4 ANALYTICAL METHODS

This chapter reports the analytical method developed for application to the data collected from observations (see section 3.4.5.1) – that is, the video recordings and field notes. I viewed the data from the video recordings, and I identified Episodes of students' epistemic interactions within this data. These Episodes of shared epistemic agency became the units of analysis. I did not analyse the data collected in the field notes in the same way as I did the recordings; instead, extracts from the field notes were used in the writing of the research to exemplify or explain information. Where I use extracts in this way, I identify them as emanating from the field notes. I did not analyse interview data beyond the part of this research concerned with enacting the pedagogy. I have discussed my intentions and subsequent decisions about interviews in the final section of the previous chapter.

4.1 The Unit of Analysis

An Episode of shared epistemic agency is a snapshot of participants' interactions in which the six characteristics of shared epistemic agency interplay to produce new knowledge. An Episode begins with an intention to resolve a state of unknowing and ends with the production of new knowledge formed during the knowledge-building process. In essence, an Episode consists of three distinct parts: the Intention, the knowledge building (comprising four patterns of action), and the New Knowledge (see Figure 4.1).

Figure 4.1 – The three parts of an Episode

Episodes do not have a specified time frame; they begin with the emergence of agency in the form of an Intention to advance knowledge, and result in an outcome, new knowledge, as a consequence of this Intention. Through participants' interactions and exercise of their agency, knowledge-building practices transform an Intention into New Knowledge. The idea of an Episode as the unit of analysis came from Clarke's (2001) method for analysing classroom interaction, which focused on the “object of interest” (p. 36). In my study, the object of interest is shared epistemic agency. The notion of an Episode allowed me to select relevant moments from the hours of video data, and to organise it in the terms of a theory (cf. Dowling & Brown, 2010). As a snapshot of shared epistemic agency operating within the classroom practice, an Episode is valid as the primary unit used to analyse the data gathered in this project.

The value of an Episode of shared epistemic agency as a unit of analysis is that it focuses on the analysis of shared epistemic agency as an encapsulation of the six characteristics (see section 2.4.3) identified in the literature in use to advance the learning of the classroom community. It also indicated how the aims of the study are being met, in that it shows the participants in control of their knowledge advancement, indicating a

relationship of active participation. I decided on this approach, as opposed to the analysis of isolated characteristics of shared epistemic agency exhibited by individuals or groups of participants. Analysing a given characteristic in isolation would have enhanced knowledge of that characteristic, but shared epistemic agency is most productive as an interplay of six characteristics. This decision enabled me to focus on the productive nature of shared epistemic agency; this is the purpose of this research. The analysis could then attend to the structure and development of Episodes in a bid to answer the research questions:

1. What are the indicators of shared epistemic agency in the mathematics classroom?
2. What sustains the emergence of shared epistemic agency in the mathematics classroom?

In essence, an Episode allows the analysis to focus on the interplay of the six characteristics employed by the participants, as part of the classroom practice, for their knowledge advancement. In this way, the outcome of the analysis, that is, the findings and discussion, will point to the purposeful and productive enactment of shared epistemic agency, answering to the research questions and meeting the aims of the study.

The Intention to advance knowledge is a response to a state of unknowing. This unknowing, tacit or explicit, is identified by the individual or group of individuals who expresses the intention to gain knowledge, or by an individual or group or individuals making a judgment about others' lack of knowledge. The Intention responds to the state of unknowing in a bid to resolve it. Knowledge building is the process that leads to the resolution of

the unknowing, with New Knowledge being the resolution of the unknowing into a form of knowing. By this definition and the definitions offered above, an Episode is productive of new knowledge.

While an Episode corresponds to a single intention, there is no limit to the number of times knowledge building can produce new knowledge within an Episode. This New Knowledge can recursively lead to further knowledge building that produces further New Knowledge without an explicit change of Intention, as exemplified in Figure 4.2 below.

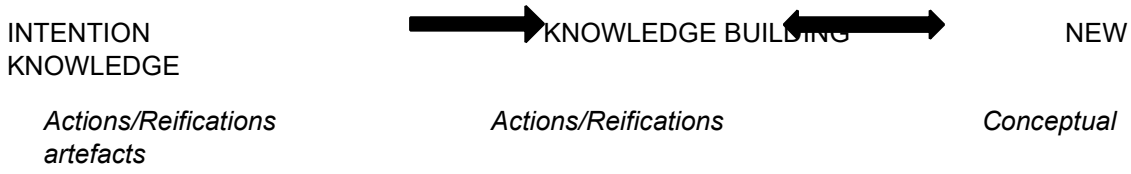

Figure 4.2. – Intention = 1, knowledge building & new knowledge ≥ 1

Each part of an Episode is made visible through actions (dialogical and physical interactions) and reifications, which are the expression of an intention, itself the proactive commitment to resolve a state of unknowing. Knowledge-building interactions are interpreted by means of the observation of actions or reifications. The third part, new knowledge, the product of an Episode, is made visible as a conceptual artefact (see Figure 4.2).

