**Supplementary material**

Supplementary Table 1. Categories for basic coding

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| **Level 1** | **Example** | **Coding instructions** |
| individual work | Group 4, student 1 (S1), line 122:  S1 observes what S4 is doing on her tablet without S4 being affected by it. | Activities at the group table that are performed alone and without communication with classmates. E.g. working with the tablet, working on notes, organizing work materials, not noticing comments from others, etc. |
| interaction with other students | Group 4, S4, line 62:  S1 speaks to S4, who is obviously listening to her (eye contact) and subsequently responds to the utterance.  S1: "I asked what is the way of my clothes."  S4: (nods) "Yes, exactly." | All activities that are carried out in contact with classmates. E.g. asking questions, answering, working on a task together, discussing, etc. Attentive listening is also counted as interaction with classmates. |
| interaction with teachers | Group 4, S4, line 219:  The teacher is standing right next to S4, who states to the teacher, "But I think it harms the environment. "  Teacher:" Yes, that's true."  S4: "The water, the food around us that's all..."  S1: "It's best if we don't buy jeans at all anymore."  S4: "And it can go in the water." | Sequences in which the teacher (teacher or student) approaches the group table and addresses one or more students are coded as interaction with the teacher. This communication does not count as interaction with classmates. Actively requesting the teacher is also coded as an interaction with the teacher.  Interactions with the teacher are also orders/instructions that are addressed to everyone without the teacher being visible in the video. |
| Level 2 |  |  |
| asking | Group 4, S2, line 58:  "What does the question mean exactly: Explore the story, to learn how a pair of jeans connects you to the rest of the world?"  Group 3, S2, line 266:  S2: "...make a linking word, Amir?"  S3: "Hmmmm?"  S2: "Do we always have to make a linking word between the words- that is, between each topic?" | A student asks the other students a comprehension question related to the lesson content or the use of the tablet. |
| explaining | Group 4, S4, line 59:  S4 explains the work assignment to S2: "No look. You're supposed to sort of listen to the story, learn about different stories, and you're also supposed to create a mind map. So to, so to speak, with the… The way from my home. No. The way of my pair of jeans to my home." | A student explains to another student what to do in relation to the lesson topic or technical difficulties, or helps another student to complete the task/operate the iPad. However, explaining also includes opinions, suggestions, and ideas related to the lesson content. Overall, explaining (as opposed to everyday language use) needs to be broader and not just refer to reasoned opinions. |
| listening/observing | Group 4, S1, line 139  S1 observes, has eyes turned to S2.  S2: “And then we do another key point of my jeans, with for example dye, you know..?”  S4: “Yes, I know.”  Group 4, S1, line 35:  S4 is having trouble finding the right page, so S1 is watching S4's tablet. S2 helps S4 by operating S4's tablet, the whole process is observed by S1. | A student gets an answer to a previously asked question or another student explains something and student listens attentively.  Student looks at what others are doing, observes others (outside observer). Student shows a quiet behaviour with the focus on the nonverbal activity of the others. |
| commenting | Group 4, student 2, line 26:  S2: "Do you want me to go on here? Ah no wait, that's wrong. What do I even have to do?" (no one responds or elaborates)  Group 4, S1, Line 124:  S1: "Dye is a liquid that changes the color of something. Yes, yes." | The student comments on his own work on the iPad or makes a statement without other students responding. |
| working on the material | Group 4, S4, lines 202,203:  S4 is typing on her iPad the whole time, completing the concept map without paying any attention to the off-task conversation of S1, S2, S3.  Group 6, S4, line 236:  S1 and S3 type separately on their tablets and complete their respective concept maps while S4 reads the worksheet. | Independent individual work on the iPad, e.g., reading on the iPad, writing on the iPad, editing the concept map. |
| off-task | Group 4, S1, line 60:  S1 is doing his/her hair and stretching.  Group 4, S1, line 103:  "Why am I so tired? I know why. I woke up at 6 this morning and went to take a shower. " | Attention is not focused on task completion, e.g., eyes roaming classroom, eyes closed, playing/typing on cell phone, joking about lesson content or technology, etc.  But also conversations/activities that have nothing to do with the content of the lesson and take place in interaction with others, e.g. conversations about private activities, doing hair, playing around with the cell phone, etc..  This includes comments/short conversations about the camera such as, "I feel like I'm being watched," "Are we actually being filmed yet?" etc. and when joking about technology (this includes iPads). |

Supplementary Table 2. Rating system for cognitive activity.

