same units aren't you? Do you know how many grammes there are in a kilogramme? Oh, go on G

P: (RES) a 1000

[T: (FOL-INI) a 1000. OK. So there are a 1000g in 1kg. And if 400g have been used, how much is going to have been left in the bag? Now [P: (b)] approximate the answer. Who thinks that they know roughly what they think it's going to be? E? [P: (INI) (b)] [P: (RES) yep]

P: (RES) about 600

T: (INI) who can show me how they are going to calculate that one?...come on, will you tell everybody how you are doing it?

P: (RES) well in a 1000…take away ….which equals 650

T: (INI) (Re-initiate?) now is there anything really, really important? she's calculated it, and knowing its sensible...we know its kind of sensible, how do we know what's a sensible answer R?

P: (RES) mmm cos if there's 400g…no…if there's a kg which is a 1000g and 400 has been used…[P: (INI) I know!]

T: (FOL-INI) good girl and you can check it by doing what? How would you check it? Go on R

P: (RES) *(indistinct)*

Comment [MSOffice20]: el, com, n, el, p

Comment [MSOffice21]: b

Comment [MSOffice22]: b

Comment [MSOffice23]: rep

Comment [MSOffice24]: m, s, n, el

Comment [MSOffice25]: rep

Comment [MSOffice26]: rep

Comment [MSOffice27]: acc

Comment [MSOffice28]: e, con, el, p, n

Comment [MSOffice29]: rep

Comment [MSOffice30]: e, cl, el, m, d, el, n

Comment [MSOffice31]: b

Comment [MSOffice32]: ack

Comment [MSOffice33]: rep

Comment [MSOffice34]: el, p, n, el

Comment [MSOffice35]: rep

Comment [MSOffice36]: s, el, com, el, n

Comment [MSOffice37]: rep

Comment [MSOffice38]: b

Comment [MSOffice39]: e, el, el, p, n

Comment [MSOffice40]: rep

T: (FOL-INI) (Re-initiate?) 600 add the 400 ok. There's something very important …and I'm very particular about this and I always say you're not really right [P: (INI) she's, she's] she's forgotten what, G?

P: (RES) *(indistinct)*

T: (FOL-INI) she's forgotten the grammes [P: ah] because I tend to put "are we talking about pink elephants or rhinos" [*pupils call out suggestions*] So, OK, the answer is, 600g…let's have a go at another one. Now it is going to disappear your working out B, so, let's try number 2. Who'd like to have a go? Er C, come and show us

(Supported child C is chosen)

You're chattering so I think you must *(indistinct)*

T: so what else is important that you've not quite underlined? what else is important?

((silent RES) *child underlines)*

[P: (INI) underline the important bits!]

T: (INI) anything else that's important. There's lots of people talking. I know you're trying to work it out but give us a minute

(noticeably restless atmosphere: pupils finding problems with interactive board amusing, calling out, fidgeting)

P: (RES) 136

T: (INI) so what else is important that you've not quite underlined then? What else is important?

P: (RES) how much taller

T: (FOL-INI) how much taller. Brilliant, good boy. That's what we're after. Now, how, what are you going to do now C, after you've done that? You've read it, now is, "how much taller", we've got "sunflower" underlined, is that, is that really important? Is it? *[pause]* just "how much taller" I would say. That would be better. Good boy. So you've underlined the important bits, what are you going to do now? What are you going to do now?

P: (RES) approximate

T: (FOL-INI) approximate, so what do you think it's going to be roughly?

P: (RES) 70

Comment [MSOffice41]: e, cl, com, el, n

Comment [MSOffice42]: b

Comment [MSOffice43]: rep

Comment [MSOffice44]: e

Comment [MSOffice45]: ack

Comment [MSOffice46]: com , m, con, d, s, i, m, m-s,

Comment [MSOffice47]: com

Comment [MSOffice48]: m, el, el

Comment [MSOffice49]: rep

Comment [MSOffice50R49]:

Comment [MSOffice51]: el, i?, d

Comment [MSOffice52]: rep

Comment [MSOffice53]: m, el, el

Comment [MSOffice54]: rep

Comment [MSOffice55]: e, com, s, el, n, el, ci?

Comment [MSOffice56]: com, e, m, con, el, el

Comment [MSOffice57]: rep

Comment [MSOffice58]: e, m, el

Comment [MSOffice59]: rep

T: (FOL-INI) about 70cm, OK [P: (FOL) what!] [P: (indistinct) (RES) cm] So, let's see how C going to go about calculating the answer. Go on C. you show us. Try not to rest your hand on it. [P: (RES) 6]

P: (silent RES) *(no explanation given while writing)* [P: (FOL) he's right!]

T: (INI) sshhh *(pupils laugh as interactive board produces peculiar scribbles)* So he thinks that the answer could be 206, is that right? *("no" is audible)*...anybody agree or disagree? Anybody got anything to say about that one? *(1 second pause)* C how might you know *(laughter from some pupils)* how might you know why that one looks a bit strange? Anybody see any clues? Go on L.

P: (RES) *(indistinct <10 word reply)*

T: (FOL-INI) OK so it's another one with mixed units. L. I hope you're listening. It's another one with mixed units. And C was very wise, he knew that 2m was how many?

P: (RES) 200

T: (FOL-INI) 200cm OK, so the calculation he needs to do is what? Anyone help him out there? Sshh, you'll have to put your hand up

(teacher notices humming)

Come on J, come round here and show us...he's underlined the important bits...OK. When you approximate it J, what do you think it's going to be? Who's the person who's humming? Can you stop? [*disagreement in background regarding identity of humming pupil*] OK, keep going, you're going to approximate the answer now J. So he thinks it's going to be. [P: ? yeah] Oh, some people are saying something to you here J. what you saying to him K?

P: (RES) he's not approximated

T: (FOL-INI) ...he's not approximated it has he? Think about how you're going to approximate first OK...what will it be roughly?

(child is working out problem silently)

P: (RES) about 16

T: (FOL-INI) about 16 OK. Right, so now we've got to calculate it, so how are you going to calculate it? What did C do wrong?

P: (RES) (*indistinct*)

Comment [MSOffice60]: acc,
Comment [MSOffice61]: e?
Comment [MSOffice62]: ack
Comment [MSOffice63]: m, m-s
Comment [MSOffice64]: rep (called out)
Comment [MSOffice65]: e
Comment [MSOffice66]: d,
Comment [MSOffice67]: con, el
Comment [MSOffice68]: el, ch
Comment [MSOffice69]: n, el, l, ch, p, n
Comment [MSOffice70]: rep
Comment [MSOffice71]: m, con, n, d, l, n, com, el
Comment [MSOffice72]: rep
Comment [MSOffice73]: e, el, ch, d, cu
Comment [MSOffice74]: p, n, d, i, com, n, el, el, d,
Comment [MSOffice75]: m, d, m-s, m, el,
Comment [MSOffice76]: ack
Comment [MSOffice77]: i, el, n
Comment [MSOffice78]: rep
Comment [MSOffice79]: e, el, el
Comment [MSOffice80]: rep
Comment [MSOffice81]: e, m, i, m, el, el
Comment [MSOffice82]: rep

T: (INI) OK, you show us what you would do [pause] sshh, people can see an easier way. Now can you see what he's doing? Sshh. OK. So "how much taller", what does all that calculation mean?

P: (RES) *(indistinct)*

T: (FOL-INI) OK, cm good. How much taller is Sally's sunflower than J?

P: (RES) it's 64 [P: yeah!]

T: (FOL) it's 64

P: (RES) cm

T: (FOL-INI) Good boy, cm. [P: (REP) or (INI?) Mrs B I've got an easier way] just write 64cm there. J said there was a much easier way. J what would you have done?

P: (RES) just have 200 take away a 100...*(indistinct)* answer straight away

T: (FOL) it does, but it's not wrong is it? Yes, you can start at ...or...Brilliant. Thank you J

(teacher quietens class)

T: (INI) ah, I've skipped one, so we're going to look now at the one that says number 2, about Sinita. So, erm, [P: (INI) (b)] come on G see if you can fit through there. We haven't left a gap today, have we? L, if you stand up and then (indistinct). Sshh, I can hear that some people are actually reading the question, but there are a few people who are not. C, move away from J please and go and sit on the hard chair. Stay where you are there C. OK. So have a read of that then G

P: (RES) *(reads question aloud)*

T: (INI) in metres, OK, so, now, what do we have to do?

P: (RES) underline it

T: (FOL-INI) underline it OK. So what's the important? We could have done with a little step for you couldn't we? OK, 177cm tall, that's important. Yes. How tall is, yes, Sinita in metres. Anything else that's important?

P: (RES) the *(indistinct)*

T: (FOL-INI) well done, Sinita is twice as tall as her brother. Brilliant. So we've got to work out roughly what you think the answer's going to be. So what do you think roughly it's going to be?