In the remainder of this section, I will explain how I have connected the characteristics of shared epistemic agency to the notion of an Episode of shared epistemic agency, and how I recognise and define this in my data. To aid in this explanation, I refer to this annotated transcript of Episode 19

throughout my discussion of intentions and knowledge building. I will also refer to another annotated transcript to explain the third part of an Episode, new knowledge. I explain the coding of these annotated transcripts below.

Extract 4.1 – Unit of Analysis – Part 1 and 2 – Episode 19

Context: Daniel and Tom are walking around the class helping students and checking their work, and Daniel is using a booklet with solutions compiled by Tom.
Daniel walks to Crimson and checks his work, and Daniel compares Crimson's solutions to Tom's solutions.

Part	Line	Participant	Actions/Reifications	Codes
INTENTION	1	Daniel (to Tom):	"Are you sure it's 11.3?"	I – Xpt.
	2	Said as Daniel walks over to Tom, he puts his hand on Tom's shoulder, and they both look at the solution in the booklet; discussion ensues. After studying their solution, they both walk back to Crimson.		MR solidarity
	3	Daniel (To Crimson):	"Did you put the 15 over 3?"	Ext
	4	Crimson:	"7 over 15."	Exp
	5	Daniel:	"Where did you get 7?"	Ext
	6	Crimson shows Daniel the work in his booklet, Daniel studies it.		

KNOWLEDGE BUILDING		7	Crimson:	“What you do … (Inaudible discussion. Crimson explains to Daniel and Daniel appearing to question and challenge.)	Exp
		8	Discussion ensues with Crimson outlining his solution.		Exp
		9	Daniel (points to a line in the booklet):	“How do you know that’s 2?”	Ext
		10	Crimson (pointing along the solution):	“This one is 6, minus this one …” (Inaudible explanation.)	Exp
		11	Roan, who is sitting nearby, joins in listening to the dialogical interaction. He comments.		
		12	Daniel (to Roan):	“I wasn’t talking to you. Sit back down.” Roan sits down.	MR
		13	Daniel keeps on studying the solution in the booklet. Tom walks up to him.		
		14	Daniel (places hand on Tom’s shoulder):	“Technical difficulties…” (pointing at Crimsons work). “He’s right.”	Xpt, MR, NK
		15	Daniel (pointing through Crimsons working out):	“That’s 4 … (inaudible explanation)”	Exp
		16	Tom:	“Why did he do it like that?”	Ext

	17	Inaudible discussion with Daniel explaining to Tom.		Exp
	18	Daniel (giving booklet to Tom):	"You correct yourself."	Xpt.
	19	Tom:	"No, I'm not going to" (Daniel holding onto the booklet)	
	20	Daniel points out something in Crimson's booklet; discussion ensues between the three, with Crimson explaining. Tom is		
		questioning and challenging Crimson's explanation; they point to the solution as the interaction goes on.		
	21	Crimson (Pointing at the question, with raised voice):	"It's not this line, it's this line!"	Xpt Exp
	22	Daniel (points to a spot on the page):	"The one here, bro."	MR
	23	Crimson (pointing at the booklet):	"The one here is 15, this one is 3."	Exp
	24	Crimson:	"You do six times four."	Exp
	25	Daniel:	"Because four is this line."	Exp
NK	26	Discussion ends with Tom taking his booklet from Daniel to correct the solution.		NK

4.1.1 Intentions

Episodes of shared epistemic agency begin with an Intention (coded as I), a proactive commitment to bring about a future outcome (Bandura, 2001, p. 6). An

Intention originates in an individual's thoughts and manifests as an action, and it is the action that the Intention produces that makes it visible. These actions can be either dialogical interactions or physical interactions. Dialogical interactions (i.e. dialogues) are verbal communications in the classroom that express the Intention, while physical interactions refer to what the participants do with their bodies to express the intention.

In Extract 4.1, I indicate where each of the characteristics of shared epistemic agency were made visible. In this way, I "coded" (cf. Saldaña, 2013, p.5) line 1 and line 2 as expressing Daniel's Intention to resolve his state of unknowing. The question "Are you sure it's 11.3?" initiates a dialogical interaction; he is verbally communicating his intention to Tom at the same time as walking over to him, a physical interaction. This verbal communication is a successful interaction as it generates a response from Tom. An intention can also be made visible by physical action; a teacher writing the working out on the board could express an intention to resolve a presumed unknowing by explaining knowledge to others. While actions make visible a current intention, reifications can make visible a previous Intention.

