9 The School-In Video Study

Inger Marie Dalehefte & Andrea Marie Olsen Hornnes

School-In aimed to elucidate how the school's link to the school surroundings and the expectation structures in school play a role for school development, inclusion, and learning. The systemic approach adopted in the project made it necessary to investigate this at different school levels and from different perspectives. By considering Desimone's conceptual framework of professional development in school (Desimone, 2009), we highlight (1) professional development; (2) teachers' knowledge and attitudes; (3) teachers' practice in instruction; and finally, 4) students' learning. This model also considers the context, such as teacher and student characteristics, curriculum, school leadership, and policy environment, which is in line with the systemic approach of School-In (chapter 2).

In School-In, pre-post questionnaires revealed valuable insight from an insider's perspective into how the teaching staff experienced their school and its development (step 1). During the focus group discussions, we gained insight into the teaching staff's knowledge of factors such as school surroundings, expectation structures, and their values and attitudes (step 2). We were also interested in taking an outsider's perspective on the learning conditions in class and teacher's practice (step 3) and an insider's perspective on students' learning (step 4). This is the reason we decided to utilise a video study using both observation and questionnaires as methods in the innovation schools as part of project School-In.

9.1 Framework of the video study in School-In

In the video study in School-In, we focused on supportive learning conditions in instruction and in relation to students' learning processes. We were curious if and how expectation structures (Rubie-Davis & Rosenthal, 2016; Midtsundstad, 2019; Ingebrigtsvold Sæbø & Midtsundstad, 2018), inclusive conditions (Booth & Ainscow, 2002; Göransson & Nilholm, 2014), and ties to the local community (Langfeldt, 2015; Dalehefte & Midtsundstad, 2019) could be identified in the instruction. It was also of interest to investigate how learning conditions that were provided in the instruction could be related to students' learning outcomes and motivation (Ryan & Deci, 2017; Prenzel, 1995; Seidel et al., 2007).

We developed and used instruments based on the theories and empirical findings mentioned above. These consider how expectation structures and local context play a role in the school, with regard to inclusion, motivation and learning. We were also curious as to whether the intervention and presence of School-In would make a difference in instruction during the intervention. One semester was a brief period in which to expect development. However, since the intervention was quite intense and encouraged concrete actions in class, we hoped to recognise some results of the reflection processes in the Dialogue Café (chapter 5), as well as results of the measures developed in the Reflection Cycle (chapter 6). Other video studies have attempted to describe development over time, such as in the SINUS for Primary Schools video study (Kobarg, Dalehefte, & Menk, 2012).

Our video study involved two instruments: (1) video recordings of instruction; and (2) student questionnaires about the videotaped lesson. This data collection procedure was tested and optimised in a pilot study before the main project started in 2017. We profited greatly from the technical report of the IPN Video Study, which describes how to conduct a video study (Seidel, Prenzel, & Kobarg, 2005). Based on this framework, we operationalised the video study in School-In.

9.2 The operationalisation of the video study in School-In

One or two mathematics classes were videotaped in each school. We videotaped in the 7th, 8th or 9th grade, depending on whether the school was a 1st to 7th grade, an 8th to 10th grade or a 1st to 10th grade school. We videotaped at the beginning (pre) and at the end (post) of the semester in order to reveal eventual development over the intervention period. This part of the study had to be permitted by both students and parents. Students who did not participate spent their time in a parallel class for the duration of the recording.

We conducted the video recordings according to standardised guidelines adapted from the IPN Video Study (Seidel, Dalehefte, & Meyer, 2005). One dynamic camera (teacher camera) was placed on a '1/3 position', filming the students from the side in the classroom. This camera was connected to the teacher's wireless microphone and handled by a person to capture the 'zone of interaction'. One fixed camera was placed at the front of the classroom, on the same side as the teacher camera, capturing the entire class (overview camera). Another person handled this camera, which was connected to the microphone of the second teacher or paraprofessional in the class. If the teacher was alone in class, his/her microphone was recorded by both cameras. Both cameras were provided with wide-angle lenses, and, as a general rule, the cameras were zoomed out to capture as much information as possible. The teachers were told to give a normal lesson as they would have with no video recording; they did not get any suggestions from the School-In team.

