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The comprehending teacher: scaffolding in content and language integrated learning (CLIL)

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ABSTRACT

Teaching through a second language (L2) poses many challenges, as second language learners (SLLs) have fewer linguistic resources in the language of instruction. Scaffolding students' learning is a possible way of overcoming these challenges, but there are few studies on this in Content and Language Integrated Learning (CLIL) contexts. The present study suggests a framework for how to empirically identify and classify scaffolding. Using the framework, the study investigates how three Norwegian CLIL teachers support learning for second language learners (SLL) through scaffolding. Twelve lessons (science, geography and social science) were filmed in one 11th-grade CLIL class. A coding manual (PLATO) was used to identify the scaffolding strategies the teachers used. The findings indicate that CLIL teachers scaffold their students to comprehend material. However, they provide few strategies to help students solve tasks, such as modelling and strategy use. CLIL teachers scaffold differently in the natural and social sciences; the natural science teaching has more visual aids, whereas the social science teachers allows for more student talk. The results imply that natural and social science teacher complement each other. However, CLIL teachers need to create more specific learning activities to provide their students with more support.

KEYWORDS

Content and language integrated learning (CLIL); English as a foreign language (EFL); scaffolding; classroom-based research; teacher education

Introduction

This study investigates how teachers use scaffolding strategies to support students learning English L2 in a content and language integrated learning (CLIL) classroom. CLIL is a bilingual teaching approach defined as an additional language integrated into a non-language subject (Coyle, Hood and Marsh 2010: 1). CLIL students have greater difficulties learning material than L1 students because they learn material at the same level as L1 students but with larger language deficits in the language of instruction (Cummins and Early 2015). CLIL teachers are generally untrained in teaching second language learners (SLLs), and they express concerns about how to teach them (Pérez-Cañado 2016). SLL researchers claim that scaffolding is a promising way to help SLLs (Gibbons 2015; van de Pol, Volman and Beishuizen 2010). By using scaffolding strategies, CLIL teachers can integrate language learning into content subjects (Pawan 2008), thus exploring meaning negotiation and linguistic assistance in the classroom. This is crucial to the language development of SLLs (Kayi-Aydar 2013). However, even though many SLL researchers note the potential benefits of scaffolding to SLLs, the research on CLIL is disparate and limited (Mahan, Brevik and Ødegaard 2018). There is a need for empirically

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grounded studies on naturally occurring CLIL teaching in order to map out how content teachers scaffold. The current study suggests a framework for how to identify and classify scaffolding based on previous literature from ELL and CLIL contexts. A coding manual is employed to identify scaffolding in video-recorded classroom interaction in a CLIL classroom in which science, geography, and social science is taught. The main unit of analysis is the interaction between the teacher and the students. The study contributes to unifying an understanding a scaffolding in the classroom, and mapping what the teachers do and do not do to scaffold the students' learning. The results may be used to further discuss how CLIL teachers may more effectively support their students in their learning processes. This study is guided by the following research question: Which scaffolding strategies do three CLIL teachers use to help their L2 English students comprehend material and complete tasks?

Theoretical background of scaffolding

The current section aims to clarify what is meant by the term 'scaffolding' in a classroom context, and how this term is understood in this study. Bruner introduced the term *scaffolding* in an educational sense in the 1970s. It refers to the 'interactional instructional relationship' between adults and learners that 'enables a child or novice to solve a problem […] beyond his unassisted efforts' (Wood, Bruner and Ross 1976: 90). Scaffolding has its roots in psychology but has since expanded into the educational sciences. Due to its flexible nature, scaffolding is a broad concept. Some researchers understand scaffolding as a new metaphor for Vygotsky's zone of proximal development, placing it firmly in sociocultural theory (Bliss, Askew and Macrae 1996; Smagorinsky 2018; Verenikina 2004). Others insist on further developing it as a tool to use in the classroom, leaning toward more constructivist approaches (Hogan and Pressley 1997).

Researchers generally agree that the goal of scaffolding is student autonomy (van de Pol, Volman and Beishuizen 2010), which is realised through tailored support from a teacher or more capable peer and involves the responsibility of learning slowly transferring from the teacher to the student (Lin et al. 2012). This study uses Maybin, Mercer and Stierer's (1992) definition of scaffolding: a type of teacher assistance that helps students learn new skills, concepts, or levels of understanding (hereafter *comprehension of material*) that leads to the student successfully *completing a task* ('a specific learning activity with finite goals') (188).

The field of SLL largely takes a practical approach to scaffolding by identifying what teachers do or should do (Echevarría, Vogt and Short 2017; Gibbons 2015; Masako and Hiroko 2008). Scaffolding strategies operate from a macro level (e.g. curriculum planning that integrates language systematically) to a micro level (i.e. interactional scaffolding). Interactional scaffolding is the minute-to-minute support teachers give their students in the classroom (van Lier 2004: 148). Interactional scaffolding poses a challenge to teachers because they must support students with unpredicted problems on the spur of the moment (Many et al. 2009; Walqui 2006). The present study focuses on scaffolding strategies CLIL teachers use during *interactional scaffolding*.