As noted in chapter 2, the term "reification" in this research draws on Bereiter's concept of conceptual artefacts (2002) and Wenger's concept of reification (1998). Artefacts denote human creations created to serve a

particular purpose, while reification refers to “the process of giving form to our experience by producing objects that congeal this experience into ‘thingness’” (p. 58). Reifications are our projections of meaning onto the material world, which we then perceive as existing in the world and having a reality of their own. The booklet of solutions compiled by Tom that is referred to in Extract 4.1 is a reification. It represents preparedness and mathematics knowledge, and Expertise as a teacher participant. The booklet congeals within it a previous intention and previous actions to advance the mathematics knowledge of the class. While Tom’s previous actions were not visible, as he produced the booklet in the past and outside the lesson, its presence in the lesson serves as a reification that illuminates these previous actions that resulted from a previous intention (not the one that initiated this Episode). Reifications can also be non-concrete objects, such as the mnemonic device “SOHCAHTOA” is also a reification; it is an acronym, a scholarly creation in which are congealed the trigonometric ratios, such that its use is indistinguishable from the use of that of which it is a reification. In addition, a reification can be a symbol, such as that formed by raising a hand in the classroom. While this could be considered an action, in the classroom context, the action gives a material form to an abstract call for attention.

4.1.2 Knowledge Building

Knowledge building is the second part of an Episode. It refers to the interaction between participants to respond to an Intention to resolve a

state of unknowing and produce new knowledge, which is the final outcome of the interaction.

I consider interaction as knowledge building if it proceeds from an intention to advance mathematics knowledge, and if the participants exhibit all four of the knowledge-building characteristics of shared epistemic agency. These characteristics are Extension, Explication, Expertise, and Mutual Relations.

4.1.2.1 Extension

Extension (coded as Ext) focuses on the actions and reifications of the individual participants as they strive to extend their existing mathematics knowledge**.** It elaborates on what the participants do to go beyond their existing knowledge. These actions and reifications implicate awareness of what is unknown and the seeking of ways to improve, interrogate, and challenge their existing knowledge. In Extract 4.1, line 3, Daniel seeks to extend his knowledge by the action of asking Crimson, “Did you put the 15 over 3?”. It is this action, in the form of dialogical interaction, that makes the characteristic of Extension visible in this Episode. Though not exemplified in this extract, an Extension can also be made visible by a reification. Showing one’s working out for the teacher participant to highlight your error is an Extension. In this instance, it is made visible through the working out, which reifies the existing knowledge one wants to extend. The working congeals within it one’s existing knowledge and unknowing.

4.1.2.2 Explication

Explication (coded as Exp) focuses on the actions or reifications that make knowledge in the form of concepts, processes, ideas, or formulae explicit to another participant. Explication could be a phrase, sentence, exposition, or even a diagram that clarifies the knowledge to make it useable to another. In Extract 4.1, line 4, Crimson's dialogical contribution of "7 over 15" in response to Daniel's Extension is an Explication, and points to Crimson's knowledgeability, or his epistemic authority (Oyler, 1996b, p. 149). It is the beginning of Crimson's effort to make the mathematics knowledge reified in his booklet and inhering in his mind explicit to Daniel. It is his action, in the form of a dialogical interaction, that makes the Explication visible. For instance, lines 7, 8, 10, and 21 indicate Crimson's continued efforts to explicate his solution. Explication can also be made visible by a reification, such as in line 15, where Daniel uses Crimson's working out as the Explication of the solution. The working out captures the solution to the problem and the knowledge that is presently unknown.

4.1.2.3 Expertise

Expertise (coded as Xpt) focuses on the participants expressing process authority (Oyler, 1996b, p.149) in the classroom community. Expertise places the participant in control of the learning culture of the classroom, the selection, pace, sequence, criteria of the mathematics knowledge, and the social base (Bernstein, 2000) that makes advancing community knowledge

in the classroom possible. In Extract 4.1, lines 14, 18, and 21 show the participants assuming authority within the learning culture; this is how the learning should occur. Line 21, which I labelled as both Explication and Expertise in this context, takes into account the tone of Crimson's voice. The Explication "it's not this line, it's this line" points to his epistemic authority as he explains which line should be considered for the calculation. But it is his raised tone of voice, expressing the belief that the teacher participants should know this already, that points to his Expertise.

In the context of his role as teacher, Daniel demonstrated expertise in lines 14 and 18, as he is behaving in a manner consistent with his responsibility for the learning in the classroom. I saw his actions in both lines as part of his bid to ensure that the knowledge reified in the booklet by fellow teacher participant Tom was accurate. His actions in line 18 show his authority as he says to Tom, "you correct yourself". These acts of authority make Expertise visible. Though not exemplified in this extract, Expertise can also be made visible by a reification. Other participants will interpret a participant placing a finger to their lips as an instruction to desist from a particular unwanted behaviour, be quiet and focus on advancing mathematics knowledge. The finger to the lips reifies the instruction "be quiet" and the authority of the participant who produces the reification.