Immediately after the lesson was finished, the students filled in a questionnaire about how they had experienced the lesson according to experienced learning conditions and cognitive and motivational outcomes. We adapted much from the questionnaire about teaching and learning processes from the IPN Video Study (Rimmele, Seidel, Knierim, Kobarg, Dalehefte, Schwindt, & Meyer, 2005). This questionnaire was translated into Norwegian and shortened and modified for our purposes. We also added questions important for our research related to students' perception of expectation structures, inclusion in class, and links to the school's local context in instruction. Scales and relevant characteristics of the questionnaire are provided in chapter 10 in this book.

This chapter presents the video material and information about how we analysed the videos. Overall, we investigated 16 video recordings from nine classes in the seven participating innovation schools. Unfortunately, one video recording session had to be cancelled due to COVID-19. Table 9.1 gives an overview of the recordings and the topics.

Table 9.1: Overview over video recordings of mathematics instructions in School-In

Video – pre	Topic	Duration
1. 010101_08	Basic operations in Excel	39 min; 10 sec.
2. 010201_09	Geometry, area, and perimeter	41 min; 30 sec.
3. 020101_09	Algebra, calculus in parentheses	35 min; 20 sec.
4. 030101_08	Letter expressions, variables, and constants	62 min; 30 sec.
5. 040101_08	Calculation order	39 min; 30 sec.
6. 050101_07	Number patterns and systems	44 min; 00 sec.
7. 060101_08	Division	37 min; 20 sec
8. 060201_09	Recognise patterns	57 min; 15 sec
9. 070101_07	Use of terms, angles	
Video – post	**Topic**	**Duration**
10. 010102_08	Rehearse tasks	56 min; 30 sec
11. 020102_09	Exchange and currency	46 min; 00 sec
12. 030102_08	Volume	45 min; 17 sec
13. 040102_08	Fraction	45 min; 31 sec
14. 050102_07	Mirroring and rotation (class split – two rooms)	48 min; 00 sec
15. 060102_08	Recognise patterns	41 min; 13 sec
16. 060202_09	Recognise patterns and problem solving	42 min; 00 sec
17. 070102_07	No video recording due to COVID-19	

In School-In, we adopted a mixed-method approach using both quantitative and qualitative methods. We used the software Videograph (Rimmele, 2013) for the transcription and quantitative coding of the video recordings. We applied a low-inference category system from the IPN Video Study in physics education (Seidel, 2005) to overview the 'surface structures', or the main activities, in instruction. This category system has been used in several other video studies (Najvar, Janík, Janikova, Hübelova, & Najvarova, 2009; Kobarg, Dalehefte, & Menk, 2012), among others in mathematics instruction in primary school. For the qualitative approach we applied Qualitative Content Analysis procedures (Mayring, 2014).

In School-In, we were interested in how expectations for students' learning activities were expressed in instruction and how cognitively demanding the instruction was in the innovation schools. This was also of particular interest because an official Norwegian report had highlighted that deep-learning processes should be emphasised more strongly in the new curriculum (LK2020) in Norway (Norwegian Ministry of Education and Research, 2015). Thus, we were required to develop a category system for this purpose. We developed a low-inference category system based on Bloom's revised taxonomy (Anderson & Krathwohl, 2001), aiming at coding uttered expectations and learning activities according to this classification (Olsen, 2020). In the following section, this category system is presented.

9.3 Category system of cognitive and knowledge dimensions

Bloom's revised taxonomy is a model that classifies *learning activities* on a cognitive process dimension from lower-order to higher-order thinking skills, and classifies a *knowledge* dimension on a scale ranging from concrete to abstract (Anderson & Krathwohl, 2001). The taxonomy is originally regarded as helpful for planning instruction. For our video study, however, the purpose of the taxonomy was changed to create an observational coding system. Assuming there is a link between higher-order thinking skills and deep learning, we considered this model important for fostering deep learning processes in instruction.

