epiSTEMe Observation Protocol

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Introduction to the draft version of the epiSTEMe observation protocol

The context and development of the instrument

The *epiSTEMe* (Effecting Principled Improvement in STEM Education) project is an ESRC-funded research project which undertook pedagogical research aimed at improving pupils' learning and engagement in early secondary-school physical science and mathematics. The *epiSTEMe* project developed and trialled a research-informed pedagogic intervention designed to incorporate teaching features known in the research literature to improve student experience and outcomes, coupled with associated professional development. Both the intervention and the professional development were intended to be suited to implementation at scale within the English education system. The most distinctive feature of the *epiSTEMe* pedagogic approach is the inclusion of a dialogic teaching component. (Ruthven et al., 2010; Ruthven et al., 2011.) In a weaker sense, dialogic teaching refers to classroom interaction in which *multiple speakers* take extended turns which build on, or at least take account of, other such turns within the discussion (Scott et al., 2006). However, drawing of the work of Scott and colleagues, the *epiSTEMe* pedagogic approach aims to incorporate and promote a stronger notion of 'dialogue' in teaching and learning which involves the existence and recognition of *different points of view* in the discussion and the explicit comparison of these. (Ruthven et al., forthcoming; Ruthven, Hofmann & Mercer, 2011; Ruthven & Hofmann, 2013.)

This observation protocol, focused on both kinds of markers of dialogic classroom activity, was developed by members of the *epiSTEMe* team (Ruthven et al., in preparation) during the development and pilot stages of the project. It was used during the scaling-up stage of the project to evaluate the fidelity of implementation of the *epiSTEMe* pedagogic intervention and gather data on the extent to which the teaching and learning in *epiSTEMe* lessons could be described as 'dialogic' on the two dimensions identified above. The observation protocol was developed based on prior research on dialogic classroom teaching (much of which was small-scale rather than large-scale quantitative) as well as analysis of recorded observations in classrooms during the *epiSTEMe* pilot stage and tested on video recordings from those pilot classrooms.

The categories and procedure of using the protocol

Not all of the categories of the observation protocol were used during subsequent quantitative analysis of the Phase 3 intervention classrooms. 7 markers achieved good levels of inter-observer agreement and were included in subsequent quantitative analyses. A further 2 markers were included due to being judged particularly indicative and having achieved acceptable levels of inter-observer agreement. It is noted here that some of these categories occurred quite rarely even in the intervention lessons. The observational categories marked with an asterisk (*) in this document were *not* used in the subsequent quantitative analysis due to low inter-rater agreement in test analysis and/or low incidence. However, they have been included in this document for two reasons:

(i) Some of these categories marked * are assumed to have obtained low inter-rater agreement due to reasons relating to different prior assumptions about those categories during reliability testing and the pace at which this process had to take place. It is expected that these categories could be identified reliably with more opportunity for testing.

(ii) Some of the categories marked as * are considered important from the perspective of dialogic teaching and while they may be challenging to identify reliably during live coding in a classroom, they may be central for thinking about the broader phenomenon if coding lessons retrospectively on video, or for discussional or teaching purposes.

The observation protocol was only used during whole-class teaching for the more technical reason that it was not possible to observe small-group work in those classroom settings without undue intrusion and impact on student activity. However, given amenable circumstances, there is no reason why the protocol could not be used on small-group discussion as well and small-group work is indeed considered an important element of the *epiSTEMe* pedagogic model and dialogic teaching more widely.

In the *epiSTEMe* study, the observation process was applied to 4-minute units of classroom activity (with subsequent 2 minutes used for coding, with no further observation). Each 4-minute segment of the lesson was coded using one observation sheet. (As we have noted, only whole-class activity was coded for reasons given above, so any element of the 4-minute segment which was not codable activity was marked descriptively on each form.) Every observational unit was coded for the incidence of each marker, irrespective of how many times the marked may have occurred. This approach to observational live coding is sometimes called a sign system or a 0/1 system (e.g., Wragg, 1999). The decision to use this approach to coding rather than attempting to code each incidence of a category was taken for three reasons:

(i) It was not deemed likely to achieve high inter-rater reliabilities for trying to identify each single incidence of a category at pace during live coding, whereas it was deemed as realistic to evaluate whether those things were happening at all during segments of classroom talk.