4.1.2.4 Mutual Relations

The concept of Mutual Relations (coded as MR) focuses on the relationships between participants in the community that enables them to interact to advance their mathematics knowledge. It refers to how they

relate to and create an environment that they find conducive to knowledge-building interactions. In Extract 4.1, line 2,

Daniel walks over to Tom and puts his hand on Tom's shoulder, both look at the solution in the booklet, and a discussion ensues. In the narrow context of the Episode, Tom putting his hand on Tom's shoulder is evidence of a mutual relation in the form of a physical action. Tom and Daniel are the teacher participants. Tom prepared the answers to the questions in the booklet that the classroom participants were using. Daniel, having discovered that Tom's solutions may not be accurate, walks up to him to share the news that is not positive. Placing a hand on Tom's shoulder communicates solidarity between educational partners, enabling Tom to be open to hearing the need for correction.

Similarly, in line 22, the use of the word "bro" reified friendship and concern for another's feelings. Though not exemplified in the extract, like Explication and Expertise, Mutual Relations can also be made visible by reifications, such as through the issuing of an achievement point to a participant who is performing well. Issuing an achievement point reifies a positive relationship to one's teacher, peers, and learning, and, in the school's context, it acknowledges the student's potential for becoming a prefect.

For the next section on New Knowledge, I will introduce the annotated transcript of Episode 9 to explain this third part of an Episode. In section 4.2, I use this and the other annotated transcript introduced earlier in this chapter to explain the final stage of the data analysis.

Extract 4.2 – Unit of Analysis – New Knowledge – Episode 9

Context: Teacher participant James is at the board introducing the concept of 'less than' and 'greater than.' He is using his PowerPoint lesson. Student participants are focused on the board, listening to his exposition.

	Participant	**Actions/Reifications**		**Codes**
1	Student A (calling out from the back of the class):	"Ja1mes …"	*INTENTION*	MR – Trust
2	James: (turns to Student A)	"Yo!"		MR
3	Student A:	"… I'll show you something easier?"		I, Exp
4	As she speaks, student A starts to come towards the board.			I, MR
5	James stops writing and turns towards where the student participant is sitting; as she comes forward, she takes the pen he is offering and writes on the whiteboard.			Xpt, Exp
6			Knowledge Building	Exp -
7	Deepz:	What is that?		Ext
8	Student A: (pointing to the board)	"Look, 4 and 7" (pointing to the four then to the 7), "4 is less than 7."		Exp
9	(She gives the pen back to James and walks back to her seat.)			MR
10	Deepz:	"Oooh, that's smart."		MR, NK
11	Other participants:	"Ahhhh."		

12	James (nodding in acknowledgment):	“That’s smart, that’s smart.”	New Knowledge	
13	James (pointing to the board):	“That’s a good way to remember it”		Xpt, MR
14	Deepz:	“You see that, 4 and 7.”		
15	Student B:	“Greater than and less than, so four is less than 7?”		Exp
16	(James at the board sits down to allow B to explain, and for the class to talk about it.)			Xpt
17	(Class chatter.)			
18	James:	“Everyone understands that?”		Xpt
19	(Acknowledging noises and gestures.)			NK
20	Student A (says happily, with a big smile on her face):	“You see that little trick there!”		End
	James gets up and continues his explanation.			

4.1.3 New Knowledge

New Knowledge (coded as NK) is the resolution of the Episode’s Intention, the product of knowledge building. As previously mentioned, an Intention is a bid to resolve an unknowing; the resolution of the unknowing is New Knowledge. This New Knowledge takes the visible form of a conceptual artefact (Bereiter, 2002, p. 64).

Conceptual artefacts (see section 2.4.1) are abstract knowledge objects such as discussable ideas, theories, algorithms, and concepts that are represented in some material form; this material form could include an

expression. These artefacts can be used as knowledge and credited as New Knowledge only if they fulfil the criteria of being of value to people other than the individual, having a value that endures beyond the moment, having application beyond the situation that gave rise to it, and displaying some measure of creativity in their production (Bereiter & Scardamalia, 2011, p. 3). The knowledge that they express can be criticised, improved upon, or used to further develop other knowledge.

In Extract 4.2, the digits “4” and “7” are fundamental reifications, as symbolic human fabrications that reify different quantities; this intersubjectivity exists beyond the mathematics lesson. The symbols for “greater than”, “less than”, and “equals to” are also reifications, of the bigness, smallness, or sameness of one quantity compared to another. What was met with approval by the class because it mnemonically superimposed the symbols of greater than and less than upon an example of their functioning, was New Knowledge, which the students found hard to express with more complex symbols, and which in this form was more readily accepted as fact.

The New Knowledge was not what Student A wrote on the board; the New Knowledge was the knowledge that was reified by the special use of the digits “4” and “7”. The numbers 4 and 7 are the artefact, and the knowledge is the corresponding concept. The conceptual artefact in this Episode is knowledge of what the symbols “<” and “>” mean individually, and of when to use them in a mathematical context. It is credited as New Knowledge as it fulfils the criteria mentioned above. It is of value to all participants; the knowledge exists beyond this lesson on inequalities, as

the participants will use it in other contexts, such as when solving quadratic equations. The use of the digits “4” and “7” is a creative way to remember the symbols. The New Knowledge is what the participants now know, the knowledge they have gained, which is an improvement on existing knowledge.