The intention of this coding system was, firstly, to investigate the frequencies and duration and, secondly, to identify the targeted cognitive level of the instruction and tasks. The *cognitive process dimension*, consisting of the categories *remember*, *understand*, *apply*, *analyse*, *evaluate*, and *create* (ranging from lower-order to higher-order thinking skills), was coded separately for the teacher and the students. The *knowledge dimension,* consisting of the categories *factual*, *conceptual*, *procedural*, and *metacognitive* (ranging from concrete to abstract knowledge), was not coded separately but could be linked to the teacher and student taxonomy coding afterwards. Within all three systems, 'none' and 'other' could also be coded if the categories did not occur (none) or fit (other). The coding systems were coded simultaneously. Figure 9.1 shows an overview of the category systems.

We developed the category system in a cyclic manner (Seidel, 2005) and used the theoretical background to describe the categories and the videos to exemplify them. We coded the categories in 10-second intervals using the software Videograph (Rimmele, 2013).

The categories were considered disjunct, meaning that only one category could be coded within a category system at a time. We tested the inter-rater reliability after two people had coded 1/3 of the total sample. The development process ended with an inter-rater agreement of Cohens kappa > .94 for all subcategories. Table 9.2 shows the inter-rater reliability values (number of coded intervals, Cohen's Kappa-value and the

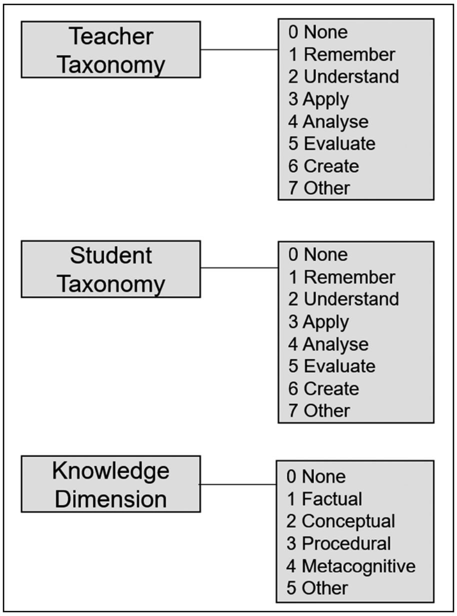

Figure 9.1: Overview of the category systems

Table 9.2: Inter-rater reliability category systems in School-In (Olsen, 2020)

	Intervals	Kappa	Agreement in %
Taxonomy teacher	868	.96	97
Taxonomy student	868	.94	97
Knowledge dimension	868	.96	98

inter-rater agreement in per cent) of the category systems 'teacher taxonomy', 'student taxonomy', and 'knowledge dimension'.

In the following, we present the category systems for coding the cognitive dimension (9.3.1) and the knowledge dimension (9.3.2) (Olsen, 2020).

9.3.1 Category system for coding the cognitive dimension

Mental processes are not observable. Therefore, the coding must be oriented towards verbal communication and/or visible actions in class.

The category systems, one for the teacher and one for the student taxonomy, consist of the categories (0) None; (1) Remember; (2) Understand; (3) Apply; (4) Analyse; (5) Evaluate, (6) Create; and (7) Other. The explanations and descriptions of the categories in the cognitive dimension are identical for both teacher and student. What the teacher or the student says, or sometimes does, determines which category is the best alternative. There is one important basic rule: If multiple categories are questioned in a sequence, the higher-order category is considered. In the following sections, each category is explained and exemplified.

Category 0: None

Content determination:

Refers to video sequences in which either the teacher or student has no verbal expressions related to the learning component in the classroom.

If the student and/or the teacher does not communicate or ask questions during the video sequence, the code 'none' is chosen. It also refers to situations where the student only answers 'yes', 'no', 'I don't know', etc., and where it is unclear to which category the question/answer belongs. This category is more common for the students than for the teacher.

Description at the observation level:

When the student and/or the teacher speaks or communicates something not related to the learning content in the class, for example, when the teacher announces that the lesson will be videotaped at the beginning of the lesson, or provides information about upcoming tests, etc.

Specific rules for coding:

If communication has nothing to do with the learning content in class.