A framework for analysing scaffolding

As viewed above, there are numerous complex understandings of what scaffolding is. In order to empirically identify scaffolding, this article has synthesised SLL studies that explicitly investigate scaffolding in the ESL/EFL classroom to create a framework for analysing scaffolding. The majority of SLL scaffolding research is qualitative and descriptive and takes place in naturally occurring teaching (Lin et al. 2012). SLL researchers typically create their own frameworks in a bottom-up approach to identify scaffolding practices in the classroom (Gibbons 2003; Kayi-Aydar 2013; Li 2012). The main unit of analysis is the dialogue between teachers and students, although some studies include non-verbal behaviour and gestures (Miller 2005). Most SLL studies use video observation and create coding schemes (e.g. Ajayi 2014; van de Pol and Elbers 2013). Researchers use vastly divergent conceptualisations, approaches and terms – in other words, they measure disparate items. As van de

Pol, Volman and Beishuizen (2010: 287) put it, 'the measurement and analysis of scaffolding still appears to be in its infancy'. To move forward, they suggest agreeing on a clear conceptualisation of scaffolding and how to empirically operationalise and measure it.

Since there are many rich descriptions of scaffolding, the current study aims to research scaffolding in a top-down manner by building on existing literature to work toward a more unified understanding of scaffolding. The following section synthesises SLL research in five emerging themes that researchers have used to describe how SLL teachers practice *interactional scaffolding* (Figure 1). The framework builds on literature primarily from English language learner (ELL) contexts and *CLIL contexts*. ELLs and CLIL students represent two of the largest SLL groups and were therefore chosen for the scaffolding framework. ELL contexts refer mainly to immigrant students who come to North America and learn English as a second language, studying the same content subjects as L1 students (see Echevarría, Vogt and Short 2017; Gibbons 2015; Walqui 2006, for examples of students). CLIL students refer to students mostly in Europe, who speak the majority language of the country (e.g. Norwegian in Norway), and together with the teacher, speak the L2, which is most frequently English (Lasagabaster and Sierra 2009; Nikula and Mård-Miettinen 2014). There are several differences between these learner groups; for instance, CLIL students are often selected from high socioeconomic backgrounds, and share a common L1 with the teacher (Bruton 2011). The teachers also have different foci; ELL teachers must accommodate to English L1 and L2 speakers simultaneously in the classroom, and CLIL teachers have language learning goals in addition to content (Coyle 2007; Pawan 2008). Even though these contexts are different, the language learning mechanism still remains the same: students have the same linguistic deficiencies in the L2. Since the ELL literature is much larger, it is used as a resource to draw upon for further CLIL research as well.

The literature review focuses on five scaffolding themes related to comprehending material and solving tasks, following Maybin, Mercer and Stierer's (1992) classification of scaffolding (see Figure 1). This classification of scaffolding was used because it provides clear goals for scaffolding. The five emerging themes also correspond to the coding manual (Protocol for Language Arts Teaching Observation [PLATO]) used in this research and presented in the methods section. In what follows, each emerging theme will be discussed. The methods section will explain how PLATO empirically measures these emerging themes in the present study.

Comprehension strategies in SLL scaffolding

Scaffolding that aids comprehension emphasises how to help students understand new material (Maybin, Mercer and Stierer 1992). Pawan (2008) found that content teachers generally focus little on comprehension scaffolding strategies (as little as 28%). The first emerging theme to support comprehension draws on the *previous knowledge* of SLLs to introduce new material (Walqui 2006). In PLATO, this concept is known as 'connecting to prior knowledge' (Grossman 2015). It stems from the idea that SLLs are not 'empty vessels' but that they bring with them 'a collection of prior

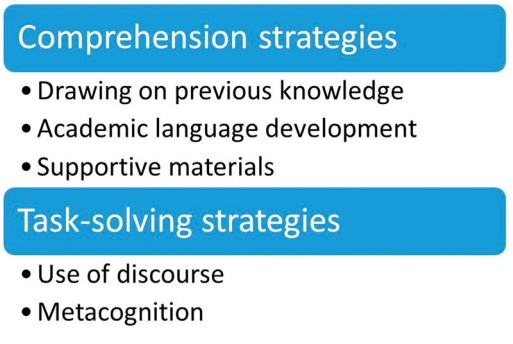

Figure 1. Mahan's classification of SLL scaffolding strategies, modified from Maybin, Mercer and Stierer (1992).

knowledge and skills acquired in their native language' (Dong 2017: 145). Linking known knowledge to unknown knowledge is pivotal, as prior knowledge is one of the most important factors in student learning (Tomlinson and Moon 2013: 421). Examples of comprehension strategies include assessing what students already know, referring to prior lessons, or using relatable real-world examples. Gallagher and Colohan (2017) argue that L1 can be a powerful scaffolding strategy in CLIL contexts (in which students and teachers have a common L1 and cultural background). Mahan, Brevik and Ødegaard (2018) and Dalton-Puffer (2007) have found that CLIL teachers frequently use L1 as a resource for helping students comprehend, drawing connections between concepts in L1 and L2.