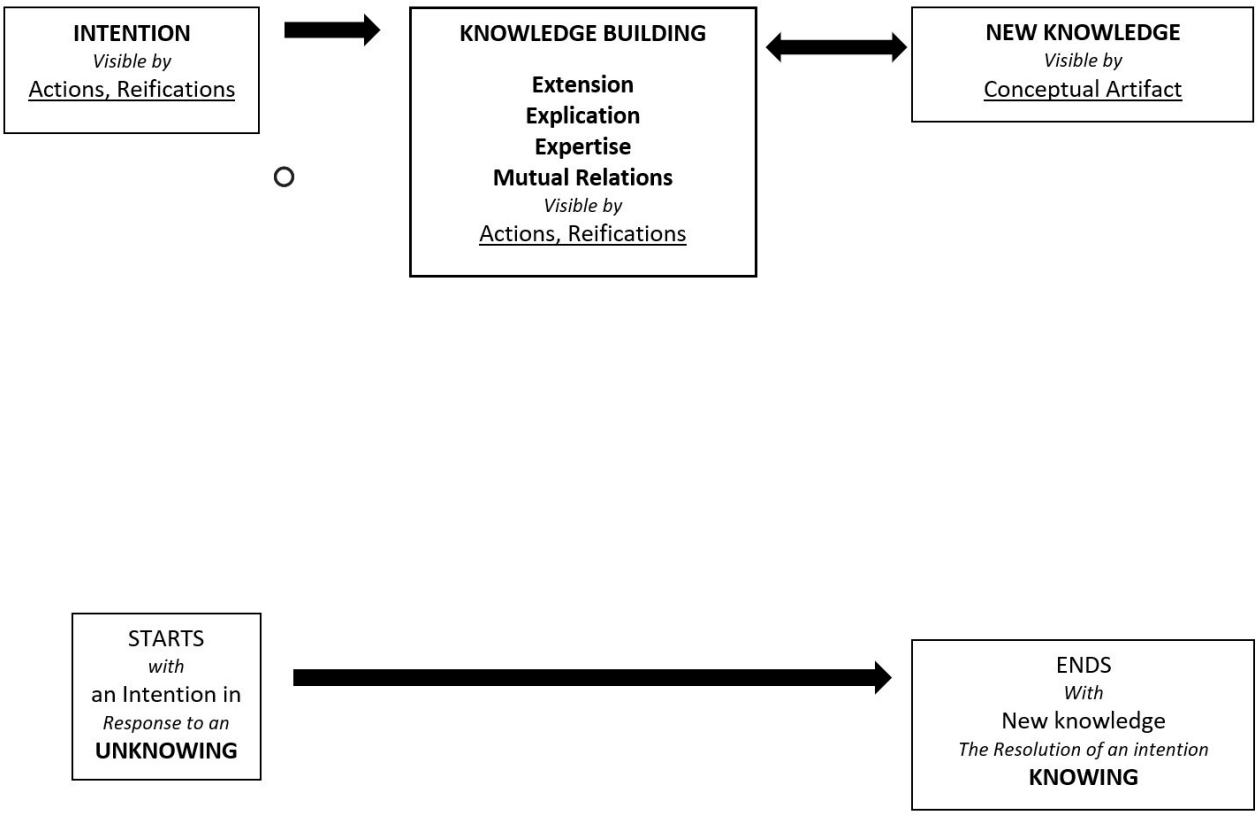

Figure 4.3 – The process of an Episode, the unit of analysis

Having demonstrated the structure of an Episode, as shown in Figure 4.3, I conclude by reiterating that the six characteristics of shared epistemic

agency are made visible through actions and the production of artefacts, as the participants interact to advance their mathematics knowledge and that of the classroom community. As is expressed in both extracts, the three parts of an Episode can overlap as they occur. In Extract 4.1, line 14, Daniel had resolved his unknowing but continued interacting with Crimson and Tom until the latter also had New Knowledge. In extract 4.1, the New Knowledge was not as explicit as in extract 4.2. However, New Knowledge was created because Tom corrected the question in the booklet, marking the end of the Episode. The following section will explain how I selected Episodes in the research.

4.2 Episode Selection

The process of identifying Episodes commenced after all the data was collected. In practice, reflection occurred at the end of each action research cycle, and data analysis did occur, though this did not result in the selection of Episodes. It took time and effort for me to develop a reliable method to analyse all the data in such a way as to answer the research questions. This was the contribution of the second action research cycle. Further reading, discussions, and feedback from my supervisors helped me develop the notion of an Episodes of shared epistemic agency that I employ as the unit of analysis.