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| **Low cognitive activity**  The value 1 is assigned when a short-term, rather superficial engagement with the subject matter takes place. This interaction is typically short (question-answer; hint; help) and no independent problem solving is discernible. The student does not contribute own thoughts or ideas and does not reflect on other students’ arguments or suggested solutions. | |
| **Code** | **Indicators** |
| 1.1 | The student asks simple comprehension questions that require brief answers, e.g. “What does that say?” |
| 1.2 | The student gives simple Yes/No answers with no added explanation. |
| 1.3 | The student expresses noncomprehension with no (discernible) desire to understand. |
| 1.4 | The student repeats information without evaluation or contextualization, such as reading a text aloud when prompted to do so (to avoid ambiguity, see indicator for medium cognitive activity). |
| 1.5 | The student follows instructions without reflecting on them, e.g. “That’s what he said,” or writes/takes notes as instructed to do so by others. |
| 1.6 | The student takes his or her cue from the other students’ solution path, e.g. “What did you put there?” and adopts the solution or solution path without questioning it. |
| **Medium cognitive activity**  The value 2 is assigned when the student is cognitively engaging with the subject matter, but not penetrating the task or the material to any depth. Nevertheless, traces of independent problem-solving or autonomous knowledge construction are discernible; for example, the student may contribute own ideas without explaining them or situating them within the overall context. | |
| **Code** | **Indicators** |
| 2.1 | The student describes his or her own solution method or states what he or she did at this point without further explanation; it is evident that these are the student’s own thoughts. |
| 2.2 | The student spontaneously reads a selected passage of text that is pertinent to the problem/question, but does not rephrase it in his or her own words. |
| 2.3 | The student uses relevant text passages for arguments, but without explaining relationships or contextualizing the passage, e.g. “It says here that…” |
| 2.4 | The student takes his or her cue from the other students’ solution path, but reconstructs the individual steps or follows the solution path independently. |
| 2.5 | The student asks content-related questions, but does not ask follow-up questions if the response is unsatisfactory. |
| 2.6 | The student contributes his or her own new keywords for the concept map, but does not situate them in the overall context. |
| **High cognitive activity**  The value of 3 is assigned when an intensive, in-depth engagement with the lesson content is clearly indicated by the students’ behaviour and verbal participation. Students contribute and explain own ideas and suggest solutions and place them into a context with other information. In the process, independent knowledge construction occurs. | |
| **Code** | **Indicators** |
| 3.1 | The student explains his or her solution process so that others can comprehend it. |
| 3.2 | The student exchanges arguments with fellow-students while referring to the contributions of the others. |
| 3.3 | The student reflects on the content of arguments. |
| 3.4 | The student draws on prior knowledge in solving the task. |
| 3.5 | The student formulates hypotheses and assumptions for solving the task. |
| 3.6 | The student asks questions in order to understand the lesson content. |
| 3.7 | The student draws comparisons in order to explain context or effects. |
| 3.8 | The student draws conclusions from different arguments and items of information and is able to give reasons for doing so. |
| 3.9 | The student relates lesson content to his or her own lifeworld in order to emphasize relevance or deepen understanding. |
| 3.10 | The student gives elaborated explanations, i.e. he or she repeats contexts in his or her own words, repeatedly rephrasing them to help others to understand. |

*Note*. All sequences (10-second intervals) previously identified as “subject matter” were coded. All indicators are derived from the references below.

**References**

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Supplementary Table 3. Example for different levels of cognitive activity.

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|  | **Code** | **Example** | **Comments for coding** |
| 1 | low cognitive activity | “(…) a long way away from food, so food supplies probably safe, so if the farmers can handle the chemicals carefully, they should be safe too.” The student is reading a longer passage aloud as prompted, then stopped and looked interrogative to the others. | Reading aloud without any own statement |
| 2 | medium cognitive activity | “I asked the question, what the path was for my clothes” | Reference to own idea of a focus question, but no further explanation |
| 3 | high cognitive activity | Mhm, yes, perfect. (S4 takes up suggestion of S2).  “And then…Yes, right? That's actually quite clever: My jeans, cotton, environment, that means (German translation)… I don’t know. Anyway…no, let’s make another circle, too, in any case a big circle, not an “in-between” circle, right? Because, if it’s a big circle, we can write „harm“ in the middle of it.” | Establishing a relationship between several aspects |

Supplementary Table 4. Triggers of high cognitive activity per student.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Engagement with material  (1) | Stimuli given by teacher  (2) | Questions from fellow-students  (3) | Observing fellow-students/ listening  (4) | *N*Student |
| Group 1 S1 | 0 | 2 | 0 | 0 | 2 |
| S2 | 0 | 0 | 1 | 1 | 2 |
| S3 | 4 | 2 | 3 | 3 | 12 |
| S4 | 2 | 0 | 0 | 0 | 2 |
| Group 2 S1 | 0 | 1 | 1 | 2 | 4 |
| S2 | 0 | 0 | 3 | 1 | 4 |
| S3 | 1 | 3 | 0 | 0 | 4 |
| S4 | 0 | 0 | 0 | 0 | 0 |
| Group 3 S1 | 0 | 1 | 6 | 9 | 16 |
| S2 | 17 | 0 | 2 | 4 | 23 |
| S3 | 0 | 0 | 0 | 2 | 2 |
| S4 | 19 | 4 | 7 | 14 | 44 |
| Group 4 S1 | 0 | 0 | 0 | 3 | 3 |
| S2 | 4 | 7 | 1 | 3 | 15 |
| S3 | 3 | 0 | 2 | 4 | 9 |
| S4 | 1 | 1 | 0 | 1 | 3 |
| Group 5 S1 | 3 | 0 | 0 | 3 | 6 |
| S2 | 17 | 0 | 1 | 8 | 26 |
| *N***Total** | 71 | 21 | 27 | 58 | 177 |

*Notes:* *N*Student = Number of (10-second) sequences per student. *N***Total** =Sum of all sequences per category for all students.