P: (RES) *(indistinct)*

Comment [MSOffice83]: acc ?, d, m, el?, d, m, el

Comment [MSOffice84]: rep

Comment [MSOffice85]: e, el

Comment [MSOffice86]: rep

Comment [MSOffice87]: ack

Comment [MSOffice88]: e

Comment [MSOffice89]: rep

Comment [MSOffice90]: e,

Comment [MSOffice91]: b, com

Comment [MSOffice92]: d, i, n, el

Comment [MSOffice93]: rep, com

Comment [MSOffice94]: acc, com, e, e

Comment [MSOffice95]: ack, i, m, m-s, m

Comment [MSOffice96]: b

Comment [MSOffice97]: p, n, com, n, d, i, n, d, d, m, d, n

Comment [MSOffice98]: rep

Comment [MSOffice99]: acc, m, el

Comment [MSOffice100]: rep

Comment [MSOffice101]: e, m, el, com, e, com, e, el

Comment [MSOffice102]: rep

Comment [MSOffice103]: e, com, e, m, m-s, m, el

Comment [MSOffice104]: rep

T: (FOL-INI) (Re-initiate?) now, I can see what she's done but there's something wrong straight away. Who can spot, what she said, how many did you say again G?

P: (RES) 170

T: (FOL-INI) a 170 she said. Who can spot something that might be wrong? Before she goes any further, C

P: (RES) you've got to approximate it in metres

T: (FOL-INI) you've got to approximate it in metres. You said it was cm, that's OK you could say it's about 160cm. If it was a 160cm what would that be in m? what's a 160 in m?

P: (RES) 1.6

(ideal opportunity here for children to ask for clarification)

T: (FOL-INI) 1.6 OK. So right, so you think it's about 1.6, OK, so how are you going to work it out then G

P: (RES) well, you could do *(indistinct)*

T: (FOL) good

P: (RES) *(indistinct)* and then if you add that together

T: (FOL-INI) good but what's that 174? "174 what" have you worked out?

P: (RES) cm

T: (FOL-INI) good girl, cm, but now we've got to make sure, knowing it's sensible, has it actually answered the question? How tall is Sinita in m? how many would it be in m?

P: (RES) *(indistinct)* 1m and 74cm

T: (FOL-INI) good you could say 1m and 74cm....what else could you say? Can you think of anything else?...R's got her hand up

P: (RES) could you say 1.74?

T: (FOL-INI) exactly 1.74 m. brilliant. OK? [2 second pause] everybody understand that? When you've got 2 different, what we call mixed measurements, you need to swap it for being the same...so everybody ok with that? ( )[1 pupil says "yes"]

Now I've got some problem solving sheets....

Comment [MSOffice105]: m, s?, ch, el, n

Comment [MSOffice106]: rep

Comment [MSOffice107]: e, ch, com, n

Comment [MSOffice108]: rep

Comment [MSOffice109]: e, acc, el, el

Comment [MSOffice110]: rep

Comment [MSOffice111]: e, m, con, el, n

Comment [MSOffice112]: rep

Comment [MSOffice113]: acc

Comment [MSOffice114]: rep

Comment [MSOffice115]: e, el, el

Comment [MSOffice116]: rep

Comment [MSOffice117]: e, s?, el, el

Comment [MSOffice118]: rep

Comment [MSOffice119]: acc, com, el, el, n

Comment [MSOffice120]: rep

Comment [MSOffice121]: e, ch, i?, m, ch,

Comment [MSOffice122]: ac k

APPENDIX 16: ANNOTATED TRANSCRIPT 6

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session

T: (INI) so today when we go through some of the problems... last week I remember a point where ...was explaining ...and J was almost bursting saying "there's a quicker way, there's a quicker way, why didn't he just take away instead of...?"....and it was good because M had a way to work out....but J had a different idea...so what I would like you to do is, if somebody's explaining the way to do it or if you think you're not sure of something or perhaps you think the "teacher" the person standing here...perhaps you could ask them a question...perhaps ask why they haven't used take away instead of add...you can ask them why they're using multiplication...so I want to see if you can actually question the person teaching...its quite hard, its harder than you might think

Comment [J1]: M, s, d, con, com

T: now, do you remember that one? (teacher reads out question). Now I want somebody to come up and explain to us how they think they would work that out and you have to explain it to everybody. But if you're in the audience, maybe there's something that you're stuck on about it, maybe you could ask them a question about it, you could learn from other people's experiences. Who'd like to have a go? Come on then K come and show us

Comment [J2]: M, ch, m, s, com, d, com, n, p,

(questions displayed on interactive whiteboard)

(K G4 first volunteer)

T: (INI) how would you work it out then K? you've read the question, what would you do now?

Comment [J3]: El, el

((RES) pupil indistinctly explains working out, teacher rephrases occasionally)

Comment [J4]: rep

T: (FOL-INI) that's the tricky part isn't it, to write each amount in KG? OK K so you need to explain to everyone what you're doing.

Comment [J5]: com, m, p

P: (RES) double all of them

Comment [J6]: rep

T: (FOL-INI) you're going to double all the ingredients. Ok let's see you do that then

((silent RES) *very quiet atmosphere while pupil is writing)*

T: (FOL-INI) OK so we've got 251... *(indistinct)* we need to write down it's flour

((INI) *x2 questions from pupils regarding use of interactive board and choice of pen)*

[background P: (REP) you could have just drawn an arrow to it]

T: (INI) so then what do you need to do K?

P: (RES) change them into kg

T: (FOL) you're going to change them into kg ok

T: (INI) a 100g of butter. What would that be of a kg? a 100g [P: (INI) B]

P: (RES) is it an eighth?

T: (INI) (Re-initiate?) have a look around some people might be able to help you K do you want to ask somebody? [*no audible response*]

P: (RES) well, there's 10 hundreds in a thousand so it's a tenth

T: (FOL-INI) one tenth, one tenth of a kg...now we've got 150g of sugar to write into kg, this is where a lot of people got stuck. A 150g, how would you write that? Some people are listening and aren't going to know. J move your chair back please

T:(continued) who can help K with that one, a 150g... written as a kg? M? No? G

P: (RES) is it one seventh?

T: (FOL-INI) is it one seventh? No. Go on L

(a pupil explains how they would convert into a fraction then a decimal- this would have been an opportunity for children to seek reinforcement if necessary)

P: (RES) *(indistinct)*

[background P: (RES) yes!]

T: (FOL-INI) OK so you will put 0.15kg. OK. Add that one on K. Now that's a good point. It's not a fraction at the minute; that one's a decimal. Would you need to change the next part K?...some people are saying you can't really have a fraction for that one. Now...J you think you can. Go on, what would you say? (*this question is posed to a pupil who tends to call out)*

P: (RES) oh, I was just saying I don't think you can

T: (INI) well it's a 150g out of a 1000. Does anybody know how... to make that into a smaller fraction? C

Comment [J7]: e, m, p

Comment [J8]: m, e?, d

Comment [J9]: com

Comment [J10]: el

Comment [J11]: rep

Comment [J12]: e

Comment [J13]: el

Comment [J14]: b

Comment [J15]: rep

Comment [J16]: d, com, el or d?

Comment [J17]: m, rep, com

Comment [J18]: e, m, s, com, el, com, d

Comment [J19]: el, com, n, acc?, n

Comment [J20]: rep

Comment [J21]: e, p, n

Comment [J22]: rep

Comment [J23]: ack

Comment [J24]: m, e, m, d

Comment [J25]: rep

Comment [J26]: m, cl, el, n

P: (RES) you could halve…*(indistinct)*

T: (FOL-INI) 75. I was thinking of something easier. T

P: (RES) if you knocked [*T interrupts*]

T: (FOL-INI) good boy, if you knocked a nought off the top, if you knock a nought off the

P: (RES) bottom

T: (INI) *(indistinct)* 15/100. How else could I make that smaller? Are there any multiples that can go into 15 and a 100? Any numbers that will go into both? [2 *multiples called out*]

P3 (RES) 5

T3 (FOL-INI) 5 would, well done J. How many 5's would go into 15?

P3 (RES) 3

T3 (FOL-INI) 3 [P: (RES) 20] How many 5's into 100?

P3 (RES) 20

T: (FOL-INI) 20. So you could have 3/20. So it is possible to do a fraction. Don't think it's not possible. Now somebody explained that one and K did very, very well, but do you know no-body actually asked her any questions, no-body felt brave enough to ask her a question, so on the next one…I'd like you to ask them a question. I'm going to choose someone, C

(C from G5 is chosen as next volunteer= clear voice)

P calls out: (REP) this is one I got stuck on

T: (RES-INI) yes a few people did get stuck on this one. OK C, tell us what you're doing at the moment

P: (RES) well, I'm underlining. I'm going to approximate it

T: (FOL) you're going to approximate it OK.

P: (RES) 5x500

T: (FOL) 5x500 OK

P: (RES) yes, which is 2500

T: (INI) is there a question there for C? is there something that you think…

(immediate question from pupil)

P: (RES-INI) I wonder why you put 500x5?

Comment [J27]: rep

Comment [J28]: acc, com, n

Comment [J29]: rep

Comment [J30]: e, el

Comment [J31]: rep

Comment [J32]: el, el

Comment [J33]: rep

Comment [J34]: e, el

Comment [J35]: rep

Comment [J36]: e, el

Comment [J37]: rep

Comment [J38]: e, con, com, m, e, com, com, n

Comment [J39]: com

Comment [J40]: acc, m, p

Comment [J41]: rep

Comment [J42]: e

Comment [J43]: rep

Comment [J44]: e

Comment [J45]: rep

Comment [J46]: el, com

Comment [J47]: el

P: (RES) because its 450 approximately near 500 and then …(*indistinct)*

T: (FOL-INI) anybody else see anything… that's a good , well done for having a go E, house point for that…J?

P: (RES-INI) why did you do it as 450 because..?