Category 1: Remember

Content determination:

Activities that require the students to recognise and recall prior knowledge.

The classroom activities focus on 'how much', 'how far', 'when did this happen', etc. The students must retrieve prior, relevant factual knowledge from long-term memory. This category is often paired with 'factual knowledge' in the knowledge dimension.

Description at the observation level:

Activities that can be understood as routine exercises, for example '3 x 3', '7 + 5', or repetitions of knowledge, for instance, 'do you remember what happened?'. The teaching is characterised by reminding the students of what the facts are. The content in the classroom is not contextualised.

Specific rules for coding:

Depends on what the teacher focuses on and what type of knowledge is demanded.

This category is used to distinguish from the category 'understand'.

Category 2: Understand

Content determination:

Relates to relevant skills like interpreting, exemplifying, classifying, comparing, and explaining, etc.

This category often co-occurs with 'conceptual knowledge' in the knowledge dimension. The 'understand' category implies explanations to a phenomenon, often with examples to aid understanding. Central to this category is also determining the meaning of instructional messages given by the teacher. Teaching strategies that focus on using everyday examples, stories, and experiences belong in this category.

Description at the observation level:

Instruction characterised by conversations, discussions, and explanations.

For example, the student and/or the teacher explains something related to the learning content by using examples. This category is coded when the teacher asks the students questions that demand explanations and descriptions. If the students answer, 'I don't understand', etc., this category is coded. It is also coded when the teacher asks if the students understand the assignment or the goal of the lesson.

Specific rules for coding:

More complex than the previous category, but also used to distinguish from the next, more complex category.

For example, in this category, the focus is on explanations and understanding of a phenomenon. In the next category, the focus is more extensive, considering both understanding of a process and how to carry out a procedure.

Category 3: Apply

Content determination:

Focuses on two cognitive processes: executing and implementing.

'Apply' is coded when the sequence reveals that the teacher and/or the student is working on and explaining how a procedure is solved and carried out. The category involves the use of factual knowledge and an understanding of a procedure, model, or formula, as well as knowledge of how to use this in practice. The situations often switch between 'apply' and 'understand' because the teacher often explains why the students have to learn the given procedure and, in the next moment, how they are going to do so. This category often co-occurs with 'procedural knowledge' in the knowledge dimension.

Description at the observation level:

Coded if questions and activities reveal knowledge about procedures and how to apply them.

This includes students explaining to the teacher what they have done to solve the problem or students asking questions about mathematical procedures. For example, 'apply' is coded if the teacher explains how to solve a specific problem step by step and then asks the students to apply the knowledge. The students use knowledge either from a book or from the teacher to solve problems. This category is coded if the students ask or communicate anything that can be understood as applying knowledge to procedures or processes to solve a problem. It is also coded if students are executing procedures they already know, or applying knowledge to new and unfamiliar issues, such as solving a mathematical problem using a learned procedure and/or a digital software (Excel).

Specific rules for coding:

Applies to sequences that focus on approaching a problem and solving it, although it implies that there might be both right and wrong ways to solve the given problem.

Category 4: Analyse

Content determination:

Used about breaking material into its constituent parts and detecting how the parts relate to one another and an overall structure or purpose (Krathwohl, 2002).

The students should possess the knowledge that enables them to establish connections, such as between numbers, and to recognise systems and explain them. They should identify what is relevant and essential in a message and comprehend the underlying meaning in a communicated message. Analysing also involves students discovering an error in their problem solving and then deducing what happened, which step went wrong, and how to fix it.

Description at the observation level:

Focuses on student analyses of the how or why concerning a problem.

In mathematics, a problem is often given as a text assignment including a significant amount of information. The students have to analyse and consider what the relevant and important parts of the text are. In class, they might have to analyse the procedure they have applied to a problem-solving process and be able to explain how and why they did what they did. The teacher's focus is on students' ability to solve problems by themselves, without the teacher's explanations. They will explore the academic challenge by themselves. Teacher questions like 'what did you find?', 'how did you do it?', 'how could you do this in a different way?', 'why do you think it's like that?', and 'are there other relevant ways to solve this problem?' often support the analysis process.