The second emerging theme concerning comprehension is the role of *supportive materials* (Gibbons 2015; Walqui 2006). Supportive materials comprise visual aids, graphic organisers, use of body language, and other items to help students understand language in context (Grossman 2015). Academic language can be more difficult to acquire because one often cannot infer the meaning of an academic word from context (Cummins 2013). Walqui (2006) asserts that SLLs therefore require rich extralinguistic contexts and supportive materials to 'construct their understanding on the basis of multiple clues and perspectives' (169). Boche and Henning (2015) describe how a teacher of 11th- and 12th-grade history used supportive materials to scaffold. By contextualising texts with visual aids, sounds, and other ways of organising information, the teacher helped students understand content. Likewise, Mahan, Brevik and Ødegaard (2018) investigated supportive materials in CLIL teaching. They found that CLIL science teaching involved visual aids, graphic organisers, and film clips that help students understand abstract concepts.

The third emerging theme is how to support SLL's *academic language development* so students can use correct terminology (cf. Meyer et al. 2015; Meyer and Coyle 2017; Morton 2015). Gibbons (2015) suggests that although academic language is also new to L1 students, they have a clear advantage because they have a solid linguistic foundation. Scaffolding strategies include allowing students to use their own words to describe terminology; bilingual translations, and so forth (Barr, Eslami and Joshi 2012). Ajayi (2014) found that Mexican-American ELLs learned vocabulary more efficiently when their English teacher employed explicit scaffolding strategies that targeted academic language. Researchers have found that vocabulary teaching can be implicit in CLIL contexts because CLIL teachers are often not language teachers (Dalton-Puffer 2007; De Graaff et al. 2007). However, one Norwegian study revealed a ninth-grade English L2 CLIL math and science class in which the CLIL teachers used several scaffolding strategies to support academic language development (Mahan, Brevik and Ødegaard 2018).

Task-solving strategies in SLL scaffolding

Task-solving strategies comprise scaffolding strategies aimed at helping students complete a specific learning activity (Maybin, Mercer and Stierer 1992). Pawan (2008) found that 70% of scaffolding (as self-reported by SLL content teachers) focuses on completing content-related tasks. The fourth theme is how teachers use *discourse* as a supportive tool to help students with tasks (cf. Gibbons 2003; Kayi-Aydar 2013). According to McNeil (2011), key scaffolding strategies include *revoicing* (repeating the student's answer in academic language), *repetition* (echoing a student's answer in class), and *elaboration* (prompting the student to justify or lengthen their answer) (398). Mahan, Brevik and Ødegaard (2018) provide evidence of these three scaffolding strategies in CLIL teaching, but they found more strategies in mathematics than in science. The science discourse included more patterns of Initiation-Response-Evaluation (IRE). McNeil (2011), Dalton-Puffer (2007), and Banse et al. (2017) have investigated types of teacher questions in ELL/CLIL classrooms. They differentiate between *referential questions* (in which the teacher does not know the answer) and *display questions* (in which the teacher knows the answer) (definitions taken from Long and Sato 1983). All three studies conclude a significant amount more of display questions than referential questions. Referential questions are more relevant for language learning because they prompt students to form longer and more complex sentences (Farooq 2007). The overabundance of display questions, particularly in

the natural sciences, indicates that students do not have many opportunities in which to speak or use L2 creatively (Banse et al. 2017; Lemke 1990; McNeil 2011).

The fifth and final emerging theme is *metacognition*, or 'learning to learn' (Coyle, Hood and Marsh 2010: 29). This theme focuses on how teachers support students in completing tasks by making students aware of their own learning processes (Gaskins et al. 1997). Research suggests that one of the most effective ways of creating independent students is by showing them how to solve tasks (Gritter, Beers and Knaus 2013; van de Pol, Volman and Beishuizen 2010). This could range from modelling and providing strategies to create tangible tasks (e.g. physical objects that the students produce), to modelling how to create an effective and respectful discussion (Grossman 2015). In science teaching, metacognition has been emphasised in 72% of scaffolding frameworks (Pawan 2008). Scaffolding strategies that target metacognition include providing examples of tasks and discussing them (e.g. modelling) and suggesting meta-strategies to help students complete tasks (Grossman 2015). In CLIL contexts, only two studies have focused on metacognition. These studies were conducted in Basque Country on fifth- and sixth-grade English L2 science students (Ruiz de Zarobe and Cenoz 2015; Ruiz de Zarobe and Zenotz 2017). The studies conclude that reading strategies have a moderate impact on reading comprehension and that they encourage the use of strategies in completing tasks. The results of the studies indicate that metacognition can be a powerful tool for the learning process in the CLIL classroom.