(ii) Due to the fairly rare incidence of many of the categories, it was considered sufficient to know if they were happening at all during 4-minute segments of classroom activity.

(iii) Some of the categories require, for their identification, the observation of longer stretches of conversation rather than an individual turn of speech, or may in themselves involve several turns of speech, as will be discussed below.

However, if being used on coding from video or for discussional purposes, different decisions may be taken regarding the use of the instrument.

We will now turn to describing and defining the individual categories. We have anonymised both teachers and students in the exemplifying data extracts but have kept a teacher signifier and the subject (science/mathematics) to illustrate the spread of the selected examples across multiple lessons, teachers and both subjects.

Teacher actions

T1. Teacher asks for explanation / clarification / reason

This category aims to capture communicative events whereby the teacher probes and further explores a response or idea offered by a student by asking the student to *elaborate* their thinking further, rather than simply evaluating, accepting or rejecting (or ignoring) it. The category excludes incidents whereby the teacher asks a student to repeat their response because the teacher or other students did not hear it acoustically. The decision was made to form a single category covering requests for explanations, clarifications and reasons as it was found in developing and trialling the instrument that these were difficult to reliably distinguish empirically between multiple coders, especially in live coding.

Teacher actions in this category may refer to the teacher requesting the contributing student to communicate their *workings out*

> **Ex 1:**
> T: "Where did you get the figures from?" [A group is giving their solution.] [V/M]

or press for *clarification* when students use particular terminology.

> **Ex 2**
> T: What forces first of all were acting on this plasticine? …
> S: Gravity and upward thrust.
> T: An upward thrust, ooh, that's a good word. Upward thrust, what do we mean by upward thrust? [B/S]

'Why' questions and explicit requests for an '*explanation'* would also be coded under this category.

> **Ex 3**
> [S says of a concept cartoon that 1, 3 and 4 are incorrect.]
> T: So we've discounted number one then, yeah? So why are you discounting three and four then in that case, why are you discounting number four? [L/S]

Also *'How' questions* can illustrate requests for explanations or clarifications when they do not only ask for recitation of facts (cf. Smith & Meux, 1970).

> **Ex 4**
> T: What is special about the shape of a coin to make it fair [for tossing a coin]?
> S: Round.
> T: How does that make it fair? [D/M]

A core idea for the *epiSTEMe* pedagogic approach is that the application of the categories does *not* require the student's idea to be correct. As we have reported elsewhere (e.g., Ruthven & Hofmann, 2013; Ruthven, Hofmann & Mercer, 2011), in the *epiSTEMe* approach teachers can also frame such requests as asking students to offer explanations or reasons to *persuade* other students' of their suggestion (correct or incorrect).

> **Ex 5**
> T: Are we ready? So the first one [question] we have [reading the task] 'both parents have one of each so the father has the big E and a little E and the mother has a bit E and a little E', and the question is 'how likely is their baby to have the same pairing'?
> [Students call out 3 different kinds of answers: 1/3, 50% and 100%, T writes all those on the board and then wants explanations for all of them:]
> T: OK would somebody like to sell us on a third please. So one of the groups that thought a third, who thought a third? [V/M] (From Ruthven, Hofmann & Mercer, 2011).

Summary of possible identifiers:
How the student reached the answer; What do you mean by..?; Can you explain, Why; How (when not only requesting facts); Can you try to convince others? [NB. Correctness of the response/idea does not matter.]
Excluded:
Can you say that again? How many times does 4 go in 36? Situations where T asks for an answer and student spontaneously offers an elaborated answer, e.g., an explanation or justification (see Student categories below).

A particular note is important here. While there may be a general assumption or expectation that the class is listening, this category does *not* require that other students are involved. A teacher may be asking an individual student to provide an explanation for their response to check that particular student's focus or understanding without involving other students in the conversation as other than passive listeners. The following category (T2) thus makes a further demand here.

T2. Teacher puts a student idea/question to whole class to listen or respond to

This category entails communicative actions whereby the teacher *explicitly* presents an idea/response originating from a student to the whole class to listen or respond to. At the most minimal level this may refer to the teacher verbally listing a student's idea/suggestion as an element in the discussion which other students are asked to take note of. The teacher may, for example, repeat a student's idea and ask other students to indicate whether they agree or disagree with it.