Specific rules for coding:

Pertains to a logical analysis of a problem.

This category can be understood as an extension of the category 'understand'. Nevertheless, the core thing is not the learning process per se but the process of analysing. Furthermore, what is of interest is not whether something is right or wrong, but how students find the solutions based on analyses and reasoning.

Category 5: Evaluate

Content determination:

Pertains to the skills to judge something based on external and internal criteria and standards (e.g., quality and efficiency).

Checking and critical questioning are essential concepts in this category. Evaluation based on criteria, values fostering critical thinking, and the ability to judge a procedure and commenting on its value are expected in this category. Students should recognise inconsistencies and compare procedures and methods to discover positive and negative aspects of a procedure/method/product.

Description at the observation level:

Pertains to the students when they are encouraged to evaluate something they have learnt and/or accomplished.

For example, the students may evaluate the effectiveness of the way in which they solved a problem. Such an evaluation is performed by judging if their solution was the best way to solve the problem and by explaining and reflecting upon the method by pinpointing both negative and positive outcomes.

Specific rules for coding:

Situations or sequences where the teacher encourages his or her students to be critical to information and procedures or encourages them to evaluate their own work or that of others (often based on criteria).

Category 6: Create

Content determination:

Characterised by aspects such as planning, generating, and producing.

This implies combining elements to form a new product or reorganising elements to form a new structural pattern that has not yet been explicit. The students must possess qualities that enable them to use various sources to create a new product.

Description at the observation level:

Applies when students use creativity to produce a new idea.

For example, the students are assigned the task of developing a plan showing how mathematics can play a role in sustainability issues and a 'cleaner' world. An assignment like this does not always have a right or wrong answer, but it highlights the importance of creativity and new ways of thinking.

Specific rules for coding:

Also implies the use of other categories, but an aspect of 'creating' is required to code 'create'.

Category 7: Other

Content determination:

A cognitive process that is not included in the other categories.

Description at the observation level:

Communication or actions that cannot be identified within any other category (0–6), for example, if a student guesses the answer to a question.

Specific rules for coding:

None

9.3.2 Category system for coding the knowledge dimension

This category system consists of the following categories: (0) None; (1) Factual; (2) Conceptual; (3) Procedural; (4) Metacognitive; and (5) Other. In the following sections, each category is explained and exemplified.

Category 0: None

Content determination:

Refers to video sequences in which either the teacher or student has no verbal expressions related to the learning component in the classroom.

Description at the observation level:

When the student and/or the teacher talks or communicates something unrelated to the learning content in the class.

For example, the teacher announces that the lesson will be videotaped at the beginning of the lesson, or provides information about upcoming tests next week, etc.

Specific rules for coding:

If communication has nothing to do with the learning content in class.

Category 1: Factual knowledge

Content determination:

Refers to basic knowledge and the focus on isolated facts.

This category reveals knowledge of concepts, facts, and specific details and elements, and often occurs with the category 'remember' in the previous category system.

Description at the observation level:

Instruction based on questions and teaching what concepts are.

Examples include 'what is pi?', 'what is 7 multiplied with 3?', 'can you tell me what the formula for calculating area/circumference/diameter/radius etc. is?'

Specific rules for coding:

Basic factual knowledge that does not require a long answer or an explanation.

Category 2: Conceptual knowledge

Content determination:

Refers to knowledge of classifications, categories, principles, and generalisations and includes knowledge of theories, models, and procedures.

The category often occurs with the category 'understand', but not exclusively. It is a more complex organised form of knowledge than the previous category and includes explanations and providing context.

Description at the observation level:

Reveals insight through a focus on phenomena, concepts etc. and through examples and explanation.

At the core is an understanding of structures, models, principles, etc., and gaining knowledge of these concepts to apply them later on.

Specific rules for coding:

When the teacher focuses on explanations and examples.

This knowledge dimension often, but not exclusively, occurs with 'understand' in the previous category system.

Category 3: Procedural knowledge

Content determination:

Focuses on knowledge of subject-specific skills, algorithms, techniques, and methods.