In conclusion, many aspects of scaffolding have been examined in SLL classrooms, but very few studies have used similar tools to investigate scaffolding. Scaffolding is a more comprehensive field in ELL literature than in CLIL (Gibbons 2015; Walqui 2006). CLIL is only now starting to look at the role of scaffolding to support learning, and there is a need for more systematic, empirical research to describe how CLIL teachers scaffold their students' learning (Mahan, Brevik and Ødegaard 2018; Ruiz de Zarobe and Zenotz 2015). The present study addresses this need by observing how three Norwegian CLIL teachers scaffold learning for their students in English L2.

Methods

The present study is an analysis of 12 video-recorded lessons from 1 CLIL classroom in which 3 CLIL subjects (science, geography, and social science) were taught. It was filmed over the span of one month during the 2015–2016 school year. The video data were transcribed and coded with an observation manual (PLATO). The research design was developed and validated by the Linking Instruction and Student Achievement (LISA) team, University of Oslo (Klette, Blikstad-Balas and Roe 2017).

Sample

The sample was an 11th-grade CLIL class at an upper secondary Norwegian school (ages 15–16). It was a convenience sample, as only 4–7% of upper secondary schools in Norway offer some form of CLIL teaching (Svenhard et al. 2007). The school offered an English CLIL programme for science, geography, and social science. Students apply for the CLIL programme and are accepted based on their grades. The participants in this study were the science, geography, and social science teachers ($n = 3$) and the CLIL students ($n = 25$). All the teachers and students were female, and most had Norwegian as their L1. The CLIL teachers had one to two years of experience teaching CLIL, and two had attended CLIL courses. Three CLIL subjects were chosen for cross-comparison to see if the CLIL teachers scaffolded similarly to the same class regardless of subject (see Mahan, Brevik and Ødegaard 2018).

Data collection and analysis

Video recordings were used for this study, as they allow researchers to systematically investigate complex educational settings (Snell 2011) and because they are useful in studying interactional

scaffolding (van de Pol, Volman and Beishuizen 2010). The CLIL classroom was filmed using two cameras: one small camera mounted in the back of the classroom, and one above the blackboard. The teacher wore a microphone; another was placed in the middle of the classroom to capture student utterances.

The video data were analysed with PLATO, which is a teacher-centred observation manual that describes 12 aspects (here called 'elements') of teaching (Grossman et al. 2013). PLATO classifies elements on a scale from 1 to 4. Raters assign scores for every 15-minute segment of video data (approximately 10 segments per subject in this study). A score of 1 or 2 signifies low-end teaching, and a score of 3 or 4 signifies high-end teaching. Low-end teaching indicates no evidence (score 1) to little evidence (score 2) of an element, whereas high-end teaching indicates limited evidence (score 3) to strong and consistent evidence (score 4). This study uses the percentage of segments that score within high-end teaching. For example, a score of 80% means that eight of the 10 segments scored a 3 or 4. PLATO was chosen because it is a useful tool with which to identify, label, and measure teaching practices across subjects, and the scaffolding field calls for reliable and valid instruments of measurement (van de Pol, Volman and Beishuizen 2010). Six of the PLATO elements correspond well with the emerging scaffolding themes (see Figure 1), allowing the researcher to accurately score them. PLATO was originally created for language arts teaching but has been used to study science and mathematics teaching, and it takes SLLs into account (see Cohen 2018; Klette, Blikstad-Balas and Roe 2017; Mahan, Brevik and Ødegaard 2018).

Six PLATO elements were selected to identify various scaffolding strategies in CLIL teaching. Three elements captured *comprehension scaffolding strategies* (*connections to prior knowledge, supportive materials,* and *academic language*). Three others captured *task-solving strategies* (*uptake of student responses, strategy use and instruction,* and *modelling and use of models*). Each element in the video data was identified, scored, and described. Table 1 defines each element and what constitutes each score. All definitions are taken from Grossman (2015).

Research credibility and ethics

In accordance with the ethical guidelines of the Norwegian Center for Research Data, the teachers and students were informed orally and in writing about the project, and they each provided written consent (NESH 2006). A certified PLATO rater coded the video data. A second certified PLATO rater double-scored 25% of the video data to ensure reliability (interrater reliability = 90%). PLATO provided a useful lens with which to observe and interpret the aspects of scaffolding (Klette and Blikstad-Balas 2018). PLATO is supported by years of research on effective teaching, and using it will allow for comparison with other research that uses the same tool (Klette and Blikstad-Balas 2018; Klette, Blikstad-Balas and Roe 2017; Mahan, Brevik and Ødegaard 2018). However, using a manual with pre-determined codes may have limited the researcher's perception of scaffolding, and cannot measure the effect of the scaffolding strategies on the students' learning processes. The limited sample does not allow for generalizability.

Findings

The findings indicate that CLIL teachers employ an array of scaffolding strategies to help students comprehend material, but they employ limited strategies to help students complete tasks. The CLIL teachers frequently make connections between known and unknown material, provide the students with supportive materials, and consistently use, define, and prompt subject-specific terminology. The teachers consistently engage in dialogue that helps students solve tasks. However, there is limited evidence of strategies and models (metacognition).