> **Ex 6**
> S: I thought that when something's flat, when it's flattened out, it's more lighter but when it's more together (…)
> T: Can I just pick on what you said and what you guys said, you said that when something's spread out more, it's lighter than when you scrunch it all up. (S: Yeah.) Who thinks that's right? [B/S]

Hereby the teacher puts an idea proposed by a student for everyone to think about, making clear the idea came from a student, and explores which students agree. It does not necessarily involve the teacher asking other students to comment on the idea at that very moment (see next category T3). The **Ex 5** from T1 above ('selling an idea'), requesting an explanation for the idea that would convince other students, would also fall under this category as the teacher is explicitly communicating that other students need to pay attention to this student's idea, framing other students as the evaluative audience. (See Ruthven, Hofmann & Mercer, 2011; Ruthven & Hofmann, 2015.)

This category excludes elements of discussion where the teacher collects multiple students' views without immediate evaluation, and may even repeat those ideas, but nothing is done with those ideas at that moment and other students are not explicitly invited to consider them (see **Ex 25** in category C2). The below extract is such an example which does *not* form part of this category. Hereby the strategy of eliciting students' ideas may serve the purpose for the teacher to explore students' knowledge and keep them engaged but does not actively frame other students as the audience for those ideas.

Summary of possible identifiers:
T asks students to take account of another student's idea in their thinking; T asks other students to indicate their stance (agreement/disagreement) to an idea originating from a student; T asks a student to convince other students of their idea; T explicitly frames other students as the evaluative audience for an idea.
Excluded:
Elicitation of individual students' ideas/responses/thinking/explanations (e.g., so that teacher can find out about students' knowledge/understanding or to keep students engaged/focused), whereby nothing further is done with those ideas and other students are simply passive listeners by way of general classroom behavioural norms.

*T3. Teacher invites a student to comment on another student's idea

In this category, a sub-category of T2, the teacher not only puts an idea originating from a student to other students to listen to or indicate agreement with, but invites them to *actively comment on* another student's idea (cf. Scott & Mortimer, 2005). There are at least two reasons why it appears relevant to have this category as a separate one from the above. Firstly, since the protocol follows a particular time segment at a time, it is possible that a teacher may 'lay the ground' for students to comment on another student's idea by first presenting that student idea to the class (as e.g., in **Ex 5** above) and only in a subsequent time segment actually invite comments. Secondly, a teacher may also simply ask class to indicate agreement with a particular answer, proposed by a student (e.g., by voting) to explore general class understanding, without ever inviting students to comment or elaborate on the idea. Below is an example of this category.

Ex 7
T: Who agreed with A? [Ss respond] Okay, can I have a volunteer to tell me why they agreed with A. *(Points to student)* Excellent, thank you.
S: Because if you throw the coin two times, you could get two heads. It, the way I did it, it doesn't, I don't think it means that you get them in that order..So I think that you wouldn't have four ways because the head and tail and tail and the head (…) are the same thing. So I think you've a one in three chance of.
T: Okay, thank you. Who disagrees with that one? I'm not necessarily going to ask you but I'd like to know who disagrees. (S hands up.) Right, who would like to explain why they disagree? [A2/M]

The first part (in red) would only qualify in category T2 but the final underlined sentence is an example of T3. A further example is illustrated in **Ex 9** further below (T4), whereby a student has to evaluate how another student's idea, with which they originally disagreed, influences their thinking.

Summary of possible identifiers:
T asks students to comment on another student's idea.
Excluded:
T asks students to indicate whether they agree with what another student said (e.g., hands up).