This category also contains knowledge of criteria for determining when and why to use an appropriate procedure, such as choosing a good way to correctly solve a mathematics equation.

Description at the observation level:

Occurs in instruction when it is obvious that the students must learn a procedure or method to achieve a goal.

Examples include how to solve an algorithm in the mathematics textbook. The teacher conveys and explains different formulas and shows the students how an algorithm can be calculated.

Specific rules for coding:

Applies when knowledge is revealed concerning procedures and methods for solving a problem or reaching a goal.

The category is often paired with the category 'apply' in the former category system, where the students are supposed to learn how to apply proper techniques and methods, but can also occur with other categories, for example 'understand', if the teacher explains the procedure without showing how to use it.

Category 4: Metacognitive knowledge

Refers to knowledge concerning one's own knowledge (knowledge of one's own strengths and weaknesses in relation to cognition and learning) and strategic knowledge (general strategies for learning, thinking, and problem-solving).

This category is about understanding and comprehending that different problems demand different cognitive strategies and levels of cognitive activation. It implies understanding that tasks can be experienced as rather difficult or easy, depending on different individual personal skills and knowledge.

Description at the observation level:

Coded if awareness is expressed about personal skills, knowledge, and arguments for making choices.

An example is 'I am good at calculating with one unknown in algebra, but for calculating with two unknown numbers, I would need more practice'. This category can also be coded if students describe what they were thinking about and why they performed a certain action. The category also covers considerations of ways to act in the sense of 'I think this method/formula is difficult; that's why I will make it easier and write down every single step in the process' or 'if you are building a house, you have to be able to calculate the angle of the roof, and this seems more important to me than learning how to calculate with abstract formulas'.

Specific rules for coding:

None

Category 5: Other

Content determination:

A kind of knowledge that is not included in the other categories.

Description at the observation level:

Communication or actions not identified within any other category (0–4).

Specific rules for coding:

None

9.4 Implications for further research and school development

The video study in School-In aimed to identify conditions in instruction relevant for students' learning and motivation, focusing specifically on conditions related to inclusion and learning. It was also of interest to investigate how instruction was linked to the local context. The latter became difficult because we experienced that this linkage hardly occurred in the lessons we had videotaped. Thus, investigating how the local context can play a role in teaching, inclusion, and learning presupposes that the local context is considered in instruction.

Nevertheless, our findings gave valuable insight into how cognitive and knowledge processes (as described by Andersen & Krathwohl, 2001) are uttered, initiated, and expected in instruction (Olsen, 2020). We used mixed methods by quantitatively capturing the amount and duration of the distinct categories presented above. Thereby, we stated that the instruction, in general, aimed at surface learning processes. Deep learning strategies were targeted to a much lesser degree. In addition, our qualitative findings indicated that expectations, for example in terms of the aims of the lessons, were not properly expressed to the students. This might have made it difficult for them to understand the relevance of the learning content (Olsen, 2020).

Due to the small sample size, we must, of course, question the generalisability of the findings. We also had to both develop and train for the coding system by using the videos in the sample, which is not optimal. Thus, further research is needed to apply the coding systems to a larger, independent sample. Nevertheless, these findings are of great value with respect to school development in the participating schools and also for other schools that will be included in the follow-up of School-In (uia.no/en/school-in).

Further research is planned in which the observational data will be linked to the student questionnaire (chapter 10) on instruction, completed directly after the end of the lesson. This has proven to be a successful approach, for example in the IPN Video Study (Seidel, Prenzel, Schwindt, Rimmele, Kobarg, & Dalehefte, 2009). Thus, we assume that this will reveal insight into how learning conditions are linked to learning processes and how students feel included in mathematics instruction in the innovation schools in the project School-In.

In School-In, we advocate clear expectations towards the students. We also suggest relating the instruction more often to the local context and claim that the local context has so far been an underestimated resource for learning and inclusion (Dalehefte & Midtsundstad, 2019). Yet more research is needed to understand the impact of expectations and the use of the local context for learning outcomes, inclusion, and the student role in instruction.

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