Table 1. Classification of scaffolding strategies and how they were scored in PLATO.

Type of scaffolding	PLATO element	Definition and coding process
	Connections to prior knowledge (CPK)	*Connections to prior knowledge* (*CPK*) refers to what degree a teacher connects new material to the students' prior knowledge (Grossman 2015). This can be done through references (e.g. 'Last week, we talked about […]'), and connections (e.g. 'We all know about weathering, so now we will talk about erosion. The main difference being?'). At the low end, the teacher does not refer to (score 1) or superficially refers to prior knowledge (score 2). At the high end, the teacher refers to prior knowledge multiple times (score 3), and new material builds on prior knowledge in such a way that students can understand it (score 4)
Comprehension of material	Supportive materials (SUP)	*Supportive materials* (*SUP*) include body language and different sorts of differentiated materials, visual aids, and graphic organisers that enable L2 English students to understand a lesson (see Mahan, Brevik and Ødegaard 2018, for examples). At the low end, the teacher does not provide supportive materials (score 1) or the provided materials are not used by the teacher or students (score 2). At the high end, the teacher provides supportive materials, prompts the students to use them (score 3), and there is evidence that students use them (score 4)
	Academic language	*Academic language* (*AL*) refers to the subject-specific terminology students will need to understand a lesson (see Mahan, Brevik and Ødegaard 2018). At the low end, the teacher does not use academic language (score 1) or uses it without explaining it to the students (score 2). At the high end, the teacher introduces, defines, and prompts students to use academic language (score 3) and provides opportunities for students to use the terminology (score 4)
Completion of task	Uptake of student responses (UP)	*Uptake of student responses* (*UP*) refers to the degree to which a teacher/student elaborates or follows up on ideas (Grossman 2015). This can include revoicing an idea in academic language or commenting, elaborating, clarifying, or expanding on an idea (see Mahan, Brevik and Ødegaard 2018). At the low end, the teacher/student provides no or few responses (score 1) or responds briefly to ideas without pushing for elaboration or expanding upon them (score 2). At the high end, the teacher revoices ideas in academic language, asks for elaboration or evidence, responds in a way that expands on student ideas, or enables students to explain, clarify, or explain their thinking briefly (score 3) or consistently (score 4)
	Strategy use and instruction (SUI)	*Strategy use and instruction* (*SUI*) describes a teacher's use of strategies and skills that support students' learning during the task at hand. A strategy is a general/flexible method or 'how to' that a teacher suggests to solve a task (Grossman 2015). At the low end, the teacher does not provide any strategy instruction (score 1) or briefly introduces a strategy but does not provide explicit instruction on how to use it (score 2). At the high end, the teacher provides explicit instruction (score 3) and specifies how, why, and when to use it (score 4)
	Modelling and use of models (MOD)	*Modelling and use of models* (*MOD*) refers to the degree to which a teacher visibly enacts targeted strategies, skills, and processes in a lesson (Grossman 2015). PLATO differentiates between physical models (e.g. an example text or a model of an item to be built) and modelling (e.g. when a teacher orally 'walks through' the process of how to solve a task). At the low end, the teacher does not provide a model (score 1) or only partially provides a model (score 2). At the high end, the model is complete (score 3) and the teacher decomposes specific features of it, explaining how and why to use it (score 4)

Comprehension scaffolding strategies

Connections to prior knowledge (CPK)

The CLIL teachers consistently create connections between known and unknown material (high-end teaching, score 3–4, science 80%, geography 50%, social science 46%). Prominent scaffolding strategies include asking students if they are familiar with concepts, making explicit links to previous lessons, and using real life or personal examples.

The science teacher in particular refers to observable, scientific phenomena, e.g. she asks the students what happens when the students cut an apple in half. *The geography teacher* uses geographical land formations with which the students are familiar. *The social science teacher* prompts students to draw on everyday experiences to understand sociological phenomena, such as discussing how the students have resocialized from lower to upper secondary school.

In the following excerpt, the science teacher illustrates a redox reaction (new topic) by dropping a sink nail into copper chloride. She draws on the students' prior knowledge to guess what will happen, and why redox reactions are relevant for Norwegians:

Excerpt 1 (Science, Connections to Prior Knowledge, score 4):