P: (RES) because…(*indistinct and cut short)*

T: (FOL) good boy actually because otherwise you are calculating it not approximating it are you?

P: (INI) how did you get actually get the answer 2500…?

T: (RES-INI) it's an estimate, yes good boy C. Go on L.

P: (RES-INI) when you ….what measurement did you use…(*indistinct)?*

P: (RES) mmm…use kilometres because…(*indistinct)*

T: (FOL-INI) …ok so I'm not, I think, go on L is that what you meant?

P: (RES) I thought...

P: (RES) (*indistinct)*

T: (FOL-INI) (Re-initiate?) now I read that a different way, did anyone else read that slightly differently to what C did, anyone see anything different? S?

(3 pupils asked and 3rd child is asked to talk directly to peer teacher)

P: (RES) (*indistinct)*

T: (INI) er, J

P: (RES-INI) (*indistinct)* don't you need to…

T: (FOL-INI) he's just approximated at the minute though J. talking about reading the . Er, E

P: (RES) it says "to and from"

T: (FOL-INI) good girl. So, go on, say it to him again. What do you think's wrong with it?

P: (RES) it says (*indistinct)*

T: (FOL-INI) ah, C recognised that he might have made a mistake. Can anyone else see it? E you're quite right. Go on E

P: (RES) *(4th pupil gives their understanding of the question)* well, because he's timesed by 5 he shouldn't have timesed by 5 because that would mean she would only go to school, but she has to go from school, so that's going to be x. C, so it has to be…

Comment [J48]: rep, com

Comment [J49]: el, e, com, n

Comment [J50]: el

Comment [J51]: rep

Comment [J52]: e, com

Comment [J53]: el

Comment [J54]: e, p, n

Comment [J55]: el

Comment [J56]: rep, com

Comment [J57]: m, p, el

Comment [J58]: com or rep?

Comment [J59]: rep

Comment [J60]: m, s, ch, n

Comment [J61]: rep

Comment [J62]: n

Comment [J63]: el

Comment [J64]: com, l, n

Comment [J65]: rep

Comment [J66]: e, p, el,

Comment [J67]: rep

Comment [J68]: con, ch, e, p

Comment [J69]: m, rep, com

T: (FOL-INI) superb. [*rephrases pupil explanation]* so carry on C. So let's approximate it again

Comment [J70]: e, m, con, m, s?

P: (RES) then it would be 900 each day (pupil calls out: (RES) no!)…

Comment [J71]: rep

Comment [J72]: b?

T: (FOL) OK so it would be 900 each day

Comment [J73]: e,

P: (RES) and it's 5 days so it's 5x900…

Comment [J74]: rep

(teacher notices exasperation from a couple of pupils)

T: (FOL-INI) good, ok be thinking of any s that you need to ask C if you're not quite sure

Comment [J75]: e, m, d

T: (INI) some people might have a question about this part…anyone got any Qs then, M?

Comment [J76]: com, el, n

P: (RES-INI) why did you put 2 noughts because it's half…and you could just put 4.5

Comment [J77]: el, com

P: (RES) well you could do that but it doesn't matter because…*(indistinct)*

Comment [J78]: m, acc? , rep

*((*REP) *Teacher provides reminder about importance of correctly placing noughts)*

Comment [J79]: i, e, n

P: (RES-INI) how did you change metres into kilometres?

Comment [J80]: el

T: (FOL-INI) that's a good question…well done S… actually being very brave and she's smiling there to herself because she's not understood it and I think that's really good and really brave because put your hand up if you also really honestly and truly are not sure how C did that and S has actually been brave enough to …and has spoken for all these people…well done, good girl. OK C, you need to explain

Comment [J81]: e, com, cu, com, e, m, p

P: (RES) well…you put a point and that shows how many km …

Comment [J82]: m, rep, com

T: (FOL-INI) Ok anybody else got a question about that? That's a good explanation…go on J

Comment [J83]: m, el, e, p, n

P: (RES-INI) what if you had 4km and you only had 5 m, if you did that…*(indistinct)*

Comment [J84]: el, com

P: (RES) *(indistinct response)*

Comment [J85]: rep

T: (FOL-INI) that's a tricky question …that's a good way of thinking about it though…J?

Comment [J86]: e, n

P: (RES) I don't understand

Comment [J87]: rep

T: (INI) ok ask C which part exactly you don't understand, C will talk directly to you this time

Comment [J88]: m, p, p,

P: (RES) I didn't understand any of it

Comment [J89]: rep

(slight snigger from some pupils)

T: (INI) which part? try and be specific

Comment [J90]: el, com

P: (RES) …all the noughts…

Comment [J91]: rep

T: (INI) which parts of the noughts are you meaning then?

Comment [J92]: el

P: (RES) (*indistinct*)

(teacher determines which part pupil struggled with and acts as go-between before handing over to peer teacher)

T: (INI) do you understand the 5x99 part J? So he does need to explain it from the beginning does he? OK come on then C. Listen carefully

P: (RES) right, to get to school each day...in a week she will go....900m each day

(teacher rephrases slightly)

T: (FOL-INI?) ...C says that 900m...carry on C

P: (RES) and then she ...which makes 4500m...(*teacher checks that pupil er understands*

T: (INI) do you get that bit J? yeah, OK) and you've got to convert that...4km and then you've got 500 left and then you've got to ...by separating it...then you put the km on the end...

T: (FOL-INI) good that's important isn't it? Well done. Has that helped you a little bit J? (*spontaneous ripple of applause*) that's very kind of you. G

P: (RES) (acting as a RES-INI?) I don't get what excess means

T: (INI) oh ok go on C

P: (RES) excess means the bit that's left over

T: (REP) (*rephrases with example)*

P: (RES) (acting as an INI) so it's the remainder?

T: (FOL-INI) it is a remainder. Good girl for asking. Well done G. anybody else? K... what would you have done?

P: (RES) ...just do 10x450

T: (FOL-INI) yes, did you think about doing that C?

P: (RES) er no I just...

(round of applause for C)

(praise from teacher for and questioners and invited applause for responses from C)

T: (FOL-INI) now, C breathes a sigh of relief. Now one more I think [P: (INI) number 8! Number 8!] I think we'll do number 8. OK lots of people have their hand up for this one. I think we'll have, oh this is difficult, oh come on G, you're bursting

(lots of eager volunteers)

(Lower mainstream pupil chosen)

Comment [J93]: rep

Comment [J94]: ch, m, el, m, p, n, d

Comment [J95]: m, i

Comment [J96]: l, p

Comment [J97]: i

Comment [J98]: ch

Comment [J99]: i

Comment [J100]: e, com, e, el, com, n

Comment [J101]: rep

Comment [J102]: ack, p, n

Comment [J103]: rep

Comment [J104]: rep

Comment [J105]: rep/el

Comment [J106]: e, n, el

Comment [J107]: rep

Comment [J108]: e, el

Comment [J109]: rep, com

Comment [J110]: m, com,

Comment [J111]: b

Comment [J112]: m, s, com, m, l, com, n, com

T: (INI) so what are you going to do then G?

P: (RES) right if they're using 500g ...I'd do 1000g...

(pupils try to point something out to G [P: (REP) grammes] *and teacher reminds children that they can ask her why)*

T: (FOL) OK, 1005, OK

P: (RES) and then *(indistinct)*

T: (INI) oh there are lots of people wanting to ask you a question this time, G you ask

(peer teacher chooses pupil questioner with little hesitation)

P: (RES-INI) why did you ....*(indistinct)*

T: (RES-INI) *(responds to underlining query)* another question, come on G

P: (INI) *(peer teacher chooses)*

P: (RES) you could have done it...*(indistinct)*

T: (INI) ok so was there a reason that you did it that way G?

P: (RES) yes it's because, I did it that way because people who good at maths...but the people who are bad....

T: (FOL-INI) ok yes alright. M?

P: (RES-INI) you know you put a 1000, why did you...

(peer teacher answers directly)

P: (RES) I just...

(teacher interrupts with query)

T: (INI) why did you do it that way G?

P: (RES) to make it easier

T: (INI) *(e & n)*

P: (RES-INI) you know your answer, why didn't you just change it into 1.5kg

(teacher interjects)

T: (FOL-INI) could do. But does it actually ask you for that?...but on this occasion, I didn't actually ask you for that part so it's not necessarily wrong...

P: (RES-INI) why did you do it as an and, you could have ...

P: (RES) *(responds with something like "it's too complicated for me")*

T: (INI) *(i & n)*

Comment [J113]: m, el

Comment [J114]: m, com, rep

Comment [J115]: cl?

Comment [J116]: e

Comment [J117]: rep

Comment [J118]: i, d or p?

Comment [J119]: el

Comment [J120]: rep, p

Comment [J121]: n

Comment [J122]: rep, com

Comment [J123]: m, el

Comment [J124]: rep, com-

Comment [J125]: e,n

Comment [J126]: el

Comment [J127]: rep

Comment [J128]: el, n

Comment [J129]: rep

Comment [J130]: e, n

Comment [J131]: el

Comment [J132]: acc, el, com, n

Comment [J133]: el, com

Comment [J134]: rep

Comment [J135]: l, n

P: (RES-INI) say someone in year 3 didn't know how much a kilogramme was and then you put 1500g…wouldn't understand

(peer teacher responds without any hesitation and without seeking confirmation from teacher)

P: (RES) yes but if I was doing it to younger…*(indistinct)*

T: (FOL) OK. Thanks G

(applause for G)

[background P: (REP) that's how I found it easier]

(M chosen as next volunteer- writes without clear oral explanation)

T: (FOL-INI) OK now I can see what you're going to write M, you're going to put 1kg… take away 500g….anyone got anything to say about that? B?