4.2.1 The Selection Processes

Having decided on what constitutes an Episode and how to identify it, I set about rewatching all 39 hours of recordings in chronological order. While watching, I was looking for instances of an Intention expressed by the classroom participants other than myself. When I observed an Intention, I asked the following questions of the Intention in the lesson context:

1. Is it epistemic, i.e., directed towards mathematics knowledge?
2. Is the Intention resolved?
3. Does the resolution result in new mathematics knowledge?
4. Is there evidence that more than one participant is involved in stating, demonstrating, or validating the new mathematics knowledge?
5. Are all the four characteristics of knowledge building – Extension, Explication, Expertise, and Mutual Relations – demonstrated by the participants?

If the answer to all five questions was yes, I had identified an Episode. Upon such an identification, I reviewed the recordings and filled in an Episode summary sheet. The summary sheet contains the details of the Episode. An exemplar of a completed summary sheet from Extract 4.2 is shown below in Figure 4.4. In the next section, I will explain how I completed this summary sheet.

9.	Intentions (**Explication**)	Knowledge Building	New Knowledge

<table>
<tr><td rowspan="2">Who: Student A
What: to show an easier method
Action: calls out, walks to board</td><td>Extension</td><td>Who: Deepz, other participants (inaudible discussion)
Action: questions</td><td rowspan="2">End time: 00:56</td></tr>
<tr><td>Explication</td><td>Who: Student A, Student B, other participants (inaudible discussion)
Reification: “4” and “7” on board</td></tr>
<tr><td rowspan="3">Start time: 00:17</td><td></td><td>Action: explanation of reification</td><td rowspan="3">Conceptual Artefact: New way to remember what greater than and less than symbols represent</td></tr>
<tr><td>Expertise</td><td>Who: Teacher participant James
Action: allows student participants to share authority, gives up pen, allows discussion time</td></tr>
<tr><td>Mutual Relations</td><td>Who: Student A, James, Deepz
Action: Trust, informal language, acknowledgment from other participants, respect for others</td></tr>
</table>

Figure 4.4 – The summary sheet of Episode 9, Extract 4.2

4.2.1.1 Completing the Summary Sheet

I used the summary sheets to document information about each Episode to enable further analysis without requiring a re-watching. I designed the summary sheet in three columns for the three parts of an Episode. In the first column, I record information about the Intention. In Figure 4.4., the Extract 4.2, the Intention in line 3 orients the student towards Explication; the statement "…I'll show you something easier?" is born out of Student A's desire to resolve an unknowing through Explication. Student A is the '"who", and the "what" is a concise description of the who's Intention. The Intention is made visible by her dialogical interactions of calling out, and her physical action of walking towards the board (lines 1-4). I documented these, along with the start and end times of the Episode, in the "action" section of the summary sheet. In the knowledge building column of the summary sheet, I filled in a concise description of the "who", and their actions or reifications that make visible each of the four characteristics of shared epistemic agency that make up knowledge building. In the above example:

- Extension was visible in lines 7, Deepz being the "who", with other students being the "who" in line 17. These instances of Extension were made visible through the dialogical modality of questioning.
- Explication was visible in lines 5 and 8, where student A was the "who", and in line 15, where Student B was the "who". These

instances of Explication were made visible through the reification – the digits “4” and “7” on the board, followed by dialogical interaction.

- Expertise was visible in lines 5, 13, 16, and 18, wherein the teacher participant James was the “who”. His actions that made Expertise visible, through dialogical and physical interaction, were allowing Student A to share his authority by handing over the board pen, sitting down to let her explain to the classroom participants, and controlling the pace of learning.
- Mutual relations were visible in lines 1, 2, 9, 10, 13, and 16 in which Student

A, James, the teacher participant, other participants, and Deepz were the “who”.

Actions that made the Mutual Relations between them visible include in line 1,

when Student A calls out from the back of the class, reifying her trust that James would not stop her from doing what she wanted to do; this is further highlighted by her simultaneously getting up from her seat and walking towards the front of the class (line 5). The informal response of “Yo!” from James (line 2) reifies equality between participants. Deepz, James, and other participants show approval for Student A’s epistemic contribution (lines 9-11).

In the third column, I recorded information about the New Knowledge ascertained. I recorded the end time of the Episode when the unknowing was resolved, along with a brief description of the conceptual artefact. I completed a summary sheet for all thirty-six Episodes. Table 4.1 below gives concise information about the Episodes I selected.