Interaction	Action
Science teacher: What color does copper have when it's solid? Do you know? I didn't bring any copper out, but … is there any copper here? At least there is copper inside the cords, but I don't see any copper here. What kind of color is copper, Student 1?	Teacher elicits prior knowledge in students.
Student 1: It's like red-brown.	Student answers.
Science teacher: Yes. So, when it's solid, you know the different states, don't you? Solid, liquid, and gas. So, when copper is solid, it's a copper … sort of, you have a small chunk of copper, it would be some brownish red. Brownish red. When it's liquid, it's blue. Or light blue. So, it's mixed with chloride. I can't smell any … it doesn't smell like [local swimming pool]. But you will notice that later when we do an experiment. And this nail that I got. It's zinc. And now I'm going to put it in here. And do you have any idea if something will happen. Do you have any suggestions? Hypothesis? If anything will happen at all? It looks like sort of just blue-ish water. So, if I put zinc in here, do I expect … what do you expect? Student 2?	Teacher refers to the different states of elements, which she had covered earlier in class. Teacher refers to an element students are familiar with, relating it to a local place. Teacher prompts students to guess what will happen to the nail, presumably based on what they know about nails.
Student 2: Maybe it will start to rust?	Student provides suggestion based on prior experience.
Science teacher: Maybe it will start to rust. Why do you suggest that? Because that's very interesting. Because she suggests that corrosion will happen. That it will start to rust. And why did you suggest that?	Teacher asks why.
Student 2: Because I've seen it before?	Student confirms her belief based on prior knowledge.
Science teacher: You've seen it before! So, any other suggestions? Or do you stick with corrosion? So, let's see, then. So, I have an extra here, so you won't forget what it look like. It's a nail made out of zinc. [Drops it in a test tube with chloride]. Ok, so it turned black. […] So, what is happening? It's a redox reaction. […] So, this is, maybe not actually this, but this is sort of an introduction to a process that we use a lot in Norway to create metals. Because how do you make metals? Well, you find some sort of chunk of the earth that you know contains a metal. But you don't want a chunk, you want only the metal. And then you can do something with electrons. You can sort of add or take away electrons to make the metal pure. And they do that a lot in Norway in Haugesund area, Karmøy, Vestlandet. And do you know why we do it there?	Teacher loops back to new material (redox reactions). Teacher elicits prior knowledge of Norwegian industry and geography.
Student 3: Because there's a lot of water?	Student replies.

Here, the science teacher uses several tools to elicit and refer to prior knowledge. She creates a clear link between known material (what they know about copper) and how this is relevant to the unknown material (redox reactions). The segment scores a 4 because the new material builds explicitly on prior knowledge (see Table 1 for more information).

Supportive materials

There is a large difference among the CLIL teachers' use of supportive materials (science 60%, geography 90%, social science 18%). The most striking difference is the role of video clips and animations to

show phenomena in the natural sciences. The *science* and *geography teacher* consistently use body language to illustrate the meanings of words. The science teacher uses Bohr models and the periodic table as aids for helping students understand the compositions of atoms. She shows a webpage that allows users to build atoms by adding and subtracting electrons and protons. The *geography teacher* uses instructional videos and pictures to illustrate geographical phenomena. The use of instructional videos allows students to see how land formations occur over time. She introduces a video clip with a song about erosion. She uses her hands and fingers to physically demonstrate the meaning of words, such as 'vertical' and 'horizontal'. Finally, the *social science teacher* uses a graphic organiser to help students categorise terminology, but she does not use other supportive materials.

Academic language

Academic language is present in all lessons, and the teachers employ many scaffolding strategies to support academic language development (science 60%, geography 90%, social science 54%). Geography concentrates the most on the meanings of many terms, and it provides the students with the most opportunities to discuss terminology. All the teachers appear highly aware of academic language, and most lessons centre around terminology. Throughout the lessons, students must identify, define, and explain subject-specific terminology. The teachers strategically use L1 to provide bilingual translations. The *science* and *geography teacher* frequently ask for definitions of subject-specific terminology, whereas the *social science teacher* asks how students personally interpret abstract concepts (see excerpt 2).

In the next excerpt, the geography teacher began the lesson by moving from one topic (weathering) to a new topic (erosion). The students were given two minutes to discuss the difference between these topics in groups, and now they have a classroom discussion:

Excerpt 2 (Geography, Academic Language, score 4):

Interaction	Action
Geography teacher: There's a difference, isn't it? Between weathering and erosion. And the main difference being?	Teacher introduces vocabulary of the day. She starts by prompting students to discuss the difference between two terms.
Student 1: Weathering is breaking?	Student 1 provides a definition of 'weathering' and 'erosion'.
Geography teacher: Yeah.	
Student 1: And erosion is like carrying it. …	
Geography teacher: Carrying it away [gesticulates]. Yeah, that's it. […] Alright, then. You talked for a couple of minutes, right? One minute. One minute. So, what is it? Weathering is, you know, in situ. Right there. Breaking it down, right there. Right? What about erosion? Student 2.	Teacher repeats and asks for clarification of 'erosion'.
Student 2: It's the transfer of sediments. Like wind and the sea.	Another student gives a more accurate definition.
Geography teacher: That's it. You know … moving … ?	Teacher is still asking for a different definition
Student 3: Rock? *Geography teacher*: It away. Transportation. Right? Transportation. Alright? What else? Student 4?	Teacher highlights key word: transportation.
Student 4: Um.	
Geography teacher: Erosion.	Teacher asks for more information about erosion.
Student 4: Well, she mentions kind of like taking away the residue? *Geography teacher*: Yeah, mm-hmm? *Student 4*: Already broken down through weathering?	Student provides answer, reformulating Student 1's answer.