P: (RES-INI?) …*(queries difficulty of mixing units) (indistinct)*

T: (INI) what do you think about that M?

P: (RES) *(indistinct)*

T: (FOL-INI) anyone thinks he's right or making it hard for himself? Anyone think it is easier? A good question to ask him

P: (RES) …*(indistinct)*…he's really just got it…*(indistinct)*

T: (INI) what might somebody do by mistake if they got that? That's what I think about it when I see it. What might somebody do, E?

P: (RES) when they think *(indistinct)* they might not know it's thousands, so *(indistinct)*

T: (FOL) yeah

Background P: (INI) I'd do it!

T: (FOL-INI) I was just a little worried when you put 1kg. Go on L

P: (RES) *(indistinct)* might think "oh it's 1kg take 500g…" *(indistinct)*

Background P: (RES) oh no

T: (INI) go on G *(indistinct)*

P: (RES) er, I wouldn't put it like that but I'd put it like I did, but if people were only just coming on and they didn't know what a kg was, I might put a 1000g and in brackets, a kg

T: (FOL-INI) that's fine the way M's done it as long as he understands it that way, but I would just be a little bit concerned that he'd not changed them all into the same units…

Comment [J136]: i or com?

Comment [J137]: Ack?, rep

Comment [J138]: e

Comment [J139]: com

Comment [J140]: m, m-s or acc and com?, ch, n

Comment [J141]: rep

Comment [J142]: el, n

Comment [J143]: rep

Comment [J144]: el, el, e

Comment [J145]: rep

Comment [J146]: el, com, l, n

Comment [J147]: rep, com

Comment [J148]: acc

Comment [J149]: b

Comment [J150]: com, p, n

Comment [J151]: rep, com

Comment [J152]: b?

Comment [J153]: p, n

Comment [J154]: rep, com

Comment [J155]: e, com

APPENDIX 17: ANNOTATED TRANSCRIPT 7

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

Whole-class introductory session

T: (INI) OK, now if I bought something for this amount of money....and I'm going to give in £5,

P: (RES) Oo

T: (INI) who can come and show me how they think they could work out the change for that one? Who's never had a go at showing us on the Smart board? A would you like to come and have a go?... How would you work out the change that you would get from£5?...

((RES) *pupil quietly describes working out)*

T: (INI) now you'll have to explain to us what you're doing as well. Watch very carefully because if she gets stuck you might want to take over

(spontaneous dialogue between A and Josh and another pupil just in front of board)

T: OK we can tell it's a 5...and what would you do with the other part A?

(remainder of class praised for waiting patiently)

T: that was really nice actually, people talking to each other and not just accepting what somebody said but asking them what they mean. Don't forget to ask questions if you're not quite sure...or you want to ask why they did it in a certain way

(background pupil discussing working out)

P: (RES) yes!

T: (INI) ...anyone got any questions for A that they'd like to ask? Go on A, you choose.

P: (RES-INI) I don't get how, why you've done the last bit where take 60 take 8 so you could just have done umm 60 take 8, 68 instead of ...separate ways...

((RES) *indistinct response from A)*

T: (INI) B?

Comment [MSOffice1]: m, s

Comment [MSOffice2]: ack

Comment [MSOffice3]: n, n, el

Comment [MSOffice4]: rep

Comment [MSOffice5]: m, el, d

Comment [MSOffice6]: P:P

Comment [MSOffice7]: Acc, el

Comment [MSOffice8]: com

Comment [MSOffice9]: com

Comment [MSOffice10]: ack

Comment [MSOffice11]: n

Comment [MSOffice12]: p and pupil nomination

Comment [MSOffice13]: rep or el?

Comment [MSOffice14]: com

Comment [MSOffice15]: n

P: (RES) see what I would have done, as in...£2, what you need to get to £5 is... *(unclear explanation of method)* but because I know if you get the...

T: shhh, don't distract him. I know....the only thing I would say there B is I can see what you are trying to do...let's just go back to the question for A and what she's actually written down. I know I'd like to ask her a question but I bet someone's going to ask before me. Go on T

P: (RES-INI) why did you do subtraction when you could have done adding, cos...68 add 2 which is 70..

(A did not respond before teacher asked next pupil questioner)

T: (FOL-INI) it would have been easier that way. I think it would. G

P: (RES) er, I know (*indistinct)* but we couldn't hear...

T: (INI) OK which bit can you follow...which bit did you get?

P: (RES) (*indistinct)*

T: (FOL-INI) OK so she's got the £5-£3, she's stuck on the next bit. What did you do then?

P: (RES) you take away the 60 and then ...equals..

T: (FOL) I think I can see what she's done now. I was a bit confused as she wrote it down. OK, so...

P: (continued RES?) it's 3

T: (INI) shh, don't forget to put up your hand and ask a question if you're not sure...er, C

P: (RES-INI) how would you check your answer?

T: (FOL-INI) good question, go on A how would you check your answer? How do you know if you're right?..

P: (RES) add

T: (FOL-INI) add what? You're right...add which number to it?...that's a good question C.

T: which would you add to it

P: (RES) £2.68

T: (FOL-INI) that's it! Good girl, well done. £2....makes £5...OK we'll just have a couple more. R

P: (RES-INI) I know where you took away the 60 and the 8 , but how did you get 32?

Comment [MSOffice16]: rep, com

Comment [MSOffice17]: d, com, n

Comment [MSOffice18]: el, com

Comment [MSOffice19]: com , n

Comment [MSOffice20]: com

Comment [MSOffice21]: el

Comment [MSOffice22]: rep

Comment [MSOffice23R22]: rep

Comment [MSOffice24]: con, el,

Comment [MSOffice25]: rep

Comment [MSOffice26]: com , m

Comment [MSOffice27]: rep

Comment [MSOffice28]: cu?, n

Comment [MSOffice29]: el

Comment [MSOffice30]: e, p,

Comment [MSOffice31]: rep

Comment [MSOffice32]: acc, e

Comment [MSOffice33]: el

Comment [MSOffice34]: rep

Comment [MSOffice35]: e, m, i?, n

Comment [MSOffice36]: e?, el

(peer teacher does not explain)

T: (FOL-INI) I wanted to know ...as well R, go on then A. Can you explain that one? We know how you got your £3 but then you did something...we're a bit confused as to how you got your answer from that bit (pause)...can anybody explain? J you were helping A at the beginning. How did she get this bit?

P: (RES) because a pound's a 100, so you just take off 68 ...which gives you 32

T: (FOL-INI) but she's got take away 60, then take away 8...J?

P: (RES) well she has the £3, then she takes away the 60 so it makes that easier

T: (INI) OK so what's she got then?

P: (RES) £2.30

T: (INI as feedback FOL) has she?

P: (RES) no £2.40

T: (FOL) £2.40

P: (continued RES?) then if you take away the 8...then that gives you 32

T: (FOL-INI) brilliant. Good girl. Was that hard to explain that A how you got that one? Were you sure you worked it out or was it because J helped you at the last bit? (pause) be honest, it doesn't matter does it? Were you not sure about that bit yourself? Let's try [P: (INI) me!] another one. Thanks A that was a good try that one. Well done. Do want to wipe it off for us? I think we'll try another one. [background pupil: (INI) use your finger! Use both of them. P: yeah]...no it's better to use a board rubber because ...OK let's try this one this time (pause) let's have [P: (RES) oh, 37]...this time I've got a £10 note...put your hand down. Who's not had a go at showing? listen very carefully to L explanation and see if you can think of any good questions to ask her...ok L what would you do?

P: (RES) ok I'm going to start with my £10. I'm going to take away £8.34.

T: (FOL) she's doing something that some people in this class have been avoiding a little bit

P: (RES inc self-evaluation of method) (*realises she is unable to use that method successfully*) I'm not going to do that one!...(*tries alternative method*) ...the reason I've done that is because I've ...(*indistinct*)

T: (FOL) [*teacher and pupils laugh]* we'll come back to that one. I thought you were very brave then L

Comment [MSOffice37]: com, p, com, el, n, com, el

Comment [MSOffice38]: rep

Comment [MSOffice39]: e, n

Comment [MSOffice40]: rep, com

Comment [MSOffice41]: m, el

Comment [MSOffice42]: rep

Comment [MSOffice43]: acc

Comment [MSOffice44]: rep

Comment [MSOffice45]: e

Comment [MSOffice46]: rep

Comment [MSOffice47]: e, el, com, el, i, e?, e, d, d

Comment [MSOffice48]: b

Comment [MSOffice49]: d, d

Comment [MSOffice50]: ack

Comment [MSOffice51]: com, m, d,

Comment [MSOffice52]: ack

Comment [MSOffice53]: s, d, n, d, m, el,

Comment [MSOffice54]: m, rep

Comment [MSOffice55]: e?

Comment [MSOffice56]: i or self-evaluation?

Comment [MSOffice57]: com

Comment [MSOffice58]: m-s, e

(majority of children still quietly paying attention to working out e.g. interested/confused/puzzled expressions, mouthing figures, whispering suggestions)

P: (REP) I'm going to add…

T: (FOL-INI) good, she's checking her answer. That's good

T: *(continued)* …does anybody have any questions?