TC	Episode	Start Time	End Time	Recording Reference	TP
3	1	1:47	2:30	1-JEDE TC3 061118.MP4	Jevonte + Deepz
	2	3:57	5:08		
	3	07:40	13:33		
	4	33:20	1:58	1-2JEDE TC3 061118.MP4	
	5	00:23	3:22	2-TEPE TC3 091118.MP4	Teesh + Pearl
	6	13:29	18:30		

	7	20:48	21:38		
	8	27:20	28:16		
	9	00:17	00:56	4-JAAD TC3 151118.MP4	James + Adam
	10	01:01	2:27		
	11	26:07	27:44		
	12	31:33	32:08		
	13	33:28	00:16	4-2JAAD TC3 151118.MP4	
	14	18:56	25:27	5-BYJA TC3 221118.MP4	Jayzee + Beyoncé
	15	08:44	10:06	5-2BYJA TC3 221118.MP4	
5	16	09:16	11:16	8-Daniel Tom TC5. MP4	Daniel +Tom
	17	31:39	32:13		
	18	1:59	4:16	8-3Daniel Tom TC5b. MP4	
	19	2.44	4:22		
	20	2:33	3:13		
	21	4:44	5:52		
	22	4:50	7:10		
	23	0:40	2:53	9-Adam James TC5.MP4	Adam +James
	24	6:25	7:52		
	25	8:36	11:40		
	26	20:46	23:06		
	27	25:04	28:29		
	28	11:49	16:50	9- 3Adam James TC5.MP4	
	29	6:25	11:05	10-Deepz Ty TC5.MP4	Deepz +Ty

	30	17:34	20:52		
	31	4:04	5:13	11-Pearl Jayzee TC5.MP4	Pearl + Jayzee
	32	13:09	29:30		
7	33	5:40	12:32	13-Adam TC7.MP4	Adam
	34	3:22	5:19	14-Deepz Ty TC7.MP4	Ty + Deepz
	35	11:28	29:22	15-Tom Jevonte TC7.MP4	Jevonte +Tom
	36	31:57	11:15	16-Adam Deepz TC7.MP4	Adam + Deepz

Table 4.1 – The thirty-six Episodes identified across the research

The first column (TC) identifies the teaching cycle of each Episode. The second column is the Episode number, the third column identifies the start time of the Episode, and the fourth column indicates the end time of the Episode. The fifth column, the lesson recording reference, identified the exact recoding file for validity. I titled the recordings of each teaching cycle with a distinctive method for easy identification. In teaching cycle 3, for instance, "1-JEDE TC3 06118" begins by indicating the recording number in chronological order. The capital letters indicate the first two letters of names of the teacher participants, the teaching cycle, and the date of the recording. In teaching cycle 5, "8-Daniel Tom TC5" identifies the recording number in chronological order of recording, the pseudonyms of the teacher participants, and the teaching cycle.

4.2.1.2 Barriers to Episode Selection

The thirty-six Episodes identified in Table 4.1 are not exhaustive of all Episodes of shared epistemic agency that occurred across the 102 lessons; they account for the Episodes I was able to identify in the video

recordings. Episodes of shared epistemic agency could have occurred during the non-recorded lessons, and Episodes of shared epistemic agency could have occurred during the recorded lessons but out of shot of the camera. The position of the camera constrained what was observable (see section 3.4.2.1.1). These constraints, in turn, limited the field of selection, which means that more Episodes occurred during the recording, but for this research, I only identified Episodes from the data collected by the camera.

My participation in any stages of an identified Episode could cause me to deselect the Episode if there is evidence that my authority hampered participant agency. For instance, in Extract 4.3 below, I was too quick to interject from line 23, so the New Knowledge produced was not solely down to the teacher participants' agency or the student participants. I habitually assumed authority.

Extract 4.3. Teaching Cycle 3. Date: 08/11/2018. Time: 06:00 – 07:28 Topic: Quadratic Formulas. Lesson 1. Teachers: Teesh & Pearl		
1	Crimson: “You know where it says minus …”	
2	Daniel: “Where …”	
3	Teesh (to Daniel): “Wait …”	
4	Crimson: “… where it says minus ‘b’, erm, and it says minus ten would you say minus and a minus is a positive or would you say …”	
5	Teesh: “you tell me …”	

6	Teesh (turning away from the board): “erm so copy …”	
7	Me: “Erm sorry, sorry, I can’t let that pass by, he did ask a valid question …”	
8	Teesh: “Erm miss, I don’t know.”	
9	Me: “Then you say you don’t know.”	
10	(Classroom chatter.)	
11	Jevonte: “Go on MathsWatch.”	