(*Continued*)

Continued.

Interaction	Action
Geography teacher: Wonderful. The sediments, right? Yeah. Mm-hmm. That's it. Mm-hmm. Alright. What else? Student 5? *Student 5*: Well, that was kind of what we talked about.	Teacher confirms and asks for more information.
Geography teacher: What you talked about, yeah? *Student 5*: You had the erosion, right? It's only the transport of rocks … *Geography teacher*: Yeah? Mm-hmm, mm-hmm. *Student 5*: By water. *Geography teacher*: Mm, ok	Student repeats information.
Student 6: Oh, uh, erosion combined together with weathering is what breaks the mountains apart, and if you were to only say that weathering is a power that breaks everything and erosion is what picks everything up and moves it. *Geography teacher*: Yeah. It moves it around. That's it.	Student understands what teacher is prompting and reformulates erosion and weathering in her own words.

There is a high use of terminology in the excerpt. An interesting observation is the tension between everyday explanations of scientific terminology (e.g. 'weathering is breaking'). The segment scores a 4 because the teacher consistently introduces, defines, and prompts terminology and because the students have many opportunities to use their own definitions.

Task-solving scaffolding strategies

Uptake of student responses (UP)

The students have many opportunities to speak, and the teachers often expand on their ideas (science 50%, geography 60%, social science 91%). The teachers revoice student answers into academic language, prompt students to elaborate, and use student examples to further build on ideas and concepts. However, there is a noticeable difference between the natural sciences (science and geography) and social science. *Science and geography* are characterised by display questions with yes/no answers half of the time, which leads to briefer student responses. This in turn leads to several IRE sequences. *The social science teacher* poses more referential questions and allots more time to open classroom discussions. The next excerpt is from social science. In this excerpt, the students are working in groups to discuss the difference between the terms 'rule' and 'law'. The teacher stops by a group to see what they are discussing:

Excerpt 3 (Social Science, Uptake of Student Responses, score 4)

Interaction	Action
Student 1: Ok, so rules are like … for smaller places, like schools and, like, organizations, and stuff, but laws are like for all of society.	Students are discussing a referential question in a group of three students: what is the difference between rules and laws? Student 1 is trying to explain to the other students.
Student 2: [Unintelligible]	
Student 1: Yeah, but he's written down, like … They're kind of the same, but not the same. Like, it depends on, like … uh, the school has kind of laws, but they're like rules, because. …	
Social science teacher: Yeah, you should listen to what she has to say.	Teacher is encouraging student to continue with her train of thought.
Student 1: Society. …	Teacher prompts student to continue.
Social science teacher: Mm. *Student 1*: And society has rules, but they're called laws because they apply to everyone. *Social science teacher*: So, rules are more limited, for example, like you said, school regulations are an example of rules. And	

(*Continued*)

Continued.

Interaction	Action
there might be rules, sort of, anywhere. You could have rules for your class, you know, you probably did that when you were in … yeah? Or might be, even, you know, in public buildings, or if you go to a gym, there might be rules, how to use the locker room, what to do or what not to do, you know. So, rules are more limited, like I said, legislation generally is, you know, nation-wide.	Teacher expands on student idea (rules are more limited). She introduces more subject-specific terminology (school regulations, legislation).
Student 1: Isn't that kind of like … you can say that if you break the rules, you can have some sort of punishment.	Student builds on her own idea of rules.
Social science teacher: Some kind of sanction, yeah.	Teacher revoices in academic language.
Student 1: But, if you break the law, it's quite the hardest punishment you. …	Student continues building on the differences between rules and laws.
Social science teacher: Mm. …	
Student 1: And it's more like … yeah, it's more serious. *Social science teacher*: Yeah. *Student 1*: And. …	Teacher confirms idea.
Social science teacher: Generally. And depending on what law you break. Of course, if you killed somebody, it's extremely serious. If you drive too fast, if it's not TOO fast, you just have to pay if you're caught.	Teacher nuances student idea.
Student 1: Yeah. *Social science teacher*: If you're not caught, of course, there are no consequences. Other than actually, maybe, causing more danger on the roads, in a way. *Student 1*: And there are different kinds of laws. And rules.	Teacher continues building on student idea.

The student responses are long and not teacher-directed. The teacher responds by building on student ideas and revoicing ideas in academic language. The teacher does not pose any questions, but the task allows students to explain how they understand terminology. The segment scores a 4, as the teacher is consistently referring to and building on student ideas.

Strategy use and instruction (SUI)

There is little evidence of strategy instruction except in science (science 40%, geography 0%, social science 18%). This means that, overall, CLIL students are provided little explicit and detailed instruction on strategies to help them complete tasks.