P: (RES) it's the wrong answer!

T: (FOL-INI)…I is saying it's the wrong answer, go on then J

P: (RES) if you do 54 add 56 that would equal 110 that's like saying 73 add 37 is going to be a 110 so you take off the 10 on the 673…663 [background P: (FOL) see I told you it was 663]

T: (FOL-INI) can you see what you've done L?...this column here…7 add 3 but you've got one on the doorstep haven't you, so you've ended up with something too much…but how would you explain that to her T?

P: (RES-INI) er, can I show my method…?

T: (FOL-INI) would you mind that L?...*(M asks teacher something as he erases L's working out)* it's up to you how you're going to explain it, the best way for everybody to understand

[background pupil: (REP? praise) go M!]

P: (RES inc self-evaluation) pretend you had £1 and …it doesn't work as easy sometimes because when you take away the 7 its normal and equals 3, yeah, oh, I'm going to start again…*(struggling with exchanging)*

T: (FOL-INI) shhh, don't talk because you won't be able to answer his question

(children are fascinated by the effort taking place: there is an air of expectancy and interest)

(M is struggling to make the answer "fit" and so fudges the working out)

(teacher spots this, laughs and light-heartedly says:

T: come on, you must have a question for him now, I can see his face, you must have a question for him now

(M is smiling away from the gaze of the class and most children are smiling or laughing)

T: go on C you tackle him

Comment [MSOffice59]: rep

Comment [MSOffice60]: e, com

Comment [MSOffice61]: n or ch?

Comment [MSOffice62]: e

Comment [MSOffice63]: e?, p

Comment [MSOffice64]: rep, com

Comment [MSOffice65]: i or com?

Comment [MSOffice66]: el, com, el

Comment [MSOffice67]: el

Comment [MSOffice68]: ch, rep

Comment [MSOffice69]: p?

Comment [MSOffice70]: i?, com

Comment [MSOffice71]: m-s (or self-evaluation?)

Comment [MSOffice72]: d

Comment [MSOffice73]: p, com, p

Comment [MSOffice74]: p, n

P: (RES-INI) how've you got 10 minus 3 equals 6?

T: (FOL-INI) thank you C! how did you get that M?

P: (RES) er! *(most children laugh)*

T: (FOL-INI) he was trying to sneak …without you noticing that one…M very cunningly known the answer but is not quite sure how it fits in with that method…so there go L, that's going to make you feel better isn't it? (pause) Oh hang on…

(one pupil is audibly saying: (INI) now what you doing M? Another P: (FOL) oh no, what's he doing?)

T: what's he trying to do now? ...he knows he's got the answer doesn't he, but he's trying to make his calculation fit his answer. Has anyone […an alternative strategy]? Come on C you're bursting, come and show us how you would have done that bit…I like the way the way you trying to work it out M…

(excited murmur from class)

T: *(continued)* actually he was trying to work with the numbers wasn't he? But when it comes to explaining how you got it, it doesn't quite work does it?

T: ok C what are you going to do?

P: (RES) convert it into pence

T: (FOL) convert it into pence C says, OK

P: (continued RES)...because that's 337p or £3.37 and then £10 is 1000p *(murmur)*

T: (REP) might have a question for you in a minute

P: (RES) … and then all you have to do is take 1000 minus 33p which is 7p and then you have to [T: OK] do…*(realizes there's a problem) (Teacher and pupils laugh)* and then you've got 7 down here *(murmur from pupils)* and then you've got..*(indistinct)*..this is … from 13 and then you've got 10 minus 7 which is 3… (audible P: (INI) Mrs. B!)…

T: (FOL-INI) we've come across a problem! Hang on

(increased murmuring and excitement from pupils)

T: …C tell us what your problem is

P: (RES) well when you've done it 10 minus 3 is 700 *(becomes a mumble; interrupted by T)*

T: (INI) now you're starting there with the thousands and the hundreds aren't you, where do you usually start for a take away? C

Comment [MSOffice75]: el

Comment [MSOffice76]: e, l?

Comment [MSOffice77]: ack

Comment [MSOffice78]: con, com, com, d

Comment [MSOffice79]: el

Comment [MSOffice80]: com

Comment [MSOffice81]: el, com, n, p, e

Comment [MSOffice82]: com, com

Comment [MSOffice83]: el

Comment [MSOffice84]: rep

Comment [MSOffice85]: e

Comment [MSOffice86]: rep, com

Comment [MSOffice87]: i

Comment [MSOffice88]: rep, com

Comment [MSOffice89]: ack

Comment [MSOffice90]: b

Comment [MSOffice91]: e, d

Comment [MSOffice92]: el

Comment [MSOffice93]: rep

Comment [MSOffice94]: com, cl, n

Another P: (RES) you start at the units?

T: (FOL-INI) you start at the units. Now there's a problem there C, why are you not starting with the units? That's my question.

(several pupils are loudly whispering that they have something to add)

T: *(continued)* when you do a take away normally you start with the units end don't you which would be zero take away 7 and everybody started off doing that and they got very frightened and said "no it doesn't work" *(pause as teacher looks to choose another pupil, audible discussion of figures/methods from pupils to each other or to peer/teacher)* can I just ask G er C is that ok? Have you got a question or did you want to show us something G?

P: (RES) show something

(pupils are more vociferous: focus of their attention is still the subtraction)

(pupils quieten again as G begins to show her working)

P: *(continues)*...a 1000 pence take away ...*(becomes confused by method)*

(sudden eruption of disquiet as pupils realise the method isn't working)

T: (FOL-INI) (Re-initiate) a 1000 pence, OK. Is everybody watching?...hang on, I'm going to get M back because he's just had a brainwave, so let's just see if he's got it this time

(audible call of (INI) "I had it! I had it!" from pupil who had shown working out earlier)

(near silence)

P: (RES) *(confidently)* so I'm taking this away first because that's 9 so that gives 1 from 10, I cross out the 10 so you can let this borrow so that's 10 take away 7 equals 3, 9 take away 3 equals 6, 9 take away 3 equals 6

(audible (FOL) "yes!" and "I did not understand that")

((INI) teacher asks J to ask him a question)

P: (RES) that's a weird method...there is a lot easier way, you've just taken it the hard way.

T: (INI) what would you have done J?

P: (RES-INI) can I show?

T: (FOL-INI) go on then, I know what you mean about that being a bit confusing, it was good way to go about it though M

Comment [MSOffice95]: rep

Comment [MSOffice96]: e, com, el, com

Comment [MSOffice97]: i?

Comment [MSOffice98]: ch, el, n

Comment [MSOffice99]: rep

Comment [MSOffice100]: rep

Comment [MSOffice101]: e, d, com, d

Comment [MSOffice102]: b

Comment [MSOffice103]: re p

Comment [MSOffice104]: ack

Comment [MSOffice105]: com

Comment [MSOffice106]: el

Comment [MSOffice107]: e, com

Comment [MSOffice108]: el

Comment [MSOffice109]: el

Comment [MSOffice110]: p, com, e

P: (RES) I know, I like hard ways

(J shows his working out but it is difficult to follow; confusing and indistinct. Nb pupils are quiet and focused- slight discussion audible)

P: (RES) I would just take that into 10...

T: (FOL-INI)) (Re-initiate) I'm not sure why you'd end up with a minus number though J. Why would you...I'm asking B. Come on B

(pupils more vociferous again, B volunteers to demonstrate method and near silence falls)

(pupils are very quiet while B describes his long confusing method using the interactive board)

(pupils are vociferous when teacher indicates that there's a problem with the method)

T: *(continued)* (FOL-INI) you were actually, you got to the right answer but some people were confused. OK B. listen

P: (RES) and then, what we've got to do is, you can safely say that it's a take-away, that which would be £7

T: (INI) OK so you're taking off the £3, yes?

P: (RES) and then take off this one which would be 3. So, but, yes, and then, we er, so we've taken away, but the £10 is not a £10 anymore *(pupils laugh)*...

T: (INI as FOL?) ah, does it?

P: (RES) something like that [background pupil: (FOL) something like that!] so we have to take a 1 off here so that equals 763

T: (FOL-INI)) (Re-initiate) OK [*vociferous response*] B, put your pen down for a second...what I would have done...is would have looked at that number as being a hundred, so if I take a one off the hundred what number would I get? ...99, ok? And we've got 1 over here, so now we've got 10 take away 7 is ....3 and 9 take away 3 is....6 and 9 take away 3 is ...6 and if I added them together would it make £10?

4 closed Q and A follow:

T: ?

P: (RES)?

Comment [MSOffice111]: acc?, com

Comment [MSOffice112]: rep

Comment [MSOffice113]: com, el, n, p

Comment [MSOffice114]: acc, com, d

Comment [MSOffice115]: rep, com

Comment [MSOffice116]: m, con,

Comment [MSOffice117]: rep

Comment [MSOffice118]: acc

Comment [MSOffice119]: rep

Comment [MSOffice120]: e?

Comment [MSOffice121]: m, d, i?

Comment [MSOffice122]: el

Comment [MSOffice123]: rep

T: (INI) so now we've got 10 take 7 is

P: (RES) 3

T: (FOL-INI) 3, then I would have 9 take away 3 is

P: (RES) 6

T: (INI) and then I've got 9 take away 3 is

P: (RES) 6

T: (INI) and if I added them together would it make £10?