12	Pearl: “Guys we don’t know so we have to come up with an answer together.”	
13	Me: “Thank you.”	
14	Jevonte: “Wow.”	
15	Other voices: “Wow.”	
16	(Class chatter.)	
17	Teesh: “Crimson repeat your answer.”	
18	Crimson: “it says minus b and b is minus 10 so does a minus and a minus become a positive?”	
19	Pearl: “minus and a minus …”	
20	Teesh: “well to be honest a minus and a minus (inaudible) … but if you’re writing it in the calculator …”	
21	(Continuous classroom chatter as they discuss.)	
22	Crimson: (inaudible)	
23	Me: “I can’t let this pass by …”	

24	Teesh: “But miss wait, if you have a minus and a minus it’s got to be a positive but …”	
24	Me: “Wait, because its crucial point, when you say minus and a minus, what’s the ‘and’?”	
26	Teesh: “Times …”	
27	Me: “Say that then … so a minus times a minus is a what?”	
28	Crimson: “Plus.”	
29	Me: “It’s a plus, there you go, so there it should be plus ten.”	
30	Teesh: “So I was saying, you get two separate answers …”	

Extract 4.3 – Example of a deselected Episode

My assumption of epistemic authority also caused me to fail to identify Episodes in the recordings of Daniel and Jayzee’s lessons. As Jayzee lost confidence and doubted her knowledge, this affected the interaction between participants, and I was called on more to take on epistemic authority, which further reduced the teacher participants’ authority. In essence, my assumption of authority on that occasion meant that I could not identify an Episode where all the interactions were based on the participants’ knowledge. Moreover, I did not select Episodes from the lessons of the three participants who did not hand in the consent forms (see section 3.4.1.1), as I did not record their lessons. Above all, the primary barrier that caused me to not select Episodes was my assumption of authority and failure to blend it with the authority of other participants.

This research does not require every Episode of shared epistemic agency to be addressed and form part of the analysis. The research questions are about discovering what indicates and sustains shared epistemic agency in a mathematics classroom, and there is ample room for this discovery in the thirty-six Episodes that I consider in this study.

4.2.2 Transcribing an Episode

After selecting the thirty-six Episodes and completing the individual summary sheets, I then transcribed each Episode. Transcribing the Episode entailed listening to and watching the recordings repeatedly, pausing, rewinding, and re-watching to note what was said, as well as any gestures and inflections of the tone that may bear on communication.

4.2.2.1 Explaining the Extract Heading

Each extract starts with a heading such as the heading of the first transcript shown below:

Unit of Analysis – Parts 1 and 2 – Episode 19

The first part of the heading identifies what is being shown by the transcript. In this chapter, I used the first transcript to explain the units of analysis (parts 1 and 2). The second part of the heading identifies the Episode to which the transcript refers; in this example, it is Episode 19. The lesson recording reference that identifies the exact recording and the pseudonyms of the teacher participants can be found in Table 4.1 above.

Below the heading is the context of each Episode or extract. This describes what is happening in the classroom to help situate the Episode or extract within the classroom environment in which it took place.

4.2.2.2 Coding the Transcript

The first step in coding each line of the transcript of an Episode required re-watching the recording and reading any field notes from the lesson to place each action and reification in context. Considering the transcript of Episode 19 in section 4.1, the dialogical interaction in line 1 shows the Intention that underwrites the Episode. I understood this Intention to advance knowledge in relation to what had transpired before the interaction. It was in response to an unknowing that the teacher participant Daniel came to identify regarding the solution that fellow teacher participant Tom had recorded in the booklet.

The second step required identifying the end of the Episode and coding it. This identification requires carefully observing at what point in the Episode the unknowing that was the object of the Intention was resolved. The resolution of the unknowing that constitutes New Knowledge does not occur at the same temporal point for every participant in the Episode. For instance, in the transcript for Episode 19, line 14, Daniel ended the dialogue by stating that Crimson was right, and the unknowing was resolved for him at this point. However, it took until line 26 for the unknowing to be resolved for Tom. The same is the case for the transcript of Episode 9 (see Extract

4.2). While Deepz's dialogical interaction in line 10 indicated that the unknowing had been resolved, it was not until line 19 that other participants indicated, by noises and gestures, that the unknowing had been resolved at a shared level. The green rectangle labelled New Knowledge indicates this in both transcripts.

The third step involved reading through each line of the Episode in its context, and deciding which of the four knowledge-building characteristics of shared epistemic agency the action or reification makes visible at which points. On reaching such decisions, I coded each line.

A line of an Episode can be coded as one or more characteristics of shared epistemic agency – for instance, line 14 in the transcript of Episode 19. There were three different actions coded as three different characteristics of shared epistemic agency that emerged at this point in the Episode. The line began with Daniel placing a hand on Tom's shoulder. In the context of the Episode, this physical interaction of placing the hand expresses solidarity on the part of Daniel with Tom, just before the former, indicated that Crimson's solution to the problem is correct, meaning that Tom's solution is incorrect. This is coded as an expression of Mutual Relations. Following Daniel's placing of a hand on Tom's shoulder, he said, "Technical difficulties" … "He's [Crimson's] right", indicating a decision regarding the quality of the mathematics knowledge that is coded as Expertise. This dialogical interaction is also coded as New Knowledge as it indicates that Daniel has resolved his unknowing.

Transcribing and coding each Episode helped me become more familiar with my data and how each characteristic of shared epistemic agency is made visible. This understanding helped with the second level of analysis that I present in the next chapter, which considers my findings.