Modelling and use of models (MOD)

No models were found, and there are limited instances of modelling (science 30%, geography 30%, social science 27%). Modelling consists of walkthroughs in which the teacher asks students to define terminology and later models an answer. The teachers do not decompose features of modelling (i.e. point to specific features) to explicitly illustrate what they are doing

Discussion

This study has sought to shed light on how CLIL teachers scaffold their students' learning by identifying what SLL scaffolding is, and labelling the teachers' scaffolding strategies during interaction. The findings indicate that CLIL teachers provide many scaffolding strategies with which to comprehend material. This is realised through linking concepts in L1 and L2, defining and prompting students to use subject-specific terminology, and the use of visual aids. Some of these strategies have been identified in previous CLIL literature (Dalton-Puffer 2007; Mahan, Brevik and Ødegaard 2018). They stand in contrast to Pawan (2008)'s study, which suggests that content teachers in ELL classrooms only use

scaffolding strategies for comprehending material 28% of the time. Nineteen per cent of ELL teachers expressed that aiding ELLs in comprehending material was not their responsibility. This may suggest a contrast between CLIL and ELL teaching: CLIL teachers are more preoccupied with students understanding the material, perhaps because all their students are SLLs. In ELL contexts (i.e. immigrant students placed in classrooms with L1 students), the needs of ELLs may be overshadowed by the needs of L1 students.

On the other hand, the findings show that CLIL teachers use limited strategies to help students solve tasks (metacognition). It is worth noting that the students do not create any tangible products (texts, posters, presentations) in the course of the 12 hours. They are largely discussing and trying to comprehend material. This may lead to a lack of strategies and modelling for students to complete tasks. However, the teachers could have provided suggestions for how to conduct a discussion, or modelled how to define words more clearly.

Subject-specificity in CLIL teaching

An important finding is the divide in the use of scaffolding strategies between natural sciences (science and geography) and social science subjects. This divide may be explained by the historicity and nature of the subjects – the way they have been developed, practised, and taught over the years (Nikula et al. 2016). The natural sciences provide multiple supportive materials, whereas social science provides limited supportive materials, which is in line with Mahan, Brevik and Ødegaard (2018). This difference incidentally makes natural sciences more understandable, as they provides students with contextual clues. The social science teaching, in turn, has more in-depth conversations. Discussions are student-led, have fewer IRE patterns, and provide more referential questions. This leads to longer stretches of student speech and allows students to expand more on their ideas. Several studies have found an overabundance of display questions and IRE patterns in the natural sciences (Lemke 1990; McNeil 2011; Mortimer 2003). Some researchers believe that the IRE pattern is incompatible with tenets of scaffolding, as it may stifle student autonomy and shorten student answers (Kinginger 2002; Walqui 2006). However, others have argued that the IRE pattern in itself is a scaffold, providing a predictable speech sequence (Silliman and Wilkinson 1994).

Although some of the scaffolding elements in PLATO score similarly, the teachers may still use different strategies. Science uses the most real-world examples to connect to prior knowledge, reflecting that it is a subject that expresses how the world works (Mortimer 2003). Geography connects to national and local knowledge, showing that it is a subject that builds national identity (Sætre 2013). Lastly, social science relates to more personal examples, relating to its promotion of civic competence (Torrez and Claunch-Lebsack 2013). These findings highlight the importance of subject-specificity in teaching. Natural science and social science subjects provide different types of support for SLLs, and these differences appear to complement each other.

Conclusion

This study has used existing literature to create a framework with which to study scaffolding. The framework (Figure 1) has proven to be a useful analytical tool to empirically identify interactional scaffolding in the CLIL classroom. In this study, 12 hours of CLIL teaching were observed, and scaffolding strategies were identified with a coding manual to determine which scaffolding strategies three CLIL teachers use to help their students comprehend material and solve tasks. The findings indicate that CLIL teachers use a variety of scaffolding strategies in science, geography, and social science. Many of the scaffolding strategies pertain to comprehension, in which the teachers show connections between known and unknown knowledge, use supportive materials, and define and prompt academic language. The teachers build on student ideas to help students solve tasks, but they show little evidence of metacognition. There are further differences between how teachers scaffold in

the natural sciences and social sciences. One implication from the findings is that context is important: there are clear differences between how CLIL and ELL teachers scaffold. The homogeneity of CLIL teachers and students allows them to better scaffold the comprehension of material, since they have similar points of reference. However, these teachers show less evidence of scaffolding the solving of tasks. Lastly, this study suggests that content teachers support their L2 students even when they do not have a background in language teaching.

The strength of this study is that it unifies understandings of scaffolding in SLL literature. It cross-compares three subjects and teachers in one classroom (see Mahan, Brevik and Ødegaard 2018). The design is systematic and detailed and uses a validated and reliable tool (PLATO) to measure scaffolding. However, the limitations of this study are that it provides insight into only one CLIL classroom and that it does not consider student perspectives. The next step in scaffolding research is to discuss how we can empirically measure how students perceive scaffolding strategies and how they become more independent learners. Teacher-centred approaches like PLATO do not fully cover these dimensions of scaffolding. Further research could delve into student-centred approaches and how students may experience scaffolding (Koole and Elbers 2014; Maybin, Mercer and Stierer 1992).

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