P: (RES) yes

T: (FOL) it would be...M yours was very close the way you did it (*M responds defensively*: (RES) I did it, I did it! I did it like that!)

Teacher praises M for tackling this vertical method

Clear time limit given for independent task 15 mins.

Comment [MSOffice124]: el

Comment [MSOffice125]: rep

Comment [MSOffice126]: e, el

Comment [MSOffice127]: rep

Comment [MSOffice128]: el

Comment [MSOffice129]: rep

Comment [MSOffice130]: el

Comment [MSOffice131]: rep

Comment [MSOffice132]: com or e?

Comment [MSOffice133]: rep

Comment [MSOffice134]: e

APPENDIX 18: ANNOTATED TRANSCRIPT 8

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

(prior to lesson, teacher told me that children had shown varying degrees of difficulty with time-related work during a recent science lesson e.g. they could often read a digital display but were unable to relate that to analogue time)

Whole -class introductory session

(teacher introduces problem solving involving time; audible groan from one pupil)

(reminder to ask questions)

T: (INI) now, I'm not saying that...but we've got ...so, D read number 1

P: (RES) I know! (*calls out quietly*) got it, I've got it Mrs B

T: (INI) you shouldn't be chattering

T: watch to see if D gets it the same way

P: (RES) yeah...ok

(the pupil makes quiet running commentary as peer shows working out: (FOL) I've got it... you've lost me D...yeah...well done! *(spontaneous applause)*

T: (INI) I can hear people whispering the answer, but you've got to get your question ready, you might want to ask...

is he absolutely and absolutely correct? P: yeah

T: You might need to ask him something

P: (RES-INI) *(calls out)* Mrs B I didn't do it that way though *(pauses while teacher chooses someone else)* I did an easy way

(teacher chooses someone else)

P: (RES) I have the answer but I don't understand how he got it [same pupil as before: (INI as RES) did you not?]

T: (INI) D how did you get it with all your calculations that you have there?

Comment [MSOffice1]: d

Comment [MSOffice2]: m, s, ms, m, n

Comment [MSOffice3]: b

Comment [MSOffice4]: d

Comment [MSOffice5]: d

Comment [MSOffice6]: ack

Comment [MSOffice7]: acc

Comment [MSOffice8]: com

Comment [MSOffice9]: acc

Comment [MSOffice10]: e

Comment [MSOffice11]: com ?, d

Comment [MSOffice12]: el

Comment [MSOffice13]: rep

Comment [MSOffice14]: com

Comment [MSOffice15]: rep

Comment [MSOffice16]: com

Comment [MSOffice17]: com

Comment [MSOffice18]: e or el?

Comment [MSOffice19]: el

P: (RES) what you do is you start off with the 30 and you add 40 on to the 30 which adds 70 and then 60 minutes you know is 1 hour so ...so you've got 70 so you add 1 more hour onto that and...*(indistinct)*

(without a pause, a pupil calls out and adds) P: (INI) Mrs B, can I tell you my way?

T: (INI) er some one else, er G?

P: (RES inc evaluation) well instead of making that complicated you could have just done, if you think of 40 minutes and then knock off the 10 add it on to 3.30 then you get 4 o clock and then you add on the next 10

T: (FOL) a bit like partitioning wasn't it?

P: (INI) have you got the clocks?

T: (RES-INI) I've got the clocks, yes, don't worry...E

P: (RES inc evaluation) the way D did it, to make it slightly a bit easier he could have just done 3.30, put 3.30 down and ...3.30 plus 30 which would make 4 o' clock and you've still got your extra 10, to make it 10 past 4

T: (FOL-INI) that's what G said wasn't it? Well done. K

P: (RES) mmm I know he got 70 and ...you know that 60 is an hour...[T*(sounds distracted)*: (INI) go on tell, say exactly what you mean, I think I know what you mean but go on

P: (RES) *(continues)* ....but you could have just took away the 10 cos you know 30 add 30 is 60 which is 1 hour *[tapping sound from whiteboard and snigger]*

T: (FOL-INI)) (Re-initiate) OK D, K is actually talking to you when she's saying this and you're not really concentrating. There's something I think that was really important that he's missed. (pause) Nobody's actually mentioned that. *(teacher asks pupil to rewrite calculation and then put pen down)*

P: (RES) *(calls out)* I know, I know!

T: (INI) what's important? L

P: (RES) is it pm or am?

T: (FOL-INI) is it pm or is it am D? Because it might, you might be thinking that they got out at 4.10am

P: (INI) *(calls out)* D! D! look at where it says 13 and it'll tell you

Comment [MSOffice20]: rep

Comment [MSOffice21]: b, el

Comment [MSOffice22]: n

Comment [MSOffice23]: e, com

Comment [MSOffice24]: com

Comment [MSOffice25]: el

Comment [MSOffice26]: rep, com, n

Comment [MSOffice27]: e, com

Comment [MSOffice28]: com , e, n

Comment [MSOffice29]: acc?

Comment [MSOffice30]: com ?

Comment [MSOffice31]: M, d, cl, d,

Comment [MSOffice32]: b

Comment [MSOffice33]: el, n

Comment [MSOffice34]: rep

Comment [MSOffice35]: e, n, cl,

Comment [MSOffice36]: cl

T: (FOL-INI/Re-initiate?) what does pm mean? ((RES) *someone calls out)* no it doesn't mean per minute. T? (pause) pm, what does the p and the m stand for? Hang on, there are some people shouting out and its not good today...K?

P: (RES) past midday?

T: (FOL-INI) past midday, OK, so its not necessarily night time it could just be afternoon couldn't it? What does am mean? *(pause)* am, think about it, am, are we in am or are we in pm now? *[several voices heard at once-* P: (RES) after midnight. P: (RES) no, a.m., P: after midnight*]* ...we're am now so ...OK, D could you just wipe that off and then sit down please because I want someone to come and have a look at number 2.

[audible excitement and (INI) "oh me!]

T: (INI) who would like to have a go at this? Who's not had a go at explaining at all on the Smartboard?....put your hand down...come on C have a go [(RES) P *reads question aloud*]

T: (INI) C, OK you work that out for us and some people could perhaps ask you

[audible (INI) "I've got it!"]

[*Very quiet whispers from pupils]*

T: if you're chattering, think to yourself "why?"

T: OK so what've we got then...? We've got *(pause)* you explain to us what you've worked out then

P: (RES) er, well I've got 10.20...

T: (INI) anyone got any questions?

P: (FOL) *(calls out quietly)* yes she's right at the answer though

T: (INI) *(ignores comment)* H.

P: (RES-INI) why does it include ... *(indistinct)*

P: (RES) *(responds directly)* ...just added all them up together

[just audible (FOL) "oh right yeah good idea!"]

T: (INI) anyone got a question back about that one? K?

P: (RES) well you've got the working out right but 1.45 it's not really 1.45 because 20 add 25 is 70

Comment [MSOffice37]: el, e, n, el, d?, com, n

Comment [MSOffice38]: rep

Comment [MSOffice39]: e, com, el, cl, n, i, m, n, d, com

Comment [MSOffice40]: b

Comment [MSOffice41]: n, d, n, p,

Comment [MSOffice42]: rep

Comment [MSOffice43]: d

Comment [MSOffice44]: b

Comment [MSOffice45]: d

Comment [MSOffice46]: m, el, p

Comment [MSOffice47]: rep

Comment [MSOffice48]: el/n

Comment [MSOffice49]: e?

Comment [MSOffice50]: n

Comment [MSOffice51]: el

Comment [MSOffice52]: rep

Comment [MSOffice53]: e

Comment [MSOffice54]: el, n

Comment [MSOffice55]: m, com (e),

T: (FOL-INI) yeah that's a good point though K you've, because, you've got the answer right C, you've got your 25 minutes but go on K carry on with what you're saying [P: (RES) oh, yeah]

P: (RES as evaluation) er, but 20 add 25 , you've got that bit right, but in the hour it's 10 not *(indistinct)*

T: (INI) can you see what you've done C? *(pause)* You had 10.20 and then you've added on 25 more minutes but because you've wrote 1.45 that means what time, what's 1.45 J?

P: (RES-INI) er, *(pause)* what do you mean?

T: (RES-INI) how else can we say 1.45?

P: (RES) quarter to 2

T: (FOL-INI) quarter to 2. So if we were on 20 past 10 Ch and we added on 25 minutes we wouldn't have got to quarter to 2, so can you see? *[realises]* You've missed off your thought, good girl. You've got your answer right but that's why people were confused. Anymore questions for Ch? *(Pause)* L?

P: (RES-INI) you've got the right answer, but if you didn't know that answer and you were working it out how else would you do it ...?

(pupils are listening quietly)

(indistinct responses from pupils)

T: (INI) have you got another way that you could have worked it out C?

(just audible response from a child other than L who seems to be responding to pupil's and teacher's questions)

T: (INI) did you have a different way L? [P: (RES) yes]

P: (RES) I did...*(indistinct)*

T: (FOL-INI) 10.45 take 10.20 (pause) OK do you want to show us? That's good C thank you

(children continue to be quietly attentive)

(sudden lively response from children when calculation is completed on board NB (silent RES)pupil teacher worked in silence)

T: any questions about that? M was itching then. M?