T4. Teacher draws out difference between student ideas

This category entails communicative events whereby the teacher rephrases/refers to students' different ideas/suggestions in a way that *makes clear that they represent a different perspective*. (cf. Scott & Mortimer, 2005). Example 8 is a direct continuation of **Ex 7Ex 7** above:

Ex 8

T: Okay, okay, thank you. Who disagrees with that one? Right, who would like to explain why they disagree?
S: Well, it sort of, you can have a tail and a head and then a head and a tail, and splitting that into sort of one section, so it should be bigger than a third.
T: Right, okay. Graham. So you're saying because that we can have heads and tail and tail and head, okay, you said that it was the same thing because you counted it, but what, can you explain again, how, what words did you use?
S: Well, sort of, basically a half and a third.
T: Okay, because it could happen two ways, couldn't it? Okay, so you think it's a half, so how many is it out of in, so that would be a half (*Writing on board*), okay, what would this one be (*Points at board*)?
S: A quarter.
T: Quarter. And this one would be (*Points at board*)?
S: A quarter.
T: Okay. What do you think? Does that make sense? So we've got two view points. One (*Points at board*) it should be, we'll just call it A, so heads tail, tail head it makes no difference. This one saying because (*Points at board*) we could have two, two chances (*Points at board*) so that's not, that's not correct. [A2/M]

In some of our lessons the teachers would write all the responses proposed by students to a problem on the board with the purpose of eliciting explanations and discussing all of them. This physical action would also be coded in this category, as would instances in which the teacher draws out the difference between view points across several turns of speech, as in Example 9 below.

Ex 9

T: Do correct me if I'm wrong here Hannah, what Hannah's saying is that this one and this one [pointing] are the same.
S (Hannah): Yeah.
T: And therefore she's saying that there's still only three different outcomes and therefore they're a third each. Kate.
S (Kate): There's three outcomes, but there's two ways of getting one outcome so that outcome has a higher probability than the other two.
T: So Hannah does that make, does that make any difference do you think? Kate's saying that although there are only three outcomes, there are two different ways that this [pointing] can happen. [V/M]

Incidents where a teacher addresses a student who has previously proposed an incorrect answer to point out that a different, correct answer, has been offered, does not count in this category if the difference between those responses is not drawn out by the teacher (instead, the existence of a difference is indicated in merely evaluative terms, to indicate one response as incorrect).

Summary of possible identifiers:
T stating that two/more view points exist (and elaborating those); T marking several ideas/answer possibilities on the board; T asking a S to respond to another S's different view elaborating the difference.
Excluded:
T pointing out to a S who had given an incorrect answer previously that a different (correct) answer has now been provided but not drawing out the difference.

*T5. Teacher refers to how to talk/work together

This category entails turns of talk whereby the teacher explicitly emphasises or clarifies to students *the role/importance of talk for learning*. In the *epiSTEMe* lessons this may, at the simplest level, have referred to the teacher reminding students of the 'ground rules for talk' (Mercer) which all the classes had constructed for themselves during the *epiSTEMe* Introductory module (see *epiSTEMe* website for accessing the Module). Each class were allowed to define their own ground rules for talk, though typically these involved principles such as People need to have **reasons for their ideas**; In group work group members need to **try to agree** and/or Students need to **listen to everyone's points of view** and/or **share all ideas**/information they have. The teachers may make explicit reference to these rules in subsequent lessons and those would be coded in this category.

> **Ex 10**
> T: You are going to doing it in pairs. I'd like you to remember our discussion rules. First of all it's important that you both join in. And secondly you're going to try and reach an agreement. [A1/M]

However, teachers may also clarify, emphasise or reinforce the importance of talk for learning in many other ways that do not explicitly identify, or go beyond, the set ground rules of the class. Teachers may emphasise to students that they will not simply be giving out the correct answers but that students/the class need to discuss to figure it out and that is a core part of the learning:

> **Ex 11**
> T: OK has anybody else changed [their mind]? There is an answer to this and we need to work out what it is. And we all need to believe it, because this is really quite important. [V/M]

> **Ex 12**
> T: [During group activity] Can I just say how impressed I am coming around the room and all of you are chatting to one another, trying to do your, you know you're working out, you are discussing what, with one another which is the whole idea of this. [D/M]

The teacher may clarify to students that the students are meant to listen and take reasoned stance to each others' ideas:

> **Ex 13**
> T: I just want to see what the blue table get because I don't think you are fully listening. Ok, part of this whole exercise works where, if someone's giving it an answer, listen to it, see if you agree with it, if not, then I might come to your table to see why you don't agree with it. [D/M]

Or that the purpose of the discussion is to convince other people of their ideas:

> **Ex 14**
> T: All those people who are getting restless think of something that you can tell us that will convince people of what's going on. Convince them of your, what you believe because the majority of you are saying that there's a 50% chance they will have the same, same grouping as their parents. We have some people who don't agree and they have good reasons for not agreeing. [V/M]

Excluded from this category are references to normal class/school ground rules, e.g., Listening to others, Not interrupting, One person speaking at a time, Being respectful. Also excluded are very general comments about learning which do *not* refer to specific rules or practices that children could follow, such as 'You need to listen to learn'; 'We all need to think to learn'; 'We all need opinions'; 'You need to feel like you are understanding something'.