Comment [MSOffice56]: acc, e, com, e, p

Comment [MSOffice57]: ack

Comment [MSOffice58]: e, com

Comment [MSOffice59]: el, cl, el, n

Comment [MSOffice60]: rep (el)

Comment [MSOffice61]: l

Comment [MSOffice62]: rep

Comment [MSOffice63]: e, con, com, e, com, el or ch?, n

Comment [MSOffice64]: e, com, el

Comment [MSOffice65]: l or el?

Comment [MSOffice66]: el, n

Comment [MSOffice67]: ack

Comment [MSOffice68]: rep

Comment [MSOffice69]: e, m, d, e

Comment [MSOffice70]: el, n

P: (RES-INI) why did you need to that, well, you know on that how you put it, P: (RES) yeah=) 3 take away 2 doesn't equal 2 *(additional indistinct comments from other pupils to support this observation?)*

(interjects) P: (RES) no but I've added that bit too *(additional indistinct comments from other pupils)*

P: (continued RES) there's an easy way, you just need to do the 45 and take away the 20 it's easy… *(additional indistinct comments called out by other pupils- you don't need to add an extra on)*

NB comments although indistinct, seem to be task-related embellishments

T: (INI)) (Re-initiate) there's something else...What else is strange about it?

*((*RES) *lots of called out comments)*

T: *(continued)* (INI) ssshhhh, G?

P: (RES) you don't need to borrow because that doesn't work

(simultaneous excited comments generated)

T: (FOL-INI) good, so why did you borrow one ?

P: (RES) to make it more difficult

T: (FOL-INI) *(laughs)* well done G for saying that. Good girl, you did spot that

T: why would that sort of calculation become difficult in time? Can someone think of a reason why doing a subtraction like that would…n

P: (RES)?

T: (FOL) ?

T: (INI) ?

P: (RES) I've got something to say. I think L might have done it the wrong way because …

T: (INI)?

P: (RES inc evaluation) the method's alright but I wouldn't do that for time because I don't know

T: (INI) ?

P: (RES) ?

T: (INI)) (Re-initiate) can you not think of a time when that would be tricky to do that though? Quite a hard question this one, C?

Comment [MSOffice71]: el, com

Comment [MSOffice72]: ack

Comment [MSOffice73]: acc, rep, com

Comment [MSOffice74]: com

Comment [MSOffice75]: com

Comment [MSOffice76]: el

Comment [MSOffice77]: d, n

Comment [MSOffice78]: rep, com

Comment [MSOffice79]: e, el, n

Comment [MSOffice80]: rep

Comment [MSOffice81]: e, e, com?

Comment [MSOffice82]: el, el

Comment [MSOffice83]: rep

Comment [MSOffice84]: e, com

Comment [MSOffice85]: n

Comment [MSOffice86]: com

Comment [MSOffice87]: n

Comment [MSOffice88]: e, com

Comment [MSOffice89]: el, n

Comment [MSOffice90]: rep

Comment [MSOffice91]: el, com, n

P: (RES) right, say if it was 3.20 [T: yeah] and you were minusing 9.45 the... minutes that you've minusing away in the minutes column is it's

(unclear explanation that teacher tries to rephrase briefly and moves on without further clarification)

T: (FOL-INI) that's right because it makes it very strange doesn't it? Because when you start taking it away it doesn't always make the time easy does it?

T: now, [*reads out question*] who's never had a go at explaining on the board? Do you want to have a go E? Come on. Good girl. Rub all that off for us. Right, it's very interesting to see how some people work it out because it's not always the way someone else would do it. Might give you some new ideas about how to go about it. OK, so E, how are you going to do that one then?

(E chosen next; (RES) *explains quietly as she is writing)*

T: (INI) any questions for E?

P: (RES-INI) how did you do it so quickly?

T: (INI) how did you do it so quickly E?

((RES) indistinct response)

T: (FOL-INI) she'd worked it out before. It was honest!]

P: (RES) I'm not sure how she got it

T: (INI) you're not sure how she got it. [audible (RES) "it's easy!"] go on E

((RES) quiet indistinct explanation)

T: (FOL-INI) well done E, that was a good explanation. R

P: (RES) ...1pm take away 60 minutes, that's an hour mmm which would be 12 o clock and then you add 10 back on which would be 12.10

T: (FOL) good, that would be another way to do it...

P: (RES or REP?) she's too quiet I can't hear her

T: (FOL-INI) well you'll have to listen very carefully because E's being very brave, I don't think I've ever known E to come up to the board...C.

P: (RES) it's not really a question, but *(indistinct)*

Comment [MSOffice92]: m
Comment [MSOffice93]: ack
Comment [MSOffice94]: rep
Comment [MSOffice95]: e, com,
Comment [MSOffice96]: m, n, el, p, d, m, i, m, n, el
Comment [MSOffice97]: el/n
Comment [MSOffice98]: el
Comment [MSOffice99]: rep
Comment [MSOffice100]: e, com, n
Comment [MSOffice101]: rep
Comment [MSOffice102]: l, p
Comment [MSOffice103]: com
Comment [MSOffice104]: rep
Comment [MSOffice105]: e, n
Comment [MSOffice106]: rep
Comment [MSOffice107]: e, com, n
Comment [MSOffice108]: com
Comment [MSOffice109]: m, d, com,, n
Comment [MSOffice110]: com

T: (FOL-INI) good girl, I was waiting for someone to spot that one. OK so it says pm, OK any body else got any questions before we go and have a look at the questions in our places? *(3 sec pause)* We're all happy with that? If you need a clock…

Comment [MSOffice111]: e, com

Comment [MSOffice112]: ch

[instructions for Independent Task follow]

APPENDIX 19: ANNOTATED TRANSCRIPT 9

- Sinclair and Coulthard annotations are "comments"
- Archer annotations are bracketed
- Bloom examples are highlighted

(children entered area with whiteboards and pens)

Whole-class introductory session:

Teacher displays "Today's Problem"

T: (INI) OK, before you show me any more, I would like to have a look *[background murmuring]* just at this one today. Now, today's problem, *[background murmuring]* ssh, listen, "Fred will be 48 in 2009, his mum was 27 when he was born. What year was his mum born and how old is she this year?" [Background pupil: (RES) oh my…]

P: (RES-INI) in 2006?

P: (RES) that's the problem of the day!

T: (INI) listen carefully. When we were doing some subtractions last week and there were lots and lots of borrowing things going on, it was quite tricky because sometimes you looked at it and you were blinded by so much information that you have to do one step at once. So I will give you a couple of minutes to discuss with the person next to you how you think you could do the first step of that calculation…

P: (REP?) *[calls out]* the person who was next to me has disappeared

T: (FOL) …OK, discuss somebody next to you. Well J's next to you.

P: (RES) hello J

[appropriate volume for paired discussion; teacher supporting]

T: (INI) OK. Just put your lid on your pen where you're up to. I was very impressed to hear you discussing with each another and correcting each another as well because you looked at it in a different way. Can I have a volunteer [P: (RES) me!] who thinks they could come up to the front of the board and explain to everybody else and then the rest of the class are going to question you, you've got very good at that? *[several voices heard but unclear what they are saying]* Well I think at this moment I'm going to ask KR. (pause) Now, be ready to ask her a question or two. *[background murmuring] (pause)*

Comment [MSOffice1]: m, s,

Comment [MSOffice2]: m, d, i

Comment [MSOffice3]: ack

Comment [MSOffice4]: el

Comment [MSOffice5]: rep

Comment [MSOffice6]: d, i,

Comment [MSOffice7]: m-s

Comment [MSOffice8]: i? (el)

Comment [MSOffice9]: rep

Comment [MSOffice10]: ack?

Comment [MSOffice11]: m, d, com (e), el (d), com

Comment [MSOffice12]: b

Comment [MSOffice13]: n, m, s (d)

We'll come to that in a minute C. OK K so where are you going to start? Sshh, please put your lid on your pen and be looking at K, be looking at your answer now, D lid on the pen. How're you going to start K?

P: (RES) er, 2009 take away 27 *(pupil writing on interactive board; remainder of class almost silent)*

T: (INI) OK so what are you working out there K?

P: (RES) er I'm working out the year she was born

T: (FOL-INI) the year she was born

[pupil voices in background quietly dispute the working but it is indistinct]

T: put your hand up if you've got a question for her. *(pause)* L

P: (RES) er, well, you're doing that...year but ...*will be* 48 in 2009

Another P: (RES-INI) yeah, so you'll have to take it away from er 2007, 6

P(L): (RES) no I would do it

T: (INI) anybody else? Go on L, carry on

P: (RES) I would do 2009 take away just 8 which would be *(indistinct)*

T: (INI) OK, anybody else got a question about what K done there? E

P: (RES-INI) er, I don't, *(indistinct)* how does she know *(indistinct)*?