NB. This category obtained low inter-rater agreement in our test analysis due to different emphasis regarding whether it required as explicit reference to agreed 'rules'. This is possible to overcome in subsequent trialling through explicit agreement. We suggest that since it may not be possible to know what the rules are for any one class (or they may not have such rules), it would be important to include in this category all specific references to the role of talk for learning in a given lesson.

Summary of possible identifiers:
References to concrete ground rules for talk as these have been agreed by the class previously (if this is the case) as well as references to the specific role of talk/discussion for learning: trying to reach agreement in groups work; eliciting all group members' views; sharing one's own ideas; providing reason's for one's ideas; T expects students to try to work out the answer through discussing it; Students need to take stance to each others' ideas, not expected ready answers from T.

Excluded:
References to general behavioural school rules: Students need to listen; be quiet; not interrupt; be respectful.

*T6. Teacher explains a phenomenon/ solution with explicit reference to students' ideas

We had an original category of "T takes up a student idea and develops it/builds on it (e.g., to teach something)" which did not necessarily have to involve the teacher going as far as explaining something or telling students about the solution but using a student idea to probe a students' thinking and develop/test the idea. However, while we analyse this phenomenon in our qualitative analyses of classroom dialogue (Ruthven et al., 2011), it was ultimately excluded from the protocol used to live in-situ coding. Instead we aimed to use a category focusing on subsequent teacher whole-class teaching in which the teacher makes explicit reference to a student originated idea when explaining something to the class. However, ultimately this category was also not used in analysis as it proved to be too rare to test whether it could be identified reliably.

Student actions

S1. Student takes an extended turn

This category was included as a separate category due to the strong emphasis on this issue in the literature on dialogic teaching. Clearly long responses by students are an obvious inclusion in this category.

> **Ex 15**
> S: I also don't think it's number one because if, if, if the energy went to the bulb, and the energy tried to travel back, because it has to go in a circuit, the energy keeps travelling round so it kind of probably would, it would probably stop elec-, there would be no electricity for the bulb to use because all the electricity would have been wasted in the bulb to light up. [L/S]

However, it was decided that giving a specific technical definition to what constituted an 'extended' turn by a student (defined e.g., by duration or number of words) was neither feasible in live coding nor desirable. In the video data, we observed that students would sometimes give responses which, based on the number of words, might appear extended (e.g., not a single word) but which contained no elaboration of their thinking:

Ex 16

S: Me and Jamie and Mike put our ideas together and we said air resistance and gravity and surface area and (last words unclear). [B/S]

The student lists all the answers given by their group but does not *explain or elaborate their thinking* behind those and this would be excluded from this category. Therefore, the definition for this category is that *a student takes an initiative turn or gives a response which goes beyond yes/no or simple recall and provides a more elaborated account of her/his thinking*, even if fairly briefly:

Ex 17

T: Can you tell us why you think a third please?

S: Because there's really 3 ways of forming a pair, a small e and a big E, 2 big Es, and 2 small Es. [V/M]

Many of the students' turns in this category would also count as category S2 (below). However, there may be examples which are considered elaborations without a reason, explanation or justification (S2), for example if a student tells the class that they first held one view or idea and then changed their mind to another, thus elaborating, to a degree, their thinking (without necessarily providing the rationale for their change of mind, and thus not justifying coding with S2).

Summary of possible identifiers:
I think it is ___, because…; I first thought ___ but I changed my mind and I now think ___.
Excluded:
Yes/No; S gives a direct recall response to T question; S lists the answer(s) suggested by their group with no further elaboration of thinking.

S2. Student gives a reason

This category applies when a student gives a *reason, explanation, justification* for their idea or solution. It will apply irrespective of whether the student gives a reason, explanation of justification spontaneously or upon the teacher's request. In our data, examples of this category involve a student responding to a teacher's direct question and backing their answer up with a reason:

Ex 18

T: No, no, I'm not talking about water at the moment. I said does it change its weight.

S: Er, no, cos you haven't took anything off it, it's just a different shape. [B/S]

A student expressing view to a discussion topic and backing it up:

Ex 19

S: I'm starting to think it's a third because you've got a big E and a small e, that's one possibility and then you've got a big E and a big E, that's another possibility and then you've got a small e and a small e that's another possibility, so three possibilities. [V/M]

Or a student commenting on another student's idea and justifying her/his view with a rationale:

Ex 20

S: I disagree with Anton because he says that the energy from the battery will go all the way round but there will be light, but there won't because all the power in the battery will only get to one of the lights. [L/S]

This category, like the others, does not require that the student's explanation is correct. This category also encompasses weak and tentative attempts by students to provide an explanation:

Ex 21
[S has claimed that a flat piece of paper is lighter than the same piece scrunched up.]
S: It's like what I explained earlier, if like something is like that (shows 'flattening' with hands), it has like more and so it's all spread out and it doesn't, just put all its weight in one thing and if it's scrunched up, it puts all its weight on like one thing. [B/S]

Some of the student turns in this category would also be included in the next category S3.

Summary of possible identifiers:
I think ___, because… (topic-related explanation); This is how I came up with my idea/response;
Excluded:
I think ___ because X says so. I think the answer is Option A because my name starts with an A.

*S3. Student suggests a new idea / response to a task / discussion

This category includes turns in which a student proposes an idea, question or connection relating to the topic discussed that hasn't been suggested previously (cf. Tarr *et al.*, 2008, C.8.; Scott & Mortimer, 2005). The category cannot be directly illustrated through individual turns of speech as the use of the category requires knowledge of what has happened previously on the conversation. The idea proposed by a student may be new because the student is the first to respond:

Ex 22
T: Who agreed with A? [Ss respond] Okay, can I have a volunteer to tell me why they agreed with A. *(Points to student)* Excellent, thank you.
S: Because if you throw the coin two times, you could get two heads. It, the way I did it, it doesn't, I don't think it means that you get them in that order..So I think that you wouldn't have four ways because the head and tail and tail and the head (…) are the same thing. So I think you've a one in three chance of. [A2/M]

Or it may be new because it is a new perspective, response or rationale which has not been suggested previously. A new idea may also take the form of a question that focuses on an aspect of the problem being discussed which has not been considered previously:

Ex 23
T [Writing into the table on the board]: So the mother can give us an E and a big E and the father could give us a big E. The mother could give us a big E and the father could give you a little E the mother could give us a little E and the father a big E and the mother could give us a little E and the father could give us a little E. --- So the question is what is the probability that they will have the same pairing as their parents isn't it? So does this help?---
S: Well are, is the small e and big E the same as a big E and a small e? [V/M]

This category does not require that these ideas are correct or taken up by the teacher. However, it does require that the ideas proposed have some relevance to the task or problem at hand. We found that this category proved to be difficult to identify reliably in live coding but is a relevant phenomenon to be considering with regard to dialogic teaching.

This category does not contain students' turns in which students list possible answers to a teacher's question (as single words, for example) without explaining them in any way, as otherwise all students' answers to a teacher's question might fall into this category.

Ex 24
T: What ideas did you come up with? First of all, what forces were acting on this plasticine in this poem? Tanya?
S: Could it be gravity?
T: Gravity, ok, good. [B/S]

Summary of possible identifiers:
S suggests a topic related to idea or response to a task or ask a question that points to a previously unmentioned aspect of the task/problem or a previously unidentified problem in a response/idea currently being discussed.
Excluded:
S lists a possible answer (e.g., as a single word response) without elaborating in any way.
S suggests an idea unrelated to the task at hand.