T: (RES-INI) well I think she's starting from the beginning bit aren't you K, is that right? ...I think I'm a bit puzzled like L...C

P: (RES) I don't know if it's years or days, 27 days she's...*(indistinct)*

T: (INI) keep going then K, just let's see what your next part would be,[*someone interrupts*] hang on

[very quiet, a whisper can be heard as K writes on whiteboard]

T: (FOL-INI) when was he born? '9...86...2 another pupil: (RES) no, no anyone got a question about that one? P: (INI) K, K thinks, K thinks that he was born in 1982. Anybody got a question about that? M

P: (RES-INI) er read the question again, it was "what year was mum born?" [background pupil: it isn't him] [P: (RES) she *(indistinct)* 76]

T: (INI) come on C

P: (RES-INI) why do you think 2009? think 2006

P: (RES) just keep it as *(indistinct)*

Comment [MSOffice14]: rep, m, (n), el

Comment [MSOffice15]: d, el, (n)

Comment [MSOffice16]: rep

Comment [MSOffice17]: el, (n)

Comment [MSOffice18]: rep

Comment [MSOffice19]: acc

Comment [MSOffice20]: cu, n

Comment [MSOffice21]: rep,

Comment [MSOffice22]: acc?, com

Comment [MSOffice23]: e, i?

Comment [MSOffice24]: n, p, n

Comment [MSOffice25]: (rep) i?

Comment [MSOffice26]: m, el, n

Comment [MSOffice27]: el

Comment [MSOffice28]: rep, com, n

Comment [MSOffice29]: rep

Comment [MSOffice30]: p, s, d

Comment [MSOffice31]: acc,

Comment [MSOffice32]: rep

Comment [MSOffice33]: el (n)

Comment [MSOffice34]: b?

Comment [MSOffice35]: s, el, n

Comment [MSOffice36]: rep, cl

Comment [MSOffice37]: rep

Comment [MSOffice38]: rep

Comment [MSOffice39]: p, n

Comment [MSOffice40]: el, com

Comment [MSOffice41]: com

P: (INI) I'm just saying in the future he will be 48 *(indistinct)*

P: (RES?) *(indistinct)*

P: (RES?) *(indistinct)* saying he is 48

T: (INI) I don't think [*several pupil voices call out at once*] Ah, come on L

P: (RES) *(indistinct)*

P: (FOL?) oh *(indistinct)*!

T: (FOL-INI) (Re-initiate) put up your hand if you think that K is right so far, do you think that he was born in 1982? Anybody agree? [*several voices at once*] OK K, could L just take over from you from now on [P: bye, bye] and then she can show you what she's got OK? [*background murmuring]* Just go and sit over that way K then you can see what's she's doing.

[very quiet, slight murmur]. Sshh

P: (RES) what I did was ...take away Fred's age

T: (FOL) Fred's age, yes…I think I would have done that

[(silent RES) *pupil continues to calculate silently; very quiet background murmur*]

T: (REP) now, we did lots of borrowing last week. Ssh.

P: (RES continued) *(indistinct)* and then 9 take 4 is 5 and I haven't got anything else to exchange, so she was born in 1951 [background P: (RES) yes!] and then *(indistinct)*

[*audible but indistinct voices from background*]

T: (INI) any…anybody got any questions about that one? *(4 sec pause during this time there is a quiet discussion taking place)* E?

P: (RES) *(indistinct)*

T: (INI) L if you added that to check it, what answer would you get?

(lengthy pause)

P: (RES) *(indistinct)*

T: (FOL-INI) ah, so something, something ((INI) *exasperated pupil trying to gain attention*) has gone wrong with the taking away part (*urging continues*). Mmm. V would you tell her what's gone wrong? Would you show her? You've got the right idea ... you've done well there but

(quiet murmur) Ssh. Just write it at the side M.

Comment [MSOffice42]: com

Comment [MSOffice43]: rep?

Comment [MSOffice44]: rep?

Comment [MSOffice45]: p, n

Comment [MSOffice46]: rep

Comment [MSOffice47]: ack

Comment [MSOffice48]: cu, el, el,

Comment [MSOffice49]: m, ch, d, d

Comment [MSOffice50]: rep

Comment [MSOffice51]: e, com

Comment [MSOffice52]: m, i, d

Comment [MSOffice53]: rep

Comment [MSOffice54]: ack

Comment [MSOffice55]: el, n

Comment [MSOffice56]: rep

Comment [MSOffice57]: n, el

Comment [MSOffice58]: rep

Comment [MSOffice59]: con,

Comment [MSOffice60]: b

Comment [MSOffice61]: n, el, e, d, (n)

higher achiever M takes over at board

P: (RES) you start off like I did but not with the 2 *indistinct* altogether

T: (FOL) good yes

P: (RES continued) with 20 you can put 1 onto this, because it's OK this 1

T: (FOL) 9 take away is OK with the 1, yes

P: (RES continued) yes, but 10 take away 4

[murmur is slightly louder]

T: (FOL-INI) er, there are a lot of people making a bit of a fuss

[background pupil: (INI) *(indistinct)* is drawing on his whiteboard]

T: so it would have been 1961 when he was born [background pupil: (RES) yes!] is that OK, yes? [background pupil: (RES) yes!] "When was he was born" OK. L you carry on from that. What year was his mum born then? How are you going to do that?

P: (RES) er *(indistinct)* his age [background pupil: (RES) oh!]

T: (INI) and how would you do that then?

P (L): (RES) what I'm *(indistinct)* [P: (INI) you said I could do that!] I'm not going to take it away like *(indistinct)*

T: (FOL) OK

P: (RES continued) I'm going to do er the *(indistinct)* 7 add 8 is [background pupil: (RES) 15] 15, and then 2 add 4 *(indistinct)* [background pupil: (RES) yeah]

T: (INI) so "what year was his mum born?" Does it answer that?

P (L): (RES) yes

P: (RES continued) yes, you take it *(indistinct)*

P: (FOL?) no

P: (RES-INI) no, no that one. No, you take 2009 take…can I take over?

T: (FOL-INI) come on L, you pass over to J then. *(pause)* You've done well so far, so *(pause)*, "when he was born?" Just write the year when he was born J just above the, yes, *(pause)* just write the answer so that we don't forget what it was, it was 1961 OK [background pupil: (RES) yes!] So what year was his mum born? That's what we've got to establish now. How would you do that? You can wipe that bit off J at the bottom [*quiet murmur*]

[background pupil: (REP) I didn't see that bottom bit]

Comment [MSOffice62]: rep
Comment [MSOffice63]: e,
Comment [MSOffice64]: rep
Comment [MSOffice65]: acc
Comment [MSOffice66]: rep (acc?)
Comment [MSOffice67]: d,
Comment [MSOffice68]: rep?
Comment [MSOffice69]: con
Comment [MSOffice70]: ack
Comment [MSOffice71]: ch?
Comment [MSOffice72]: ack
Comment [MSOffice73]: l, n, p, el, el
Comment [MSOffice74]: rep
Comment [MSOffice75]: ack
Comment [MSOffice76]: el
Comment [MSOffice77]: rep
Comment [MSOffice78]: b (com?)
Comment [MSOffice79]: acc
Comment [MSOffice80]: m-s
Comment [MSOffice81]: rep
Comment [MSOffice82]: ack
Comment [MSOffice83]: el, el
Comment [MSOffice84]: rep
Comment [MSOffice85]: rep, com
Comment [MSOffice86]: rep
Comment [MSOffice87]: rep, com, el
Comment [MSOffice88]: p, (n), d, com,
Comment [MSOffice89]: s (d),
Comment [MSOffice90]: ack
Comment [MSOffice91]: el, m-s, el, d
Comment [MSOffice92]: com

T: OK

P: (RES) 2009...take away 75...*[quiet whisper in background]* what I would do first

T: (INI) (*interjects*) where did you get 75 from?

P: (RES) because her age ...(*whispered dates)*

T: (INI) anybody agree with him there? *(pause)* Anybody think they've got something completely different?

[background pupil: (RES) his age is 75!] [another background pupil: (FOL) that's OK, that's OK]

T: (INI) OK keep going then J

P: (RES continued) well instead of doing that first I would do 75 take away *(indistinct)* so that would leave that with...66 and that with 2000*(pause)*

[remainder of class very quiet, faint whispers]

T: (FOL) right OK

P: (RES continued) and if you do that from that you would get 1934

T: (INI) who agrees that his mum was born in 1934?

[(RES) *several voices heard simultaneously but unclear what they are saying]*

T: (INI) OK. How old is she this year then J?

P: (RES-INI) In 2009? *(background murmuring)*

T: (RES-INI) In 2006, how old is she *this* year?

P: (RES) If she's 75, take away 3

T: (INI)) (Re-initiate) *(interrupts)* If you think she was born in 1934, how old is she this year?*(pause)*

[background murmuring] [background pupil: 72, 72]

T: (INI) go on G how old is she?

P: (RES) 72

T: (FOL-INI) 72. Now that was actually very difficult. [*lots of squealing voices and muttering]* OK, now we haven't got an awful lot of time because we've been practising that, but in the middle of your table there are some problems.... *(instructions for Independent Tasks; time reduced to 10 minutes)*

Comment [MSOffice93]: p

Comment [MSOffice94]: rep,

Comment [MSOffice95]: el

Comment [MSOffice96]: rep

Comment [MSOffice97]: el, ch

Comment [MSOffice98]: rep, e?

Comment [MSOffice99]: m, p, n

Comment [MSOffice100]: m, i?

Comment [MSOffice101]: acc

Comment [MSOffice102]: rep

Comment [MSOffice103]: el

Comment [MSOffice104]: m, el, n

Comment [MSOffice105]: el

Comment [MSOffice106]: rep, el

Comment [MSOffice107]: rep

Comment [MSOffice108]: s, el

Comment [MSOffice109]: rep (b)

Comment [MSOffice110]: p, n

Comment [MSOffice111]: rep

Comment [MSOffice112]: e, m, com, m, i