*S4. Student takes up another students' idea

This category involves students' turns in which a student comments on another students' idea or responds to another students' question, either spontaneously or upon teacher request. A student may explicitly take up another student's view to take stance to it as in **Ex 20** above.
A student may take up a perspective to the topic under discussion which another student has expressed but which has been presented to the class by the teacher through a rephrase, as in **Ex 9** earlier. In Example 9 a student is not responding directly to another student speaker, but there are responding to an idea initiated by another student and that counts under this category. Or a student may change their mind during a discussion based on an idea and its rationale previously/originally presented by other student(s) without explicitly referring to anyone, as in **Ex 19** above.

Identifying this requires knowledge of previous events during the discussion and was also challenging to identify reliably during live coding but is a significant aspect of dialogic teaching to be considered.

This category does not include student comments in the vain of "I think the same as X!" which entail no explanation or elaboration (or naming of the idea).

Summary of possible identifiers:
I agree/disagree with X because…; T rephrases a S idea and another S responds: I think that can't be right because…
Excluded:
I think the same as [my friend] X (with no elaboration and no naming of the idea).

Actions involving the teacher and students

C1. No. of students who do the listed ("orange") things is 3 or more

This category is used if at least 3 students did one of the actions described by the above categories S1-S4 during an observational segment. This category enables the weighting of the above codes to differentiate whether the occurred more than once during an observational segment.

C2. Teacher collects at least 2 student views without evaluating them

This category queries whether the teacher, at one point during the segment, collects student ideas in a discussion while refraining from immediate evaluation of those ideas or responses (cf. Scott & Mortimer, 2005), at least from 2 students. This would mean the teacher eliciting students' answers or ideas through questions which probe the students' point of view, instead of authoritative questions aimed at eliciting the right answer.

> **Ex 25**
> S: If it was number one, all the energy would be going to the bulb and because it isn't going out, all the energy's getting stored in the bulb but it might just like pop thing, it might pop.
> T: Right, so it might not work anymore.
> S: Yeah.
> T: Brilliant, that's a credit for you, that's really good. Oscar, yeah?
> S: I also don't think it's number one because if, if, if the energy went to the bulb, and the energy tried to travel back, because it has to go in a circuit, the energy keeps travelling round so it kind of probably would, it would probably stop elec, there would be no electricity for the bulb to use because all the electricity would have been wasted in the bulb…to light up.
> T: Right. That's a really interesting one as well, well done. Oh, we've got a few more hands as well. What do you reckon then Anton then? [L/S]

This may involve students reacting to a task such as a diagram on the board and depicting their responses non-verbally which would also be coded in this category.

However, if the teacher uses strategies to clearly signal to students that an answer is incorrect, even if no explicit and direct verbal evaluation takes place, those exchanges do not count under this category.

> **Ex 26**
> T: Can you tell me what the probability of rolling a 2 or a 6 are, if you fill in the table below. Rolling a 2 or a 6. What do you reckon John.
> S1: Two out of six and two line six.
> T: Two out of six. Ok. (pause) Who's got something different? (No-one says anything.) John is saying, two out of six. [writes it in the table on the board and immediately underlines it with a zig zag line] Who agrees with that, put your hands up if you agree with that.
> (Very few student hands up.)
> Sx (talking aloud): Yes I agree with that.
> T: Jane you agree with that [to another student who has her hand up]?
> S2: Yeah [nodding].
> T: You agree with that. Does someone have something different [pointing to the response on the board]? Who think there's something different than two out of six? [As T says this, he wipes the response '2 out of 6' off the board.] What do you think Wayne? [D/M]

Summary of possible identifiers:
[S suggests a response/idea], T responds e.g., 'thank you, any other ideas?'; 'that is interesting', 'I am not going to say what is right or wrong, I am just collecting answers/ideas'.
Excluded:
Non-verbally/Indirectly indicating an answer is incorrect, e.g., by not recording it on the board or by ignoring it and continuing to ask for the 'answer'.

C3. Teacher collects feedback from planned small-group work

This is a practical category that marks whether the teacher asks groups to feedback from their work and this feedback is obtains for *at least one minute* (so in other words not just a single question or vote of agreement to a correct answer).

C4. Different perspectives discussed

This category refers to the occurrence of whole-class talk in which more than one perspective, idea or solution is seriously considered and reasoned about, for at least 1 min during any one segment. Identifying this category requires following a sequence of talk, not only individual turns of speech. This is a significant indicator of dialogic teaching in the stronger sense of the term as discussed at the beginning of this document.

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